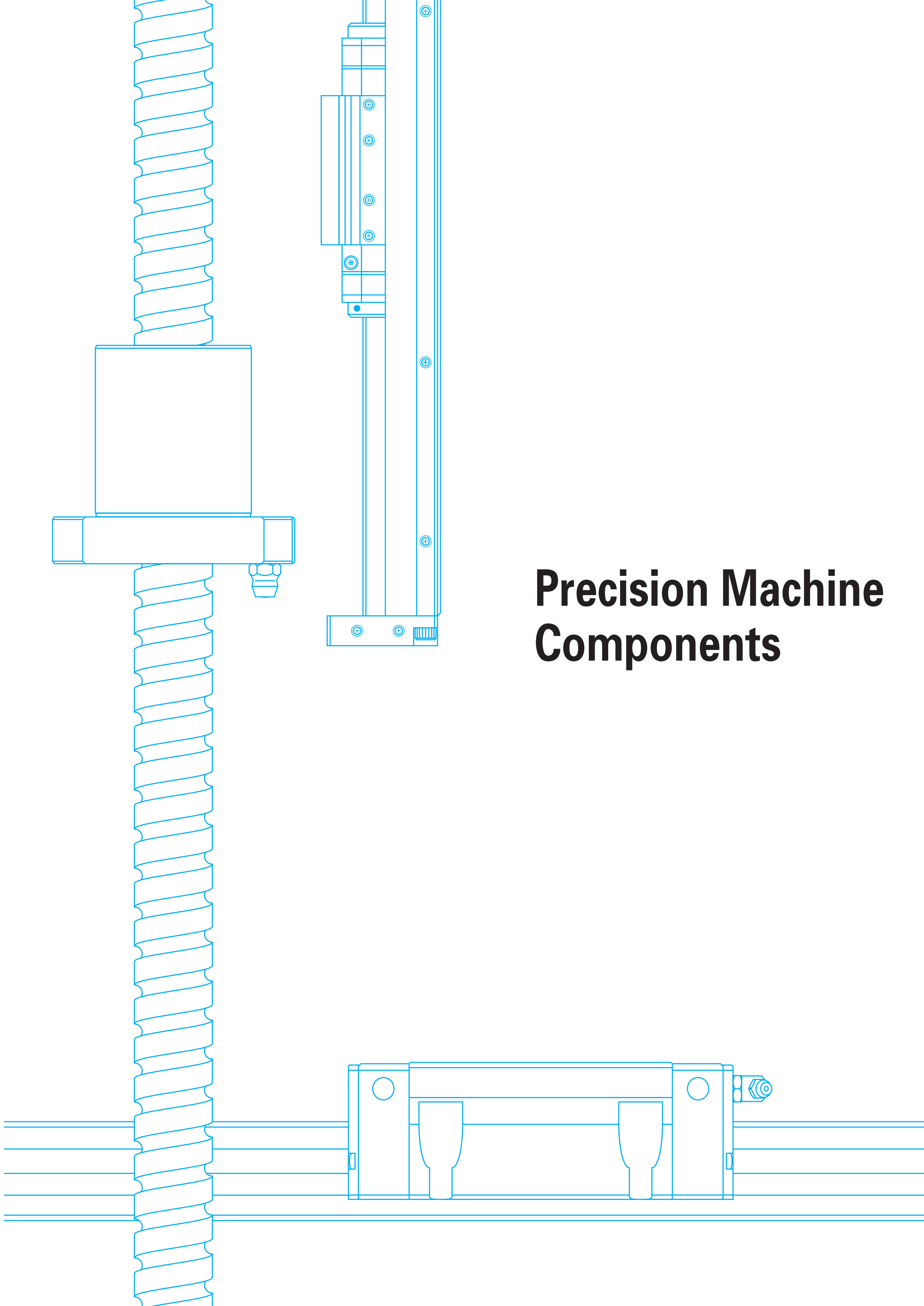
MOTION & CONTROL™
NSK

Precision Machine Components

NSK Linear Guides™
Ball Screws
Monocarrier™



Precision Machine Components

Preface

We are proud to present this revised edition of our catalog of NSK precision machine components.

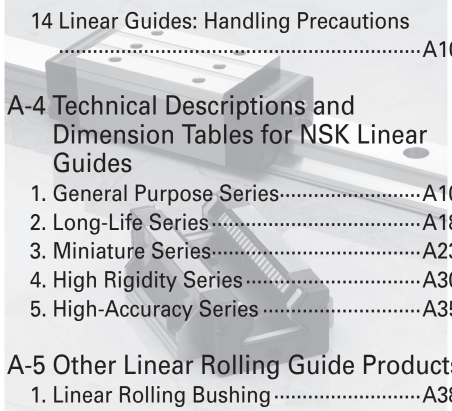
Market needs for more sophisticated and diversified equipment continue to grow, and NSK linear motion products rise to meet these needs across a variety of fields.

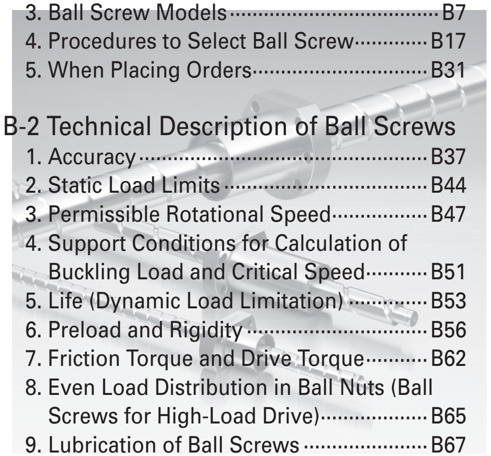
As crucial machine components, NSK ball screws, NSK linear guides, and Monocarriers must be highly reliable, maintenance-free, compact, and lightweight. They must also reduce waste and function in special environments. We've spared no effort in creating an extensive lineup of products to match your application.

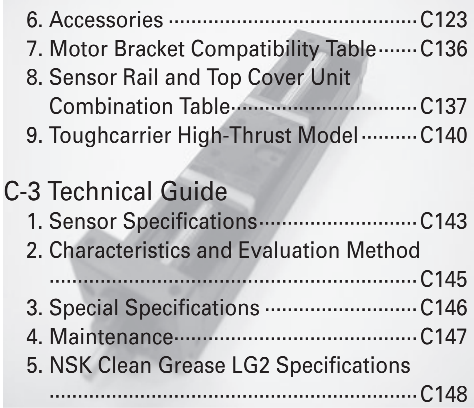
Products are organized by category with each containing selection guides and extensive technical explanations, including the results of the latest experiments and research, as well as dimension tables and figures. Section D contains pages detailing requirements in special environments and lubrication considerations for precision products.

We hope the variety of information in this catalog will aid in selecting the most suitable products for your purpose and look forward to serving you.

Contents

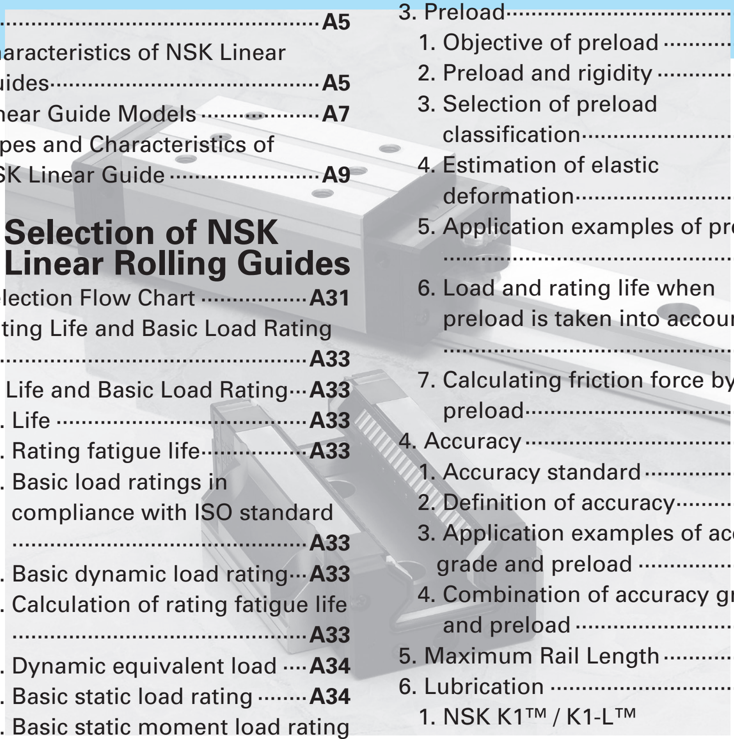






A BLOCK

NSK Linear Rolling Guide Products



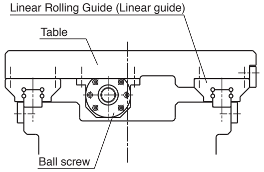
A-1 Characteristics of NSK Linear Rolling Guides

Characteristics of NSK linear rolling guides:

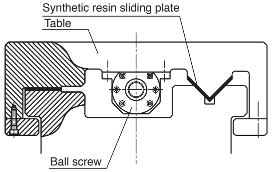
- Designs are simple and economic. This contributes to a highly accurate and low cost guide way system.
- Low friction coefficient facilitates a compact and low cost driving mechanism.
- Ultra-high purity of materials and superb processing technology ensure long-term reliable operation.
- Prompt delivery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

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

The following describes the characteristics of general rolling and sliding guideways:



Example rolling guide



Example sliding guide

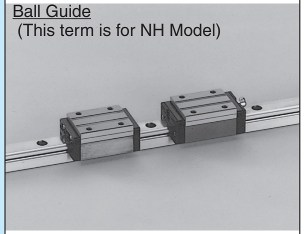
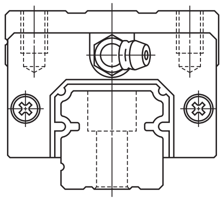
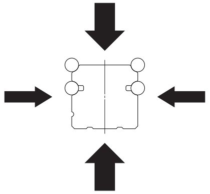
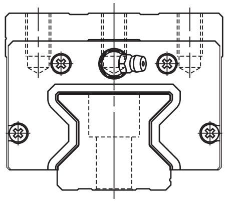
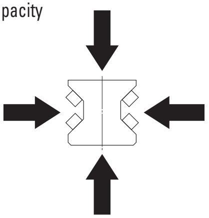
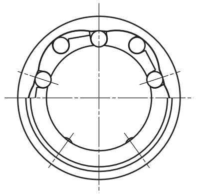
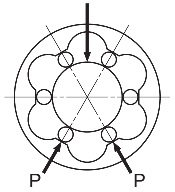
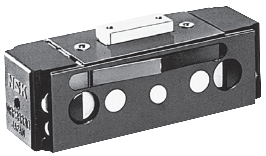
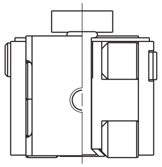
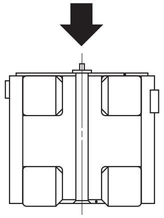
Comparative characteristics of rolling and sliding guideways

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	• Greater 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 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 simple maintenance	• Precision is greatly lost if the guideway surface is worn.

Today's rolling guides respond to needs for high speed, precision, quality, and easy maintenance. Utilizing the technology we have sharpened in rolling bearings, NSK makes various types of rolling linear guides which are highly accurate and reliable.

A-1-2 Types of NSK Linear Rolling Guides

Rigidity: ☆, Extremely high; ⊚, High; ◎, Medium; ○, Low
Friction: ◎, Low; ○, Normal
Ease of installation: ◎, Good; ○, Fair

Product	Appearance	Shape	Rolling element	Load capacity	Rigidity	Friction	Ease of installation	Major applications	Page
NSK Linear Guides	Ball Guide (This term is for NH Model) 		Ball	High vertical load carrying capacity 	◎	◎	◎	• Industrial robots • Materials handling equipment • Semiconductor manufacturing equipment • Laser cutting machines • Electric discharge machines • Packaging/packing machines	A105
	Roller Guide 		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	A303
Linear rolling bushing			Ball		○	◎	○	• Materials handling equipment • Packaging/packing machines • Medical equipment • Pneumatic equipment • Office equipment • Assembling machines	A389
Roller pack			Roller		⊚	◎	○	• Large machine tools • Conveyor system for heavy objects (guide ways for heavy loads)	A399

A-2 NSK Linear Guides™

A-2-1 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. NSK's unique and patented structure added to the original invention (**Fig. 1**) helps contribute 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 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.

A-2-2 Characteristics of NSK Linear Guides

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

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

On top of that, we have developed and marketed 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 rolling 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 types for any purpose

- Various models are available with sizes standardized to satisfy any requirement. Our technology, polished by abundant experience in the use of special materials and surface treatments, meets your most pressing needs.

(4) Development of interchangeable 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 mixing and 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 ball-type NSK linear guides. This increases impact load resistance (**Fig. 5**).

(6) Ultra high load capacity lineup

- The LA model provides top class high-load capacity through a unique load carrying configuration with three ball recirculation circuits on one side.
  By installing rollers with the largest possible diameter and length, NSK roller linear guides realize ultra-high load capacity far superior to various competing products.

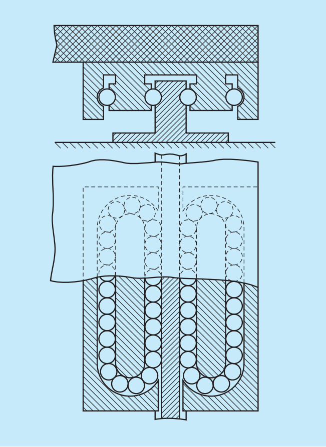


Fig. 1 • **French Patent in 1932.**
• **Inventor: Gretsh (German)**

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

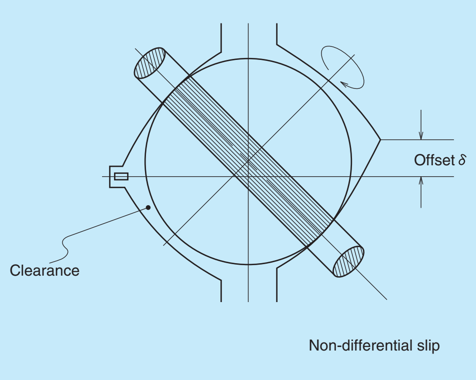


Fig. 3 Two contact point at offset Gothic arch groove

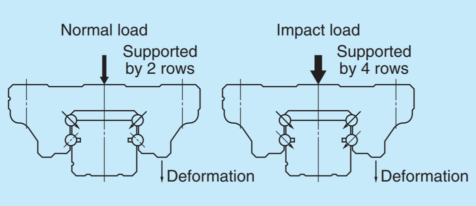


Fig. 5 Shock-resistance

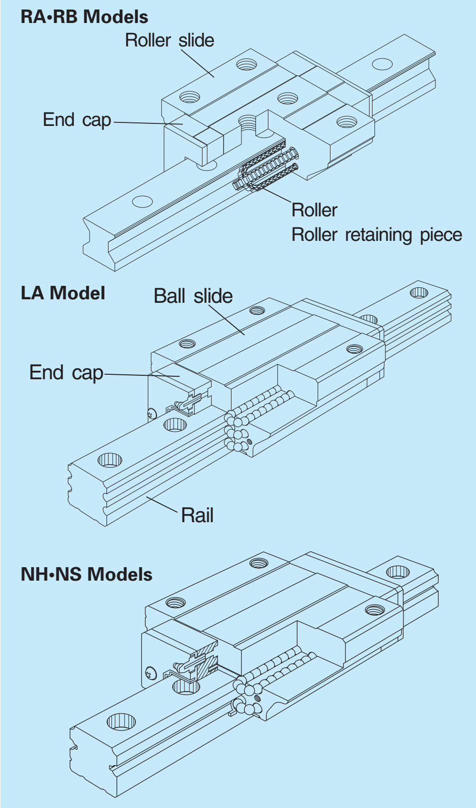


Fig. 2 Structure of NSK linear guides

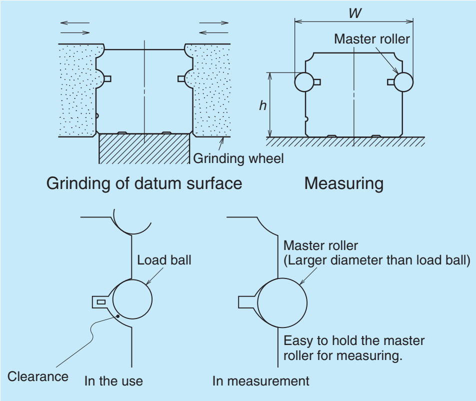


Fig. 4 Processing and measuring grooves

Measuring grooves accuracy is easy. You can obtain highly accurate results for all NSK linear guide models. This is why you can purchase interchangeable rails and slides seperately.

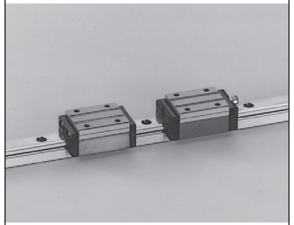
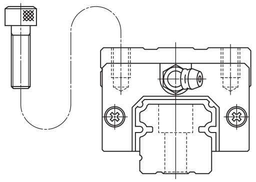
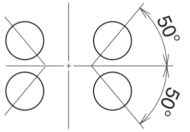
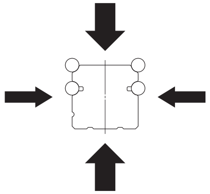
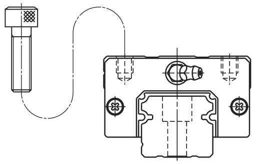
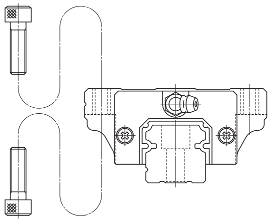
A-2-3 Linear Guide Models

Linear Guides

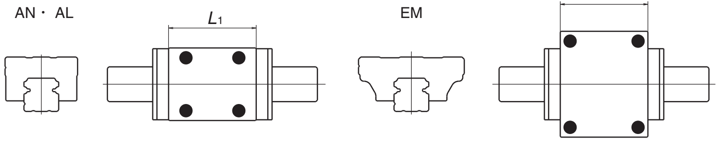
			Page
General-Purpose Series	NH Model	Standard, High Load Capacity, Self-Aligning, Interchangeable	**A105**
	Dust-Resistant VH Model	High Dust Resistance, High Load Capacity, Self-Aligning, Interchangeable	**A125**
	NS Model	Compact, High Load Capacity, Self-Aligning, Interchangeable	**A145**
	LW Model	Wide Rail, High Moment Load Capacity, Interchangeable	**A163**
Long-Life Series	DH Model	Standard, High Load Capacity, Long Life, Self-Aligning	**A179**
	Dust-Resistant DV Model	High Dust Resistance, High Load Capacity, Long Life, Self-Aligning	**A199**
	DS Model	Compact, High Load Capacity, Long Life, Self-Aligning	**A217**
Miniature Series	PU Model	Standard, Low Inertia, Interchangeable	**A237**
	LU Model	Standard, Interchangeable	**A247**
	PE Model	Wide Rail, High moment Load Capacity, Low Inertia, Interchangeable	**A259**
	LE Model	Wide Rail, High Moment Load Capacity, Interchangeable	**A269**
	Miniature LH Model	Self-Aligning	**A283**
	LL Model	Lightweight	**A293**
High-Rigidity Series	RA Model Roller Guide	Super-High Load Capacity, Super-High Rigidity, Interchangeable	**A299**
	With V1 Seals	High Dust Resistance, Super-High Load Capacity, Super-High Rigidity	**A309**
	RB Model Roller Guide	Super-High Load Capacity, Super-High Rigidity, Ultra Low Profile	**A321**
	LA Model	High Load Capacity, High Rigidity	**A337**
High-Accuracy Series	HA Model	Super-High Accuracy, Super-high Load Capacity, High Rigidity	**A357**
	HS Model	Ultra High Accuracy, High Load Capacity, Self-Aligning	**A371**

A-2-4 Types and Characteristics of NSK Linear Guides

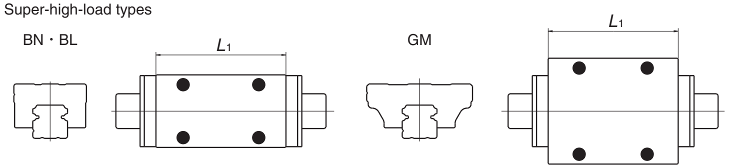
Rigidity: ☆, Extremely high; ⊚, High; ◎, Medium; ○, Low
Friction: ◎, Low; ○, Normal
Ease of installation: ◎, Good; ○, Fair

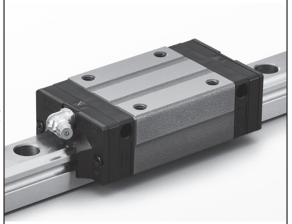
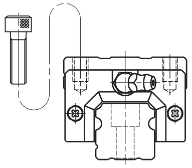
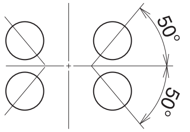
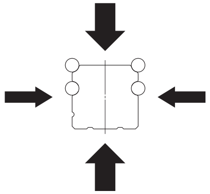
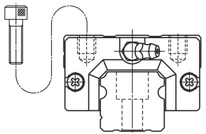
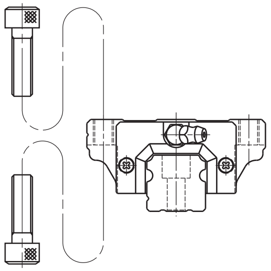
Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity	Features	Characteristics	Applications	Page
General Purpose Series	NH	High vertical load carrying capacity Self-aligning 	AN BN		Rolling element: ball  	Rigiidity: ◎ Friction: ◎ Ease of installation: ◎	The NH model is applicable across a wide range, from general industrial use to high-accuracy applications. Interchangeable rails and ball slides are standard. ● The contact angle between the ball and ball groove 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 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 makes measuring of grooves accurate and easy. ● Rails and slides can be purchased separately in the standard interchangeable lineup. ● Stainless steel standard 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 • Flat panel display manufacturing equipment • Medical equipment • Electric discharge machines • Laser cutting machines • Press machines • Tool grinders • Flat surface grinders • NC lathes • Machining centers • Automatic tool changers	A127
			AL BL						
			EM GM						

High-load types



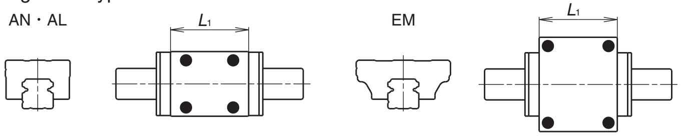
Super-high-load types



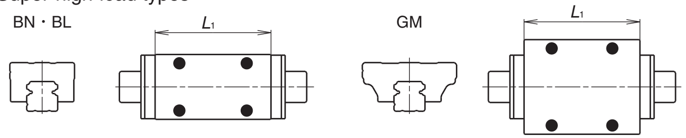
Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity
General Purpose Series	High-resistant VH	High vertical load carrying capacity Self-aligning 	AN BN		Rolling element: ball  
			AL BL		
			EM GM		

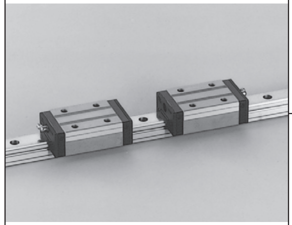
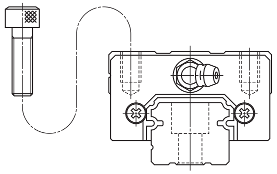
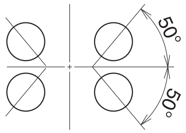
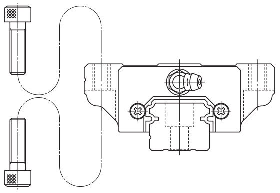
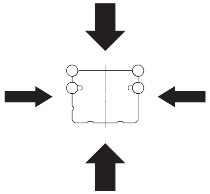
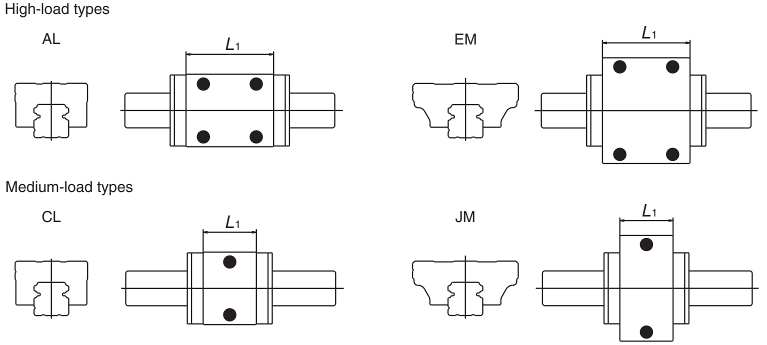
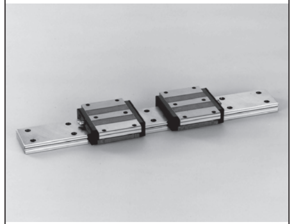
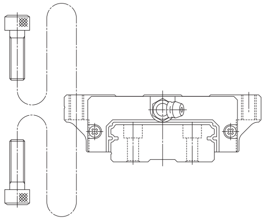
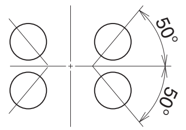
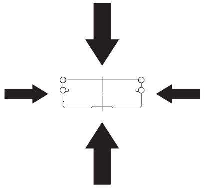
Features	Characteristics	Applications	Page
Rigiidity: ◎ Friction: ◎ Ease of installation: ◎	The VH model delivers outstanding dust-resistant functionality and thus ensures long operating life under contaminated environments. Interchangeable rails and ball slides are standard. ● The contact angle between 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 installation error in the perpendicular direction to the rail. ● Thanks to the offset Gothic arch groove, balls make contact at two points. This keeps friction to a minimum. ● High resistance against shock load due to the unique load carrying structure. ● Gothic arch groove makes measuring grooves accurate and easy. ● Rails and slides can be purchased separately in the standard interchangeable lineup. ● Penetration of fine contaminants has been reduced by 90% or more. ● 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	A127

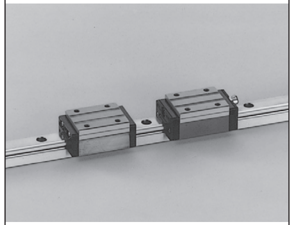
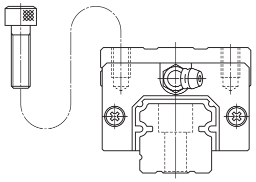
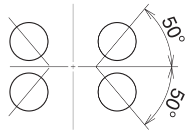
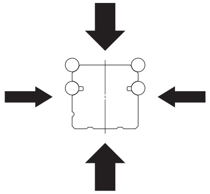
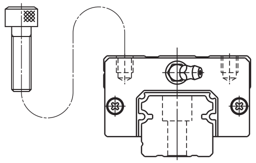
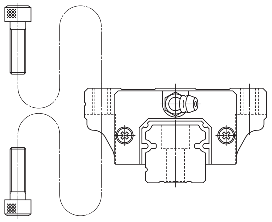
High-load types



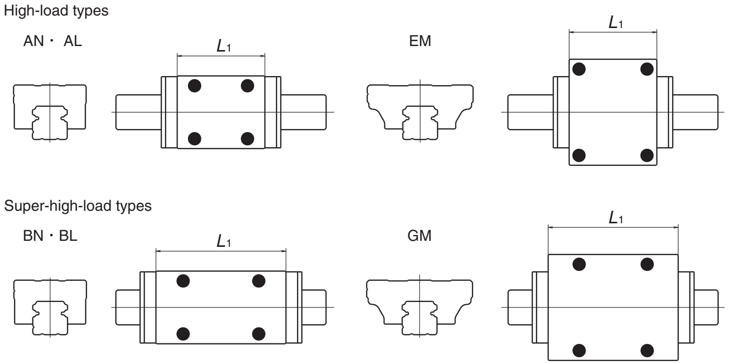
Super-high-load types

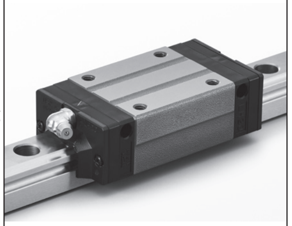
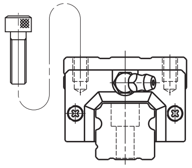
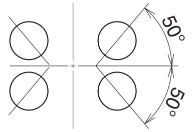
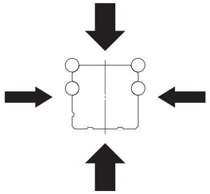
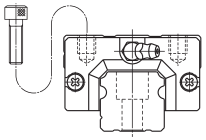
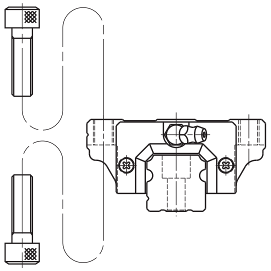


Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity	Features	Characteristics	Applications	Page
General Purpose Series	NS	High vertical load carrying capacity Self-aligning 	AL CL		Rolling element: ball 	Rigiidity: ◎ Friction: ◎ Ease of installation: ◎	The NS model is low in height and is applicable across a wide range, from general industrial use to high-accuracy applications. Interchangeable rails and ball slides are 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 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 makes measuring grooves accurate and easy. ● Rails and slides can be purchased separately in the standard interchangeable lineup. ● Stainless steel is also available.	• Cartesian 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 • Flat panel display manufacturing equipment • Medical equipment • Electric discharge machines • Laser cutting machines • Press machines	A147
			EM JM						
	LW	High vertical load carrying capacity High moment capacity 	EL		Rolling element: ball  	Rigiidity: ◎ Friction: ◎ Ease of installation: ◎	High-moment rigidity and low profile products are most suited for a single rail linear guideway system. Interchangeable rails and ball slides are 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 ● Rails and slides can be purchased separately in the standard interchangeable lineup.	• Semiconductor manufacturing equipment • Flat panel display manufacturing equipment • Conveyor systems • Medical equipment • Microscope XY stages	A167

Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity
Long-Life Series	DH	High vertical load carrying capacity Self-aligning 	AN BN		Rolling element: ball  
			AL BL		
			EM GM		

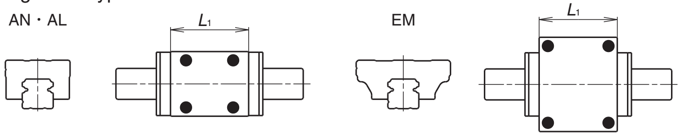
Features	Characteristics	Applications	Page
Rigiidity: ◎ Friction: ◎ Ease of installation: ◎	The DH model is applicable across a wide range, from general industrial use to high accuracy applications. ● The contact angle between the ball and ball groove is set at 50 degrees. This design increases the load carrying capacity against the vertical directions, which is the main load acting direction in most operations. ● Applying our special TF heat treatment, life is doubled compared to NH model. ● 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. ● A High resistance against shock load due to the unique load-carrying structure. ● Gothic arch groove makes measuring of grooves accurate and easy.	• Cartesian type robots • Robots that remove plastic molds from injection machine • Material handling equipment • Printing machines • Woodworking machines • Paper manufacturing machines • Semiconductor manufacturing equipment • Flat panel display manufacturing equipment • Electric discharge machines • Laser cutting machines • Press machines • Tool grinders • Flat surface grinders • NC lathes • Machining centers • Automatic tool changers	A183



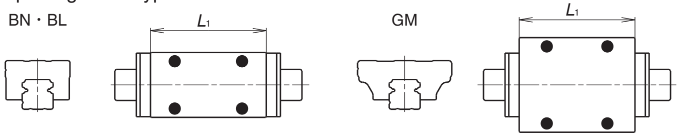
Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity
Long-Life Series	High-resistant DV	High vertical load carrying capacity Self-aligning 	AN BN		Rolling element: ball  
			AL BL		
			EM GM		

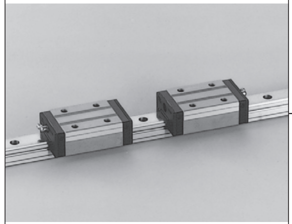
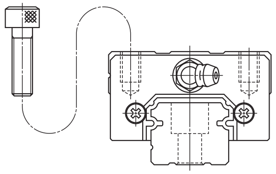
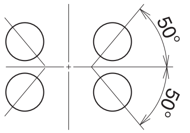
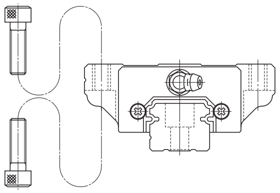
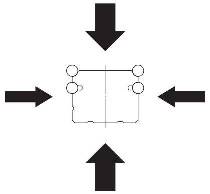
Features	Characteristics	Applications	Page
Rigiidity: ◎ Friction: ◎ Ease of installation: ◎	The VH model delivers outstanding dust-resistant functionality and thus ensures long operating life under contaminated environments. ● Applying our special TF heat treatment, life is doubled compared to VH model. ● 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 installation error in the perpendicular direction to the rail. ● Thanks to the offset Gothic arch groove, balls make contact at two points. This keeps friction to a minimum. ● High resistance against shock load due to the unique load carrying structure. ● Gothic arch groove makes measuring grooves accurate and easy. ● Penetration of fine contaminants has been reduced by 90% or more. ● 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	A203

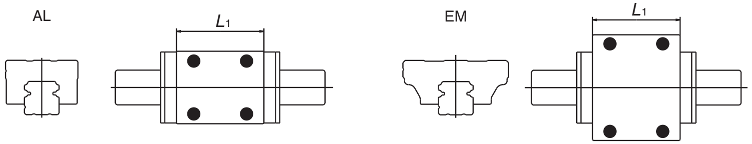
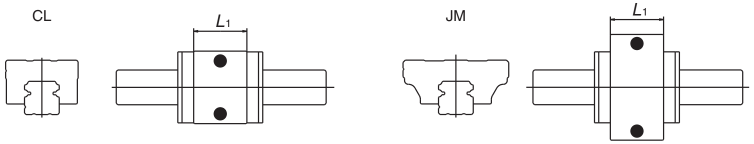
High-load types

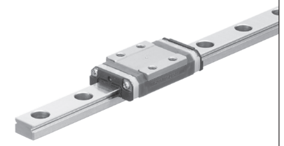
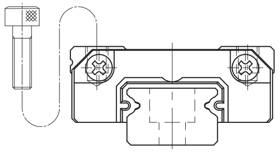
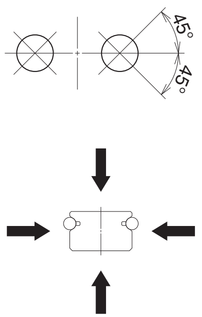
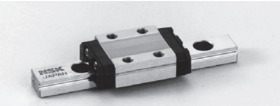
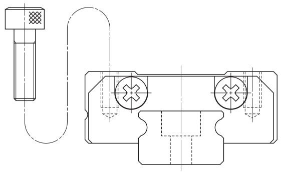
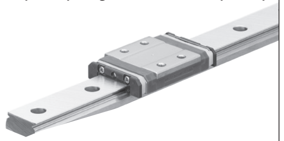
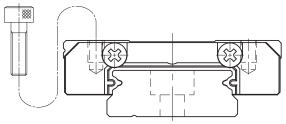
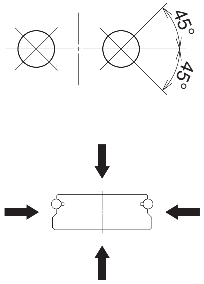
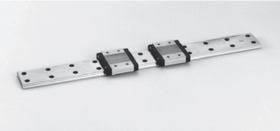
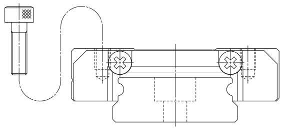


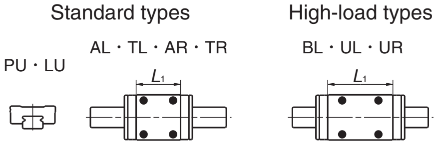
Super-high-load types

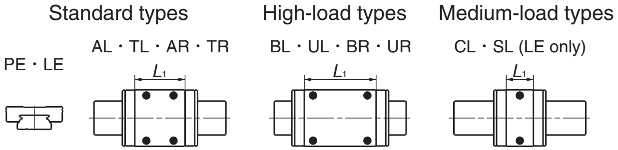


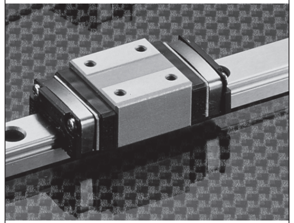
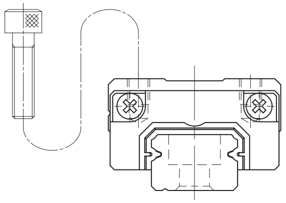
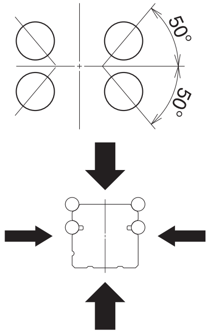
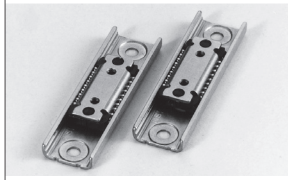
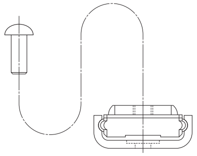
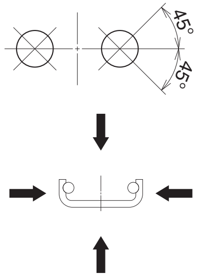
Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity
Long-Life Series	DS	High vertical load carrying capacity Self-aligning 	AL CL		Rolling element: ball 
			EM JM		

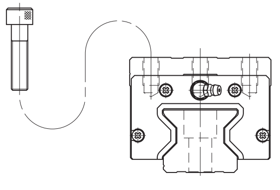
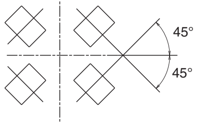
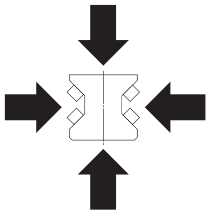
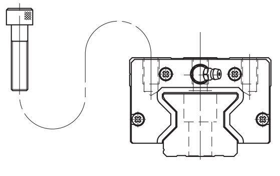
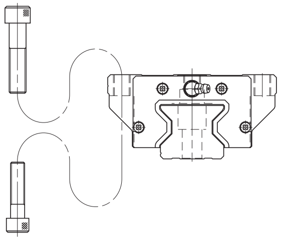
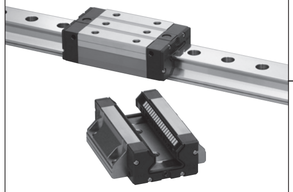
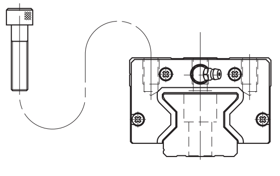
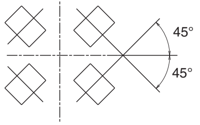
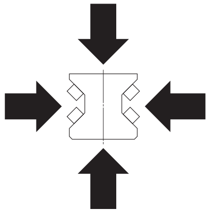
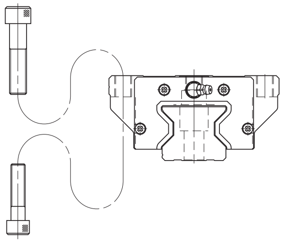
Features	Characteristics	Applications	Page
Rigiidity: ◎ Friction: ◎ Ease of installation: ◎	The DS model is low in height and is applicable across a wide range, from general industrial use to high-accuracy applications. ● Applying our special TF heat treatment, life is doubled compared to DS model. ● 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 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 makes measuring grooves accurate and easy.	• Cartesian robots • Robots that remove plastic molds from injection machine • Material handling equipment • Printing machines • Woodworking machines • Paper manufacturing machines • Semiconductor manufacturing equipment • Flat panel display manufacturing equipment • Electric discharge machines • Laser cutting machines • Press machines	A221
	High-load types  Medium-load types 		

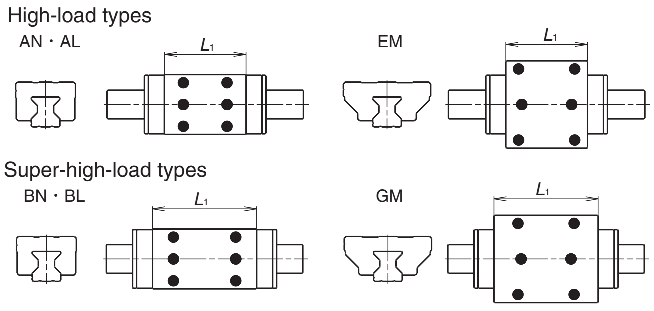
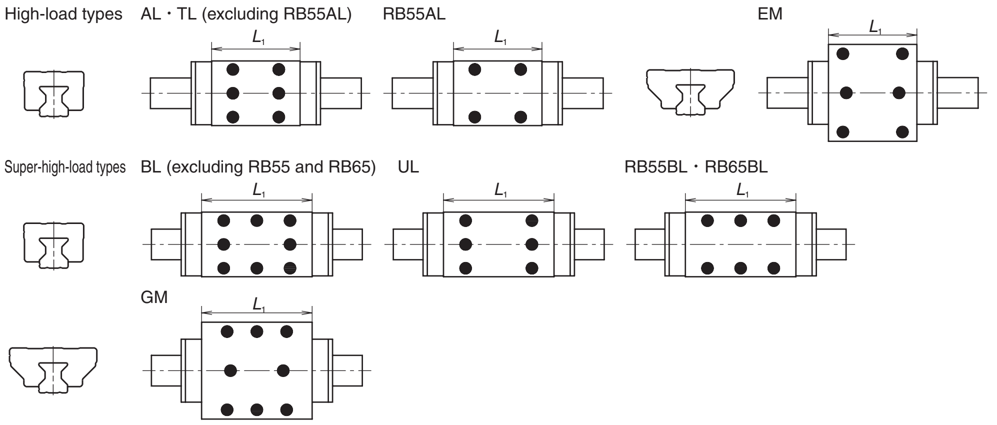
Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity	Features	Characteristics	Applications	Page
Miniature Series	PU	Four-way equal load carrying capacity/Standard 	AL TR UR BL		Rolling element: ball 	Rigiidity: ○ Friction: ◎ Ease of installation: ◎	Low inertia and low dust generation miniature model. ● Low dust generation and highly smooth operation ● Super-compact size ● Stainless steel is the standard material. ● A ball retainer is standard equipment. ● Rails and slides can be purchased separately in the standard interchangeable lineup.	• Semiconductor manufacturing equipment • Flat panel display manufacturing equipment • Medical equipment • Optical stages • Microscope XY stages • Conveying system of optical fibers • Miniature robots • Computer peripherals • Pneumatic equipment	A241
	LU	Four-way equal load carrying capacity/Standard 	AL TL AR TR BL UL			Rigiidity: ○ Friction: ◎ Ease of installation: ◎	Miniature model ● Extremely compact size ● Stainless steel is the standard material. ● A ball retainer is standard equipment. ● Rails and slides can be purchased separately in the standard interchangeable lineup.		A251
	PE	Four-way equal load carrying capacity/High moment capacity 	AR TR UR BR		Rolling element: ball 	Rigiidity: ○ Friction: ◎ Ease of installation: ◎	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 standard equipment. ● Rails and slides can be purchased separately in the standard interchangeable lineup.	• Semiconductor manufacturing equipment • Flat panel display manufacturing equipment • Medical equipment • Optical stages • Microscope XY stages • Conveying system of optical fibers • Miniature robots • Computer peripherals • Pneumatic equipment	A263
	LE	Four-way equal load carrying capacity/High moment capacity 	AL TL AR TR BL UL CL SL			Rigiidity: ○ Friction: ◎ Ease of installation: ◎	Miniature wide model ● Super-small size in wide rail type ● Stainless steel is the standard material. ● A ball retainer is standard equipment. ● Rails and slides can be purchased separately in the standard interchangeable lineup.		A273

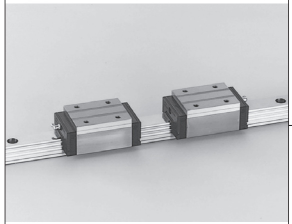
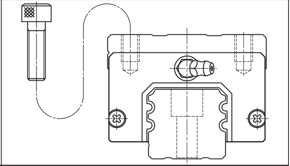
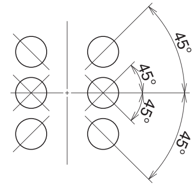
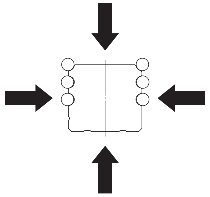
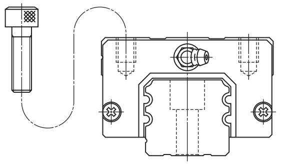
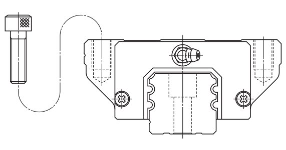
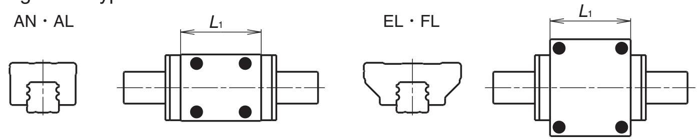
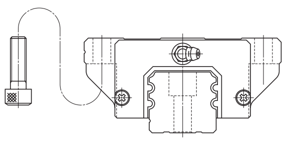
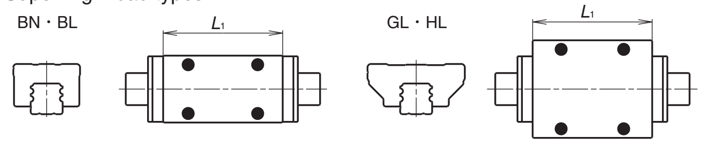
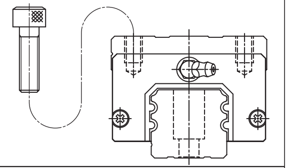
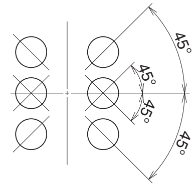
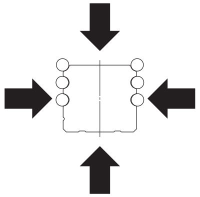
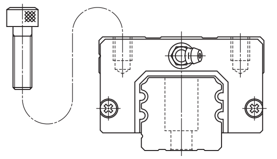
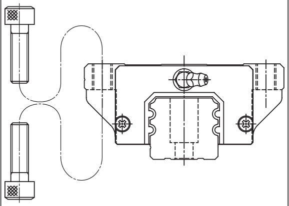
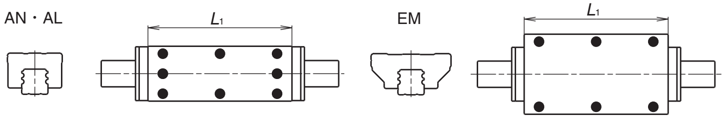


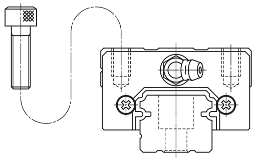
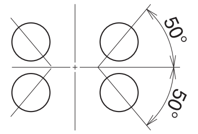
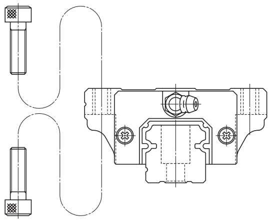
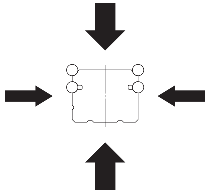
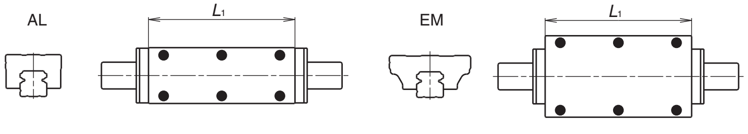


Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity	Features	Characteristics	Applications	Page
Miniature Series	LH	High vertical load carrying capacity Self-aligning 	AN		Rolling element: ball 	Rigiidity: ◎ Friction: ◎ Ease of installation: ◎	High vertical load carrying capacity and selfaligning miniature model ● The contact angle between the ball and ball groove 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 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 makes measuring of ball grooves accurate and easy. ● A ball retainer is standard equipment. (LH10~12) ● Stainless steel type is standard.	• Semiconductor manufacturing equipment • Flat panel display manufacturing equipment • Medical equipment • Optical stages • Microscope XY stages • Miniature robots • Computer peripherals • Pneumatic equipment	A287
	LL	Four-way equal load carrying capacity/Stsandard 	PL		Rolling element: ball 	Rigiidity: ○ Friction: ◎ Ease of installation: ◎	The LL model 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	A297

Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity
High-rigidity series	RA	Four-way equal load carrying capacity/Super-high rigidity 	AN BN		Rolling element: roller  
			AL BL		
			EM GM		
	RB	Four-way equal load carrying capacity/Super-high rigidity 	AL TL BL UL		Rolling element: roller  
			EM GM		

Features	Characteristics	Applications	Page
Rigiidity: ☆ Friction: ◎ Ease of installation: ◎	RA model roller guides have realized the world's highest load capacity. Super-high rigidity and smooth motion contribute to higher performance of machine tools. ● Unique and optimum design of rollers and other components facilitates high-load capacity and high rigidity. ● The installation of a retaining piece achieves smooth motion. ● Rails and slides can be purchased separately in the standard interchangeable lineup. ● Also available dust-resistant V1 end seals with enhanced abrasion resistance (RA25~65).	• Machining centers • NC lathes • Heavy cutting machine tools • Gear cutters • Electric discharge machines • Press machines • Various types of grinders	A303
			
Rigiidity: ☆ Friction: ◎ Ease of installation: ◎	With low mounting height, the RB model is effective for compact machine design, while maintaining the load capacity of the RA model. ● Unique and optimum design of rollers and other components facilitates high-load capacity and high rigidity. ● The installation of a retaining piece achieves smooth motion.	• Machining centers • NC lathes • Heavy cutting machine tools • Gear cutters • Electric discharge machines • Press machines • Various types of grinders	A325
			

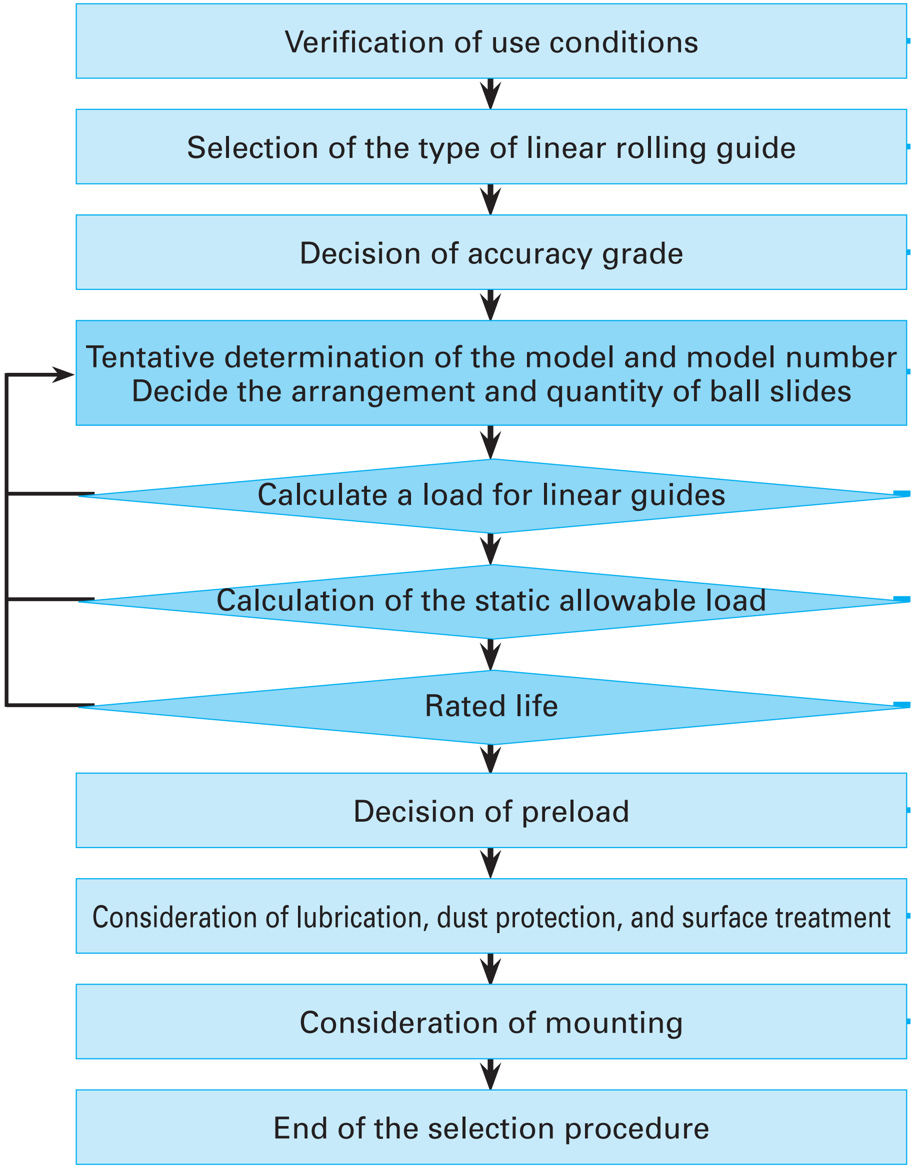
Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/Load direction, capacity	Features	Characteristics	Applications	Page
High-rigidity series	LA	Four-way equal load carrying capacity/Super rigid 	AN BN		Rolling element: ball  	Rigiidity: ◎ Friction: ○ Ease of installation: ◎	The LA model provides top class high-load capacity for ball linear guides. This model 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	A341
			AL BL						
			EL GL				High-load types  		
			FL HL				Super-high-load types  		
High-accuracy series	HA	Four-way equal load carrying capacity/Super rigid/ High accuracy 	AN		Rolling element: ball  	Rigiidity: ◎ Friction: ○ Ease of installation: ◎	HA Model ball guide with high-precision and high-load carrying capacity, featuring highmotion accuracy equivalent to hydrostatic linear bearings. ● Ball passage vibration has been reduced to one-third that of conventional models thanks to ultra-long ball slides and new design specifications. ● 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 a superfinished ball groove (optional). ● End seals, bottom seals, and inner seals of highly dust-resistant specifications are standard equipment. ● Contributes to higher quality machined surfaces.	• Die molding machines • High precision processing machine • Heavy cutting machine tools • Gear cutters • Press machines • Various types of NC grinders	A361
			AL						
			EM				 		

Series	Model	Category/appearance	Slide shape code	Shape/installation method	Rolling element contact structure/ Load direction, capacity	Features	Characteristics	Applications	Page
High-accuracy series	HS	High vertical load carrying capacity Self-aligning/High accuracy 	AL		Rolling element: ball 	Rigiidity: ◎ Friction: ◎ Ease of installation: ◎	HS Model ball guide with high-precision featuring high-motion accuracy equivalent to hydrostatic linear bearings. ● Ball passage vibration has been reduced to onethird that of conventional models thanks to ultra-long ball slides and new design specifications. ● 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 installation error in the perpendicular direction of the rail. ● Thanks to the offset Gothic arch groove, balls make contact at two points, thus keeping friction low.	• High precision processing machines • Electric discharge machines • Various types of NC grinders • Flat panel display manufacturing equipment	A375
			EM						

A-3 Selection of NSK Linear Rolling Guides

A-3-1 Selection Flow Chart

The flow chart below shows the basic steps for selection.



		Page
Verification of use conditions	• Machine structure, installation space and position of the linear guide • Functional requirements (required life, rigidity and accuracy) and use environment	A33 Description of rated life A46 Description of preload A50 Description of accuracy A71 Description of rust prevention and surface treatment A77 Description of arrangement and mounting A103 Technical descriptions and dimension tables 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 requirements.	
Decision of accuracy grade	• Decide the required running accuracy of the machine.	A50 Description of accuracy
Tentative determination of the model 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.	A33 Description of rated life A103 Technical descriptions and dimension tables 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.	A33 Description of 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 such as bolts and their material.	A34 Description of static load rating
Rated life	• Estimate the life and confirm it is within use conditions.	A33 Description of rated life
Decision of preload	• Select a preload and clearance most suitable to requirements.	A46 Description of 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 (seals, bellows or surface treatment) for the use environment.	A58 Description of lubrication A66 Description of dust protection
Consideration of mounting	• Decide installation position, shoulder height and corner radius R of mounting surface of machine base. • Confirm installation procedures.	A77 Description of arrangement and mounting CAT.No.E9008 Description of the mounting of linear guides
End of the selection procedure		

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. Broadly, this period until the linear guide becomes unusable is called "life." There is also "fatigue life " caused by flaking, and "accuracy life" resulting from wear of components.

2. Rating fatigue life

When the linear guide runs under load, 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 in fatigue of the material itself.

"Rating fatigue life" is the total running distance which allows 90% of a group of linear guides of the same reference number to run without 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 ratings listed in "**A-4 Technical Descriptions and Dimension Table for NSK Linear Guides**" comply with the ISO standard.

ISO: International Organization for Standardization

[Basic dynamic load ratings]

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

Part 1: Dynamic load ratings and rating life

[Basic static load ratings]

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

Part 2: Static load ratings

4. Basic dynamic load rating

- ISO international standard 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 downward to the center of the slide.
- For balls as rolling elements, 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 rating.

- 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 elements $C_{100}=\dfrac{C_{50}}{1.26}$
- For rollers as rolling elements $C_{100}=\dfrac{C_{50}}{1.23}$

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 elements] 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 elements] 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) come from various directions up/down and right/left 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 calculations, 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 linear guides, it is a load which is applied in downward direction to the center of the slide.
- Values of basic static load rating C_0 are shown in "**A-4 Technical Descriptions and Dimension Tables 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 conditions, 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-4 Technical Descriptions and Dimension Tables 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. As shown in **Table 2.1**. For example, basic dynamic/static load ratings for RA, LA, etc. models are the same regardless of load direction, whereas the load ratings for NH, NS, etc. models differ based on direction as shown.

Table 2.1 Basic load ratings by load direction

Load rating	Basic dynamic load rating			Basic static load rating		
Model / Load direction	Downward	Upward	Lateral	Downward	Upward	Lateral
NH,VH,NS,LW, DH,DS,DV,LH,HS	C	C	$0.84C$	C_0	$0.78C_0$	$0.65C_0$
PU,LU,PE,LE,LL, RA,RB,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
Applied 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 applied to each assembled slide in a machine. The Table shows six typical patterns of linear guide installation.
- 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
  K_r : Vertical direction rigidity of the slide (N/μm)
  K_s : Lateral direction rigidity of the slide (N/μm)

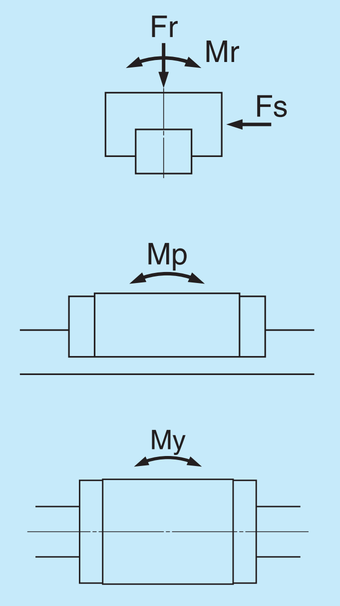
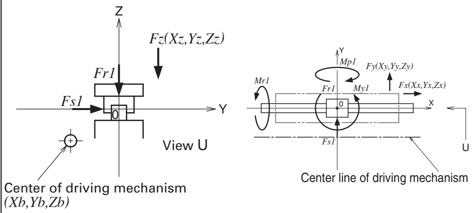
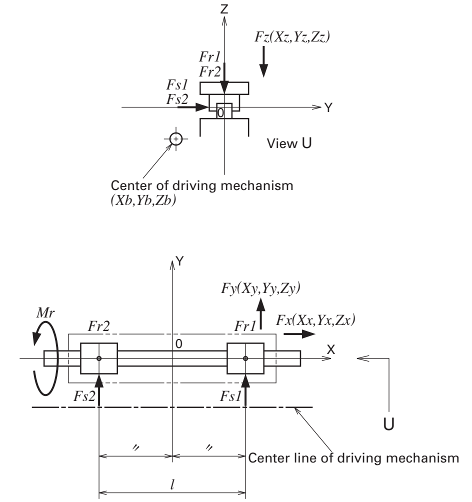
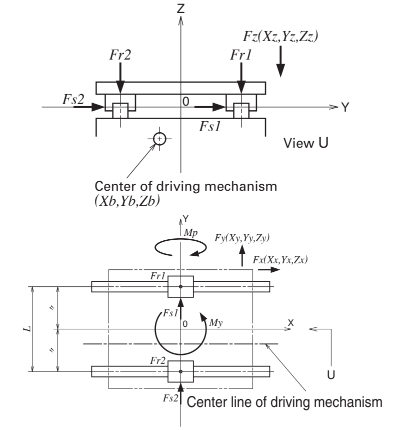
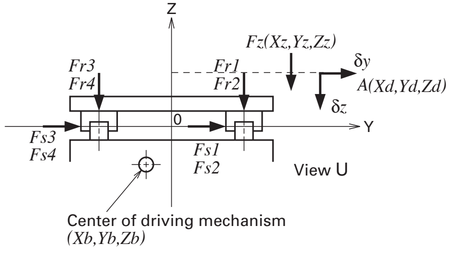
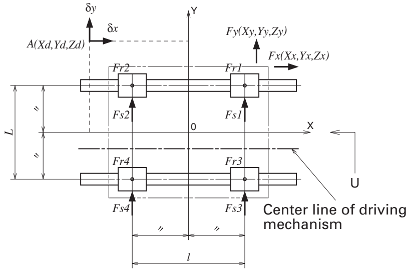
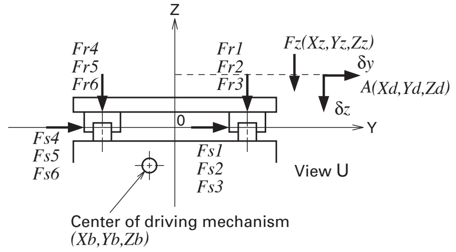
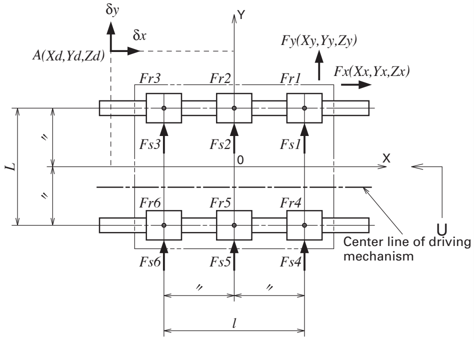
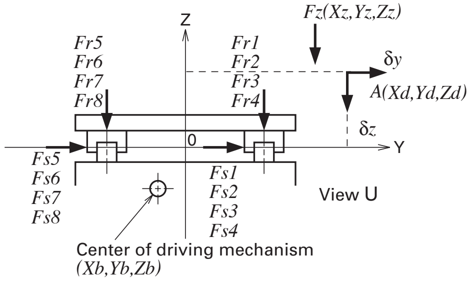
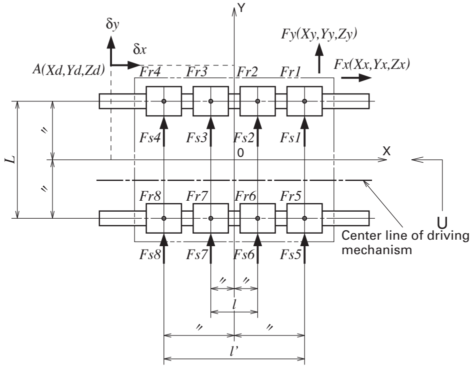


Fig. 2.1

Table 2.2 Loads applied to the slides

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

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

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.

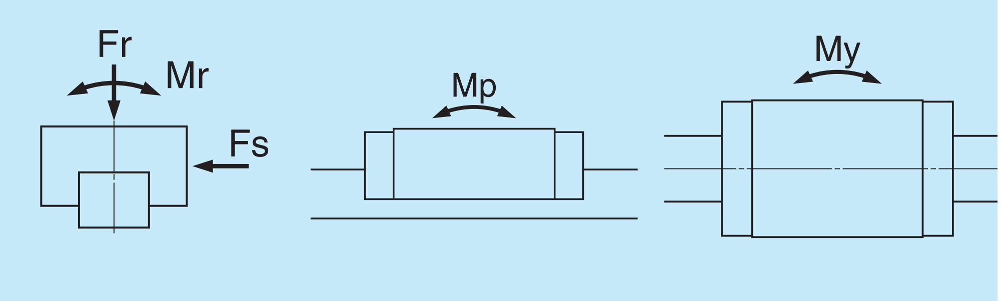
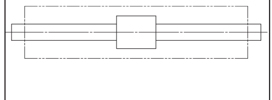
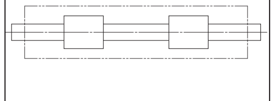
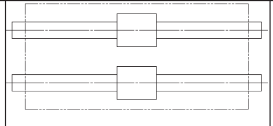
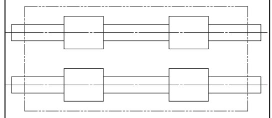


Fig. 2.2

Table 2.3 Loads by arrangement

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, DH, DV, DS, LH, HS Models $\alpha = 50°$ PU, LU, PE, LE, RA, RB, LA, HA Models $\alpha = 45°$
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	DH45L	60	30	36	LE12	90	125	125
NH15L	188	72	86	DH55	51	31	37	LE12S	90	233	233
NH20	142	81	97	DH55L	51	25	30	LE12L	90	86	86
NH20L	142	57	68	DH65	43	27	32	LE15	50	102	102
NH25	123	68	81	DH65L	43	20	24	LE15S	50	174	174
NH25L	123	51	61	DV15	188	111	132	LE15L	50	68	68
NH30A	98	70	83	DV15L	188	72	86	LH08	316	269	321
NH30E	98	58	69	DV20	142	81	97	LH10	253	203	242
NH30L	98	44	52	DV20L	142	57	68	LH12	223	136	162
NH35	78	51	61	DV25	123	68	81	RA15	105	95	95
NH35L	78	36	43	DV25L	123	51	61	RA15L	105	70	70
NH45	60	38	45	DV30A	98	70	83	RA20	79	74	74
NH45L	60	30	36	DV30E	98	58	69	RA20L	79	55	55
NH55	51	31	37	DV30L	98	44	52	RA25	71	64	64
NH55L	51	25	30	DV35	78	51	61	RA25L	71	50	50
NH65	43	27	32	DV35L	78	36	43	RA30	56	58	58
NH65L	43	20	24	DV45	60	38	45	RA30L	56	44	44
VH15	188	111	132	DV45L	60	30	36	RA35	46	52	52
VH15L	188	72	86	DV55	51	31	37	RA35L	46	39	39
VH20	142	81	97	DV55L	51	25	30	RA45	37	40	40
VH20L	142	57	68	DS15	177	116	138	RA45L	37	30	30
VH25	123	68	81	DS15S	177	174	208	RA55	32	33	33
VH25L	123	51	61	DS20	127	94	112	RA55L	32	24	24
VH30A	98	70	83	DS20S	127	136	162	RA65	26	28	28
VH30E	98	58	69	DS25	111	70	83	RA65L	26	19	19
VH30L	98	44	52	DS25S	111	108	129	RB30	56	58	58
VH35	78	51	61	DS30	94	63	75	RB30L	56	44	44
VH35L	78	36	43	DS30S	94	102	121	RB35	46	52	52
VH45	60	38	45	DS35	76	54	64	RB35L	46	39	39
VH45L	60	30	36	DS35S	76	87	104	RB45	37	40	40
VH55	51	31	37	PU09	215	222	222	RB45L	37	30	30
VH55L	51	25	30	PU09L	215	136	136	RB55	32	33	33
NS15	177	116	138	PU12	163	204	204	RB55L	32	24	24
NS15S	177	174	208	PU12L	163	125	125	RB65	26	28	28
NS20	127	94	112	PU15	133	174	174	RB65L	26	19	19
NS20S	127	136	162	PU15L	133	102	102	LA25	122	76	76
NS25	111	70	83	LU05	385	359	359	LA25L	122	47	47
NS25S	111	108	129	LU07	286	305	305	LA30	105	63	63
NS30	94	63	75	LU09	217	242	242	LA30L	105	43	43
NS30S	94	102	121	LU09L	217	138	138	LA35	84	54	54
NS35	76	54	64	LU09R	217	203	203	LA35L	84	37	37
NS35S	76	87	104	LU12	167	204	204	LA45	60	41	41
LW17	66	125	149	LU12L	167	116	116	LA45L	60	31	31
LW21	59	108	129	LU15	133	174	174	LA55	51	33	33
LW27	53	76	91	LU15L	133	94	94	LA55L	51	26	26
LW35	32	51	61	PE09	123	161	161	LA65	43	29	29
LW50	25	38	46	PE09L	123	108	108	LA65L	43	20	20
DH15	188	111	132	PE12	90	136	136	HA25	122	33	33
DH15L	188	72	86	PE12L	90	90	90	HA30	105	27	27
DH20	142	81	97	PE15	50	111	111	HA35	84	23	23
DH20L	142	57	68	PE15L	50	72	72	HA45	60	20	20
DH25	123	68	81	LE05	196	248	248	HA55	51	16	16
DH25L	123	51	61	LE05S	196	323	323	HS15	177	45	54
DH30A	98	70	83	LE07	141	188	188	HS20	127	39	47
DH30E	98	58	69	LE07S	141	349	349	HS25	111	33	39
DH30L	98	44	52	LE07L	141	122	122	HS30	94	27	32
DH35	78	51	61	LE09	123	149	149	HS35	76	23	28
DH35L	78	36	43	LE09S	123	277	277				
DH45	60	38	45	LE09L	123	102	102				

Definitions of codes appearing at the end of the Model No. in **Table 2.4**:

L : Super-high-load ; NH45L
S : Medium load ; NS25S
No code : High-load ; NH45_
A : Ball slide shape is square ; NH30A (only NH30, VH30, DH30, and DV30)
E : Ball slide shape is flanged (EM type) ; NH30E (only NH30, VH30, DH30, and DV30)
R : Miniature Model with ball retainer ; LU09R (only LU and LE)

- After obtaining the dynamic equivalent coefficient in **Table 2.4**, the full dynamic equivalent load can be obtained using the appropriate equation below as determined by the magnitude of the load:

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

  The values for dynamic equivalent load in the formulas above should be absolute values that disregard load directions.

- It is necessary to include the amount of preload for the calculation of rating life when selecting "Z3 medium preload" or "Z4 heavy preload". For the calculation of full dynamic equivalent loads that consider preload, see "**A-3-3 6**" on page A49.

4. Calculation of mean effective load

When the load on a slide varies, 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 full dynamic equivalent load as it is.

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

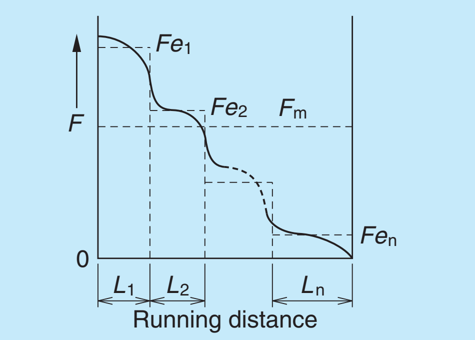


Fig. 2.3 Stepwise load change

Running distance while full dynamic equivalent load Fe_1 is applied: L_1

Running distance while full dynamic equivalent load Fe_2 is applied: L_2

Running distance while full dynamic equivalent load Fe_3 is applied: L_3

• • • • • • • • • • • • • • • • • •

Running distance while full dynamic equivalent load Fe_n is applied: L_n

From the above, mean effective load F_m can be obtained by the following formula.

For balls:

$$F_m = \sqrt[3]{\frac{1}{L}(Fe_1^3 L_1 + Fe_2^3 L_2 + \dots\dots + Fe_n^3 L_n)}$$

For rollers:

$$F_m = \sqrt[\frac{10}{3}]{\frac{1}{L}(Fe_1^{\frac{10}{3}} L_1 + Fe_2^{\frac{10}{3}} L_2 + \dots\dots + Fe_n L_n)}$$

$\frac{10}{3}$

F_m : Mean effective load of the deviating load (N)

L : Running distance (ΣL_n)

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

Approximate mean effective load F_m can be obtained by the following formula.

$$F_m \fallingdotseq \frac{1}{3}(F_{min} + 2F_{max})$$

F_{min} : Minimum value of dynamic equivalent load (N)

F_{max} : Maximum value of dynamic equivalent load (N)

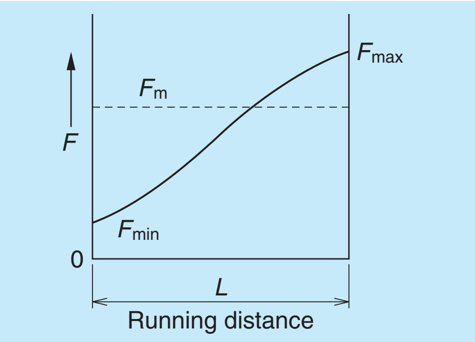
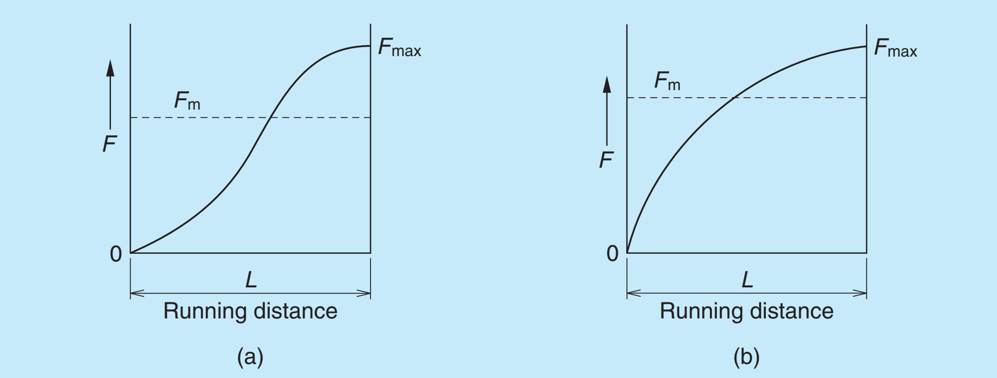


Fig. 2.4 Linear load change

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

At time of (a): $F_m = 0.65\ F_{max}$

At time of (b): $F_m = 0.75\ F_{max}$



(a)

(b)

Fig. 2.5 Load that changes in a 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 f_w

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 to function optimally, both the rolling elements and contact surface must have a hardness of HRC58 or higher.
- NSK linear guides typically have a hardness at or above HRC58 and thus satisfy this requirement; however, if the guide uses a special material by request and the hardness is HRC58 or lower, use the following formulas for adjustment.

$$\boldsymbol{C_H = f_H \cdot C}$$

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

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**)

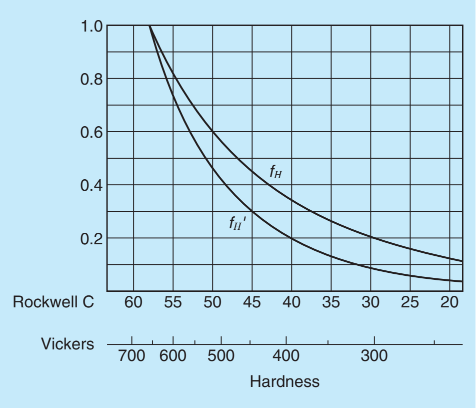


Fig. 2.6 Hardness coefficient

(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 calculations.

6. Calculation of rating life

(1) Life calculation formula

The life calculation formula for stroke movement with normal lubrication has the following relationships 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 elements]

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 elements]

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 or basic static moment ratings M_{R0}, M_{P0} or M_{Y0} for calculations of 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.

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."

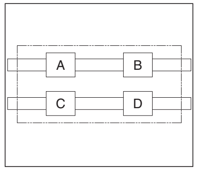


Fig. 2.7 Life of a system

7. Examination of the basic static load rating

(1) Considerations for 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, DH, DV, DS, LH, and HS Models:

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 PU, LU, PE, LE, LL, RA, RB, LA and HA Models:

$$P_0 = Fr + Fs$$

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

Table 2.6 Slides with balls as rolling elements

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

Table 2.7 Slides with rollers as rolling elements

Use conditions	f_s
Under normal operating conditions	2 – 3
Operating under vibration/impact	2.5 – 4

- Basic static load rating is not a destructive force on 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 destructive load designed for general machines.
- However, when a heavy load is applied to the rail and slide in the direction the bolts are tightened, the strength of the bolts securing the rail and the ball slide affects the strength of the entire system. Strength of the bolt and its material should be considered.

(2) Considerations for static moment load rating

- Examine the static permissible moment load M_o from the basic static moment load M_{po} and the static permissible load factor fs.

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

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

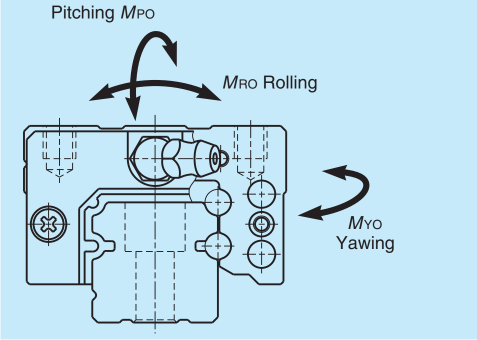


Fig. 2.8 Moment load directions

8. Design precautions regarding life

The following points must be heeded in examining life.

In case of oscillating motion

- If the rolling elements rotate 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 moments

- The load applied to rolling element rows inside the slide is inconsistent if a pitching or yawing moment load is applied. Loads are heavy on the rolling elements at the both ends of a 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 positions 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 cases, the contact pressure to the rolling elements and the rolling contact surface is extraordinarily high.
- If the linear guides are operated under such states continually, their life is significantly affected by the loss of lubrication and the presence of dust, and thus the actual life becomes shorter than calculated.
- Reduce load on the slides by reviewing the linear guide arrangement, the number of slides, and the model or Model No.
- 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 A49.

(∗) For DH, DV, and DS models, less than 6 000 km.

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.
- End caps with high speed specifications 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

- Eliminating the clearance between the raceway and rolling elements allows mechanical play to be eliminated.
- 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 inserted in the slide, control the clearance and amount of preload.
- In NSK linear guides, rigidity is further increased and 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 the preload (**Fig.3.2**). For roller guide system, it becomes about 2.2 times the preload.
- **Fig. 3.3** shows the relationship between ball slide deformation and 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**).

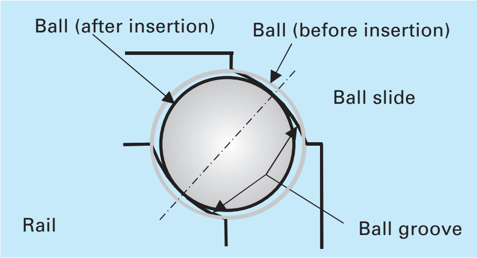


Fig. 3.1 Preloading method

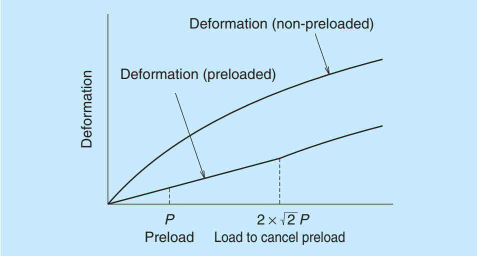


Fig. 3.2 Elastic deformation

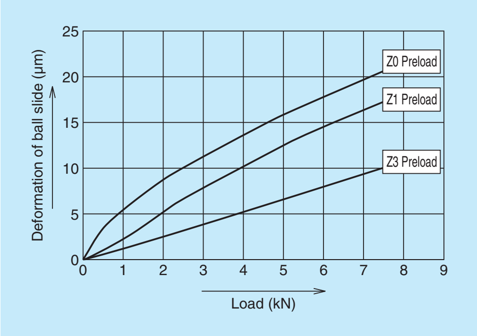


Fig. 3.3 Rigidity of NH35, downward direction load (example)

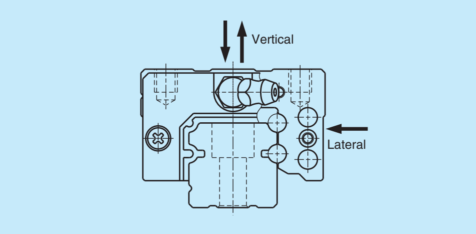


Fig. 3.4 Radial rigidity

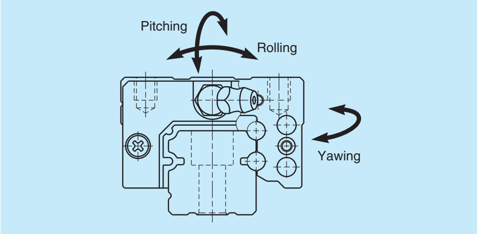


Fig. 3.5 Moment rigidity

- 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.

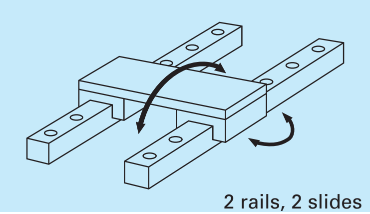


Fig. 3.6 Pitching and yawing direction

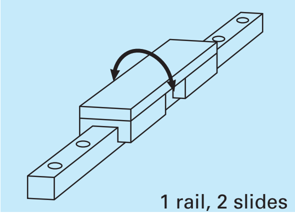


Fig. 3.7 Rolling direction

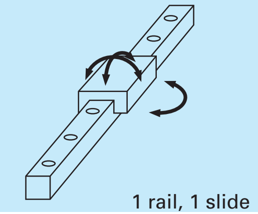


Fig. 3.8 All directions

3. Selection of preload classification

- The preload supported by NSK linear guides varies by model.
- Types of preload available are shown in **Table 3.1**. **Table 3.2** shows selection criteria for preload.

Table 3.1 Classification of preload by model

Preload		Preloaded assembly (not interchangeable)				Interchangeable type		
		Heavy preload	Medium preload	Slight preload	Fine clearance	Medium preload	Slight preload	Fine clearance
Model		Z4	Z3	Z1	Z0	ZH	ZZ	ZT
Ball guide	NH, NS		○	○	○	○	○	○
	VH		○	○	○		○	○
	LW		(○)	○	○		○	○
	DH, DS		○	○	○			
	DV		○	○	○			
	PU, LU			○	○			○
	PE, LE			○	○			○
	Miniature LH			○	○			
	LL				○			
	LA	○	○					
	HA		○	○				
	HS		○	○				
Roller guide	RA		○	○		○	○	
	RB		○					

Table 3.2 Selection criteria for preload

Classification of preload	Use condition	Applications
Z0 and ZT (Fine clearance)	• A set of two parallel linear guides (four slides/two rails) is used to sustain a unidirectional load with low vibration and impact. • 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. • 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)	• Extremely high stiffness is essential. • Vibration and impact load will be applied.	Machining centers, Lathes, Milling machines, Boring machines, Grinders

4. Estimation of elastic deformation

Load and deformation have the following relationship:

- Without preload
  When the rolling elements are balls
  The deformation is proportional to the 2/3 power of the load.
  When rolling elements are rollers
  The deformation is proportional to the 9/10 power of the load.
- With preload
  The deformation is directly proportional to the load.

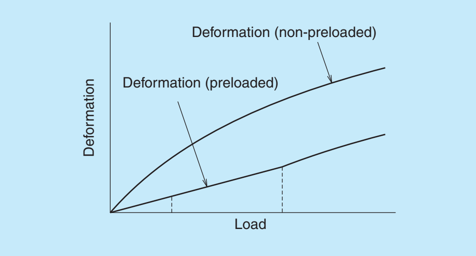


Fig. 3.9 Elastic deformation

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 for the particular model.

<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 driving mechanism

Please refer to the calculation formula of deformation for typical table structures on pages A36 to A38.

5. Application examples of preload

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

Table 3.3 Application examples of preload

Type of machine	Application	Preload						
		Preloaded assembly				Interchangeable type		
		Heavy preload Z4	Medium preload Z3	Slight preload Z1	Fine clearance Z0	Medium preload ZH	Slight preload ZZ	Fine clearance ZT
Machine tools	Machining centers	○	○			○		
	Jig borers	○	○			○		
	Grinder	○	○			○		
	Lathes	○	○			○		
	Milling machines	○	○			○		
	Drilling machines	○	○			○		
	Boring machines	○	○			○		
	Gear cutters	○	○			○	○	
	Laser cutting machines		○	○	○	○	○	
	Electric discharge machines	○	○	○		○		
	Turning centers	○	○			○		
	Transport section (including ATC, etc.)		○	○	○	○	○	○
	Punch presses		○	○	○	○	○	○
	Other processing machines		○	○		○		
Industrial machines and equipment	Press machines		○	○	○	○	○	○
	Welding machines		○	○	○	○	○	○
	Painting machines		○	○	○	○	○	○
	Coil winders		○	○	○	○	○	○
	Woodworking machines		○	○	○	○	○	○
	Glass processing machines		○	○	○	○	○	○
	Stone cutting machines		○	○	○	○	○	○
	Industrial robots		○	○	○	○	○	○
	Assembling devices		○	○	○	○	○	○
	Material handiing equipment		○	○	○	○	○	○
	Packing machines		○	○	○	○	○	○
	Paper manufacturing machines		○	○	○	○	○	○
	Steel machinery		○	○	○	○	○	○
	Textile machines		○	○	○	○	○	○
	Tire manufacturing equipment		○	○	○	○	○	○
	Measuring/inspection equipment			○		○	○	
	Image processing device		○	○	○	○	○	
	Three-dimensional measuring equipment		○	○		○	○	
	Medical equipment			○	○	○	○	○
	Food processing equipment			○	○	○	○	○
	OA equipment			○	○	○	○	○
	Pneumatic equipment			○	○	○	○	○
	Platform door (railway related)			○			○	
	Rechargeable battery manufacturing equipment		○	○	○	○	○	○
	Other inspection equipment		○	○	○	○	○	○
	Other machines		○	○	○	○	○	○
Semiconductor and flat panel display manufacturing equipment	Wafer slicers		○			○	○	
	Chemical processing equipment		○	○	○	○	○	○
	Lithographic machines		○	○		○	○	
	Probers		○	○		○	○	
	Wafer dicers		○			○	○	
	Bonders		○	○		○	○	
	Wire bonders		○	○		○	○	
	IC handlers		○	○	○	○	○	○
	Printed circuit board drilling machines		○	○		○	○	
	Electronic component mounting machines		○	○	○	○	○	○
	Semiconductor/flat panel display inspection equipment			○		○	○	○
	Other semiconductor/flat panel display equipment		○	○	○	○	○	○

6. Load and rating life when 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 elements

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

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 elements

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

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.
  Use the slight preload (Z1) of a preloaded linear guide to find the slight preload (ZZ) of an interchangeable linear guide.

$F = iP$

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

Use the following contact coefficient values (i).

NH, VH, NS, LW, DH, DV, DS, LH, and HS Models	: 0.004
LA and HA Models	: 0.010
PU, LU, PE, and LE Models	: 0.026

- The starting friction force when the slide begins to move depends on lubrication conditions. Roughly estimate it at 1.5 to 2 times 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 model preload)
$F = \mathrm{i}P$
$= 0.004 \times 2\ 350 = 9.4$ (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 model.

A-3-4 Accuracy

1. Accuracy standard

The accuracy of a particular model of linear guide is specified by its 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 where accuracy is required. The accuracy of a linear guide can be selected to match your 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.

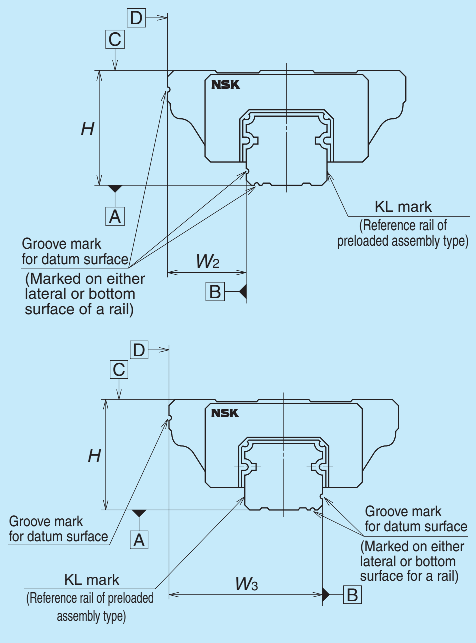


Fig. 4.1 Assembled dimensions

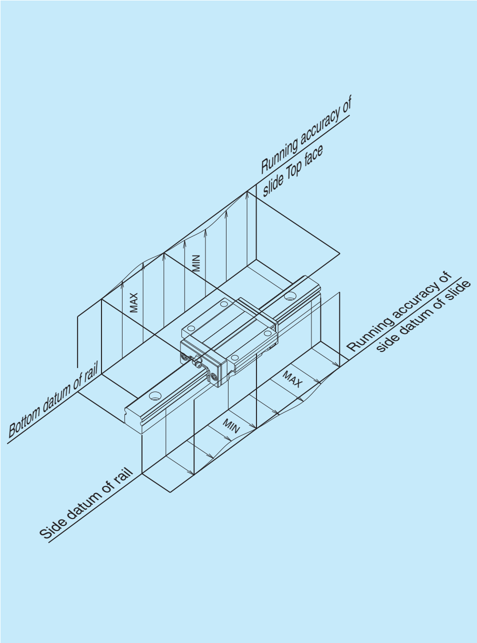


Fig. 4.2 Running parallelism of slide

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**)

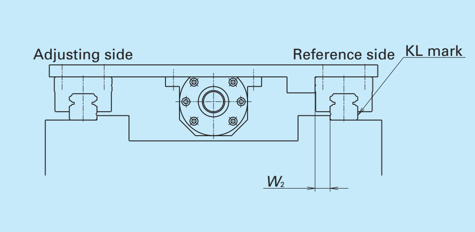


Fig. 4.3 Mounting width W_2

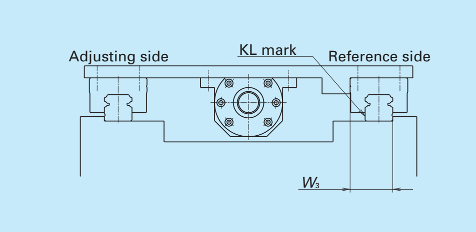


Fig. 4.4 Mounting width W_3

Running Parallelism of Slide

The running parallelism is set to match the characteristics of each model. These are shown in Tables 4.2 and 4.3. Note that applicable accuracy grades differ by model. Refer to Table 4.5 "Accuracy grade and applicable models" on page A55 for more information.

Table 4.2 Running parallelism of slide for NH, VH, NS, LW, DH, DV, DS, RA, RB, LA, HA, HS Models

Unit: μm

Rail length (mm) \ Accuracy grade		Preloaded assembly (not interchangeable)					Interchangeable type	
		Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	High precision PH	Normal grade PC
over	or less							
–	50	2	2	2	4	5	2	5
50 –	80	2	2	3	4	5	3	5
80 –	125	2	2	3	4	5	3	5
125 –	200	2	2	3.5	5	6	3.5	6
200 –	250	2	2.5	4.5	6	7.5	4.5	7.5
250 –	315	2	2.5	5	6.5	8.5	5	8.5
315 –	400	2	3	5.5	7	9.5	5.5	9.5
400 –	500	2	3	6	7.5	11	6	11
500 –	630	2	3.5	6.5	8.5	12	6.5	12
630 –	800	2	4	7	9.5	13	7	13
800 –	1 000	2.5	4.5	7.5	10	15	7.5	15
1 000 –	1 250	3	5	8.5	12	16	8.5	16
1 250 –	1 600	3.5	5.5	9.5	13	17	9.5	17
1 600 –	2 000	4	6.5	11	14	19	11	19
2 000 –	2 500	4.5	7.5	12	16	21	12	21
2 500 –	3 150	5.5	8.5	13	18	23	13	23
3 150 –	4 000	6	9.5	14	19	25	14	25

Table 4.3 Running parallelism of slide for PU, LU, PE, LE, Miniature LH Models

Unit: μm

Rail length (mm) \ Accuracy grade		Preloaded assembly (not interchangeable)				Interchangeable type
		Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC
over	or less					
–	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
1 250 –	1 600	7	11	19	23	23
1 600 –	2 000	8	13	21	26	26
2 000 –	2 500	10	15	22	29	29
2 500 –	3 150	11	17	25	32	32
3 150 –	4 000	16	23	30	34	34

3. Application examples of accuracy grade and preload

Table 4.4 shows examples of accuracy grade and preload of NSK linear guides for specific purposes. Refer to this table when selecting the accuracy grade and preload type for your application.

Table 4.4 Application examples of accuracy grade and preload

Type of machine	Application	Accuracy grade							Preload						
		Preloaded assembly					Interchangeable type		Preloaded assembly				Interchangeable type		
		Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	High precision PH	Normal grade PC	Heavy preload Z4	Medium preload Z3	Slight preload Z1	Fine clearance Z0	Medium preload ZH	Slight preload ZZ	Fine clearance ZT
Machine tools	Machining centers		○	○	○		○		○	○			○		
	Jig borers	○	○	○	○		○		○	○			○		
	Grinder	○	○	○	○		○		○	○			○		
	Lathes		○	○	○		○		○	○			○		
	Milling machines		○	○	○		○		○	○			○		
	Drilling machines		○	○	○		○		○	○			○		
	Boring machines		○	○	○		○		○	○			○		
	Gear cutters		○	○	○		○		○	○			○	○	
	Laser cutting machines		○	○	○		○			○	○	○	○	○	
	Electric discharge machines	○	○	○			○		○	○	○		○		
	Turning centers		○	○	○		○		○	○			○		
	Transport section (including ATC, etc.)				○	○	○	○		○	○	○	○	○	○
	Punch presses		○	○	○		○	○		○	○	○	○	○	○
	Other processing machines		○	○	○		○			○	○		○		
Industrial machines and equipment	Press machines				○	○	○	○		○	○	○	○	○	○
	Welding machines				○	○	○	○		○	○	○	○	○	○
	Painting machines				○	○	○	○		○	○	○	○	○	○
	Coil winders				○	○	○	○		○	○	○	○	○	○
	Woodworking machines				○	○	○	○		○	○	○	○	○	○
	Glass processing machines				○	○	○	○		○	○	○	○	○	○
	Stone cutting machines				○	○	○	○		○	○	○	○	○	○
	Industrial robots			○	○	○	○	○		○	○	○	○	○	○
	Assembling devices			○	○	○	○	○		○	○	○	○	○	○
	Material handiing equipment			○	○	○	○	○		○	○	○	○	○	○
	Packing machines				○	○	○	○		○	○	○	○	○	○
	Paper manufacturing machines				○	○	○	○		○	○	○	○	○	○
	Steel machinery				○	○	○	○		○	○	○	○	○	○
	Textile machines				○	○	○	○		○	○	○	○	○	○
	Tire manufacturing equipment				○	○	○	○		○	○	○	○	○	○
	Measuring/inspection equipment	○	○	○	○		○				○		○	○	
	Image processing device	○	○	○	○		○			○	○	○	○	○	
	Three-dimensional measuring equipment	○	○	○	○		○			○	○		○	○	
	Medical equipment		○	○	○		○	○			○	○	○	○	○
	Food processing equipment				○	○	○	○			○	○	○	○	○
	OA equipment				○	○	○	○			○	○	○	○	○
	Pneumatic equipment				○	○	○	○			○	○	○	○	○
	Platform door (railway related)					○		○			○			○	
	Rechargeable battery manufacturing equipment			○	○	○	○	○		○	○	○	○	○	○
	Other inspection equipment		○	○	○		○			○	○	○	○	○	○
	Other machines			○	○	○	○	○		○	○	○	○	○	○
Semiconductor and flat panel display manufacturing equipment	Wafer slicers	○	○	○	○					○			○	○	
	Chemical processing equipment	○	○	○	○		○			○	○	○	○	○	○
	Lithographic machines	○	○	○	○		○			○	○		○	○	
	Probers	○	○				○			○	○		○	○	
	Wafer dicers	○	○							○			○	○	
	Bonders									○	○		○	○	
	Wire bonders			○	○		○			○	○		○	○	
	IC handlers		○	○	○		○	○		○	○	○	○	○	○
	Printed circuit board drilling machines	○	○	○			○			○	○		○	○	
	Electronic component mounting machines		○	○	○		○	○		○	○	○	○	○	○
	Semiconductor/flat panel display inspection equipment										○		○	○	○
	Other semiconductor/flat panel display equipment			○	○	○	○	○		○	○	○	○	○	○

Note: Only Z1 and Z0 are available for PN grade.
For interchangeable types, 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

- Available accuracy grades are determined by the characteristics of the NSK linear guide model.
- **Table 4.5** shows the accuracy grades available for each model.
- Refer to **"3. Application examples of accuracy grade and preload"** which shows cases of appropriate accuracy grades for specific purposes.

Table 4.5 Accuracy grades and applicable models

Model	Preloaded assembly (not interchangeable)					Interchangeable 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	○	○	○	○	○		○
LW			○	○	○		○
DH, DS	○	○	○	○	○		
DV	○	○	○	○	○		
PU, LU, PE, LE		○	○	○	○		○
Miniature LH		○	○	○	○		
LL					○		
RA	○	○	○	○		○*	
RB	○	○	○	○			
LA	○	○	○	○			
HA, HS	○	○	○				

*) Only RA25 to RA65 are available as interchangeable types.

(2) Preload

- Available preload types are determined by the characteristics of the NSK linear guide model.
- **Table 4.6** shows the preload classifications available for each model.
- Refer to the specifications of each model for details of radial clearance, preload, and rigidity.
- **"3. Application examples of accuracy grade and preload"** shows cases of appropriate preload classifications and accuracy grades for specific purposes.

Table 4.6 Classification of preload

Model	Preloaded assembly (not interchangeable)				Interchangeable 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		○	○	○		○	○
LW		(○)	○	○		○	○
DH, DS		○	○	○			
DV		○	○	○			
PU, LU, PE, LE			○	○			○
Miniature LH			○	○			
LL				○			
RA		○	○		○	○	
RB		○					
LA	○	○					
HA, HS		○	○				

Notes: 1) Z3 preload classification is only applicable to LW35 and LW50 in the LW model.
2) Only RA25 to RA65 are available as interchangeable types.
3) Preload code of "Z" is omitted from the Ref. No. Only the preload classification code is specified at the end of the reference number. (Refer to the reference numbers for each model.)

(3) Combinations of accuracy grade and preload

- Combinations of accuracy grade and preload are shown in **Table 4.7**.

Table 4.7 Combinations of accuracy grade and preload type

	Accuracy grade	Preload
Preloaded assembly	P3 – P6	Z4 – Z0
	PN	Z1, Z0
Interchangeable type	PC, PH$^{*1, *2}$	ZH, ZZ, ZT

*1) The interchangeable type is available for models 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-Purpose Models

Unit: mm

Model	Size Material	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				
NS	Special high carbon steel	2 920	3 960	3 960	4 000	4 000			
	Stainless steel	1 800	3 500	3 500	3 500	3 500			

Unit: mm

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

Long-Life Series

Unit: mm

Model	Size Material	15	20	25	30	35	45	55	65
DH	Special high carbon steel	2 980	3 960	3 960	4 000	4 000	3 990	3 960	3 900
DV	Special high carbon steel	2 000	3 960	3 960	4 000	4 000	3 990	3 960	
DS	Special high carbon steel	2 920	3 960	3 960	4 000	4 000			

Miniature Models

Unit: mm

Model	Size Material	05	07	08	09	10	12	15
PU	Stainless steel				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				800		1 000	1 200
LE	Stainless steel	150	600		800		1 000	1 200
LH	Stainless steel			375		600	800	

High Rigidity Models

Unit: mm

Model	Size Material	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
RB	Special high carbon steel				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

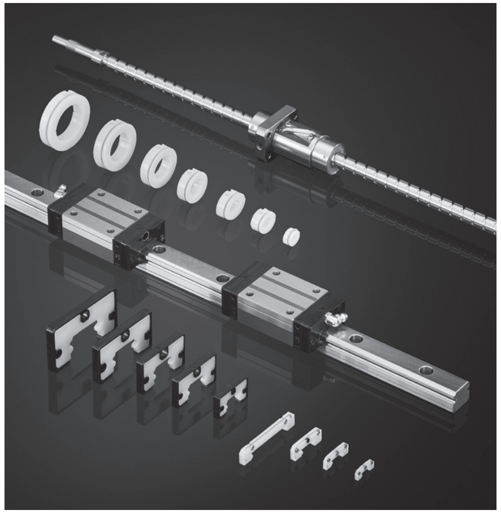
High-Accuracy Models

Unit: mm

Model	Size Material	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	1 300	3 500	3 500	3 500	3 500		

A-3-6 Lubrication

1. NSK K1™/K1-L™ lubrication units



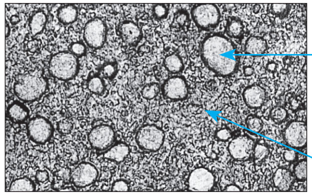
NSK K1 and K1-L lubrication units reduce costs and environmental impacts.

Long-term, maintenance-free operation

Linear guides equipped with NSK K1 units do not require maintenance for five years or up to 10 000 km of operation.

Unique lubricating structure

NSK K1 and K1-L lubrication units consist a porous synthetic resin with abundant lubricating oil. As NSK K1 and NSK K1-L units contact the raceway surface close to the rolling element contact point, fresh oil seeps out from the resin to provide continuous lubrication.



Enlarged surface of NSK K1 Lubrication Unit

Polyolefin

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

Lubrication oil

Uses a mineral oil-based lubricant. The oil has a viscosity of 100 cSt.

The revolutionary NSK K1 lubrication unit

With a porous resin structure full of oil, NSK K1 units are installed on the inner side of end seals where they enhance lubricating capabilities.

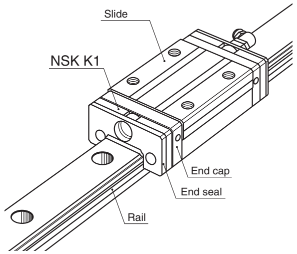


Fig. 6.1

In food processing machinery and medical equipment where hygiene control is essential, we offer NSK K1 units for sanitary environments. For details, refer to Sec. A-3-9 4.

The NSK K1-L lubrication unit—for even longer maintenance-free operation!

NSK K1-L units offer greatly improved lubricating capabilities and even longer maintenance-free operation compared to NSK K1 units. NSK K1-L units are available for NH, VH, NS, DH, DV, DS, and HS models.

For more details, please see the NSK K1-L catalog (No. E3335).

(1) Features

NSK K1 and NSK K1-L are compact and efficient lubrication units that keep linear guides lubricated longer.

1) Extended maintenance intervals

NSK K1 and K1-L units provide long-term, maintenance-free grease lubrication ideal for systems and environments where replenishing is difficult.

▼

For automotive component processing lines, etc.

2) Clean and efficient

A very small volume of grease combined with NSK K1 or NSK K1-L units can provide sufficient lubrication in environments where grease would normally be undesirable and in environments where high cleanliness is required.

▼

Food processing/medical equipment, flat panel display/semiconductor manufacturing equipment, etc.

We also provide NSK K1 lubrication units for sanitary environments; ideal for food processing machinery and medical equipment where hygiene control is essential. For details, refer to **A-3-9 4**.

(2) Functionality

The high-performance functionality of NSK K1 units has been tested thoroughly at NSK and in the field.

1) Durability test at high speed with no other lubrication

Fig. 6.2 shows test results for a linear guide operated with no lubrication and the NSK K1 unit alone. Typically, the linear guide breaks down and is unable to travel after a short period; however, when equipped with NSK K1, the guide easily travels 25 000 km.

Test Conditions

Sample : LH30AN (preload Z1)
Travel speed : 200 m/min
Stroke : 1 800 mm

3) Excels in wet environments

Using NSK K1 or K1-L units with grease prolongs the life of equipment even when the machine is exposed to rain, wind, or wash water.

▼

Food processing equipment, housing/construction machines, etc.

4) Maintains lubrication in environments with dust

In environments where oil- and grease-absorbing dust is produced, NSK K1 or K1-L units with grease maintain lubrication long-term and prevent foreign matter entry.

▼

Woodworking machines, etc.

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

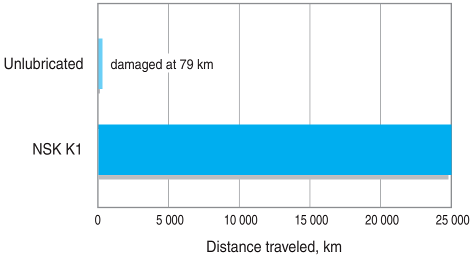


Fig. 6.2 Durability test at high speed, with no lubrication (lubricated by NSK K1 only)

2) Immersion test

Fig. 6.3 shows test results after immersing a linear guide in water once per week for 24 hours at a time before 2 700 km of travel. Without NSK K1, the ball groove surface wore out at an early stage and broke. With NSK K1, the wear generated was reduced to about 1/3 (**Table 6.1**) that of the initial test, proving the powerful effect of the NSK K1.

Test 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
(*) Exclusively for food processing machines
Immersion conditions:
Immersed and traveled once per week for 24 hours at a time.

* Grease made in U.S.A.
Characteristics
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

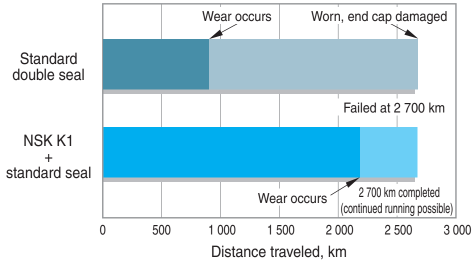


Fig. 6.3 Durability test immersed in water

4) Dust generation

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

3) Durability test with wood chips

Wood chips absorb lubricant making it extremely difficult to maintain lubrication in such environments. Fig. 6.4 shows that the life of a linear guide equipped with NSK K1 and a standard seal is two times longer than the life when two seals are combined (standard double seal).

Test 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

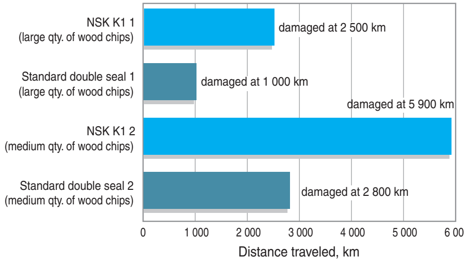


Fig. 6.4 Durability test with wood chips

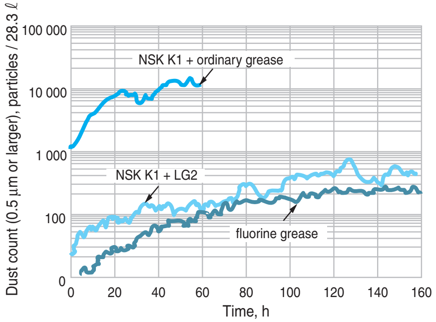


Fig. 6.5 Comparison of dust emissions

(3) Specifications

1) Applicable models and sizes

a) NSK K1

Can be installed in LW, PU, LU, PE, LE, LH, RA, RB, LA, and HA models.

b) NSK K1-L

Can be installed in NH, VH, NS, DH, DV, DS, and HS models. NSK K1-L is standard equipment for the VH model.

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

2) Standard specifications

a) NSK K1/NSK K1-L units are installed between the end seal and end cap.

(Double-seal specifications and specifications with a protector are also available upon request.)

b) NSK standard grease is packed inside the slide. (The type of grease may be specified.)

c) Accuracy and preload classifications are the same as standard items. (Dynamic friction will increase slightly when NSK K1/NSK K1-L units are present.)

3) Number of installed NSK K1

Normally, one NSK K1 unit should be installed on both ends (two K1 units for one slide).

However, more NSK K1 units may be required under more stringent operating conditions and environments. Please consult NSK for details in such cases.

Handling Precautions

To maintain the high functionality of NSK K1 and K1-L units for a long period, observe the following precautions:

1. Operating temperature range: Maximum operating temperature: 50°C
(Momentary maximum temperature: 80°C)

2. Chemicals to avoid: Do not allow NSK K1 or K1-L units to make contact with organic solvents that remove oil, such as hexane and oil thinners. Do not leave NSK K1 or K1-L units in white kerosene or rust preventive oils that contain white kerosene.

Note: Water- and oil-based cutting fluid and grease (mineral oil or ester-based) will not cause damage.

2. Types of Lubrication

Linear guides generally use either grease or oil lubrication.
Use a lubricant agent and method most suitable to conditions, requirements, and purpose to optimize linear guide functions.
In general, lubricants with low base oil kinematic viscosity are used in low temperatures and in high-speed operations where thermal expansion has a large impact.
Lubricants with high base oil kinematic viscosity are used in high temperatures and under oscillating operations or low speeds.
The following provides more details on grease and oil lubrication methods.

(1) Grease Lubrication

Grease lubrication is widely used because it does not require a special oil supply system or piping.
Grease lubrication accessories available from NSK include:

- A variety of grease types in bellows tubes that can be attached to a hand grease pump with one touch.
- NSK Grease Units that consist of a hand grease pump and various nozzles. These are compact and easy to use.

1) NSK grease lubricants

Table 6.2 shows the types of general grease widely used for linear guides. In addition to these, NSK provides special greases for specific conditions and purposes. Please see page D13 for properties of NSK Grease, etc.

Table 6.2 Grease lubricant for linear guides

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

*1) Standard grease of NH, VH, NS, LW, DH, DV, DS, LH, RA, RB, LA, HA, and HS Models.
*2) Standard grease of PU, LU, PE, and LE Models.

2) How to replenish grease

Use grease fittings unless a specialized grease supply system is used. Supply the required amount of grease with a grease pump.

Wipe off old grease and accumulated dust before supplying new grease. If the grease fitting cannot be used due to size limitations, apply grease directly to the rail. Remove the seal if possible, and move the slide a few strokes to allow the grease to permeate. NSK offers a hand grease pump exclusively for the easy lubrication of linear guides.

Please see page D19 onward for hand grease pump, various types of grease in bellows containers that can be attached to the pump, and grease nozzles.

3) Volume of grease to be replenished

Once grease is applied, another supply is typically not required for a long time. However, some operational conditions require more periodic grease replenishment.

Here are a few methods:

- If using a specialized grease supply system and the volume from the spout can be controlled:

Replenish to fill about 50% of the internal space of the slide.

This method eliminates grease waste and is efficient.

Table 6.4 on Page A64 shows the internal space of the slide by model.

- If using a grease pump:

Use the pump to fill the inside of the slide with grease until it comes out from the slide area.

Move the slide by hand while filling so that the grease permeates all areas.

Do not operate the machine immediately after replenishing.

Always perform a run-in with several trial runs to spread the grease throughout the system and to remove excess grease from inside. Running-in is necessary because the sliding force of the linear guide greatly increases immediately after replenishment (when fully packed) due to stirring resistance and may cause problems.

Wipe off any excess grease that accumulates at the end of the rail after trial runs so that the grease does not spread to other areas.

4) Intervals of checks and replenishments

Even high-quality grease gradually deteriorates and loses its lubricating functionality. Additionally, grease in the slide is gradually removed by stroke movement. In some environments, the grease may become dirty and foreign matter may enter the slide. New grease should be supplied depending on the frequency of use. The following is a guide of intervals of grease replenishment for 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 matter such as cutting chips	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 check results warrant it necessary.

Notes: 1) As a general rule, do not mix greases of different brands. Grease structures 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 particularly high in winter due to low temperatures. Pay attention to increases in linear guide sliding resistance in such occasions.

Table 6.4 Internal space of the slide

NH, DH Models

Unit: cm^3

Model / Model No.	NH, DH	
	High-load type	Super-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, DV Models

Unit: cm^3

Model / Model No.	VH, DV	
	High-load type	Super-high-load type
15	3	4
20	6	8
25	9	13
30	13	20
35	22	30
45	47	59
55	80	100

NS, DS Models

Unit: cm^3

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

LW Model

Unit: cm^3

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

PU, LU Models

Unit: cm^3

Model / Model No.	PU		LU	
	Standard type	High-load type	Standard type	High-load type
05	–	–	0.1	–
07	–	–	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 Models

Unit: cm^3

Model / Model No.	PE		LE		
	Standard type	High-load type	Medium-load type	Standard type	High-load type
05	–	–	0.1	0.1	–
07	–	–	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 Model

Unit: cm^3

Model / Model No.	LH
08	0.2
10	0.4
12	1.2

RA Model

Unit: cm^3

Model / Model No.	RA	
	High-load type	Super-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

LA Model

Unit: cm^3

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

RB Model

Unit: cm^3

Model / Model No.	RB	
	High-load type	Super-high-load type
30	5	6
35	6	8
45	10	13
55	15	20
65	33	42

HA, HS Models

Unit: cm^3

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

(2) Oil lubrication

The required amount of new oil is regularly supplied by:

- A manual or automatic intermittent supply system or
- An oil mist lubricating system via piping.

Equipment for oil lubrication is more costly than for grease lubrication. However, an oil mist lubricating system supplies air as well as oil, thus raising the inner pressure of the slide. This prevents foreign matter from entering, and the air cools the system.

Use an oil with a high atomizing rate such as ISO VG 32-68 for oil mist lubrication systems.

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

For ball-type linear guides excluding the LA model:

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

For LA, RA, and RB models:

$Q \geq n/100$ (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 oil lubrication supplied by gravity, the oil supply position and installation position of the slide are crucial. In linear guides, unless installed in a horizontal position, oil will only drip downward and not spread to all raceway surfaces.

This may cause insufficient lubrication. Please consult NSK to correct such situations prior to use.

NSK has internal designs which allow oil lubricant to flow throughout the system.

Table 6.7 shows the criteria for oil checks and replenishments.

Table 6.7 Intervals of checks and replenishments

Method	Intervals of checks	Items to check	Replenishment/change intervals
Automatic intermittent supply	Weekly	Volume of oil, dirt, etc.	Replenish at each check with a suitable volume for the 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 systems, please confirm oil supply amounts at each outlet port.

A-3-7 Dust Resistance

1. Standard specification parts

- To keep foreign matter 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.
- **Table 7.1** shows standard specification seals by model.
- Seal friction force for a standard slide is shown in the dust resistance section of a model's technical description.

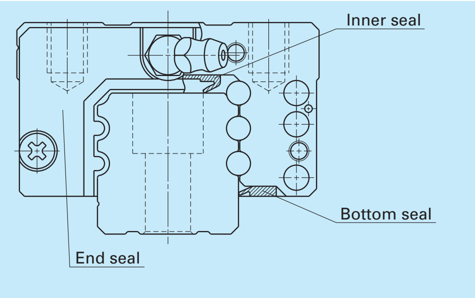


Fig. 7.1

Table 7.1 Standard seals

		End seal	Bottom seal	Inner seal
NH Model	NH15	○	○	–
	NH20, NH25, NH30, NH35, NH45, NH55, NH65	○	○	△
VH Model	VH15	○	○	–
	VH20, VH25, VH30, VH35, VH45, VH55	○	○	△
NS Model	NS15	○	○	–
	NS20, NS25, NS30, NS35	○	○	–
LW Model	LW17, LW21, LW27, LW35, LW50	○	○	–
DH	DH15	○	○	–
	DH20, DH25, DH30, DH35, DH45, DH55, DH65	○	○	△
DV	DV15	○	○	–
	DV20, DV25, DV30, DV35, DV45, DV55	○	○	△
DS	DS15	○	○	–
	DS20, DS25, DS30, DS35	○	○	△
PU Model	PU09, PU12, PU15	○	–	–
LU Model	LU05, LU07, LU09	△	–	–
	LU12, LU15	○	–	–
PE Model	PE09, PE12, PE15	○	–	–
LE Model	LE05, LE07, LE09, LE12, LE15	○	–	–
Miniature LH Model	LH08, LH10	○	–	–
	LH12	○	○	–
RA Model	RA15, RA20	○	○	△
	RA25, RA30, RA35, RA45, RA55, RA65	○	○	○
RB Model	RB30, RB35, RB45, RB55, RB65	○	○	○
LA Model	LA25, LA30, LA35, LA45, LA55, LA65	○	○	△
HA Model	HA25, HA30, HA35, HA45, HA55	○	○	○
HS Model	HS15, HS20, HS25, HS30, HS35	○	△	–

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

2. Dust-resistant parts

- NSK offers a variety of dust-resistant options to suit your environment.

Table 7.2 Optional dust-resistant parts

Name	Purpose	Reference page
NSK K1 lubrication unit	A lubrication device that combines oil and resin in a single unit. Enhances lubricating functions.	A58 – 61
Double seal	Combines tow end seals for enhanced seal effectiveness.	A67
Protector	Protects the end seal from hot and hard contaminants.	A68
Rail cap	Prevents foreign matter, such as swarf generated in cutting operations, from clogging the rail-mounting holes.	A68
Inner seal	Installed inside the slide to prevent foreign matter from entering and affecting the rolling contact surface.	A69
Bellows	Covers the linear guide.	A69
Rail cover *	Covers the rail top surface, and prevents foreign matter, such as cutting dust, from collecting in the rail mounting holes.	A310

∗) In the RA model, rail covers are only available for RA25 to RA65.

(1) Double seal

- It is a combination of two end seals to enhance seal functions.
- When the double seal is installed, the end seal section becomes thicker than standard items. Please pay attention to the increase in slide length when designing the mounting dimension of slide and the table stroke. Refer to the dust resistance section of a model's technical description for details on dimensional increases in the rail axial direction when mounting double seals.
- 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 model are described in the dust resistance section of a model's technical description.
- Attaching a grease fitting to the end cap after the double seal is equipped requires a connector shown in **Fig. 7.2**. Please specify the connector set when ordering linear guides.
- For VH, DV, RA, RB, LA, HA, and HS Models, the double-seal set can be only installed before shipping from the factory.

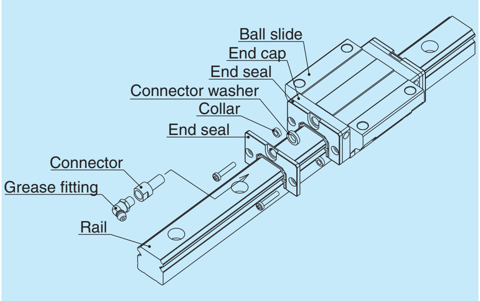


Fig. 7.2 Double seal

(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 matter 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. Refer to the dust resistance section of a model's technical description for details on dimensional increases in the rail axial direction when installing a protector.
- Protectors are available from stock and can be installed to standard assemblies upon request. Refer to the dust resistance section of a model's technical description for details on protector reference numbers.
- Attaching a grease fitting to the end cap after the protector is equipped requires the connector shown in **Fig. 7.3**. Please specify the connector set when ordering linear guides.
- For VH, DV, RA, RB, LA, HA, and HS Models, the protector can only be installed only before shipping from the factory.

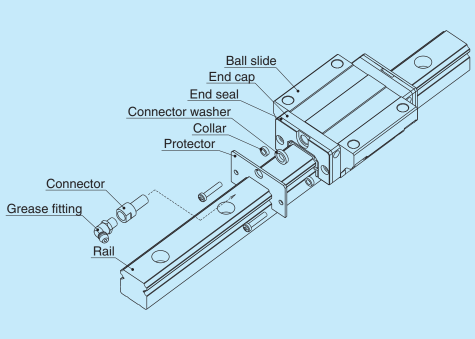


Fig. 7.3 Protector

(3) Bolt-hole caps 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 matter 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 resistance to oil and abrasion.
- Refer to the dust resistance section of a model's technical description for details on bolt sizes and reference numbers.
- 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. Refer to the dust resistance section of a model's technical description for details on bolt cap sizes and reference numbers.
- Caps made of metal also available upon request.

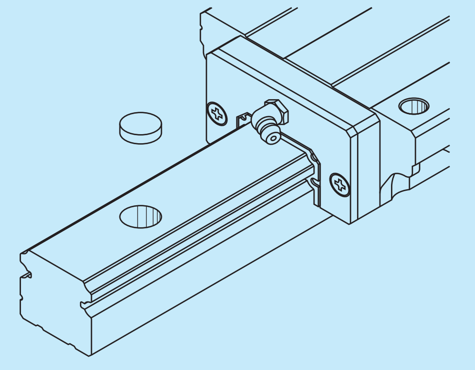


Fig. 7.4

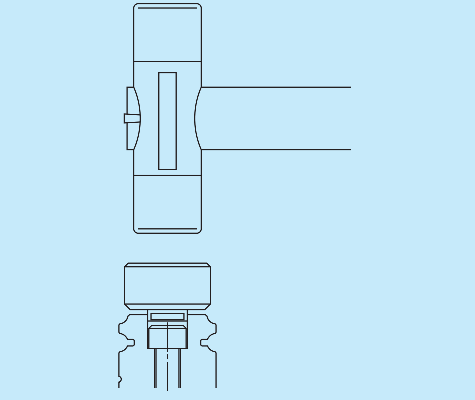


Fig. 7.5

(4) Inner seal

- The end seal installed on both ends of a slide cannot stop all contaminants, though the missed amount is negligible. An inner seal protects the rolling contact surface from such contaminants 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 bellows and double seals along with the inner seal to maintain the precision of the linear guide.
- Refer to **Table 7.1** for availability of inner seal.

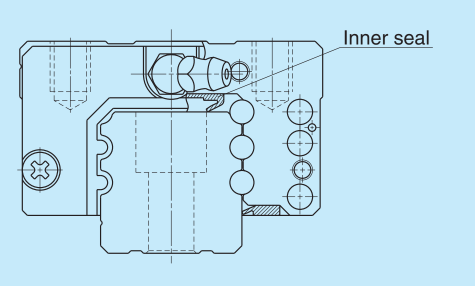


Fig. 7.6 Inner seal when installed

[1] Installation of bellows: NH, NS, DH, and DS Models

*** 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 and DS15, 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).

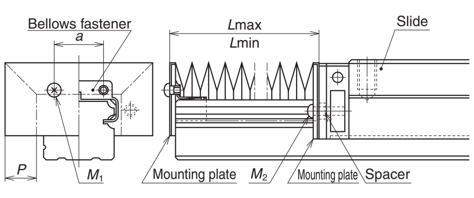


Fig. 7.7

(5) Bellows

- Bellows cover the entire linear guide. They are widely used for protection in environments where foreign matter is prevalent.
- NSK provides specialized bellows for the NH, NS, LW, DH, DS, RA, and LA models. We offer a middle bellows and end bellows for all these models. Bellows for the NH and DH model are further divided into high/low types based on the slide type.
- The high type is used with AN and BN slide shapes, while the low type is used with EM, GM, AL, and BL slide shapes. 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 a grease fitting, it will be put on the side of end cap or slide body. Consult NSK for details.
- Refer to the dust resistance section of a model's technical description for details on bellows dimensions.

*** Fixing to the rail**

- To install bellows for NH, NS, DH, and DS Models 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, 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 horizontal mounting positions. For other mounting positions, sliding plate is required (see **Fig. 7.10** on page A70.)

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

[2] LW and LA Models

*** 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.

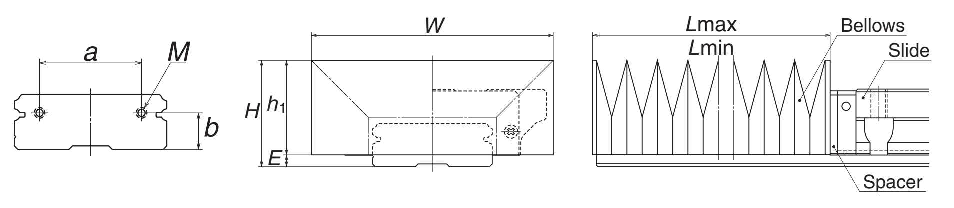


Fig. 7.8

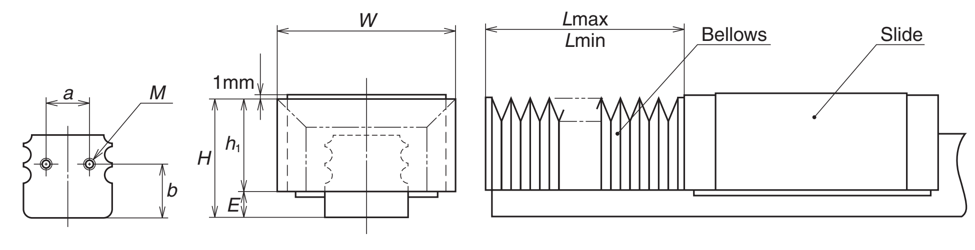


Fig. 7.9

[3] RA Model

- Please refer to page A260.

Calculating length of bellows

- The formula is as follows excluding the RA model.
- 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 :
  Lmax = 7 × P × Number of BL
- Length when contracted to the minimum :
  Lmin = 17 × Number of BL
- Stroke : ***St* = Lmax – Lmin**
- The dimension of *P* and the number of BL are shown in the bellows dimension tables of each model.
- For the RA model, refer to page A314.

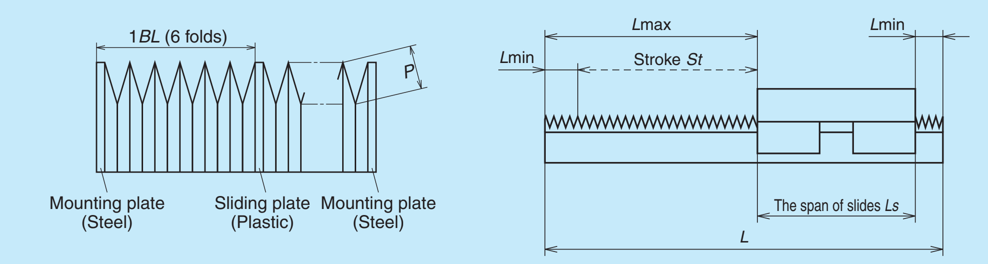


Fig. 7.10

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

1. Stainless steel

NSK linear guides are available in stainless steel.

○Stainless steel standard models

PU Model **PE Model**
LE Model **Miniature LH Model** **LL Model**

○Available in stainless steel

NH Model
NS Model
LU Model

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 an adverse effect on antirust characteristics.
Refer to the next page for the results of a humidity chamber test.
Please consult NSK for other surface treatments.

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

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

○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 treatments.

(2) Rust prevention of fluoride low temperature chrome plating

NSK linear guides are used in various applications and environments, from industrial machinery to semiconductor/FPD manufacturing and aerospace equipment. Preventing rust from developing in these applications is crucial, particularly for machines around water such as part/device washers and for semiconductor/FPD manufacturing equipment involved in chemical wet processing. NSK applies a fluororesin coating to an electrolytic black plating (fluoride low-temperature chrome plating) on these linear guides for optimal rust resistance.

● What is "Fluoride low temperature chrome plating?"

This type of black chrome plating 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 treatments and stainless steel products.

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

A-3-9 Special Environments

1. Heat-resistant specifications

- Standard linear guides use plastic for rolling element recirculation components. The maximum temperature in use for standard linear guides is 80°C.
- Use a heat-resistant linear guide when operating temperatures exceed 80°C.

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 Model
LW Model
DS Model
LE Model
NS Model
DH Model
LU Model

See page A76 for availability.

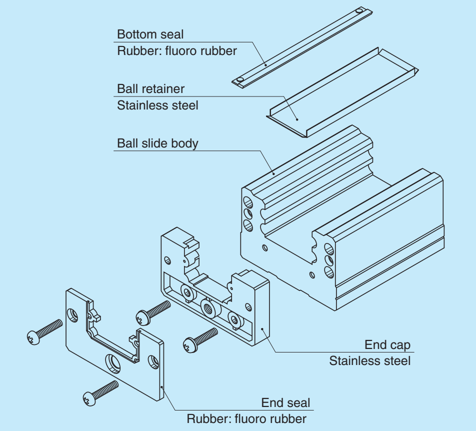


Fig. 9.1

2. Vacuum and cleanroom specifications

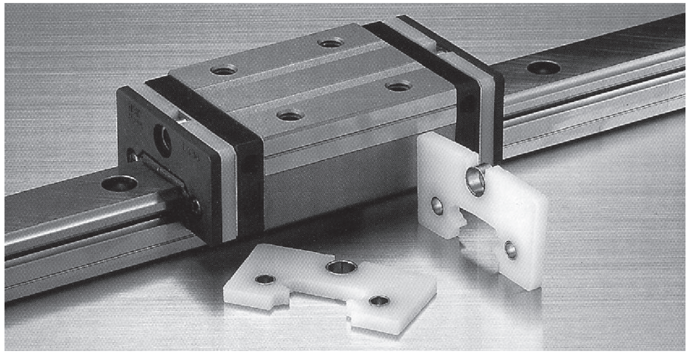
- Based on its abundant experience and technology, NSK manufactures linear guides that can be used in a vacuum or in cleanroom environment. Please consult NSK for more details.
- Linear guide specifications vary for environmental conditions.
  For example, "all stainless steel plus special grease", or "solid film lubricant" is suitable for vacuum environments.
- NSK has low-dust generating grease "**LG2**" and "**LGU**" which are ideal for cleanroom environments.
  Refer to page D15 for details.

3. Low dew point environment specifications for rechargeable battery production

- NSK K1-L and NSK K1 lubrication units ensure effective lubrication function even in low dew point environments.
- LGU grease which is for cleanroom environments and free of metallic elements is available.
- Grease fittings and fastening parts are made of stainless steel instead of copper or zinc plated parts.

4. NSK linear guides for sanitary environments (food processing machinery/medical equipment)

Featuring NSK K1 for food processing machinery/medical equipment and specialized grease.



What is NSK K1^{TM} for food processing machinery/medical equipment?

NSK K1 for food processing machinery/medical equipment is safe and FDA-compliant.
With a porous resin structure full of lubricating oil, NSK K1 units are installed inside a end seal where they greatly enhance lubricating capabilities. After success in general industry, we utilized special materials to allow use in food processing and medical equipment.

(1) Features

1) NSK linear guides for sanitary environments use NSF H1 food-grade grease.

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

<Features of grease for food processing machines>

- This grease is certified to the H1 food-grade standard (previously USDA H1) by NSF international.

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

- Superb water resistance and antirust capabilities
- Superb wear resistance
- Applicable with centralized oiling systems

2) Appropriate volume of grease

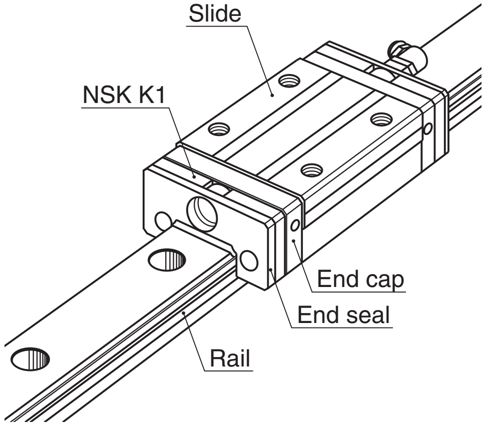
A supply of the appropriate volume of grease reduces grease drain and scattering and maintains a clean environment.

(2) Available models

Table 9.2 shows available models.

Table 9.2

NH Model	NH15, NH20, NH25, NH30, and NH35
NS Model	NS15, NS20, NS25, NS30, and NS35
LW Model	LW17, LW21, LW27, and LW35
DH Model	DH15, DH20, DH25, DH30, and DH35
DS Model	DS15, DS20, DS25, DS30, and DS35
PU Model	PU09, PU12, and PU15
LU Model	LU09, LU12, and LU15
PE Model	PE09, PE12, and PE15
LE Model	LE09, LE12, and LE15
Miniature LH Model	LH12



Handling Precautions

To maintain the high functionality of NSK K1 units for a long period, observe the following precautions:

1. Operating temperature range:	Maximum operating temperature: 50°C (Momentary maximum temperature: 80°C)
2. Chemicals to avoid:	Do not allow NSK K1 units to make contact with organic solvents that remove oil, such as hexane and oil thinners. Do not leave NSK K1 units in white kerosene or rust preventive oils that contain white kerosene.

Note: Water- and oil-based cutting fluid and grease (mineral oil or ester-based) will not cause damage.

5. 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	
Cleanroom	Atmosphere, normal temperature	Standard material	Standard material	Standard material	LG2 Grease, LGU Grease	D8
					NSK K1-L/K1 lubrication unit	A58
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	LG2 Grease, LGU Grease	D8
					NSK K1-L/K1 lubrication unit	A58
					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		
	Acid, alkali, clean	Martensitic stainless steel	Martensitic stainless steel		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-L/K1 lubrication unit	A58
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		
	Water, under water		Standard material	Standard material		
			Martensitic stainless steel	Austenitic stainless steel		

6. Responsiveness of NSK linear guides for special environments

Model	Model No.	Special environment which linear guide can tolerate					
		Cleanroom	Vacuum	Corrosive	High-temperature	Hygienic	Dust-contaminated
NH	NH15	○		○		○	
	NH20	○	○	○	○	○	
	NH25	○	○	○	○	○	
	NH30	○	○	○	○	○	
	NH35	○		○	○	○	
	NH45	○		○	○		
	NH55	○		○			
	NH65	○		○			
VH	VH15			○			○
	VH20			○			○
	VH25			○			○
	VH30			○			○
	VH35			○			○
	VH45			○			○
	VH55			○			○
NS	NS15	○	○	○	○	○	
	NS20	○	○	○	○	○	
	NS25	○	○	○	○	○	
	NS30	○	○	○	○∗1)	○	
	NS35	○		○		○	
LW	LW17	○		○	○∗1)	○	
	LW21	○		○	○∗1)	○	
	LW27	○		○	○	○	
	LW35	○		○		○	
	LW50	○		○			
DH	DH15	○		○		○	
	DH20	○		○		○	
	DH25	○		○		○	
	DH30	○		○		○	
	DH35	○		○		○	
	DH45	○		○			
	DH55	○		○			
	DH65	○		○			
DV	DV15			○			○
	DV20			○			○
	DV25			○			○
	DV30			○			○
	DV35			○			○
	DV45			○			○
	DV55			○			○
DS	DS15	○		○		○	
	DS20	○		○		○	
	DS25	○		○		○	
	DS30	○		○		○	
	DS35	○		○		○	
PU	PU09	○		○		○	
	PU12	○		○		○	
	PU15	○		○		○	

∗1) Applicable except for dust-resistant parts.

∗2) Available with dust-resistant V1 seal.

Model	Model No.	Special environment which linear guide can tolerate					
		Cleanroom	Vacuum	Corrosive	High-temperature	Hygienic	Dust-contaminated
LU	LU05	○		○			
	LU07	○		○			
	LU09_L	○	○	○	○	○	
	LU09_R	○		○		○	
	LU12_L	○	○	○	○	○	
	LU12_R	○		○		○	
	LU15	○	○	○	○∗1)	○	
PE	PE09	○		○		○	
	PE12	○		○		○	
	PE15	○		○		○	
LE	LE05	○		○			
	LE07	○	○	○	○∗1)		
	LE09_L	○	○	○	○∗1)	○	
	LE09_R	○		○		○	
	LE12_L	○	○	○	○	○	
	LE12_R	○		○		○	
	LE15_L	○	○	○	○	○	
	LE15AR	○		○		○	
Miniature LH	LH08	○		○			
	LH10	○		○			
	LH12	○	○	○	○∗1)	○	
RA	RA15	○		○			
	RA20	○		○			
	RA25	○		○			○∗2)
	RA30	○		○			○∗2)
	RA35	○		○			○∗2)
	RA45	○		○			○∗2)
	RA55	○		○			○∗2)
	RA65	○		○			○∗2)
RB	RB30	○		○			
	RB35	○		○			
	RB45	○		○			
	RB55	○		○			
	RB65	○		○			
LA	LA25	○		○			
	LA30	○		○			
	LA35	○		○			
	LA45	○		○			
	LA55	○		○			
	LA65	○		○			
HA	HA25	○		○			
	HA30	○		○			
	HA35	○		○			
	HA45	○		○			
	HA55	○		○			
HS	HS15	○		○			
	HS20	○		○			
	HS25	○		○			
	HS30	○		○			
	HS35	○		○			

7. Precautions for handling

Please observe the following precautions to maintain NSK Linear Guide performance.

- 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 a desiccater with desiccating agent (e.g. silica gel). Do not apply rust preventive oil or an antirust paper that vaporizes rust preventive agents.
- Wear plastic gloves and handle products in a clean place.

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

A-3-10 Arrangement and Mounting of Linear Guides

1. Arrangement

- For NSK linear guides, the datum surfaces of the rail and slide are either marked with a "datum surface groove mark" or "arrow."
- If two or more linear guides are used together, one linear guide is designated as the reference side guide, and the others as adjusting side guides. 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 respective mounting datum surfaces, 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 minimized as set by the accuracy standard. (**Figs. 10.2** and **10.3**)
- Indications of the datum surfaces for different models are shown in **Table 10.1**.

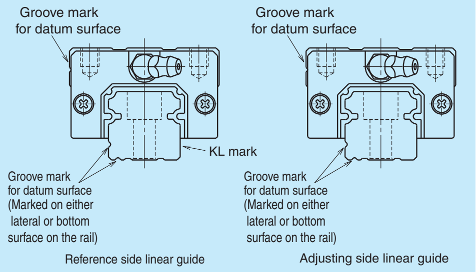


Fig. 10.1 Datum surface

Example arrangements

- The arrangment of the linear guide must consider the table mounting position (horizontal, vertical, inclined, or upside-down), the stroke, and the size of the machine base to which the table is mounted.

  Table 10.2 shows the properties of common arragements including their features and precautions.

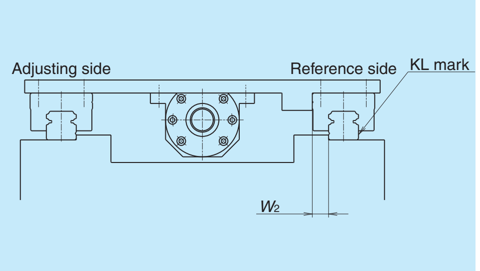


Fig. 10.2 Most common setting of the reference side rail

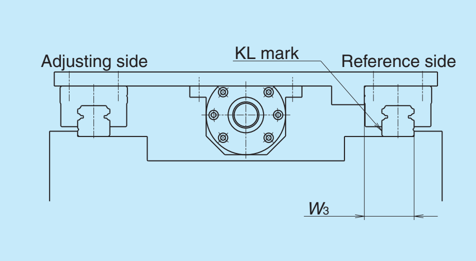


Fig. 10.3 Setting of the reference side rail in certain occasions

Table 10.1 Marks on the rail datum surfaces in each model

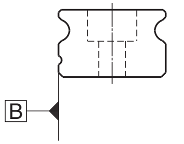
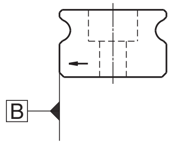
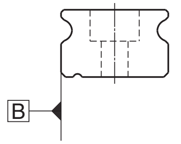
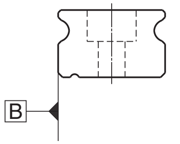
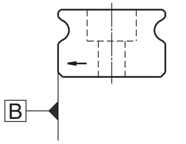
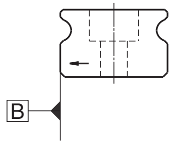
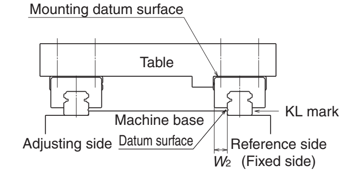
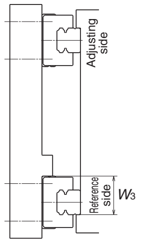
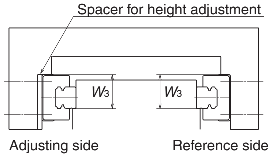
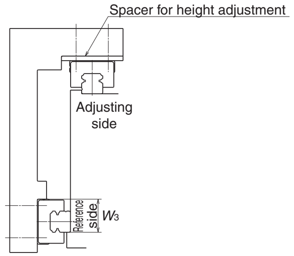
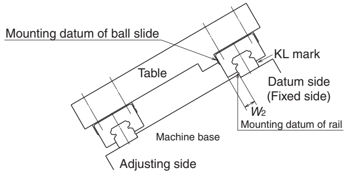
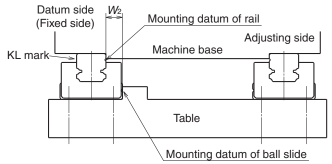
Model No. / Material	Standard	LU05, 07, 09 PU09, 12, 15 LE07, 09, 12	LU12, 15, NH15, VH15, NS15 DH15, DS15, DV15	LE05, 15 LE09, 12 (with a ball retainer) PE model LH08, 10, 12 LW17, 21 RA15
Special high carbon steel	 B	 B	 B	 B
Stainless steel	 B		 B	

Table 10.2 Arrangement example

Arrangement	Features/Precautions
 Mounting datum surface Table KL mark Machine base Adjusting side Datum surface Reference side W_2 (Fixed side)	• Easy for a highly-accurate installation (recommended arrangement)
 Adjusting side Reference side W_3	• Easy 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.
 Spacer for height adjustment W_3 W_3 Adjusting side Reference side	• Slightly difficult for a highly-accurate installation • The life of the linear guides is affected by mounting accuracy. • When oil lubricant is used, special care is required to design the oil supply routing.
 Spacer for height adjustment Adjusting side Reference side W_3	• Difficult for a highly-accurate installation • When oil lubricant is used, special care is required to design the oil supply routing.
 Mounting datum of ball slide KL mark Table Datum side (Fixed side) W_2 Mounting datum of rail Machine base Adjusting side	• Rather easy for a highly-accurate installation • When oil lubricant is used, special care is required to design the oil supply routing.
 Datum side (Fixed side) W_2 Mounting datum of rail Adjusting side KL mark Machine base Table Mounting datum of ball slide	• Easy highly-accurate installation if the linear guides are installed to the machine base first, and then hung 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 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**).

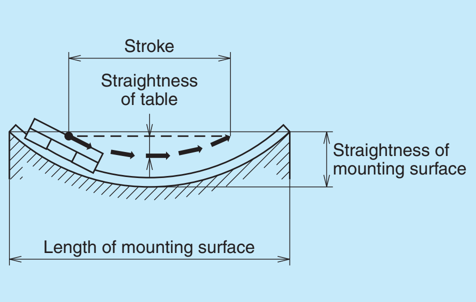
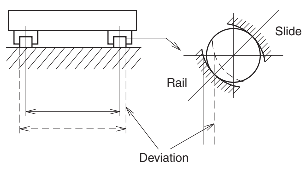
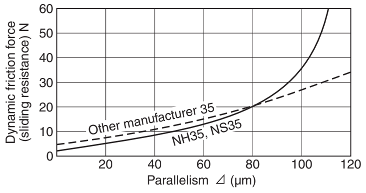
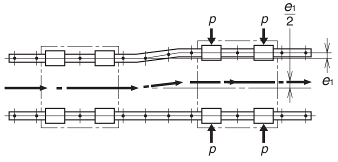


Fig. 10.4

(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 Models 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. • Mounting error severely affects friction of LA Models 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 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 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** represent the mounting errors of e_1 and e_2. Their permissible values are shown in description "**5. Installation**" of each model.

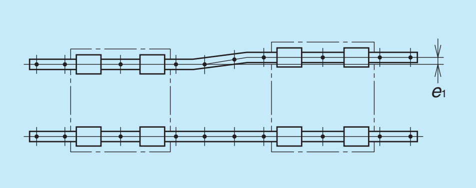


Fig. 10.5

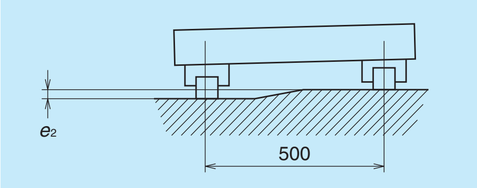


Fig. 10.6

(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.

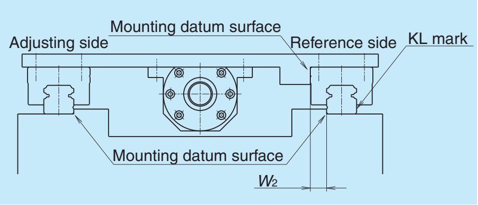


Fig. 10.7

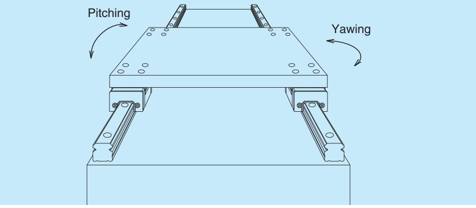


Fig. 10.8

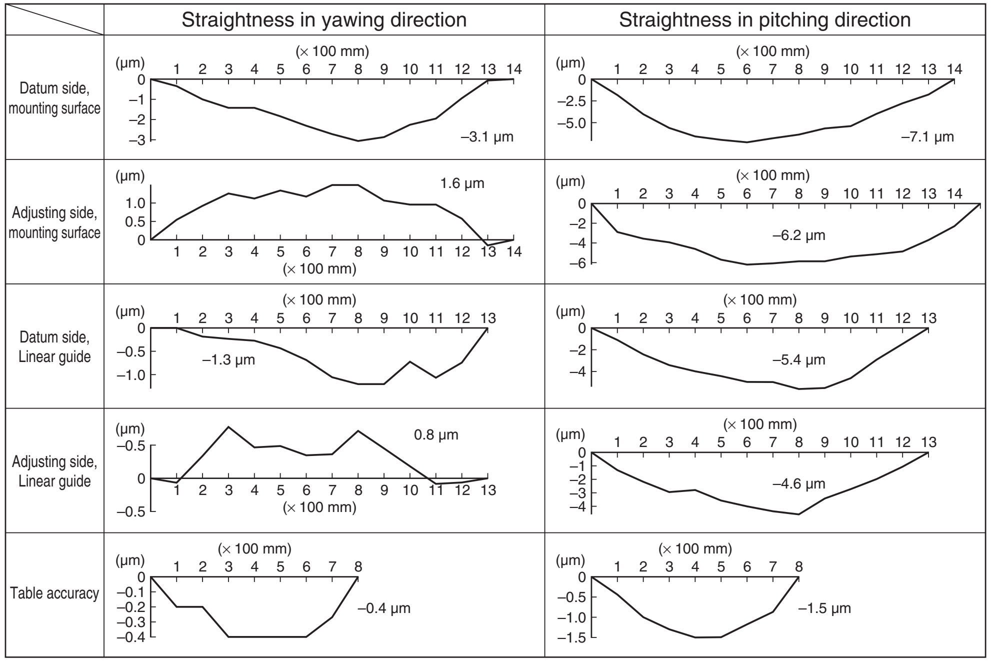


Fig. 10.9 Straightness of the table equipped with linear guide

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 "Shoulder height and corner radius r" for each model.
- The shoulder should be thick (wide) enough, so it is not deformed by the pressing force.

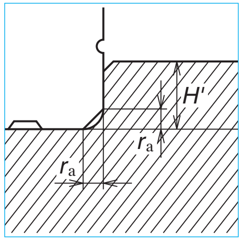


Fig. 10.10 Shoulder for the rail datum surface

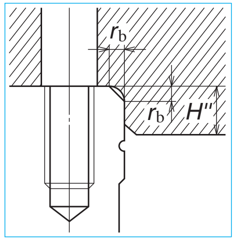


Fig. 10.11 Shoulder for the slide datum surface

(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	0.27	M8	22
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

(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.

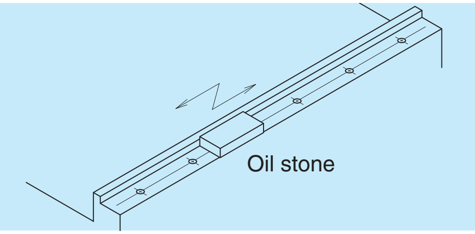


Fig. 10.12

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.

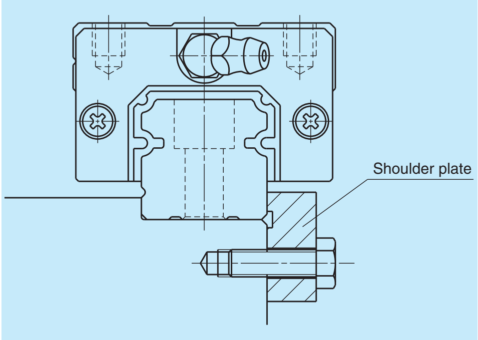


Fig. 10.13 Pressing the rail from sideways

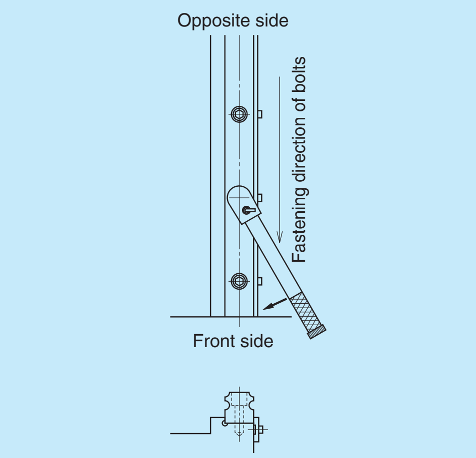


Fig. 10.14 Rail installation

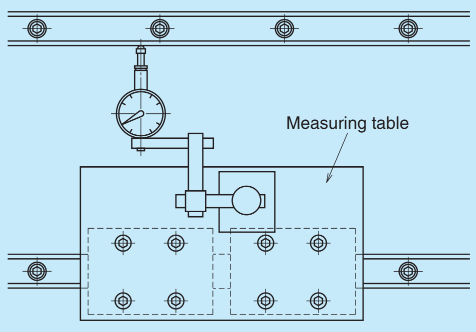


Fig. 10.15 Measuring parallelism

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.

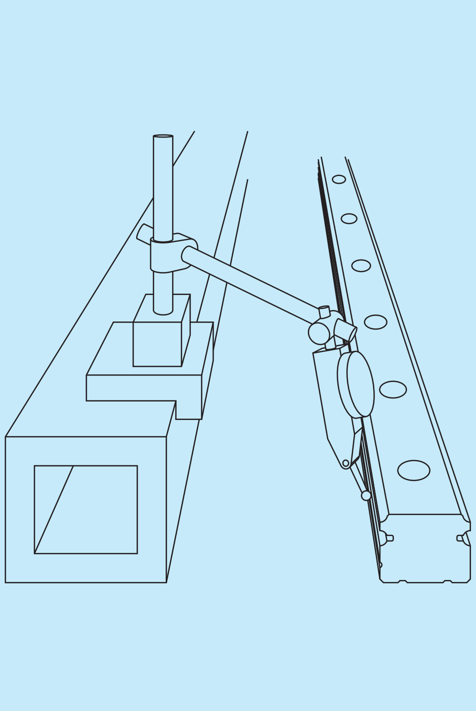


Fig. 10.16

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**).

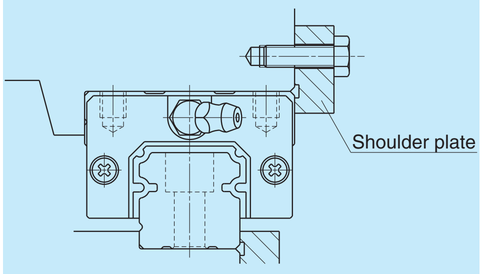


Fig. 10.17 Pressing slide from sideways

[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.

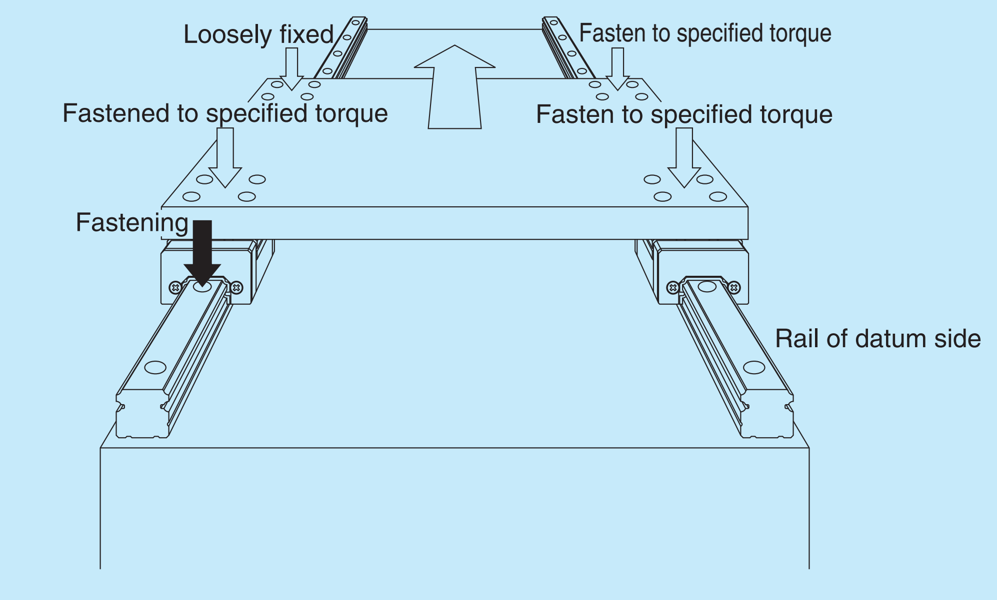


Fig. 10.18 Easy installation

(4) Various methods to press linear guide sideways

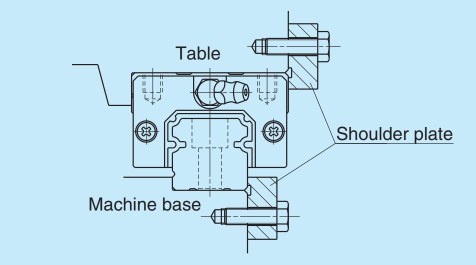


Fig. 10.19 Recommended method

- 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.

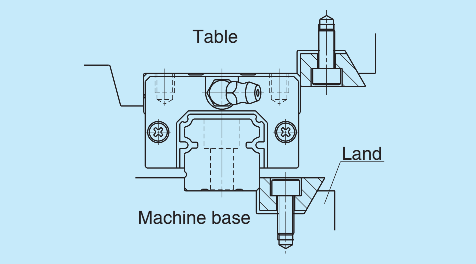


Fig. 10.20 Installation that requires caution

- 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.

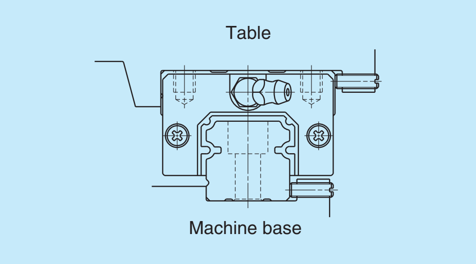


Fig. 10.21

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

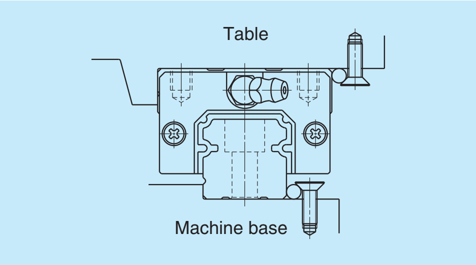


Fig. 10.22

- 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. Interchangeable linear guides

- Interchangeable (also called "random-matching") linear guide slides come delivered on a provisional rail (installation tool) (**Fig. 10.23**).
- NSK standard grease is packed into the slide, allowing immediate use.

Assembly procedures for an interchangeable linear guide

Follow steps as described below.

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

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

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

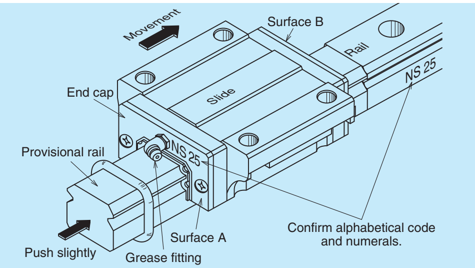


Fig. 10.23 Installing slide onto rail

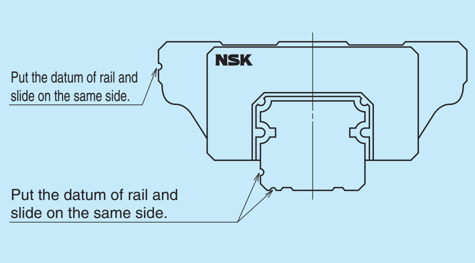


Fig. 10.24

5. Butting rail specification

- Rails may be butted to achieve a length longer than the maximum manufactured length.
- The rails with butting specification are marked with letters (A, B, C ...) and an arrow on the opposite side of the mounting datum surface. Use the letters and arrows for assembly order and direction of the rail (**Fig. 10.25**).
  The interchangeable rails for butting specification are only marked with 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 higher running accuracy is required, consider installing the slides into the table so that they do not simultaneously pass the butting sections.

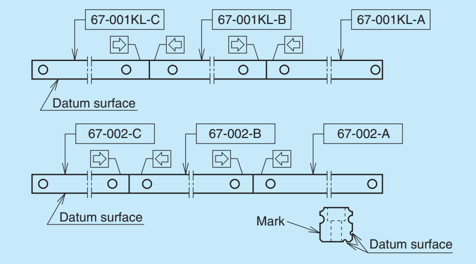


Fig. 10.25

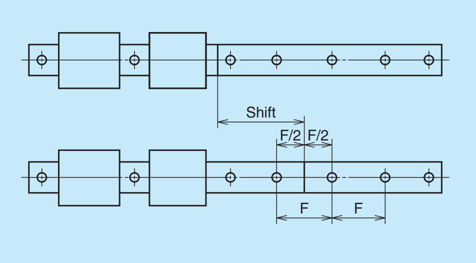


Fig. 10.26

6. Handling preloaded assembly

- When handling a preloaded assembly (not interchangeable 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**.
- Provisional rails are available for each model and size.
- Pay due attention to the assembly mark when returning the slide back to the rail. Follow the precautions described below.

Mark for assembling ball slide and rail

- Rails of preloaded assembly (not interchangeable type) are marked with a reference number and a serial number opposite 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.
- If 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 numbers 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 caution is required.

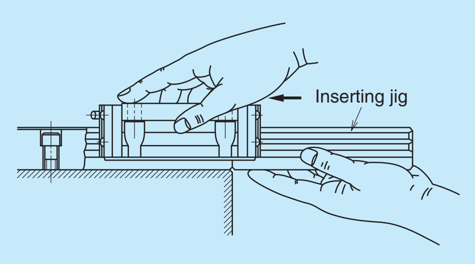


Fig. 10.27

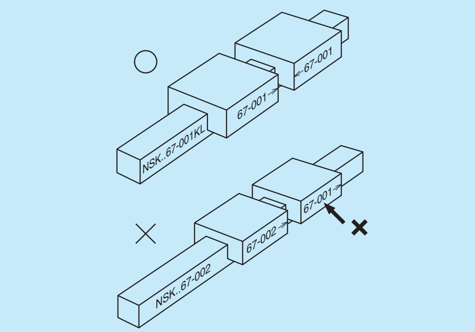


Fig. 10.28

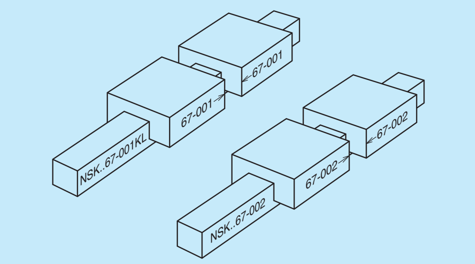


Fig. 10.29 When two rails have the same reference number

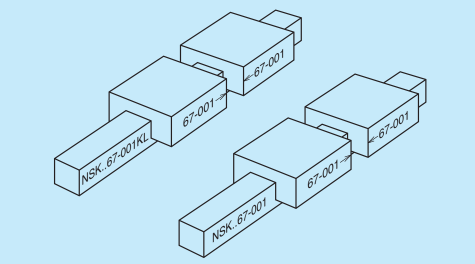


Fig. 10.30 When two rails have different reference numbers

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.

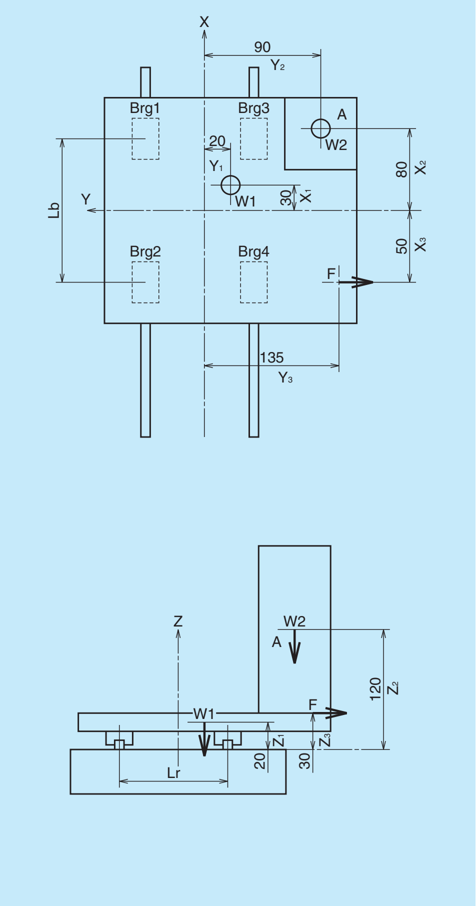


Fig. 11.1 Single axis material handling system

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-2-3 Linear Guide Models"** Since this material handling system has two rails and four ball slides, **NH, NS, and PU Models** are suitable. Here, we'll temporarily select PU15 because of the dimensions of the 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 A37 in **Table 2.2**

When a work is mounted on the table

Vertical loads

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

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

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

Similarly

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

Lateral loads

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

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

Similarly

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

No work mounted on the table

Vertical load

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

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

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

Similarly

$F_{r2} = -35\ (\mathrm{N})$

$F_{r3} = 110\ (\mathrm{N})$

$F_{r4} =\ \ 65\ (\mathrm{N})$

Lateral loads

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

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

Similarly

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

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

$$\boldsymbol{F_r = F_r}$$

Lateral direction dynamic equivalent load

$$\boldsymbol{F_{se} = F_s\cdot\tan\alpha = F_s}$$

Use the formula for full dynamic equivalent load (page A41) 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 Slide3.

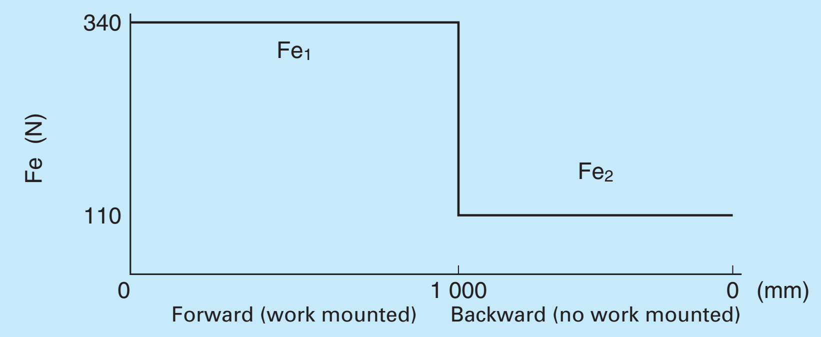
Therefore;

Work mounted $\boldsymbol{F_{e1} = 340\ (\mathrm{N})}$

No work mounted $\boldsymbol{F_{e2} = 110\ (\mathrm{N})}$

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: $L = L_1 + L_2$.

$$Fm = \sqrt[3]{\frac{1}{L}\left(F_{e1}^3 L_1 + F_{e2}^3 L_2\right)}$$

$$= \sqrt[3]{\frac{1}{2\,000}\left(340^3 \times 1\,000 + 110^3 \times 1\,000\right)}$$

$$= 273\ (\mathrm{N})$$

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 above HRC58. Use a hardness coefficient $\boldsymbol{f_H = 1}$ and take the value of basic dynamic load rating as 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

Rating fatigue life$L$ = 100 × $\left(\dfrac{\quad}{f_H \bullet C_{100}}\right)^3$ $\left(\dfrac{f_w \bullet F_m}{1 \times 4\,400}\right)^3$

= 100 × 1.2 × 273

= approximately 242 280 (km)

Travel speed, 12 m/min; Operating hours, 16 hr/day.

Convert the above rating fatigue life into hours:

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

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 fs is:

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

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 model,"** the rigidity of linear guide PU15AL with Z1 preload is:

$\boldsymbol{K_s = K_r = 45\ (\mathrm{N}/\mu\mathrm{m}) = 45\,000\ (\mathrm{N/mm})}$

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 A37)

Work mounted:

$$\delta_{x1} = Y_d \cdot \frac{F_{s2} - F_{s1}}{L_b \cdot K_s} + Z_d \cdot \frac{F_{r1} - F_{r2}}{L_b \cdot K_r}$$

$$= -90 \times \frac{-100 - 0}{100 \times 45\,000} + 120 \times \frac{40 - (-165)}{100 \times 45\,000}$$

$$= 0.0075\,(\mathrm{mm}) = 7.5\ (\mu\mathrm{m})$$

Similarly, $\delta_{y1} = -0.0082\ (\mathrm{mm}) = -8.2\ (\mu\mathrm{m})$

$\delta_{z1} = \ 0.0123\ (\mathrm{mm}) = \ 12.3\ (\mu\mathrm{m})$

No work mounted:

$$\delta_{x2} = Y_d \cdot \frac{F_{s2} - F_{s1}}{L_b \cdot K_s} + Z_d \cdot \frac{F_{r1} - F_{r2}}{L_b \cdot K_r}$$

$$= -90 \times \frac{-100 - 0}{100 \times 45\,000} + 120 \times \frac{10 - (-35)}{100 \times 45\,000}$$

$$= 0.0032\ (\mathrm{mm}) = 3.2\ (\mu\mathrm{m})$$

Similarly, $\delta_{y2} = -0.0023\ (\mathrm{mm}) = -2.3\ (\mu\mathrm{m})$

$\delta_{z2} = \ 0.0039\ (\mathrm{mm}) = \ 3.9\ (\mu\mathrm{m})$

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

$\delta_x = \delta_{x1} - \delta_{x2} = 7.5 - 3.2 = \ 4.3\ (\mu\mathrm{m})$

$\delta_y = \delta_{y1} - \delta_{y2} = -8.2 - (-2.3) = -5.9\ (\mu\mathrm{m})$

$\delta_z = \delta_{z1} - \delta_{z2} = 12.3 - 3.9 = \ 8.4\ (\mu\mathrm{m})$

2. Machining center

The following is a calculation example for a horizontal machining center. Arrangements for 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)

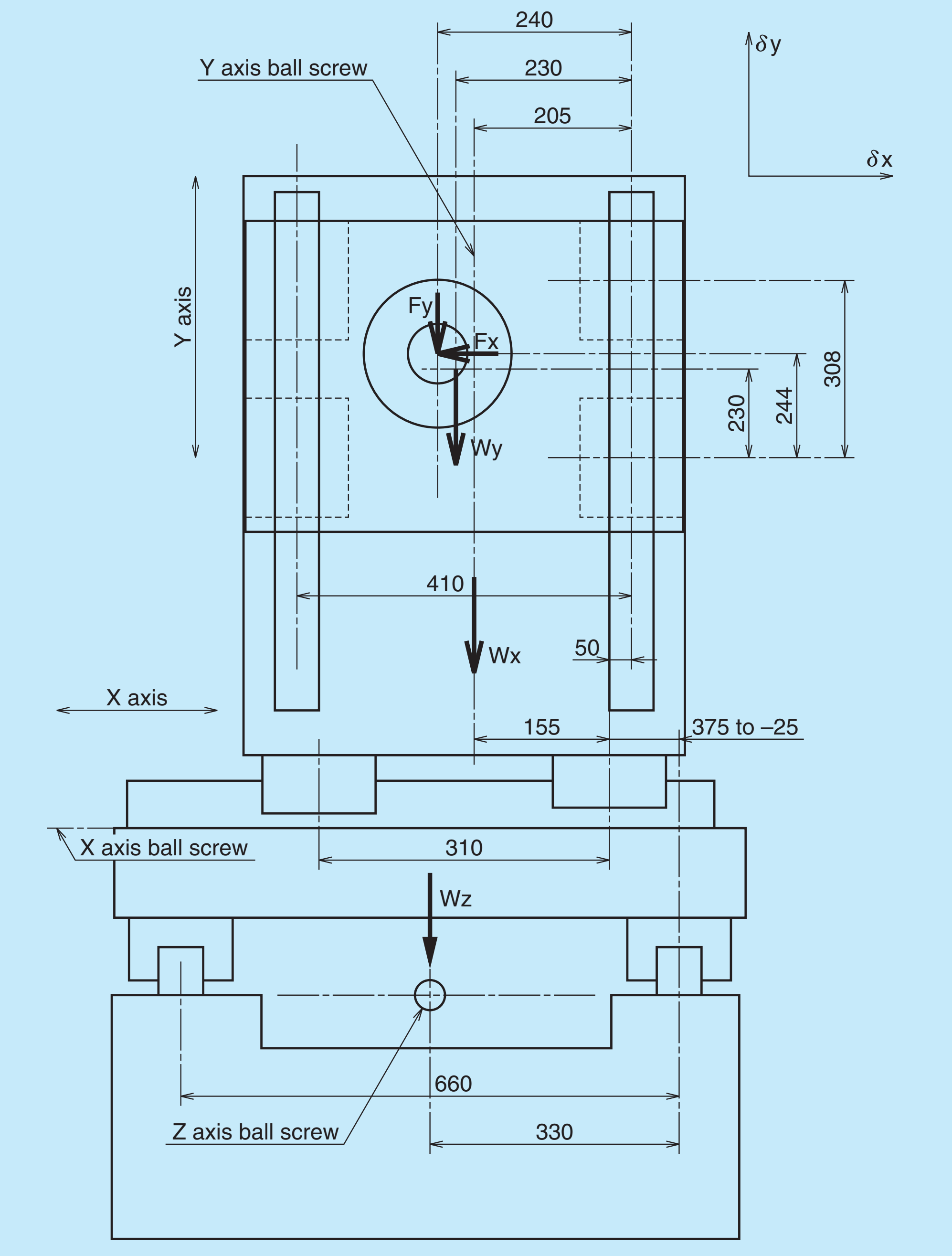


Fig. 11.2 Machining center (front view)

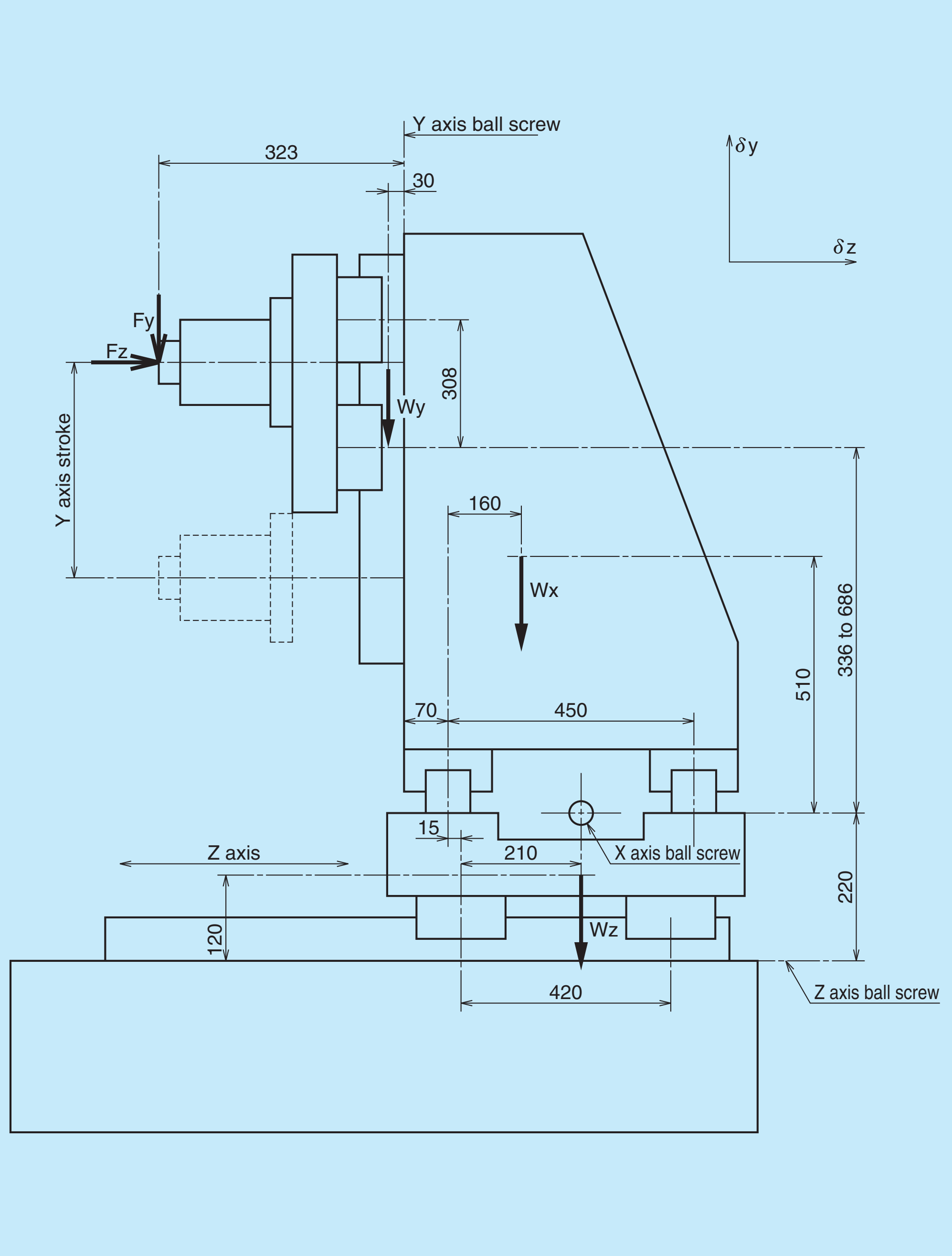


Fig. 11.3 Machining center (side view)

(1) Selection of linear guide model

Based on these operating conditions, an LA Model linear guide is suitable for this 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

Examine 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: *F*x = *F*y = *F*z = 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 *F*r	1 156	955	4 045	3 844
	Lateral direction *F*s	0	0	0	0
Y axis	Vertical direction *F*r	122	–122	122	–122
	Lateral direction *F*s	102	–102	102	–102
Z axis	Vertical direction *F*r	765	3 860	3 890	6 985
	Lateral direction *F*s	0	0	0	0

In case of milling process: *F*x = *F*y = 1 000 (N)

Similarly,

X axis: Loads to be considered *W*x, *W*y, *F*x, and *F*y
Y axis: Loads to be considered *W*y, *F*x, and *F*y
Z axis: Loads to be considered *W*x, *W*y, *W*z, *F*x, and *F*y

The table below shows calculations for load coordinates at a stroke end which imposes the most strict conditions.

Unit: N

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

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

X axis: Loads to be considered *W*x, *W*y, and *F*z
Y axis: Loads to be considered *W*y and *F*z
Z axis: Loads to be considered *W*x, *W*y, *W*z, and *F*z

The table below shows calculations for load coordinates at a stroke end which imposes the most strict conditions.

Unit: N

Axis	Load direction	Slide1	Slide2	Slide3	Slide4
X axis	Vertical direction *F*r	4 256	4 055	945	744
	Lateral direction *F*s	919	581	919	581
Y axis	Vertical direction *F*r	305	938	561	1 195
	Lateral direction *F*s	102	–102	102	–102
Z axis	Vertical direction *F*r	4 872	–247	7 997	2 878
	Lateral direction *F*s	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, *F*r and *F*se are, as the linear guide model will be an LA Model, obtained as follows.

Vertical dynamic equivalent load

***F*r = *F*r**

Lateral dynamic equivalent load

***F*se = *F*s • tan α = Fs**

From the above, calculate *F*e using formulas for full dynamic equivalent loads shown in page A41.

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 *F*ep 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 based on **"A-3-2.2 5. Various coefficients."**

For this case the factors are :

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 A43).

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 high-load milling process with large load.

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

Similarly,

Y axis fs = 61.5

Z axis fs = 42.0

Therefore, there is no problem.

(4) 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 convenience.

"Motion & Control" is compiled to introduce NSK products and technologies.

For inquiries and orders please contact your local NSK sales office, or representative.

Table 12.1 Motion & Control (NSK Technical Journal): Articles relating to linear guides (2001 –)

Issue No.	Date of Publication	Articles related to linear guides[1]
No.11	October 2001	Development of the NSK S1 Series$^{\text{TM}}$ Ball Screws and Linear Guides High Load Capacity Mini LH Series of NSK Linear Guides
No.12	April 2002	NSK Linear Guides & Ball Screws Equipped with NSK K1$^{\text{TM}}$ Lubrication Unit
No.12	April 2002	NSK S1 Series$^{\text{TM}}$ NSK Linear Guides and Ball Screws
No.13	October 2002	Translide$^{\text{TM}}$ -New Rolling Element Linear Motion Bearing-
No.14	May 2003	New Generation of NSK Linear Guides Miniature PU Series
No.15	December 2003	Ultra-Precision NSK Linear Guides for Machine Tools-the HA Series
No.16	August 2004	Numerical Analysis Technology & NSK Linear Guides for Machine Tools
No.16	August 2004	NSK RA Series Roller Guide
No.18	August 2005	New Generation of NSK Linear Guides Miniature PU Series/PE Series
No.20	August 2007	V1 Series of Highly Dust-Resistant NSK Linear Guides
No.21	December 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	March 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	June 2013	Technological Trends in Linear Motion Rolling Guides for Machine Tools
No.24	December 2014	Slight-Preload Type RA Series Roller Guides of NSK Linear Guides
No.25	September 2015	Precision-Grade, Medium-Preload, Random-Matching NSK Linear Guides Random-Matching, Miniature PU and PE Series of NSK Linear Guides
No.26	April 2016	NSK Roller Guides Equipped with V1 Seals Random-Matching, High-Precision-Grade RA Series Roller Guides
No.27	November 2016	NH Series and NS Series NSK Linear Guides: More than Twice the Life of Conventional NSK Linear Guides
No.30	June 2019	The Technical Trend of Machine Tool Components
No.31	June 2020	Improved Reliability of Roller Guides for Machine Tools NSK K1-L Lubrication Unit
No.33	June 2022	NSK Linear Guides$^{\text{TM}}$ Long-life Series: DH/DS Models
No.34	June 2023	Evaluation of Lubrication Performance in Ball Screws and Linear Guides by the Electrical Impedance Method

1. Titles reflect the original publication. Note that product names, expressions, etc. may have been changed/corrected since publication.

A-3-13 Guide to Technical Services

(1) CAD drawing data

NSK offers CAD data for linear guides. Please download it from NSK's website.

http://www.nsk.com

- Data in drawings are filed in actual size (some parts are simplified). You can use these data without processing.
- Three-view drawings are available.
- Dimension lines are omitted to render the data as standard drawings for databases.

CAD data offered

NSK linear guides

- **NH Model**
- **VH Model**
- **NS Model**
- **LW Model**
- **PU Model**
- **LU Model**
- **PE Model**
- **LE Model**
- **Miniature LH Model**
- **RA Model**
- **RB Model**
- **LA Model**
- **HA Model**
- **HS Model**

(2) Telephone consultation with NSK engineers

This catalog contains technical explanations for each section. However, some descriptions and explanations may be insufficient due to page limitations, 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 offices or representatives in your area.

A-3-14 Linear Guides: Handling Precautions

NSK linear guides are high quality and 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 rust preventive oil has been applied, thoroughly wipe it and put lubricant inside slide before using. For seal lubrication, put lubricant on the rail.

b. Do not mix greases of different brands.

c. If your linear guide has rust prevention specifications, put lubricant inside slide before using.

(2) Handling

Handle with care.

Do not disassemble.

Do not drop.

Do not impact.

a. Interchangeable slides are installed on a provisional rail when they leave the factory. Handle the slide with care during installation to the rail.

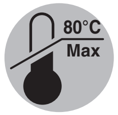
b. Do not disassemble the linear guide unless absolutely necessary. Not only does it allow dust to enter, but it lessens precision.

c. The slide may move by simply leaning the rail. Make sure that the slide does not disengage from the rail.

d. Standard end caps are made of plastic. Beating it or hitting it against an object may cause damage.

(3) Usage precautions

Avoid contamination.



Follow temperature limits.

Use care when hanging upside-down

a. Make every effort not to allow dust or foreign objects to enter.

b. Please apply splash guard or bellows to the linear guide to prevent solvents or coolant from adhering when they contain corrosive material.

c. The temperature where linear guides are used should not exceed 80°C (excluding heat-resistant 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 and the slide faces downward), should the end cap be damaged causing the balls or rollers to fall out, the slide may detach from the rail and fall. For such use, take measures including installing safety devices.

(4) Storage

Store properly.

a. When storing the product, store it in the original packaging. Do not open the package or break the inner packaging unnecessarily. It may cause foreign matter to enter or rusting and may cause deterioration of functions.

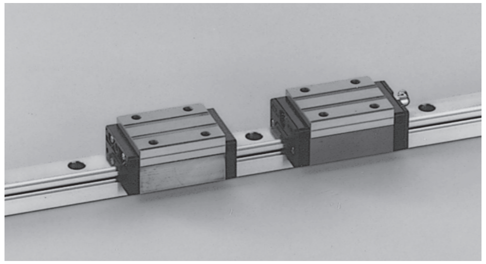
b. A place where the indoor environment is hot and humid is not suitable because it significantly reduces the rust prevention effect. Store in a place with low humidity and little temperature change.

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

A-4 Technical Descriptions and Dimension Tables for NSK Linear Guides

A-4-1 General Purpose Series

A-4-1.1 NH Model



1. Features

(1) Improves rating life dramatically

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

Load rating capacity is 1.3 times higher than LH Model and life is doubled[*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 for model.

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

By reexamining the design for the ball circulation path, we have attained smooth ball circulation and reduced noise. This makes NH models more suited for high-speed applications compared with LH models.

(3) All mounting dimensions are the same as the LH and SH Models

The dimensions surrounding the mounting (assembled dimensions), such as mounting height, width, mounting hole diameter/pitch, etc. of the NH model are identical to the LH and SH models, allowing for easy replacement without design changes.

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

Similar to a DF arrangement of angular contact bearings, NH models offer large self-aligning capability with the internal intersection of the contact lines of the balls and grooves reducing moment rigidity.

This increases the capacity to absorb errors in installation.

(5) High vertical load carrying capacity

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

(6) High resistance against impact load

The bottom ball groove forms a Gothic arch and the center of the top and bottom grooves are offset as shown in **Fig. 2**.

Vertical load is generally carried by the top rows at two contact points, but with this design, the bottom rows also carry load when a large impact load is applied vertically as shown in **Fig. 3**. This assures high resistance to 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 for easy and accurate measuring of ball grooves.

(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 variations and sizes

The NH model comes in several sizes and ball slide shapes, allowing for use in a variety of applications.

(10) Fast delivery

A lineup of interchangeable rails and ball slides supports and facilitates fast delivery. Interchangeable precision grade and medium preload types are also available. (Special high-carbon steel products)

(11) Option for smooth motion specification

The option provides smooth motion ideal for equipment that requires high performance by reducing conflict between balls in the slide. (NH15, NH20, and NH25)

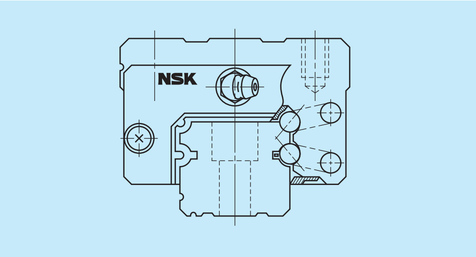


Fig. 1 NH Model

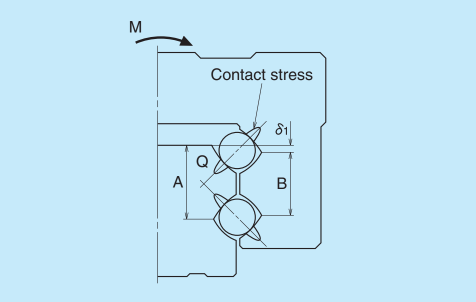


Fig. 2 Enlarged illustration of the offset Gothic arch groove

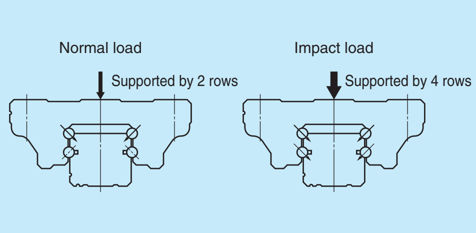
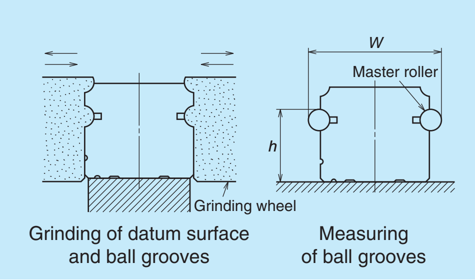


Fig. 3 When load is applied

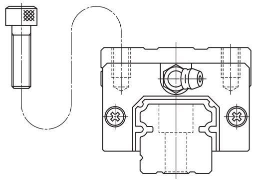
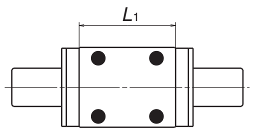
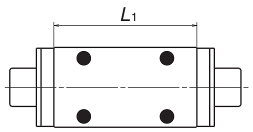
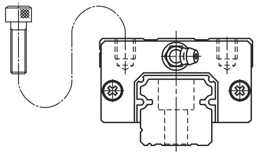
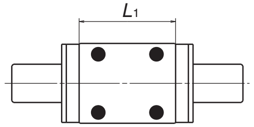
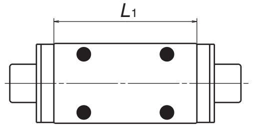
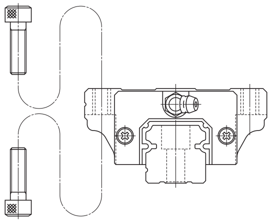
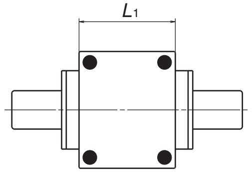
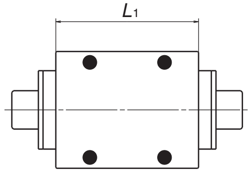


Grinding of datum surface and ball grooves

Measuring of ball grooves

Fig. 4 Rail grinding and measuring

2. Ball slide shape

Ball slide shape code	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		High-load	Super-high-load
		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) \ Accuracy grade		Preloaded assembly (not interchangeable)					Interchangeable	
over	or less	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	High precision PH	Normal grade PC
–	50	2	2	2	4	5	2	5
50 –	80	2	2	3	4	5	3	5
80 –	125	2	2	3	4	5	3	5
125 –	200	2	2	3.5	5	6	3.5	6
200 –	250	2	2.5	4.5	6	7.5	4.5	7.5
250 –	315	2	2.5	5	6.5	8.5	5	8.5
315 –	400	2	3	5.5	7	9.5	5.5	9.5
400 –	500	2	3	6	7.5	11	6	11
500 –	630	2	3.5	6.5	8.5	12	6.5	12
630 –	800	2	4	7	9.5	13	7	13
800 –	1 000	2.5	4.5	7.5	10	15	7.5	15
1 000 –	1 250	3	5	8.5	12	16	8.5	16
1 250 –	1 600	3.5	5.5	9.5	13	17	9.5	17
1 600 –	2 000	4	6.5	11	14	19	11	19
2 000 –	2 500	4.5	7.5	12	16	21	12	21
2 500 –	3 150	5.5	8.5	13	18	23	13	23
3 150 –	4 000	6	9.5	14	19	25	14	25

(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 interchangeable 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)	±8 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)	±10 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 interchangeable 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	20	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-L lubrication unit		P3	P4	P5	P6	PN	PH	PC
With NSK K1-L lubrication unit		L3	L4	L5	L6	LN	LH	LC
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	○	○	○	○	—	—	—
	Interchangeable type with fine clearance ZT	—	—	—	—	—	—	○
	Interchangeable type with slight preload ZZ	—	—	—	—	—	○	○
	Interchangeable type with medium preload ZH	—	—	—	—	—	○	○

(4) Assembled accuracy

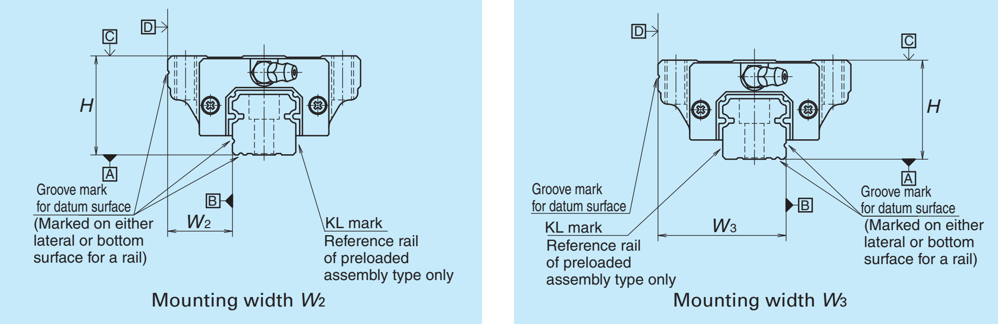


Fig. 5 Special high carbon steel

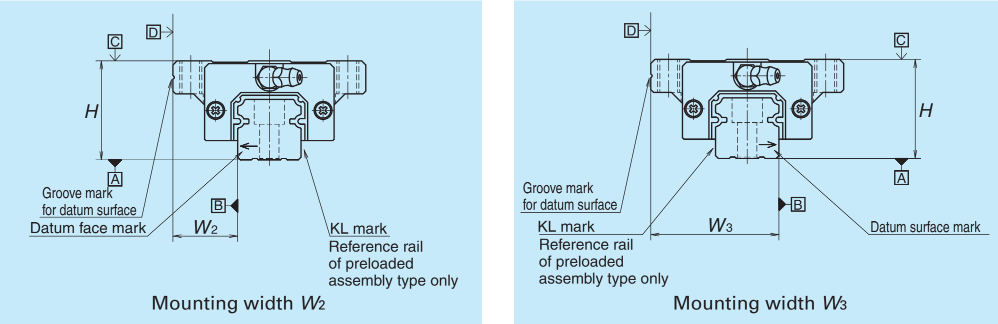


Fig. 6 Stainless steel

(5) Preload and rigidity

We offer six levels of preload: Slight preload Z1, Medium preload Z3 and Fine clearance Z0, along with interchangeable linear guides with 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	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	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

Notes:1) Clearance for Fine clearance Z0 is 0 to 3μm. Therefore, preload is zero.
However, Z0 of PN grade is 0 to 15μm.
2) In case of being applied option for smooth motion operation, preloads are shown in Table 11.

- **Clearance and preload of interchangeable type**

Table 6

Unit: μm

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

Model	Size / Material	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 requirements exceed the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

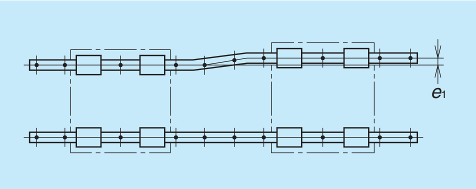


Fig. 7

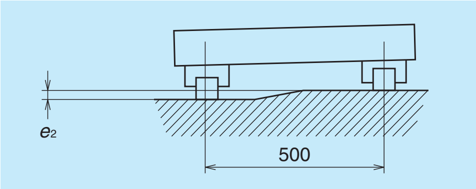


Fig. 8

Table 8

Unit: μm

Value	Preload	Model No.							
		NH15	NH20	NH25	NH30	NH35	NH45	NH55	NH65
Permissible values for parallelism error of 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 for height error of 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

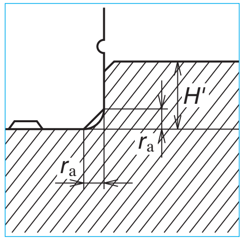


Fig. 9 Shoulder for the rail datum surface

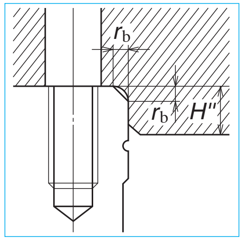


Fig. 10 Shoulder for the ball slide datum surface

Table 9

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	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

Table 10 indicates the maximum allowable speed for 10,000 km operation when using an NH model under normal conditions. 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

Model / Size	15	20	25	30	35	45	55	65
NH	300					200		150

7. Option for smooth motion specification

- This optional specification greatly suppresses fluctuations in friction, supporting equipment that requires particularly smooth operation such as measuring instruments. It also delivers in applications where operating characteristics often deteriorate, such as hung on wall or vertical installations (Refer to Fig. 11).

(1) Mechanism for smooth motion

- As shown in Fig.12, linear guides contain numerous steel balls inside the circulation path. Curved sections existing in tha path cause the balls to become crowded as they travel, impacting operating characteristics. Elastic members added between the balls help to relieve this conflict and realize smoother motion.

(2) Supported models

- 3 models supported: NH15, NH20, and NH25. Can be combined with various options, including newly developed NSK K1-L lubrication units, stainless steel specifications, surface treatments, interchangeable types, etc.
- Mounting dimensions such as assembly height, assembly width, and screw diameter/pitch of mounting hole are identical to standard specfications.

(3) Handling precautions

- In case of being applied option for smooth motion specification, preloads and rigities are shown in Table 11, and the basic load ratings are shown in Table 12.
- When the smooth motion specification is applied, the maximum allowable speed is 100 m/min regardless of size.
- When removing the slide from the rail, make certain to use a provisional rail (a jig used to insert a slide to the rail).

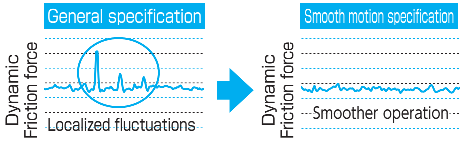


Fig. 11 Image of dynamic friction force of slide

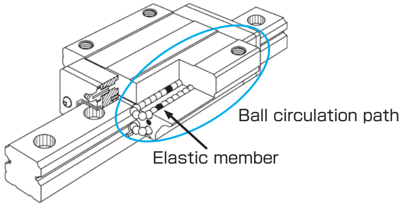


Fig. 12 Mechanism (structure)

Table 11

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)
NH15 AN、EM	78	490	122	201	87	166
NH20 AN、EM	147	835	165	298	121	218
NH25 AL、AN、EM	196	1 270	181	334	130	251
NH15 BN、GM	98	685	182	318	127	262
NH20 BN、GM	196	1 080	244	442	181	328
NH25 BL、BN、GM	245	1 570	271	517	199	370

Table 12

Model No.	Basic load rating							
	Dynamic		Static	Static moment (N･m)				
	[50km] C_{50}(N)	[100km] C_{100}(N)	C_0 (N)	M_{RO}	M_{PO}		M_{YO}	
					One slide	Two slides	One slide	Two slides
NH15 AN、EM	13 400	11 300	18 800	98	79	530	66.5	445
NH20 AN、EM	22 300	18 800	29 600	199	155	1 060	130	885
NH25 AL、AN、EM	31 500	26 800	41 500	325	267	1 700	224	1 430
NH15 BN、GM	17 400	14 400	30 000	157	192	1 090	161	915
NH20 BN、GM	29 000	24 000	47 500	320	375	2 120	315	1 780
NH25 BL、BN、GM	44 000	36 500	66 500	525	645	3 550	545	2 960

8. Lubrication components

Refer to pages A58 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 13 and **Table 13** show grease fittings and tube fittings.

We provide lubrication accessories with an extended thread body length (*L*) for the addition of dust-resistant accessories such as NSK K1-L lubrication units, double seals and protectors.

We provide suitable lubrication accesories for special dust-resistant requirements upon request.

NSK can also provide extended length threads for ease of replenishment.

Please contact NSK if stainless lubrication accessories are required.

(2) Mounting position of lubrication accessories

The standard position for grease fittings is at the end face of the ball slide, but we can mount them on the side of the end cap as an option. (**Fig. 14**)

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

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

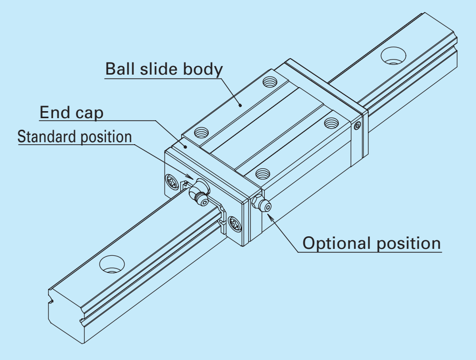


Fig. 14 Mounting position of lubrication accessories

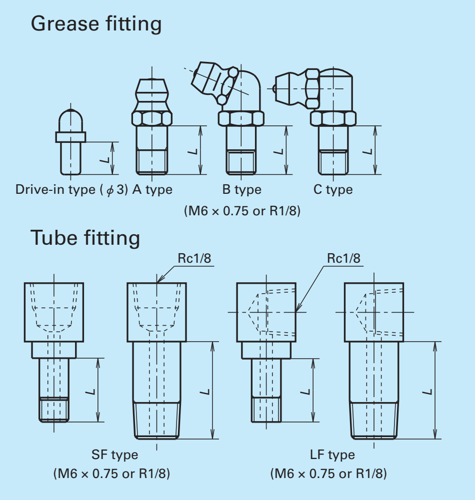


Fig. 13 Grease fitting and tube fitting

Table 13 Unit: mm

Model No.	Dust-resistant specification	Dimension *L*		
		Grease fitting /Drive-in type	Tube fitting	
			SF type	LF type
NH15	Standard	5	–	–
	With NSK K1-L	10	–	–
	Double seal	*	–	–
	Protector	*	–	–
NH20	Standard	5	–	–
	With NSK K1-L	12	–	–
	Double seal	10	–	–
	Protector	10	–	–
NH25	Standard	5	5	5
	With NSK K1-L	12	12	12
	Double seal	10	9	9
	Protector	10	9	9
NH30	Standard	5	6	6
	With NSK K1-L	14	12	13
	Double seal	12	10	11
	Protector	12	10	11
NH35	Standard	5	6	6
	With NSK K1-L	14	12	13
	Double seal	12	10	11
	Protector	12	10	11
NH45	Standard	8	13.5	17
	With NSK K1-L	18	20	21.5
	Double seal	14	16	17
	Protector	14	13.5	17
NH55	Standard	8	13.5	17
	With NSK K1-L	18	20	21.5
	Double seal	14	16	17
	Protector	14	13.5	17
NH65	Standard	8	13.5	17
	With NSK K1-L	20	22	25.5
	Double seal	16	18	19
	Protector	16	13.5	17

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

9. Dust-resistant components

(1) Standard specification

Under normal applications, the NH model can be used without modification thanks to its dust resistance. These ball slides come standard with an end seal on both ends and bottom seals on the bottom.

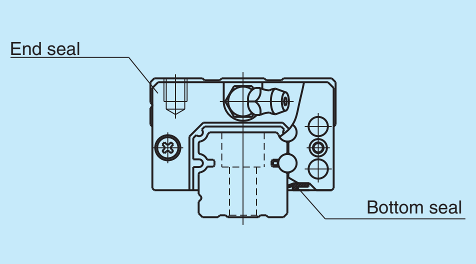


Fig. 15

Table 14 Seal friction per ball slide (maximum value)

Unit: N

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

(2) NSK K1-L™ and NSK K1™ lubrication units for food processing machinery/medical equipment

Table 15 shows linear guide dimensions when equipped with NSK K1-L lubrication units.

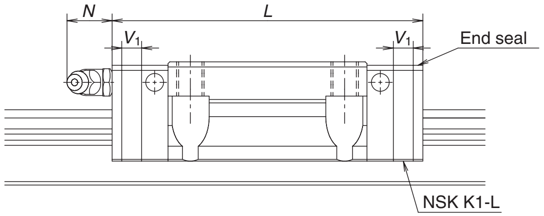


Table 15 Dimensions when equipped with NSK K1-L lubrication units

Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1-L units L	Thickness of single NSK K1-L unit V_1	Protrusion of grease fitting N
NH15	Standard	AN, EM	55	65.6	5.3	(5)
	Long	BN, GM	74	84.6		
NH20	Standard	AN, EM	69.8	80.4	5.3	(14)
	Long	BN, GM	91.8	102.4		
NH25	Standard	AL, AN, EM	79	90.6	5.8	(14)
	Long	BL, BN, GM	107	118.6		
NH30	Standard	AL, AN	85.6	97.6	6	(14)
		EM	98.6	110.6		
	Long	BL, BN, GM	124.6	136.6		
NH35	Standard	AL, AN, EM	109	122	6.5	(14)
	Long	BL, BN, GM	143	156		
NH45	Standard	AL, AN, EM	139	154	7.5	(15)
	Long	BL, BN, GM	171	186		
NH55	Standard	AL, AN, EM	163	178	7.5	(15)
	Long	BL, BN, GM	201	216		
NH65	Standard	AN, EM	193	211	9	(16)
	Long	BN, GM	253	271		

Notes: 1) When using NSK K1 for food processing machinery/medical equipment, refer toTable 16.
2) Slide length when equipped with NSK K1-L = (standard ball slide length) + (V_1 thickness of single NSK K1-L unit) × (number of K1-L units).

Table 16 shows linear guide dimensions when equipped with NSK K1 for food processing machinery/medical equipment.

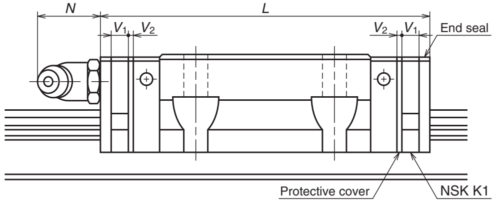


Table 16 Dimensions when equipped with NSK K1 for food processing machinery/medical equipment

Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1 V_1	Protective cover thickness V_2	Protrusion of 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			

Note: Slide length when equipped with NSK K1 for food processing machinery/medical equipment = (standard ball slide length) + (V_1 thickness of single NSK K1 unit) × (number of K1 units) + (V_2 thickness of the protective cover) × 2.

(3) Double seal

Use a double seal set as shown in **Table 17** when installing an extra seal to completed standard products. (**Fig. 16**)

When installing a grease fitting after the installation of double seals, a connector as shown in **Fig.16** is required.

(4) Protector

Use a protector set as shown in **Table 18** when installing a protector to completed standard products. (**Fig.17**)

When installing a grease fitting after the installation of protectors, a connector as shown in **Fig.17** is required.

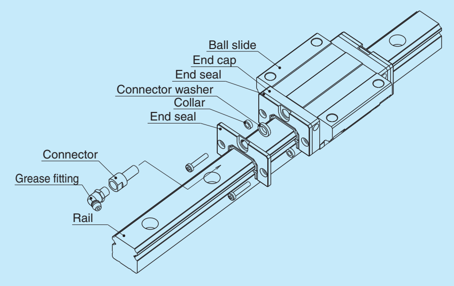


Fig. 16 Double seal

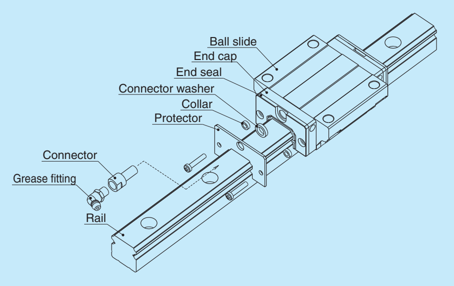


Fig. 17 Protector

Table 17 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 18 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 grease fitting, contact NSK.

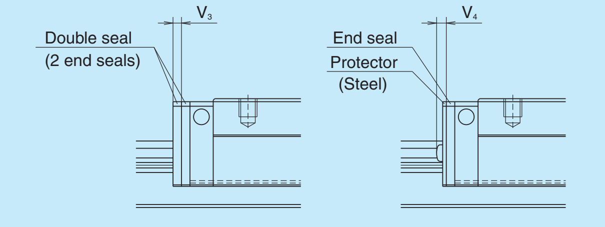


Fig. 18

(5) Caps to plug the rail mounting bolt hole

Table 19 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 20

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

(7) Bellows

- A bellows fastener kit, which includes one bellows fastener, two M_1 set screws, two M_2 set screws, and two collars for M_2 set screws as shown in Fig. 7.7 on page A69, is supplied with bellows for the ends.
- Middle bellows are supplied with four set screws and four collars.
- Use a bellows fastener kit as shown in **Table 21**, when installing bellows to completed standard products.
- When NSK K1/K1-L units, NSK K1 for food and medical equipment, double seals, or protectors are used, the set screws of bellows fastener kits cannot be used.

  Please contact NSK for details.
- Bellows fasteners are available only for horizontal mounting positions; other mounting positions require a sliding plate (see **Fig. 7.10** on page A70).

  To fix the bellows to the rail, make tap holes on the rail end surface. Fix the bellows mounting plate to the rail end surface through these tap holes with a machine screw. NSK prepares tap holes on the rail end surface when bellows are ordered with a linear guide.

Table 21 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 for bellows
NH Model

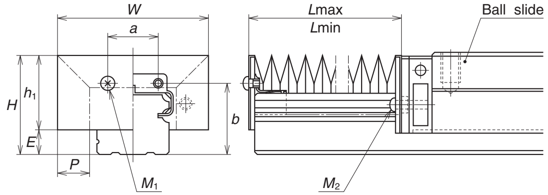


Fig. 19 Dimensions of bellows

Bellows reference number

J A H 20 N 08

Bellows

A: Bellows for the ends
B: Middle bellows

Bellows for NH model

Number of BL
(fold number)

N: High type L: Low type

Size number of linear guide

Table 22 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 23 Numbers of folds (BL) and lengths of bellows

Unit: mm

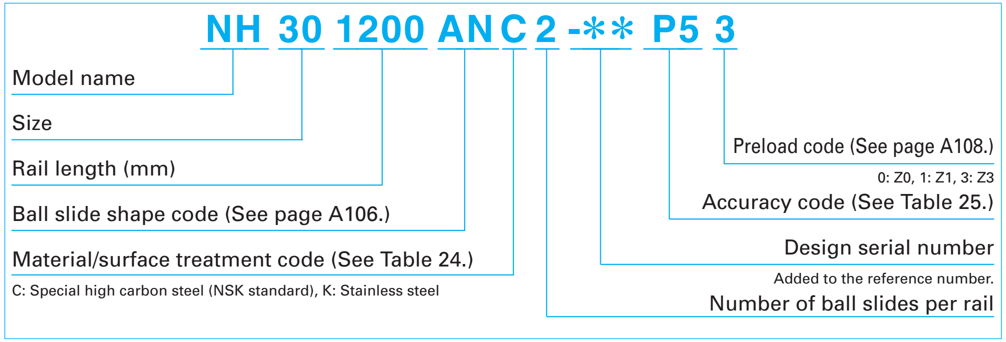
Model No.	Number of BL	2	4	6	8	10	12	14	16	18	20
	Lmin	34	68	102	136	170	204	238	272	306	340
JAH20N	Stroke	106	212	318	424	530	636	742	848	954	1 060
	Lmax	140	280	420	560	700	840	980	1 120	1 260	1 400
JAH25L	Stroke	106	212	318	424	530	636	742	848	954	1 060
	Lmax	140	280	420	560	700	840	980	1 120	1 260	1 400
JAH25N	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	Lmax	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
	Lmax	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
	Lmax	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
	Lmax	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
	Lmax	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
JAH45L	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	Lmax	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
	Lmax	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
	Lmax	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
	Lmax	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
	Lmax	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 both sides, then by dividing the sum by 2.

10. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.
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


NH 30 1200 AN C 2 -** P5 3

Model name

Size

Rail length (mm)

Ball slide shape code (See page A106.)

Material/surface treatment code (See Table 24.)
C: Special high carbon steel (NSK standard), K: Stainless steel

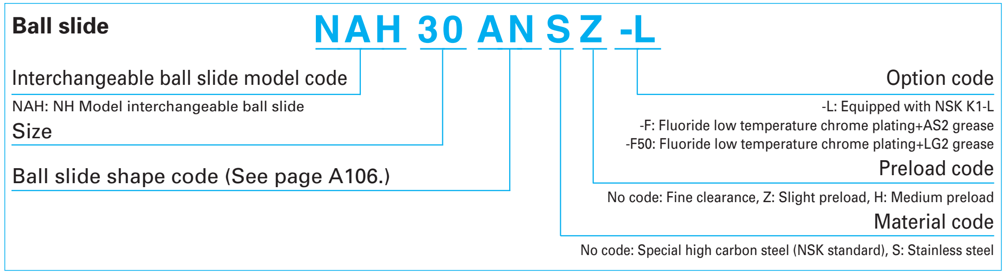
Preload code (See page A108.)
0: Z0, 1: Z1, 3: Z3

Accuracy code (See Table 25.)

Design serial number
Added to the reference number.

Number of ball slides per rail

(2) Reference number for interchangeable type


Ball slide

NAH 30 AN S Z -L

Interchangeable ball slide model code
NAH: NH Model interchangeable ball slide

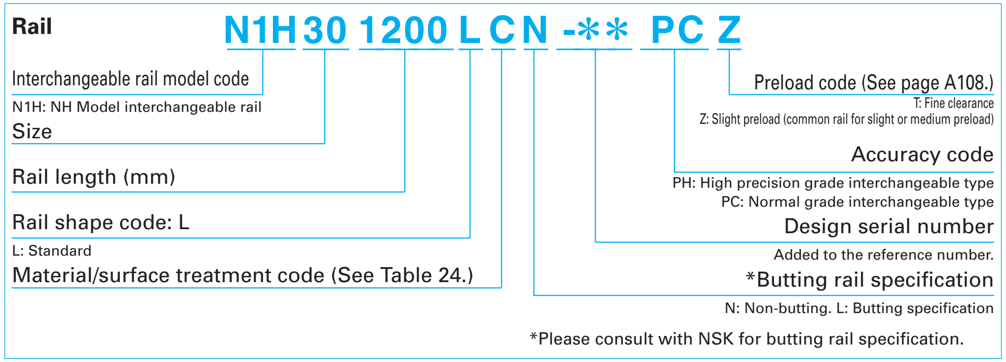
Size

Ball slide shape code (See page A106.)

Option code
-L: Equipped with NSK K1-L
-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


Rail

N1H 30 1200 L C N -** PC Z

Interchangeable rail model code
N1H: NH Model interchangeable rail

Size

Rail length (mm)

Rail shape code: L
L: Standard

Material/surface treatment code (See Table 24.)

Preload code (See page A108.)
T: Fine clearance
Z: Slight preload (common rail for slight or medium preload)

Accuracy code
PH: High precision grade interchangeable type
PC: Normal grade interchangeable type

Design serial number
Added to the reference number.

*Butting rail specification
N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.

When interchangeable rails and slides are assembled, reference number coding is the same as that for preloaded assemblies. However, only preload codes T (fine clearance), Z (slight preload), and H (medium preload) may be used (Refer to Page A108.)
Click!Speedy™ NSK Linear Guide Quick Delivery System uses a new numbering system. For details, please refer to the Click!Speedy general catalog CAT. No. E3191.

Table 24 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 interchangeable types are not available in stainless steel.

Table 25 Accuracy code

Accuracy	Standard (Without NSK K1-L)	With NSK K1-L	With NSK K1 for food and medical equipment	Standard (Without NSK K1-L)	With NSK K1-L
				With smooth motion specification	
Ultra precision grade	P3	L3	F3	S3	T3
Super precision grade	P4	L4	F4	S4	T4
High precision grade	P5	L5	F5	S5	T5
Precision grade	P6	L6	F6	S6	T6
Normal grade	PN	LN	FN	SN	TN
High precision grade (interchangeable type)	PH	LH	FH	SH	TH
Normal grade (interchangeable type)	PC	LC	FC	SC	TC

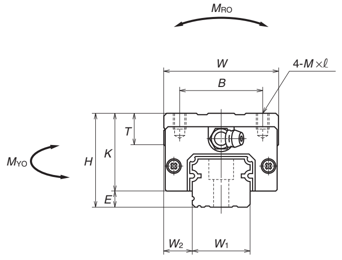
Notes:1) Refer to page A58 for details on NSK K1-L lubrication units and to page A73 for details on NSK K1 lubricaiton units for food processing machinery/medical equipment.
2) Refer to page A111 for option for smooth motion operation.

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

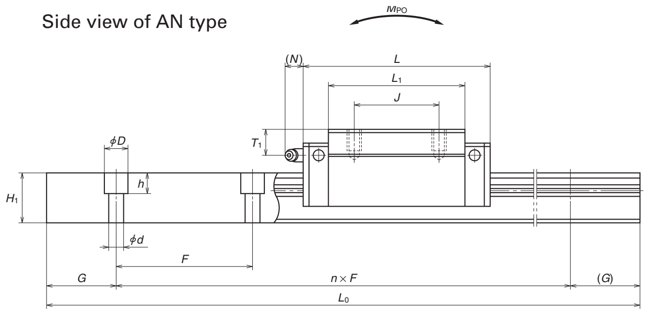
NH 30 1200 AN C 2 - PC Z**

Model name
Size
Rail length (mm)
Ball slide shape code (See page A106.)
Material/surface treatment code (See Table 24.)
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 25.)
Preload code (See page A108.)
0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ, H: ZH

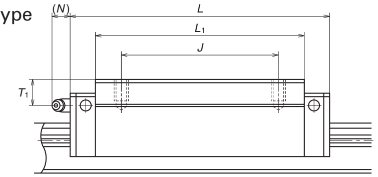
Front view of AN and BN types



Side view of AN type



Side view of BN type



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

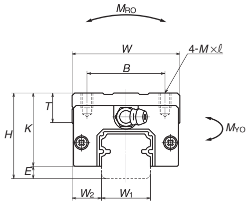
Notes: 1) The external appearance of stainless steel ball slides differs slightly from that of carbon steel ball slides.

Reference number for ball slide of interchangeable type

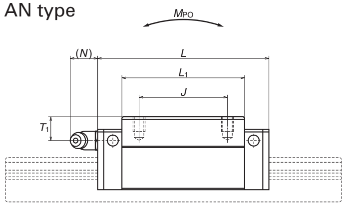
Ball slide **NAH 30 AN S Z -L**

Interchangeable ball slide model code
NAH: NH Model interchangeable ball slide
Size
Ball slide shape code (See page A106.)
Option code
-L: Equipped with NSK K1-L
-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

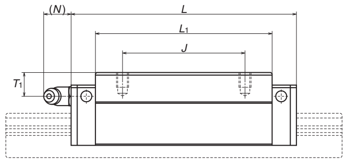
AN and BN types



AN type



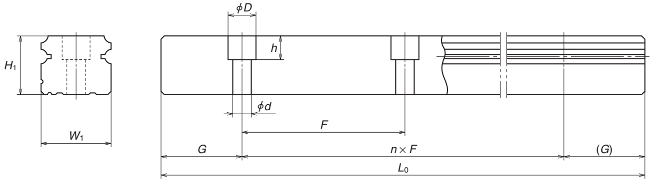
BN type



Reference number for rail of interchangeable type

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

Interchangeable rail model code
N1H: NH Model interchangeable rail
Size
Rail length (mm)
Rail shape code: L
L: Standard
Material/surface treatment code (See Table 24.)
Preload code (See page A108.)
T: Fine clearance.
Z: Slight preload (common rail for medium preload)
Accuracy code
PH: High precision grade. PC: Normal grade
Design serial number
Added to the reference number.
*Butting rail specification
N: Non-butting. L: Butting specification
*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Rail				Basic load ratings								Weight	
	Pitch	Mounting bolt hole	G	Max. length $L_{0max.}$ ( ) for stainless	[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)		C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
NH15AN **NH15BN**	60	4.5×7.5×5.3	20	2 980 (1 800)	14 200 18 100	11 300 14 400	20 700 32 000	108 166	94.5 216	575 1 150	79.5 181	480 965	0.18 0.26	1.6
NH20AN **NH20BN**	60	6×9.5×8.5	20	3 960 (3 500)	23 700 30 000	18 800 24 000	32 500 50 500	219 340	185 420	1 140 2 230	155 355	955 1 870	0.33 0.48	2.6
NH25AN **NH25BN**	60	7×11×9	20	3 960 (3 500)	33 500 45 500	26 800 36 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.55 0.82	3.6
NH30AN **NH30BN**	80	9×14×12	20	4 000 (3 500)	41 000 61 000	32 500 48 500	51 500 91 500	490 870	350 1 030	2 290 5 600	292 865	1 920 4 700	0.77 1.3	5.2
NH35AN **NH35BN**	80	9×14×12	20	4 000	62 500 81 000	49 500 64 500	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.5 2.1	7.2
NH45AN **NH45BN**	105	14×20×17	22.5	3 990	107 000 131 000	84 500 104 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	3.0 3.9	12.3
NH55AN **NH55BN**	120	16×23×20	30	3 960	158 000 193 000	125 000 153 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	4.7 6.1	16.9
NH65AN **NH65BN**	150	18×26×22	35	3 900	239 000 310 000	190 000 246 000	281 000 410 000	6 150 8 950	4 950 10 100	27 900 51 500	4 150 8 450	23 400 43 500	7.7 10.8	24.3

2) Basic load ratings comply with ISO standards (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. In case of being applied option for smooth motion operation, basic load ratings are shown in Table 12.

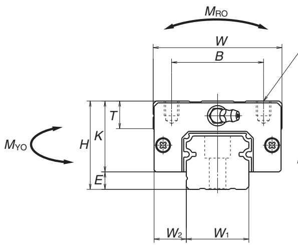
3) High-precision grade and medium preload interchangeable types are available for high-carbon steel products.

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

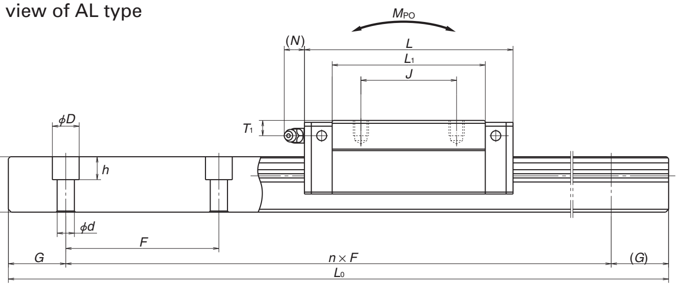
NH 30 1200 AL C 2 -∗∗ PC Z

Model name
Size
Rail length (mm)
Ball slide shape code (See page A106.)
Material/surface treatment code (See Table 24.)
C: Special high carbon steel (NSK standard), K: Stainless steel
Preload code (See page A108.)
0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ, H: ZH
Accuracy code (See Table 25.)
Design serial number
Added to the reference number.
Number of ball slides per rail

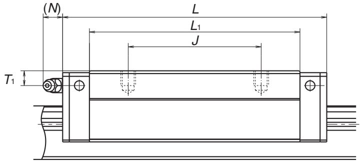
Front view of AL and BL types



Side view of AL type



Side view of BL type

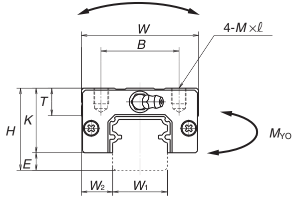


Reference number for ball slide of interchangeable type

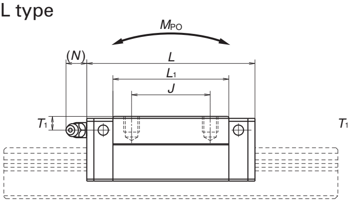
Ball slide **NAH 30 AL S Z -L**

Interchangeable ball slide model code
NAH: NH Model interchangeable ball slide
Size
Ball slide shape code (See page A106.)
Option code
-L: Equipped with NSK K1-L
-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

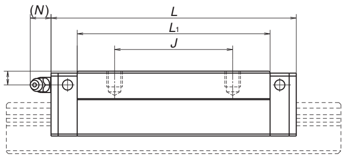
AL and BL types



AL type



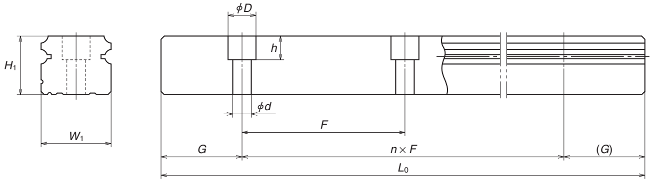
BL type



Reference number for rail of interchangeable type

Rail **N1H30 1200 L C N -∗∗ PC Z**

Interchangeable rail model code
N1H: NH Model interchangeable rail
Size
Rail length (mm)
Rail shape code: L
L: Standard
Material/surface treatment code (See Table 24.)
Preload code (See page A108.)
T: Fine clearance.
Z: Slight preload (common rail for medium preload)
Accuracy code
PH: High precision grade
PC: Normal grade
Design serial number
Added to the reference number.
*Butting rail specification
N: Non-butting. L: Butting specification
*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide											Rail						Basic load ratings								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]		M_{RO}	M_{PO}		M_{YO}			
	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)	$L_{0max.}$ ( ) for stainless	C_{50}(N)	C_{100}(N)	C_0 (N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
NH25AL	36	7	12.5	48	79	35	35	M6×1×6	58	29	12	M6×0.75	6	11	23	22	60	7×11×9	20	3 960	33 500	26 800	46 000	360	320	1 840	267	1 540	0.46	3.6
NH25BL					107		50		86											(3 500)	45 500	36 500	71 000	555	725	3 700	610	3 100	0.69	
NH30AL	42	9	16	60	85.6	40	40	M8×1.25×8	59	33	14	M6×0.75	7	11	28	26	80	9×14×12	20	4 000	41 000	32 500	51 500	490	350	2 290	292	1 920	0.69	5.2
NH30BL					124.6		60		98											(3 500)	61 000	48 500	91 500	870	1 030	5 600	865	4 700	1.16	
NH35AL	48	9.5	18	70	109	50	50	M8×1.25×8	80	38.5	15	M6×0.75	8	11	34	29	80	9×14×12	20	4 000	62 500	49 500	80 500	950	755	4 500	630	3 800	1.2	7.2
NH35BL					143		72		114												81 000	64 500	117 000	1 380	1 530	8 350	1 280	7 000	1.7	
NH45AL	60	14	20.5	86	139	60	60	M10×1.5×10	105	46	17	Rc1/8	10	13	45	38	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
NH45BL					171		80		137												131 000	104 000	187 000	2 860	3 000	15 600	2 520	13 100	2.9	
NH55AL	70	15	23.5	100	163	75	75	M12×1.75×13	126	55	15	Rc1/8	11	13	53	44	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
NH55BL					201		95		164												193 000	153 000	264 000	4 850	5 150	26 300	4 350	22 100	4.7	

Notes: 1) The external appearance of stainless steel ball slides differs slightly from that of carbon steel ball slides.

2) Basic load ratings comply with ISO standards (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. In case of being applied option for smooth motion operation, basic load ratings are shown in Table 12.

3) High-precision grade and medium preload interchangeable types are available for high-carbon steel products.

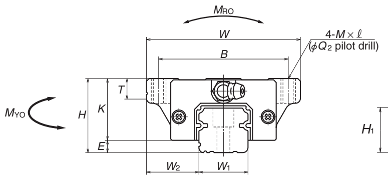
NH-EM (High-load / Standard)
NH-GM (Super-high-load / Long)

NH 30 1200 EM C 2 -✻✻ PC Z

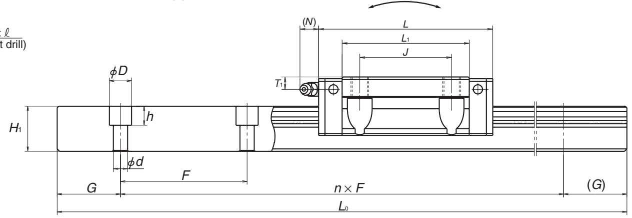
Model name
Size
Rail length (mm)
Ball slide shape code (See page A106.)
Material/surface treatment code (See Table 24.)
C: Special high carbon steel (NSK standard), K: Stainless steel

Preload code (See page A108.)
0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ, H: ZH
Accuracy code (See Table 25.)
Design serial number
Added to the reference number.
Number of ball slides per rail

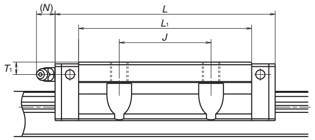
Front view of EM and GM types



Side view of EM type



Side view of GM type



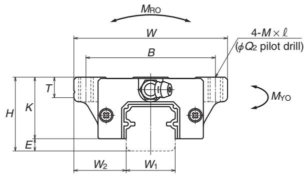
Reference number for ball slide of interchangeable type

Ball slide **NAH 30 EM S Z -L**

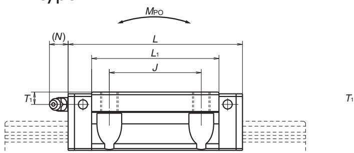
Interchangeable ball slide model code
NAH: NH Model interchangeable ball slide
Size
Ball slide shape code (See page A106.)

Option code
-L: Equipped with NSK K1-L
-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

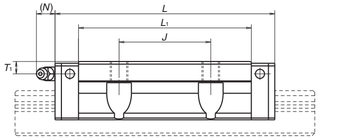
EM and GM types



EM type



GM type



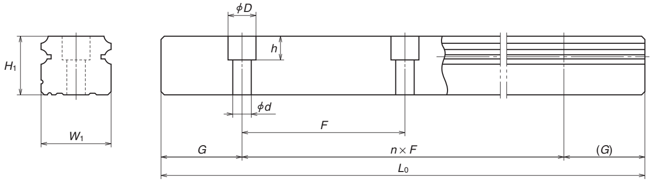
Reference number for rail of interchangeable type

Rail **N1H 30 1200 L C N -✻✻ PC Z**

Interchangeable rail model code
N1H: NH Model interchangeable rail
Size
Rail length (mm)
Rail shape code: L
L: Standard
Material/surface treatment code (See Table 24.)

Preload code (See page A108.)
T: Fine clearance.
Z: Slight preload (common rail for medium preload)
Accuracy code
PH: High precision grade. PC: Normal grade
Design serial number
Added to the reference number.
*Butting rail specification
N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.



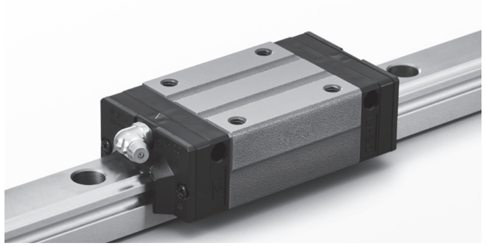
Unit: mm

Model No.	Assembly			Ball slide														Rail				Basic load ratings								Weight	
	Height			Width	Length	Mounting hole							Grease fitting			Width	Height	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}			
	H	E	W_2	W	L	B	J	M × pitch × ℓ	Q_2	L_1	K	T	Hole size	T_1	N	W_1	H_1	F	d × D × h	(reference)		C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
NH15EM **NH15GM**	24	4.6	16	47	55 74	38	30	M5×0.8×7	4.4	39 58	19.4	8	ϕ3	4.5	3.3	15	15	60	4.5×7.5×5.3	20	2 980 (1 800)	14 200 18 100	11 300 14 400	20 700 32 000	108 166	94.5 216	575 1 150	79.5 181	480 965	0.17 0.25	1.6
NH20EM **NH20GM**	30	5	21.5	63	69.8 91.8	53	40	M6×1×9.5	5.3	50 72	25	10	M6×0.75	5	11	20	18	60	6×9.5×8.5	20	3 960 (3 500)	23 700 30 000	18 800 24 000	32 500 50 500	219 340	185 420	1 140 2 230	155 355	955 1 870	0.45 0.65	2.6
NH25EM **NH25GM**	36	7	23.5	70	79 107	57	45	M8×1.25×10 (M8×1.25×11.5)	6.8	58 86	29	11 (12)	M6×0.75	6	11	23	22	60	7×11×9	20	3 960 (3 500)	33 500 45 500	26 800 36 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.63 0.93	3.6
NH30EM **NH30GM**	42	9	31	90	98.6 124.6	72	52	M10×1.5×12 (M10×1.5×14.5)	8.6	72 98	33	11 (15)	M6×0.75	7	11	28	26	80	9×14×12	20	4 000 (3 500)	47 000 61 000	37 500 48 500	63 000 91 500	600 870	505 1 030	3 150 5 600	425 865	2 650 4 700	1.2 1.6	5.2
NH35EM **NH35GM**	48	9.5	33	100	109 143	82	62	M10×1.5×13	8.6	80 114	38.5	12	M6×0.75	8	11	34	29	80	9×14×12	20	4 000	62 500 81 000	49 500 64 500	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.7 2.4	7.2
NH45EM **NH45GM**	60	14	37.5	120	139 171	100	80	M12×1.75×15	10.5	105 137	46	13	Rc1/8	10	13	45	38	105	14×20×17	22.5	3 990	107 000 131 000	84 500 104 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	3 3.9	12.3
NH55EM **NH55GM**	70	15	43.5	140	163 201	116	95	M14×2×18	12.5	126 164	55	15	Rc1/8	11	13	53	44	120	16×23×20	30	3 960	158 000 193 000	125 000 153 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	5 6.5	16.9
NH65EM **NH65GM**	90	16	53.5	170	193 253	142	110	M16×2×24	14.6	147 207	74	23	Rc1/8	19	13	63	53	150	18×26×22	35	3 900	239 000 310 000	190 000 246 000	281 000 410 000	6 150 8 950	4 950 10 100	27 900 51 500	4 150 8 450	23 400 43 500	10 14.1	24.3

Notes: 1) Parenthesized dimensions are for items made of stainless steel.
2) The external appearance of stainless steel ball slides differs slightly from that of carbon steel ball slides.

3) Basic load ratings comply with ISO standards (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. In case of being applied option for smooth motion operation, basic load ratings are shown in Table 12.
4) High-precision grade and medium preload interchangeable types are available for high-carbon steel products.

A-4-1.2 VH Model



1. Features

(1) High-performance end seals

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

(2) NSK K1-L™ lubrication unit (standard)

The outstanding lubrication support provided by NSK K1-L units further improves resistance to dust and durability. Additional NSK K1-L units can be mounted for specific usage conditions and environments.

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

In addition to standard mounting bolt holes (counterbores on the rail top surface), a specification for tapped holes on the rail bottom surface for enhanced dust resistance is available. (Refer to the dimension tables for details.)

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

Similar to a DF arrangement of angular contact bearings, VH models offer large self-aligning capability with the internal intersection of the contact lines of the balls and grooves reducing moment rigidity.

This increases the capacity to absorb errors in installation.

(5) High vertical load carrying capacity

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

(6) High resistance against impact load

The bottom ball groove forms a Gothic arch and the center of the top and bottom grooves are offset as shown in **Fig. 2**.

Vertical load is generally carried by the top rows at two contact points, but with this design, the bottom rows also carry load when a large impact load is applied vertically as shown in **Fig. 3**. This assures high resistance to impact load.

(7) High accuracy

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

(8) Interchangeable

Interchangeable rails and ball slides are available.

(9) Improve rating life dramatically

A new ball groove geometry is introduced utilizing NSK's state-of-the-art tribological and analytical technologies. Rating life is dramatically increased due to the optimized distribution of contact surface pressures.

Load rating capacity is 1.3 times higher than conventional products and life is doubled[*1].

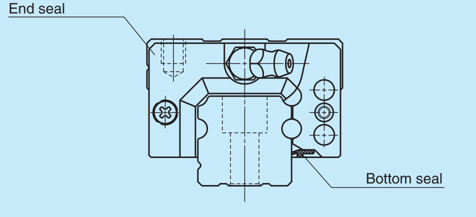


Fig. 1 VH Model

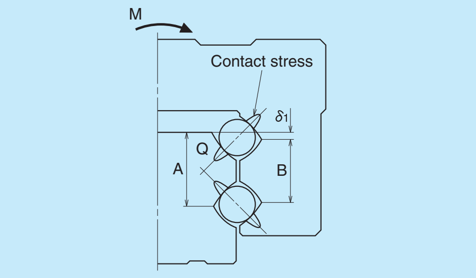


Fig. 2 Enlarged illustration of the offset Gothic arch groove

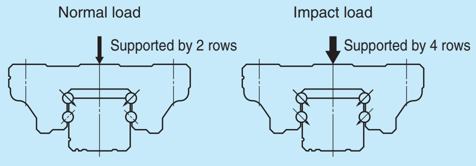
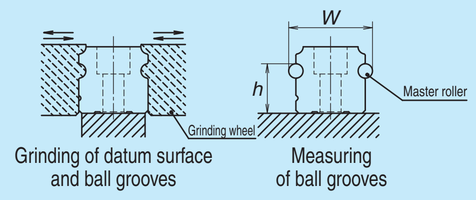


Fig. 3 When load is applied



Grinding of datum surface and ball grooves

Measuring of ball grooves

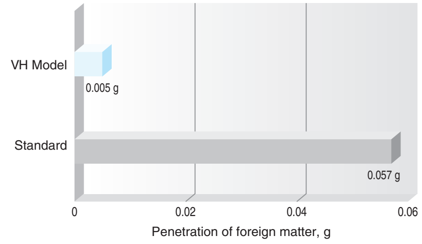
Fig. 4 Rail grinding and measuring

●Comparison with NSK standard products

Level of fine contaminants reduced by 90% or more.

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

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

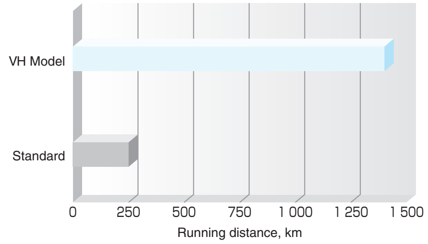


Operating life under contaminated environments is more than 5 times longer

Durability test with rubber fragments

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

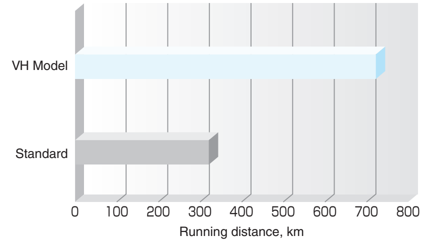
Test sample : VH30AN, preload code Z1 (preload of 245 N)
Rail orientation : Horizontal (wall mount)
Speed : 500 mm/sec
Lubrication : AS2 grease (prepacked AS2 only)
Contaminant : Rubber fragments

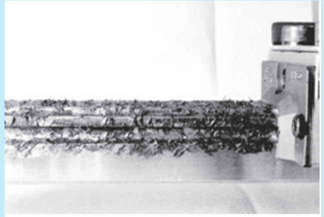


Durability test with fine wood particles

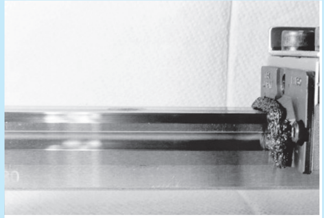
Extreme durability tests in a contaminated environment with fine wood particles show that durability of the VH Model is more than double that of the standard model, as shown in the graph.

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 particles)

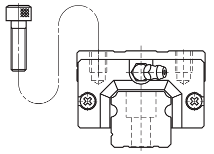
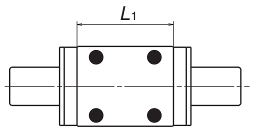
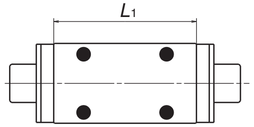
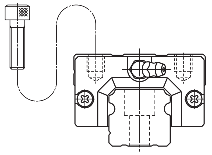
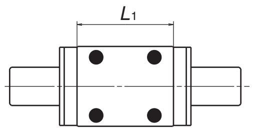
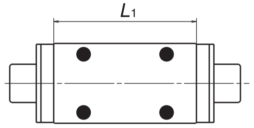
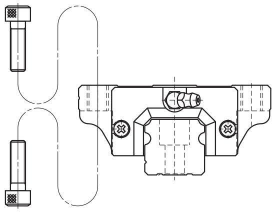
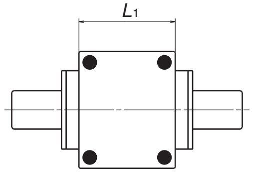
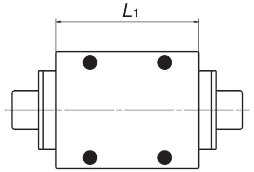


After the passage of ball slide
(All contaminant particles are swept away)

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

[*1] Representative values for model.

2. Ball slide shape

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

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3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Accuracy grade / Rail length (mm)		Preloaded assembly (not interchangeable)					Interchangeable type
over	or less	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC
–	50	2	2	2	4	5	5
50 –	80	2	2	3	4	5	5
80 –	125	2	2	3	4	5	5
125 –	200	2	2	3.5	5	6	6
200 –	250	2	2.5	4.5	6	7.5	7.5
250 –	315	2	2.5	5	6.5	8.5	8.5
315 –	400	2	3	5.5	7	9.5	9.5
400 –	500	2	3	6	7.5	11	11
500 –	630	2	3.5	6.5	8.5	12	12
630 –	800	2	4	7	9.5	13	13
800 –	1 000	2.5	4.5	7.5	10	15	15
1 000 –	1 250	3	5	8.5	12	16	16
1 250 –	1 600	3.5	5.5	9.5	13	17	17
1 600 –	2 000	4	6.5	11	14	19	19
2 000 –	2 500	4.5	7.5	12	16	21	21
2 500 –	3 150	5.5	8.5	13	18	23	23
3 150 –	4 000	6	9.5	14	19	25	25

(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 interchangeable type has Normal PC grade only.

- **Tolerance of preloaded assembly**

Table 2

Unit: μm

Accuracy grade / Characteristics	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)	±8 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)	±10 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 interchangeable type: Normal grade PC**

Table 3

Unit: μm

Model No. / Characteristics	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-L lubrication unit		L3	L4	L5	L6	LN	LC
Preload	Fine clearance Z0	○	○	○	○	○	—
	Slight preload Z1	○	○	○	○	○	—
	Medium preload Z3	○	○	○	○	—	—
	Interchangeable type with fine clearance ZT	—	—	—	—	—	○
	Interchangeable type with slight preload ZZ	—	—	—	—	—	○

(4) Assembled accuracy

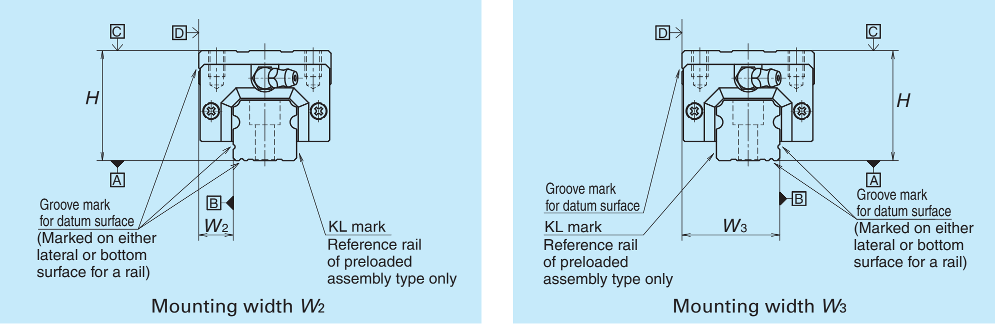

Fig. 5 Special high carbon steel

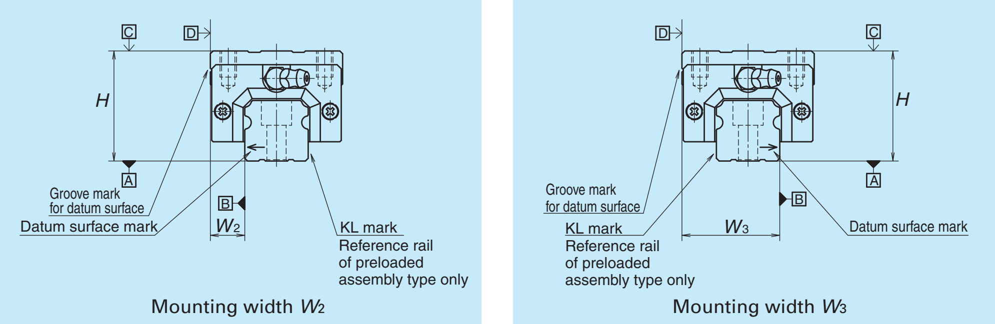

Fig. 6 Stainless steel

(5) Preload and rigidity

We offer five levels of preload: Slight preload Z1, Medium preload Z3 and Fine clearance Z0, while the interchangeable type offers 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	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	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 interchangeable type**

Table 6 Unit: μm

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

Model	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 requirements exceed the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

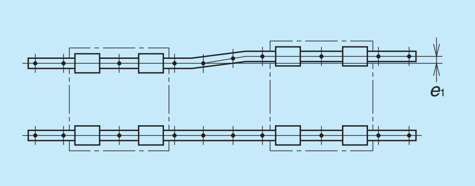

Fig. 7

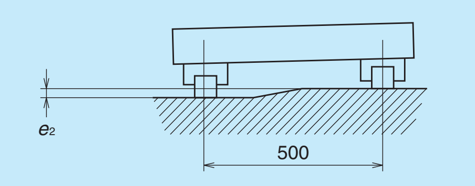

Fig. 8

Table 8

Unit: μm

Value	Preload	Model No.						
		VH15	VH20	VH25	VH30	VH35	VH45	VH55
Permissible values for parallelism error of 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 for height error of 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

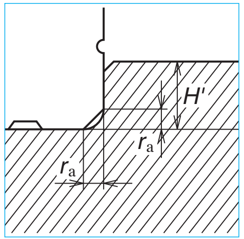

Fig. 9 Shoulder for the rail datum surface

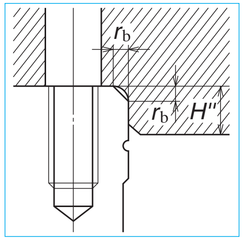

Fig. 10 Shoulder for the ball slide datum surface

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

- Special high carbon steel is available for this specification.
- Applicable accuracy grades are precision grade (P6) and normal grades (PN and PC) 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.

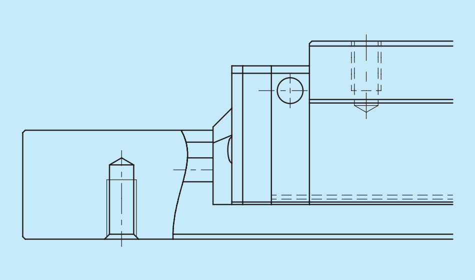

Fig. 11

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6. Lubrication components

Refer to pages A58 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 an extended thread body length (*L*) for the addition of dust-resistant accessories such as NSK K1-L lubrication units, double seals and protectors.

We provide suitable lubrication accesories for special dust-resistant requirements upon request.

NSK can also provide extended length threads for ease of replenishment.

Please contact NSK if stainless lubrication accessories are required.

(2) Mounting position of lubrication accessories

The standard position for grease fittings is at the end face of the ball slide, but we can mount them on the side of the end cap as an option. (**Fig. 13**)

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

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

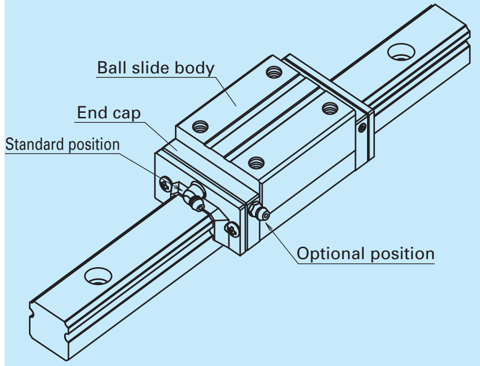


Fig. 13 Mounting position of lubrication accessories

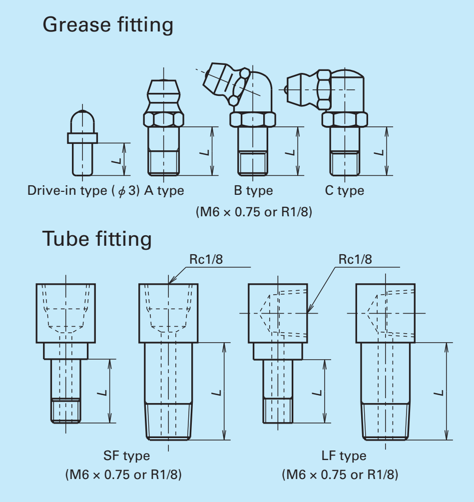


Fig. 12 Grease fitting and tube fitting

Table 10

Unit: mm

Model No.	Dust-resistant specification	Dimension *L*		
		Grease fitting /Drive-in type	Tube fitting	
			SF type	LF type
VH15	Standard*	10	–	–
	Double seal	**	–	–
	Protector	**	–	–
VH20	Standard*	12	–	–
	Double seal	18	–	–
	Protector	18	–	–
VH25	Standard*	12	15	16
	Double seal	18	23	24.5***
	Protector	18	17	18
VH30	Standard*	14	18	17.5
	Double seal	22	25	24.5
	Protector	22	19.5	19
VH35	Standard*	14	15	15
	Double seal	22	25	24.5
	Protector	22	21.5	22
VH45	Standard*	18	22	21.5
	Double seal	22	32	32
	Protector	28	28	30
VH55	Standard*	18	20	20
	Double seal	22	32	32
	Protector	28	28	30

*) NSK K1-L units are mounted as a standard specification for VH models.

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

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

7. Dust-resistant components

(1) Standard specification

Under normal applications, the VH model can be used without modification thanks to its dust resistance. To keep foreign matter from entering inside the ball slide, the VH model has an end seal on both ends and bottom seals at the bottom.

Two NSK K1-L lubrication units, one at each end, are installed as standard.

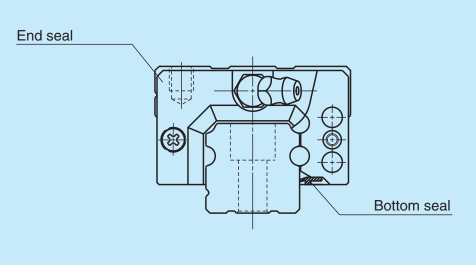


Fig. 14

Table 11 Seal friction per ball slide (maximum value)

Unit: N

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

(2) Double seal and protector

For VH Models, double-seals and protectors can be installed only before shipping from the factory. Please consult with NSK when double seals or protectors are required.

Table 12 shows the ball slide length when a double seal set and a protector are installed.

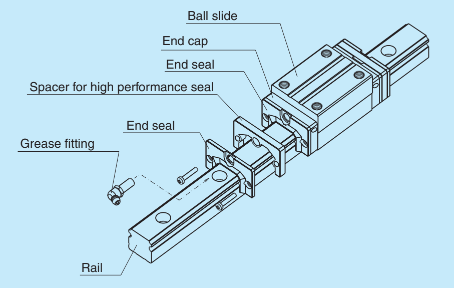


Fig. 15 Double seal

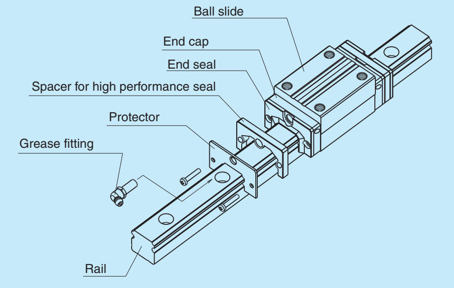
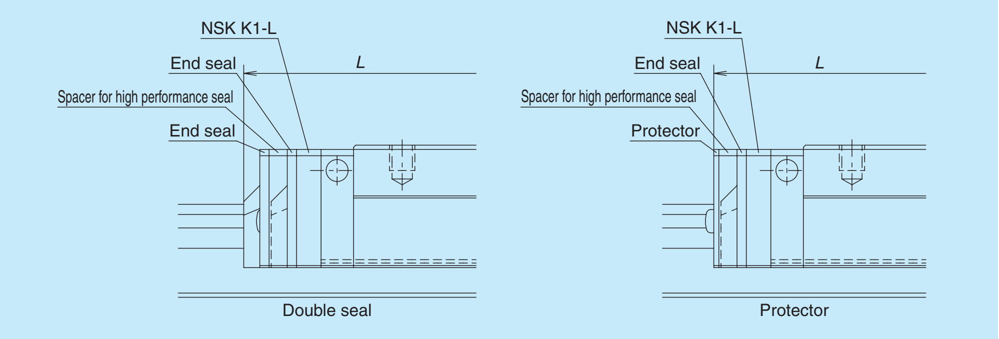


Fig. 16 Protector

Table 12 Dimensions with optional dust-resistant components installed

Unit: mm

Model No.	Ball slide length	Ball slide shape code	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



Double seal

Protector

Fig. 17

(3) Caps 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

Inner seals are only available for the models shown below.

Table 14

Model	Model No.
VH	VH20, VH25, VH30, VH35, VH45, VH55

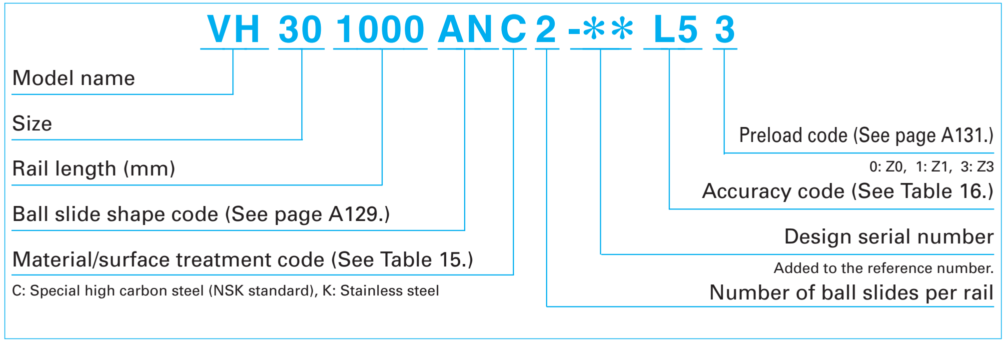
8. Design Precautions

Because the product is used under severe operating conditions that require high performance end seals, please inform NSK about your service conditions using the technical data sheet on page A146.

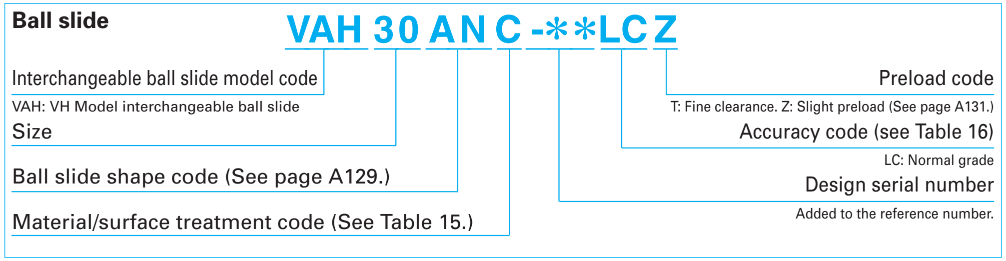
9. Reference number

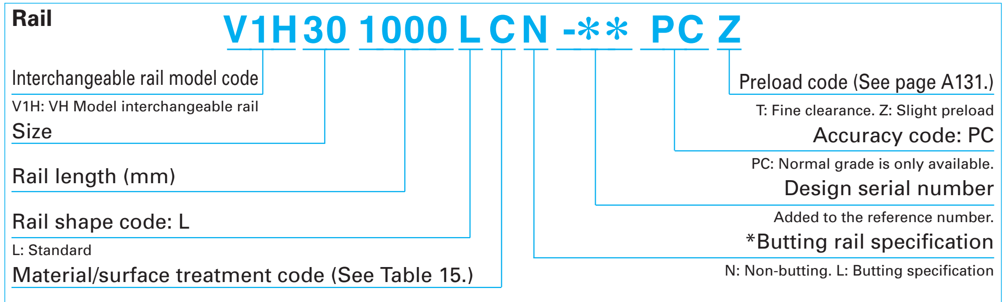
A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for preloaded assembly



(2) Reference number for interchangeable type





＊Please consult with NSK for butting rail specification.

When interchangeable rails and slides are assembled, reference number coding is the same as that for preloaded assemblies. However, only preload codes T (fine clearance) and Z (slight preload) may be used (Refer to Page A131.)

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
W	Special high carbon steel with surface treatment + tapped holes on a rail bottom surface
Z	Other, special

Table 16 Accuracy code

Accuracy	With NSK K1-L
Ultra precision grade	L3
Super precision grade	L4
High precision grade	L5
Precision grade	L6
Normal grade	LN
Normal grade (interchangeable type)	LC

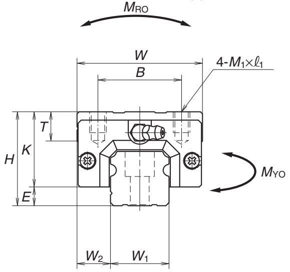
Note: Refer to page A58 for details on NSK K1-L lubrication units.

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

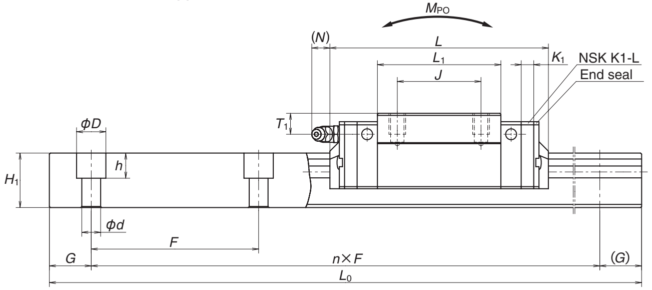
VH 30 1000 AN C 2 -＊＊ LC Z

- VH: Model name
- 30: Size
- 1000: Rail length (mm)
- AN: Ball slide shape code (See page A129.)
- C: Material/surface treatment code (See Table 15.)
  C: Special high carbon steel (NSK standard), K: Stainless steel
- 2: Number of ball slides per rail
- -＊＊: Design serial number
  Added to the reference number.
- LC: Accuracy code (See Table 16.)
- Z: Preload code (See page A131.)
  0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ

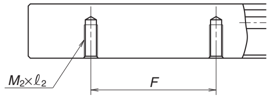
Front view of AN and BN type



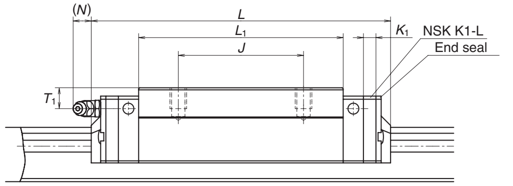
Side view of AN type



Specification for tapped holes on a rail bottom face



Side view of BN type

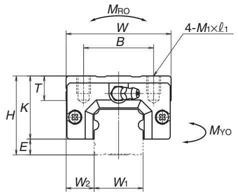


Reference number for ball slide of interchangeable type

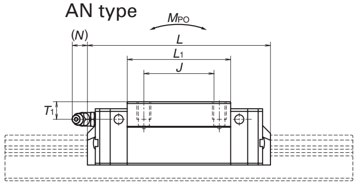
Ball slide **VAH 30 AN C -＊＊ LC Z**

- VAH: Interchangeable ball slide model code
  VAH: VH Model interchangeable ball slide
- 30: Size
- AN: Ball slide shape code (See page A129.)
- C: Material/surface treatment code (See Table 15.)
- -＊＊: Design serial number
  Added to the reference number.
- LC: Accuracy code (see Table 16)
  LC: Normal grade
- Z: Preload code (See page A131.)
  T: Fine clearance. Z: Slight preload

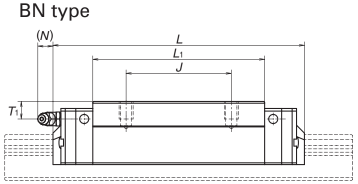
AN and BN types



AN type



BN type

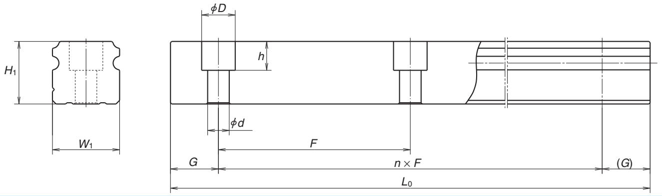


Reference number for rail of interchangeable type

Rail **V1H 30 1000 L C N -＊＊ PC Z**

- V1H: Interchangeable rail model code
  V1H: VH Model interchangeable rail
- 30: Size
- 1000: Rail length (mm)
- L: Rail shape code: L
  L: Standard
- C: Material/surface treatment code (See Table 15.)
- N: *Butting rail specification
  N: Non-butting. L: Butting specification
- -＊＊: Design serial number
  Added to the reference number.
- PC: Accuracy code: PC
  PC: Only normal grade is available.
- Z: Preload code (See page A131.)
  T: Fine clearance. Z: Slight preload

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide														Rail					Basic load ratings								Weight	
	Height			Width	Length	Mounting hole							Grease fitting			Width	Height	Pitch	Mounting bolt hole	Tapped hole	G	Max. length $L_{0max.}$ ( ) for stainless	4)Dynamic		Static	Static moment (N·m)					Ball slide	Rail
	H	E	W_2	W	L	B	J	M × pitch × ℓ	L_1	K	T	K_1	Hole size	T_1	N	W_1	H_1	F	d × D × h	M_2 × pitch × ℓ_2	(reference)		[50km] C_{50}(N)	[100km] C_{100}(N)	C_0 (N)	M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	(kg)	(kg/m)
VH15AN **VH15BN**	28	4.6	9.5	34	70.6〈 77〉 89.6〈 96〉	26	26	M4×0.7×6	39 58	23.4	8	5.3	ϕ3	8.5	1 〈 8.2〉	15	15	60	4.5×7.5×5.3	M5×0.8×8	20	2 000 [1 800]	14 200 18 100	11 300 14 400	20 700 32 000	108 166	94.5 216	575 1 150	79.5 181	480 965	0.18 0.26	1.6
VH20AN **VH20BN**	30	5	12	44	87.4〈 94.2〉 109.4〈116.2〉	32	36 50	M5×0.8×6	50 72	25	12	5.3	M6×0.75	5	11.1〈12.3〉	20	18	60	6×9.5×8.5	M6×1×10	20	3 960 [3 500]	23 700 30 000	18 800 24 000	32 500 50 500	219 340	185 420	1 140 2 230	155 355	955 1 870	0.33 0.48	2.6
VH25AN **VH25BN**	40	7	12.5	48	97 〈104.4〉 125 〈132.4〉	35	35 50	M6×1×9	58 86	33	12	5.8	M6×0.75	10	9.6〈12.9〉	23	22	60	7×11×9	M6×1×12	20	3 960 [3 500]	33 500 45 500	26 800 36 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.55 0.82	3.6
VH30AN **VH30BN**	45	9	16	60	104.4〈114.8〉 143.4〈153.8〉	40	40 60	M8×1.25×10	59 98	36	14	6	M6×0.75	10	11.4〈14.2〉	28	26	80	9×14×12	M8×1.25×15	20	4 000 [3 500]	41 000 61 000	32 500 48 500	51 500 91 500	490 870	350 1 030	2 290 5 600	292 865	1 920 4 700	0.77 1.3	5.2
VH35AN **VH35BN**	55	9.5	18	70	128.8〈139.2〉 162.8〈173.2〉	50	50 72	M8×1.25×12	80 114	45.5	15	6.5	M6×0.75	15	10.9〈13.7〉	34	29	80	9×14×12	M8×1.25×17	20	4 000	62 500 81 000	49 500 64 500	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.5 2.1	7.2
VH45AN **VH45BN**	70	14	20.5	86	161.4〈174.2〉 193.4〈206.2〉	60	60 80	M10×1.5×17	105 137	56	17	7.5	Rc1/8	20	12.5〈14.1〉	45	38	105	14×20×17	M12×1.75×24	22.5	3 990	107 000 131 000	84 500 104 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	3.0 3.9	12.3
VH55AN **VH55BN**	80	15	23.5	100	185.4〈198.2〉 223.4〈236.2〉	75	75 95	M12×1.75×18	126 164	65	18	7.5	Rc1/8	21	12.5〈14.1〉	53	44	120	16×23×20	M14×2×24	30	3 960	158 000 193 000	125 000 153 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	4.7 6.1	16.9

Notes: 1) Figures inside 〈 〉 apply when equipped with a protector.
2) VH models do not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.
3) The external appearance of stainless steel ball slides differs slightly from that of carbon steel ball slides.

4) Basic load ratings comply with ISO standards (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.

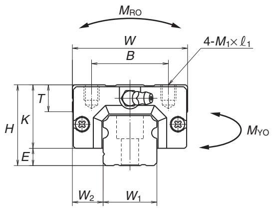
VH-AL (High-load / Standard)
VH-BL (Super-high-load / Long)

VH 30 1000 AL C 2 -** LC Z

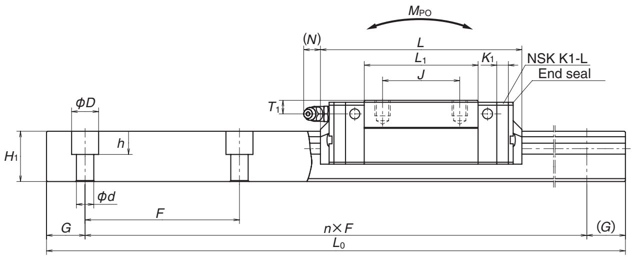
Model name
Size
Rail length (mm)
Ball slide shape code (See page A129.)
Material/surface treatment code (See Table 15.)
C: Special high carbon steel (NSK standard), K: Stainless steel

Preload code (See page A131.)
0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ
Accuracy code (See Table 16.)
Design serial number
Added to the reference number.
Number of ball slides per rail

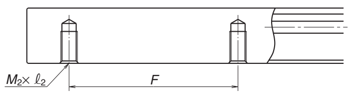
Front view of AL and BL type



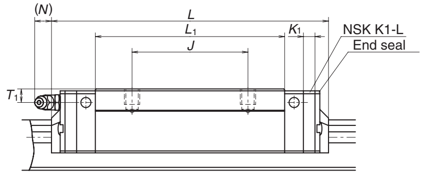
Side view of AL type



Specification for tapped holes on a rail bottom face



Side view of BL type



Model No.	Assembly			Ball slide													
	Height			Width	Length	Mounting hole							Grease fitting			Width	Height
	H	E	W_2	W	L	B	J	M × pitch × ℓ	L_1	K	T	K_1	Hole size	T_1	N	W_1	H_1
VH25AL	36	7	12.5	48	97 ⟨104.4⟩	35	35	M6×1×6	58	29	12	5.8	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	6	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	6.5	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	7.5	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	7.5	Rc1/8	11	12.5⟨14.1⟩	53	44
VH55BL					223.4⟨236.2⟩		95		164								

Notes: 1) Figures inside ⟨ ⟩ apply when equipped with a protector.
2) VH models do not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.
3) The external appearance of stainless steel ball slides differs slightly from that of carbon steel ball slides.

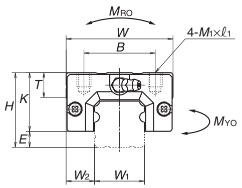
Reference number for ball slide of interchangeable type

Ball slide VAH 30 AL C -**LC Z

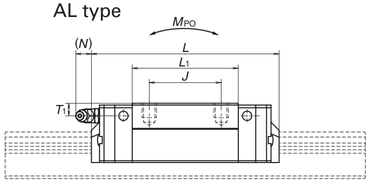
Interchangeable ball slide model code
VAH: VH Model interchangeable ball slide
Size
Ball slide shape code (See page A129.)
Material/surface treatment code (See Table 15.)

Preload code (See page A131.)
T: Fine clearance. Z: Slight preload
Accuracy code (see Table 16)
LC: Normal grade
Design serial number
Added to the reference number.

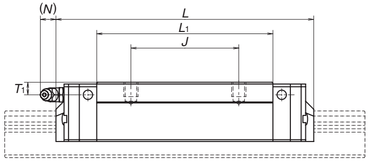
AL and BL types



AL type



BL type



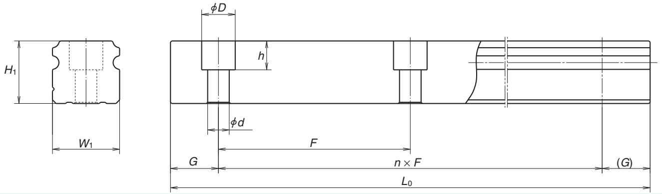
Reference number for rail of interchangeable type

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

Interchangeable rail model code
V1H: VH Model interchangeable rail
Size
Rail length (mm)
Rail shape code: L
L: Standard
Material/surface treatment code (See Table 15.)

Preload code (See page A131.)
T: Fine clearance. Z: Slight preload
Accuracy code: PC
PC: Only normal grade is available.
Design serial number
Added to the reference number.
*Butting rail specification
N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Rail					Basic load ratings								Weight	
	Pitch	Mounting bolt hole	Tapped hole	G	Max. length L_{0max}. ( ) for stainless	[4)] Dynamic		Static	Static moment (N·m)					Ball slide	Rail
						[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}			
	F	d × D × h	M_2 × pitch × ℓ_2	(reference)		C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
VH25AL	60	7×11×9	M6×1×12	20	3 960	33 500	26 800	46 000	360	320	1 840	267	1 540	0.46	3.6
VH25BL					[3 500]	45 500	36 500	71 000	555	725	3 700	610	3 100	0.69	
VH30AL	80	9×14×12	M8×1.25×15	20	4 000	41 000	32 500	51 500	490	350	2 290	292	1 920	0.69	5.2
VH30BL					[3 500]	61 000	48 500	91 500	870	1 030	5 600	865	4 700	1.16	
VH35AL	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
VH35BL						81 000	64 500	117 000	1 380	1 530	8 350	1 280	7 000	1.7	
VH45AL	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
VH45BL						131 000	104 000	187 000	2 860	3 000	15 600	2 520	13 100	2.9	
VH55AL	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
VH55BL						193 000	153 000	264 000	4 850	5 150	26 300	4 350	22 100	4.7	

4) Basic load ratings comply with ISO standards (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.

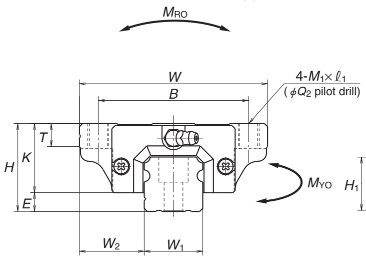
VH-EM (High-load / Standard)
VH-GM (Super-high-load / Long)

VH 30 1000 EM C 2 -∗∗ LC Z

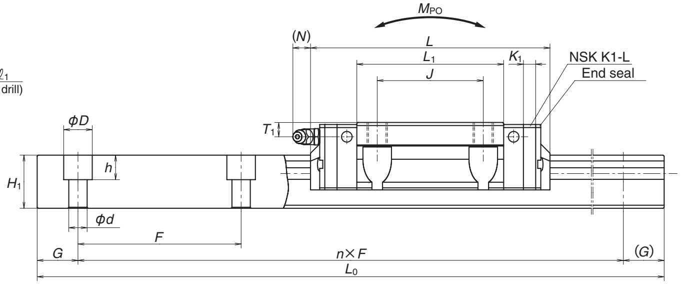
Model name
Size
Rail length (mm)
Ball slide shape code (See page A129.)
Material/surface treatment code (See Table 15.)
C: Special high carbon steel (NSK standard), K: Stainless steel

Preload code (See page A131.)
0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ
Accuracy code (See Table 16.)
Design serial number
Added to the reference number.
Number of ball slides per rail

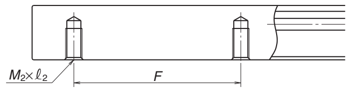
Front view of EM and GM type



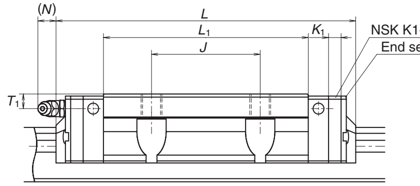
Side view of EM type



Specification for tapped holes on a rail bottom face



Side view of GM type



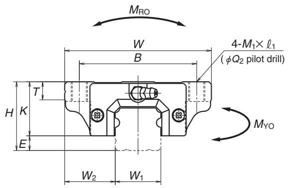
Reference number for ball slide of interchangeable type

Ball slide **VAH 30 EM C -∗∗ LC Z**

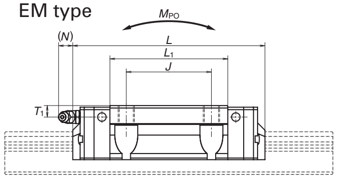
Interchangeable ball slide model code
VAH: VH Model interchangeable ball slide
Size
Ball slide shape code (See page A129.)
Material/surface treatment code (See Table 15.)

Preload code (See page A131.)
T: Fine clearance. Z: Slight preload
Accuracy code (see Table 16)
LC: Normal grade
Design serial number
Added to the reference number.

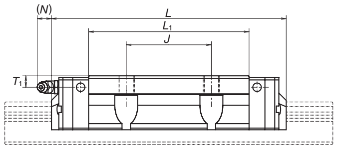
EM and GM types



EM type



GM type



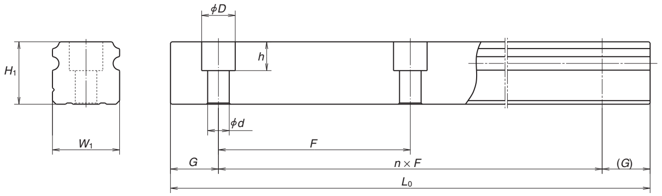
Reference number for rail of interchangeable type

Rail **V1H 30 1000 L C N -∗∗ PC Z**

Interchangeable rail model code
V1H: VH Model interchangeable rail
Size
Rail length (mm)
Rail shape code: L
L: Standard
Material/surface treatment code (See Table 15.)

Preload code (See page A131.)
T: Fine clearance. Z: Slight preload
Accuracy code: PC
PC: Only normal grade is available.
Design serial number
Added to the reference number.
∗Butting rail specification
N: Non-butting. L: Butting specification

∗Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide														
	Height			Width	Length	Mounting hole								Grease fitting			Width	Height
	H	E	W_2	W	L	B	J	M_1 × pitch × ℓ_1	Q_2	L_1	K	T	K_1	Hole size	T_1	N	W_1	H_1
VH15EM **VH15GM**	24	4.6	16	47	70.6〈 77〉 89.6〈 96〉	38	30	M5×0.8×7	4.4	39 58	19.4	8	5.3	ϕ3	4.5	1 〈 8.2〉	15	15
VH20EM **VH20GM**	30	5	21.5	63	87.4〈 94.2〉 109.4〈116.2〉	53	40	M6×1×9.5	5.3	50 72	25	10	5.3	M6×0.75	5	11.1〈12.3〉	20	18
VH25EM **VH25GM**	36	7	23.5	70	97 〈104.4〉 125 〈132.4〉	57	45	M8×1.25×10 [M8×1.25×11.5]	6.8	58 86	29	11 [12]	5.8	M6×0.75	6	9.6〈12.9〉	23	22
VH30EM **VH30GM**	42	9	31	90	117.4〈127.8〉 143.4〈153.8〉	72	52	M10×1.5×12 [M10×1.5×14.5]	8.6	72 98	33	11 [15]	6	M6×0.75	7	11.4〈14.2〉	28	26
VH35EM **VH35GM**	48	9.5	33	100	128.8〈139.2〉 162.8〈173.2〉	82	62	M10×1.5×13	8.6	80 114	38.5	12	6.5	M6×0.75	8	10.9〈13.7〉	34	29
VH45EM **VH45GM**	60	14	37.5	120	161.4〈174.2〉 193.4〈206.2〉	100	80	M12×1.75×15	10.5	105 137	46	13	7.5	Rc1/8	10	12.5〈14.1〉	45	38
VH55EM **VH55GM**	70	15	43.5	140	185.4〈198.2〉 223.4〈236.2〉	116	95	M14×2×18	12.5	126 164	55	15	7.5	Rc1/8	11	12.5〈14.1〉	53	44

Model No.	Rail					Basic load ratings								Weight	
	Pitch	Mounting bolt hole	Tapped hole	G	Max. length $L_{0max.}$ ( ) for stainless	5)Dynamic		Static	Static moment (N·m)					Ball slide	Rail
						[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}			
	F	d × D × h	M_2 × pitch × ℓ_2	(reference)		C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
VH15EM **VH15GM**	60	4.5×7.5×5.3	M5×0.8×8	20	2 000 [1 800]	14 200 18 100	11 300 14 400	20 700 32 000	108 166	94.5 216	575 1 150	79.5 181	480 965	0.17 0.25	1.6
VH20EM **VH20GM**	60	6×9.5×8.5	M6×1×10	20	3 960 [3 500]	23 700 30 000	18 800 24 000	32 500 50 500	219 340	185 420	1 140 2 230	155 355	955 1 870	0.45 0.65	2.6
VH25EM **VH25GM**	60	7×11×9	M6×1×12	20	3 960 [3 500]	33 500 45 500	26 800 36 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.63 0.93	3.6
VH30EM **VH30GM**	80	9×14×12	M8×1.25×15	20	4 000 [3 500]	47 000 61 000	37 500 48 500	63 000 91 500	600 870	505 1 030	3 150 5 600	425 865	2 650 4 700	1.2 1.6	5.2
VH35EM **VH35GM**	80	9×14×12	M8×1.25×17	20	4 000	62 500 81 000	49 500 64 500	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.7 2.4	7.2
VH45EM **VH45GM**	105	14×20×17	M12×1.75×24	22.5	3 990	107 000 131 000	84 500 104 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	3.0 3.9	12.3
VH55EM **VH55GM**	120	16×23×20	M14×2×24	30	3 960	158 000 193 000	125 000 153 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	5.0 6.5	16.9

Notes: 1) Figures inside 〈 〉 apply when equipped with a protector.
2) Figures inside [ ] apply to stainless steel products.
3) VH models do not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.
4) The external appearance of stainless steel ball slides differs slightly from that of carbon steel ball slides.

5) Basic load ratings comply with ISO standards (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.

NSK Data Sheet for Linear Guides in Contaminated Environments

[Example]

(Please copy) 1／1

Model: Graphite milling machine
Location: Table axis

1. Operating Conditions

Operating Conditions	[✓ a) Ball or roller slide motion] b) Rail motion	Mounting Orientation	a) Vertical [✓ b) Horizontal] c) Wall d) Upside-down e) Inclined f) Other
Stroke in Normal Use	200 [mm] (Please indicate operating pattern)		
Lubricant	[✓ a) Grease] (Brand: NSK AS2 grease) b) Oil (Brand:)	Lubricating Method	a) Automatic [✓ b) Manual] (cm^3/ min)
Operating Duration	2 years months		

2. Linear Guide Environment (Accessories & Contamination)

Contaminant	Graphite powder	Contaminant Size	Particle diameter 20 - 60 μm
Contamination State	Falls evenly on the rail surface. (Please reference with photographs)		
Countermeasures (Complete after inspection for existing machines)	a) Telescopic cover [✓ b) Bellows] [✓ c) Dust collector] ~~d) Dust-resistant lubricant~~ e) Other ( ) (Please supply drawings to demonstrate dust countermeasures)		

3. Linear Guide Dimensions

Model	VH25AN	Rail Length	540 mm	No. of Slides/Rail	2	Accuracy Grade	P6
Preload	Z1	Max. Speed	20 mm/sec	Dust-Resistant Accessories	a) Double seal [✓ b) Mounting hole caps] c) Protector d) Bellows		

Remarks

4. Durability Test

Durability test → [✓ Scheduled]
→ Not scheduled (Reason:)

Linear Guide Use in Contaminated Environments

※Please read the below and tick the relevant boxes

☑ The results for evaluation tests carried out by NSK for dust-resistant seals represent an example under set testing conditions (foreign matter and operating conditions). Seals may be unable to completely prevent contamination under actual conditions and life may be affected by the environment, lubrication conditions, etc.

☑ **Dust-resistant accessories (covers, lubrication, collectors, etc.)** are required in addition to the seals to improve wear life in contaminated environments.

☑ Linear guide wear life is greatly impacted by foreign matter entering the slide, offset load from misalignment, and lubricating conditions. The customer is responsible for evaluating and checking final durability in the actual machine.

Company Name:	Date:		NSK Ltd. Sales Representative	NSK Ltd. Sales Manager
Department:	Name:			
Address:	Tel:	Fax:	Sign	Sign

NSK Ltd.

NSK Data Sheet for Linear Guides in Contaminated Environments

(Please copy) 1／1

Model:
Location:

1. Operating Conditions

Operating Conditions	a) Ball or roller slide motion b) Rail motion	Mounting Orientation	a) Vertical b) Horizontal c) Wall d) Upside-down e) Inclined f) Other
Stroke in Normal Use	[mm] (Please indicate operating pattern)		
Lubricant	a) Grease (Brand:) b) Oil (Brand:)	Lubricating Method	a) Automatic b) Manual (cm^3/ min)
Operating Duration	years months		

2. Linear Guide Environment (Accessories & Contamination)

Contaminant		Contaminant Size	Particle diameter -
Contamination State	(Please reference with photographs)		
Countermeasures (Complete after inspection for existing machines)	a) Telescopic cover b) Bellows c) Dust collector d) Dust-resistant lubricant e) Other ( ) (Please supply drawings to demonstrate dust countermeasures)		

3. Linear Guide Dimensions

Model		Rail Length	mm	No. of Slides/Rail		Accuracy Grade	
Preload		Max. Speed	mm/sec	Dust-Resistant Accessories	a) Double seal b) Mounting hole caps c) Protector d) Bellows		

Remarks

4. Durability Test

Durability test → Scheduled
→ Not scheduled (Reason:)

Linear Guide Use in Contaminated Environments

※Please read the below and tick the relevant boxes

☐ The results for evaluation tests carried out by NSK for dust-resistant seals represent an example under set testing conditions (foreign matter and operating conditions). Seals may be unable to completely prevent contamination under actual conditions and life may be affected by the environment, lubrication conditions, etc.

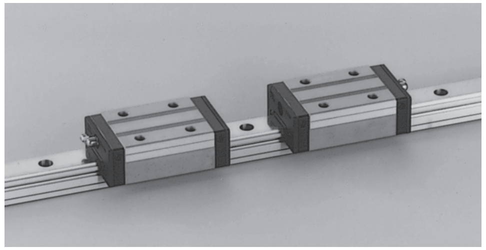
☐ **Dust-resistant accessories (covers, lubrication, collectors, etc.)** are required in addition to the seals to improve wear life in contaminated environments.

☐ Linear guide wear life is greatly impacted by foreign matter entering the slide, offset load from misalignment, and lubricating conditions. The customer is responsible for evaluating and checking final durability in the actual machine.

Company Name:	Date:		NSK Ltd. Sales Representative	NSK Ltd. Sales Manager
Department:	Name:			
Address:	Tel:	Fax:	Sign	Sign

NSK Ltd.

A-4-1.3 NS Model



1. Features

(1) Improves rating life dramatically

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

Load rating capacity is 1.3 times higher than LS Model and life is doubled[*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 model.

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

By reexamining the design for the ball circulation path, we have attained smooth ball circulation and reduced noise level. This makes NS models more suited for high-speed applications compared with LS models.

(3) All mounting dimensions are the same as the LS and SS Models

The dimensions surrounding the mounting (assembled dimensions) such as mounting height, width, mounting hole diameter/pitch, etc. of the NS model are identical to the LS and SS models, allowing for easy replacement without design changes.

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

Similar to a DF arrangement of angular contact bearings, NS models offer large self-aligning capability with the internal intersection of the contact lines of the balls and grooves reducing moment rigidity.

This increases the capacity to absorb errors in installation.

(5) High vertical load carrying capacity

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

(6) High resistance against impact load

The bottom ball groove forms a Gothic arch and the center of the top and bottom grooves are offset as shown in **Fig. 2**.

Vertical load is generally carried by the top rows at two contact points, but with this design, the bottom rows also carry load when a large impact load is applied vertically as shown in **Fig. 3**. This assures high resistance to impact load.

(7) High accuracy

As shown in **Fig. 4**, fixing the measuring rollers to the ball grooves is simple thanks to the Gothic arch groove. This makes for 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 variations and sizes

The NS model comes in several sizes and ball slide shapes, allowing for use in a variety of applications. The NS model also features long stainless steel rails as standard (maximum 3 500 mm)

(10) Fast delivery

A lineup of interchangeable rails and ball slides supports and facilitates fast delivery.

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

(11) Option for smooth motion specification

The option provides smooth motion ideal for equipment that requires high performance by reducing conflict between balls in the slide. (NS15, NS20, NS25, and NS30)

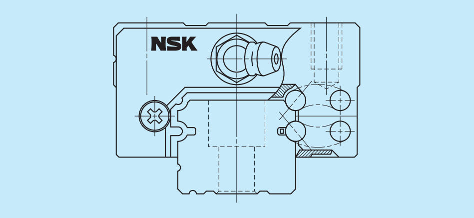


Fig. 1 NS Model

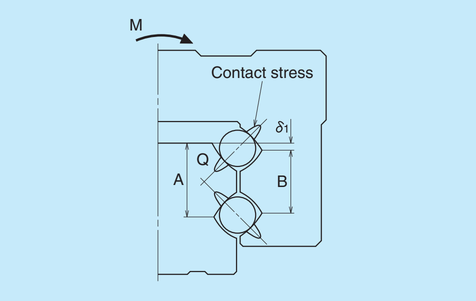


Fig. 2 Enlarged illustration of the offset Gothic arch groove

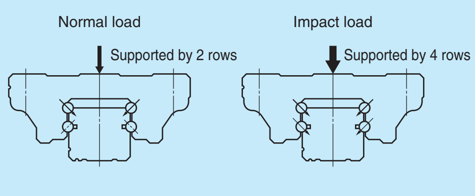


Fig. 3 When load is applied

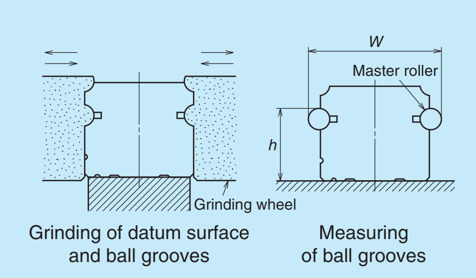
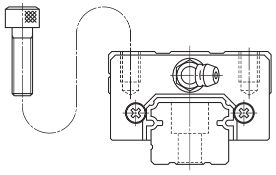
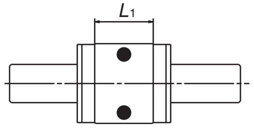
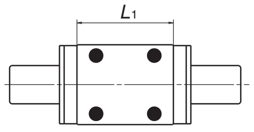
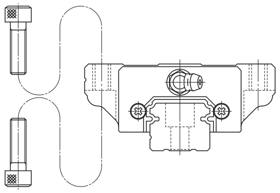
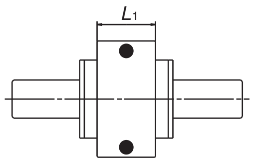
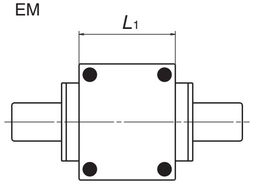


Fig. 4 Rail-grinding and measuring

2. Ball slide shape

Ball slide shape code	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		Medium-load	High-load
		Standard	Long
AL CL		CL 	AL 
EM JM		JM 	EM 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm)		Preloaded assembly (not interchangeable)					Interchangeable type	
over	or less	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	High precision PH	Normal grade PC
–	50	2	2	2	4	5	2	5
50 –	80	2	2	3	4	5	3	5
80 –	125	2	2	3	4	5	3	5
125 –	200	2	2	3.5	5	6	3.5	6
200 –	250	2	2.5	4.5	6	7.5	4.5	7.5
250 –	315	2	2.5	5	6.5	8.5	5	8.5
315 –	400	2	3	5.5	7	9.5	5.5	9.5
400 –	500	2	3	6	7.5	11	6	11
500 –	630	2	3.5	6.5	8.5	12	6.5	12
630 –	800	2	4	7	9.5	13	7	13
800 –	1 000	2.5	4.5	7.5	10	15	7.5	15
1 000 –	1 250	3	5	8.5	12	16	8.5	16
1 250 –	1 600	3.5	5.5	9.5	13	17	9.5	17
1 600 –	2 000	4	6.5	11	14	19	11	19
2 000 –	2 500	4.5	7.5	12	16	21	12	21
2 500 –	3 150	5.5	8.5	13	18	23	13	23
3 150 –	4 000	6	9.5	14	19	25	14	25

Accuracy grade

(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 interchangeable 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)	±8 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)	±10 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 interchangeable 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	15① 30②	15① 30②
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**	

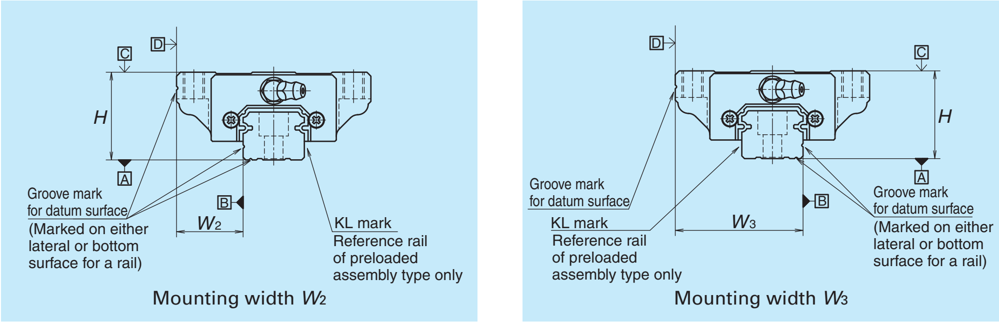
Notes: ① Variation on the same rail
② Variation on multiple rails

(3) Combinations of accuracy and preload

Table 4

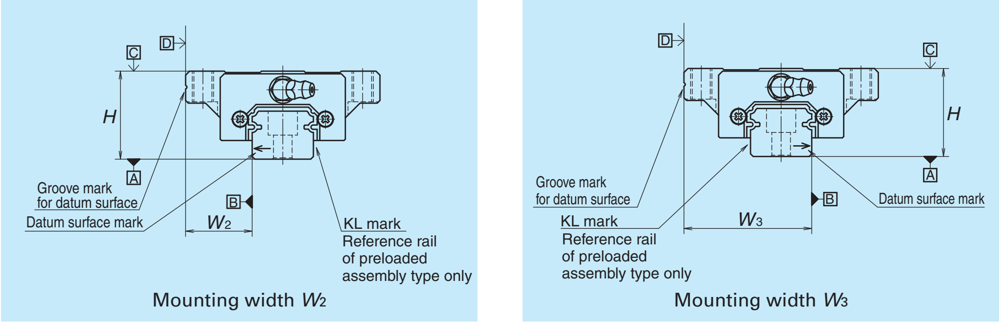
		Accuracy grade						
		Ultra precision	Super precision	High precision	Precision grade	Normal grade	High precision	Normal grade
Without NSK K1-L lubrication unit		P3	P4	P5	P6	PN	PH	PC
With NSK K1-L lubrication unit		L3	L4	L5	L6	LN	LH	LC
With NSK K1 for food and medical equipment		F3	F4	F5	F6	FN	FH	FC
Preload	Fine clearance Z0	○	○	○	○	○	—	—
	Slight preload Z1	○	○	○	○	○	—	—
	Medium preload Z3	○	○	○	○	—	—	—
	Interchangeable type with fine clearance ZT	—	—	—	—	—	—	○
	Interchangeable type with slight preload ZZ	—	—	—	—	—	○	○
	Interchangeable type with medium preload ZH	—	—	—	—	—	○	○

(4) Assembled accuracy



Mounting width W_2 Mounting width W_3

Fig. 5 Special high carbon steel



Mounting width W_2 Mounting width W_3

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 interchangeable 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	Medium preload	Slight preload	Medium preload	Slight preload	Medium preload
		Z1	Z3	Z1	Z3	Z1	Z3
High-load	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	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

Notes:1) Clearance for Fine clearance Z0 is 0 to 3μm. Therefore, preload is zero.
However, Z0 of PN grade is 0 to 15μm.
2) In case of being applied option for smooth motion operation, preloads are shown in Table 11.

- **Clearance and preload of interchangeable type**

Table 6

Unit: μm

Model No.	Fine clearance	Slight preload	Medium preload
	ZT	ZZ	ZH
NS15	–4 to 15	–4 to 0	–7 to –3
NS20	–4 to 15	–4 to 0	–7 to –3
NS25	–5 to 15	–5 to 0	–9 to –4
NS30	–5 to 15	–5 to 0	–9 to –4
NS35	–5 to 15	–6 to 0	–10 to –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

Model	Size / Material	15	20	25	30	35
NS	Special high carbon steel	2 920	3 960	3 960	4 000	4 000
	Stainless steel	1 800	3 500	3 500	3 500	3 500

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

5. Installation

(1) Permissible values of mounting error

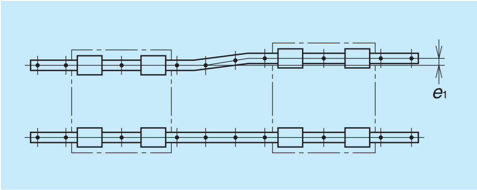


Fig. 7

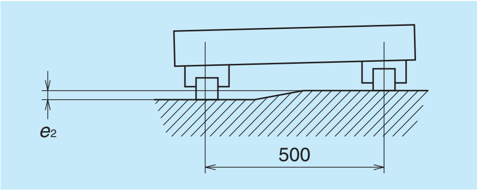


Fig. 8

Table 8

Unit: μm

Value	Preload	Model No.				
		NS15	NS20	NS25	NS30	NS35
Permissible values for parallelism error of 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 for height error of 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

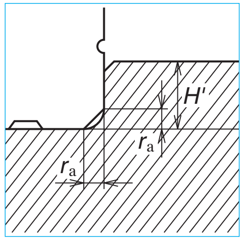


Fig. 9 Shoulder for the rail datum surface

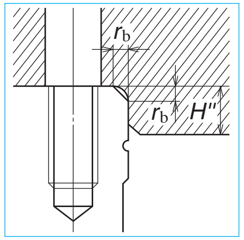


Fig. 10 Shoulder for the ball slide datum surface

Table 9

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	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

Table 10 indicates the maximum allowable speed for 10,000 km operation when using an NS model under normal conditions. 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

Size / Model	15	20	25	30	35
NS	300				

7. Option for smooth motion specification

- This optional specification greatly suppresses fluctuations in friction, supporting equipment that requires particularly smooth operation such as measuring instruments. It also delivers in applications where operating characteristics often deteriorate, such as hung on wall or vertical installations (Refer to Fig. 11).

(1) Mechanism for smooth motion

- As shown in Fig.12, linear guides contain numerous steel balls inside the circulation path. Curved sections existing in tha path cause the balls to become crowded as they travel, impacting operating characteristics. Elastic members added between the balls help to relieve this conflict and realize smoother motion.

(2) Supported models

- 4 models supported: NS15, NS20, NS25, and NS30. Can be combined with various options, including newly developed NSK K1-L lubrication units, stainless steel specifications, surface treatments, interchangeable types, etc.
- Mounting dimensions such as assembly height, assembly width, and screw diameter/pitch of mounting hole are identical to standard specfications.

(3) Handling precautions

- In case of being applied option for smooth motion specification, preloads and rigities are shown in Table 11, and the basic load ratings are shown in Table 12.
- When the smooth motion specification is applied, the maximum allowable speed is 100 m/min regardless of size.
- When removing the slide from the rail, make certain to use a provisional rail (a jig used to insert a slide to the rail).

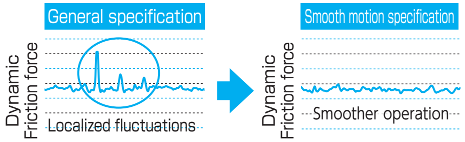


Fig. 11 Image of dynamic friction force of slide

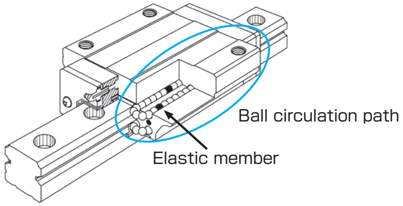


Fig. 12 Mechanism (structure)

Table 11

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)
NS15 AL、EM	69	390	114	202	79	149
NS20 AL、EM	88	540	133	257	98	187
NS25 AL、EM	147	880	186	335	134	250
NS30 AL、EM	245	1 370	228	412	167	311
NS15 CL、JM	49	294	70	132	54	98
NS20 CL、JM	69	390	100	170	71	126
NS25 CL、JM	98	635	116	215	81	162
NS30 CL、JM	147	980	133	249	98	187

Table 12

Model No.	Basic load rating							
	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
NS15 AL、EM	10 600	8 850	15 600	78	66.5	445	55.5	370
NS20 AL、EM	14 900	12 400	21 800	149	115	710	96.5	595
NS25 AL、EM	24 800	20 700	33 500	266	224	1 380	188	1 160
NS30 AL、EM	36 000	30 000	50 500	480	375	2 480	315	2 080
NS15 CL、JM	6 550	5 750	7 800	39	18.6	175	15.6	147
NS20 CL、JM	9 700	8 400	11 800	80	36.5	300	30.5	252
NS25 CL、JM	16 200	14 000	18 200	143	71	590	59.5	495
NS30 CL、JM	22 300	19 600	25 400	241	105	960	88	805

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8. Lubrication components

Refer to pages A58 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 13 and **Table 13** show grease fittings and tube fittings.

We provide lubrication accessories with an extended thread body length (*L*) for the addition of dust-resistant accessories such as NSK K1-L lubrication units, double seals and protectors. We provide suitable lubrication accesories for special dust-resistant requirements upon request.

NSK can also provide extended length threads for ease of replenishment.

Please contact NSK if stainless lubrication accessories are required.

(2) Mounting position of lubrication accessories

The standard position for grease fittings is at the end face of the ball slide, but we can mount them on the side of the end cap as an option. (**Fig. 14**)

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

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

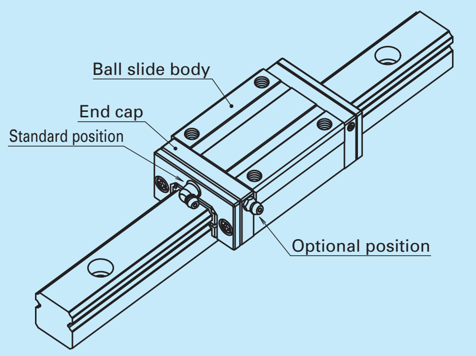


Fig. 14 Mounting position of lubrication accessories

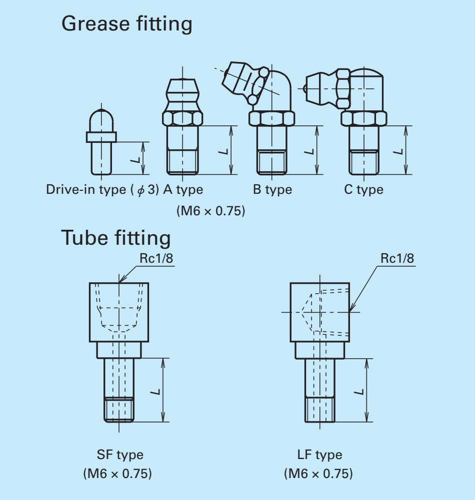


Fig. 13 Grease fitting and tube fitting

Table 13 Unit: mm

Model No.	Dust-resistant specification	Dimension *L*		
		Grease fitting /Drive-in type	Tube fitting	
			SF type	LF type
NS15	Standard	5	–	–
	With NSK K1-L	10	–	–
	Double seal	*	–	–
	Protector	*	–	–
NS20	Standard	5	–	–
	With NSK K1-L	10	–	–
	Double seal	8	–	–
	Protector	8	–	–
NS25	Standard	5	6	6
	With NSK K1-L	12	11	11
	Double seal	10	9	9
	Protector	10	9	9
NS30	Standard	5	6	6
	With NSK K1-L	14	12	13
	Double seal	12	10	11
	Protector	12	10	11
NS35	Standard	5	6	6
	With NSK K1-L	14	12	13
	Double seal	12	10	11
	Protector	12	10	11

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

9. Dust-resistant components

(1) Standard specification

Under normal applications, the NS model can be used without modification thanks to its dust resistance. As standard equipment, the ball slides have an end seal on both ends, and bottom seals at the bottom.

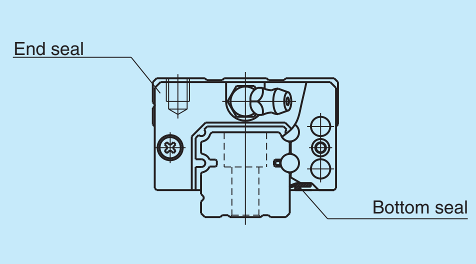


Fig. 15

Table 14 Seal friction per ball slide (maximum value)

Unit: N

Model \ Size	15	20	25	30	35
NS	8	9	9	9	10

(2) NSK K1-L™ and NSK K1™ lubrication units for food processing machinery/ medical equipment

Table 15 shows linear guide dimensions when equipped with NSK K1-L lubrication units.

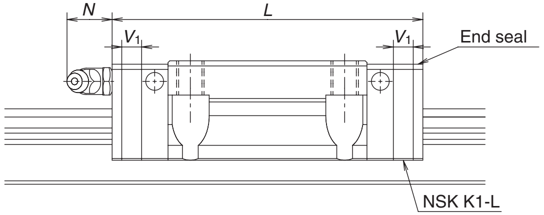


Table 15 Dimensions when equipped with NSK K1-L lubrication units

Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1-L units L	Thickness of single NSK K1-L unit V_1	Protrusion of grease fitting N
NS15	Standard	AL, EM	56.8	66.4	4.8	(5)
	Short	CL, JM	40.4	50		
NS20	Standard	AL, EM	65.2	75.8	5.3	(14)
	Short	CL, JM	47.2	57.8		
NS25	Standard	AL, EM	81.6	92.2	5.3	(14)
	Short	CL, JM	59.6	70.2		
NS30	Standard	AL, EM	96.4	108.4	6	(14)
	Short	CL, JM	67.4	79.4		
NS35	Standard	AL, EM	108	121	6.5	(14)
	Short	CL, JM	77	90		

Notes: 1) When using NSK K1 for food processing machinery/medical equipment, refer toTable 16.
2) Slide length when equipped with NSK K1-L = (standard ball slide length) + (V_1 thickness of single NSK K1-L unit) × (number of K1-L units).

Table 16 shows linear guide dimensions when equipped with NSK K1 for food processing machinery/ medical equipment.

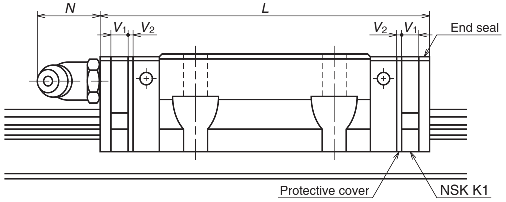


Table 16 Dimensions when equipped with NSK K1 for food processing machinery/medical equipment

Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1 V_1	Protective cover thickness V_2	Protrusion of 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: Slide length when equipped with NSK K1 for food processing machinery/medical equipment = (standard ball slide length) + (V_1 thickness of single NSK K1 unit) × (number of K1 units) + (V_2 thickness of the protective cover) × 2.

(3) Double seal

Use a double seal set as shown in **Table 17** when installing an extra seal to completed standard products. (**Fig. 16**)

When installing a grease fitting after the installation of double seals, a connector as shown in **Fig.16** is required.

(4) Protector

Use a protector set as shown in **Table 18** when installing a protector to completed standard products. (**Fig.17**)

When installing a grease fitting after the installation of protectors, a connector as shown in **Fig.17** is required.

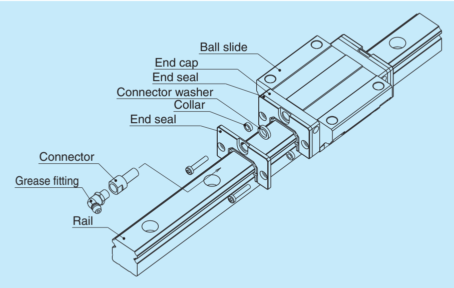


Fig. 16 Double seal

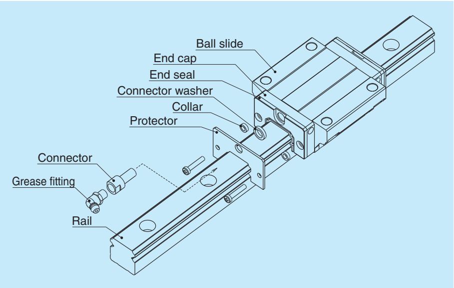


Fig. 17 Protector

Table 17 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 18 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 grease fitting, contact NSK.

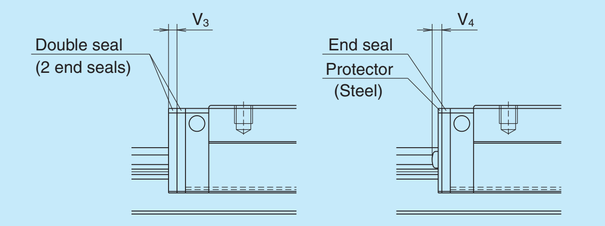


Fig. 18

(5) Caps to plug the rail mounting bolt hole

Table 19 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) Bellows

- A bellows fastener kit, which includes one bellows faster, two M_1 set screws, two M_2 set screws, and two collars for M_2 set screws as shown in Fig. 7.7 on page A69, is supplied with bellows for the ends.
- Middle bellows are supplied with four set screws and four collars.
- Use a bellows fastener kit as shown in **Table 20**, when installing bellows to completed standard products.
- When NSK K1/K1-L units, double seals, or protectors are used, the set screws of bellows fastener kits cannot be used.
  Please contact NSK for details.
- Bellows fasteners are available only for horizontal mounting positions; other mounting positions require a sliding plate (see **Fig. 7.10** on page A70).
  To fix the bellows to the rail, make tap holes on the rail end surface. Fix the bellows mounting plate to the rail end surface through these tap holes with a machine screw. NSK prepares tap holes on the rail end surface when bellows are ordered with a linear guide.

Table 20 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 for bellows
NS Model

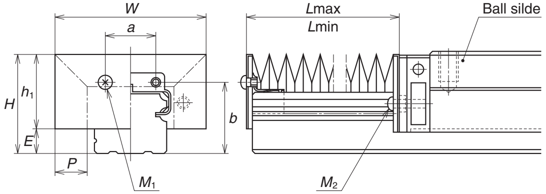


Fig. 19 Dimensions of bellows

Bellows reference number

J A S 15 L 08

Bellows (J)
A: Bellows for the ends
B: Middle bellows
Bellows for NS model (S)
Size number of linear guide (15)
L: Low type
Number of BL (fold number) (08)

Table 21 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
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 22 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

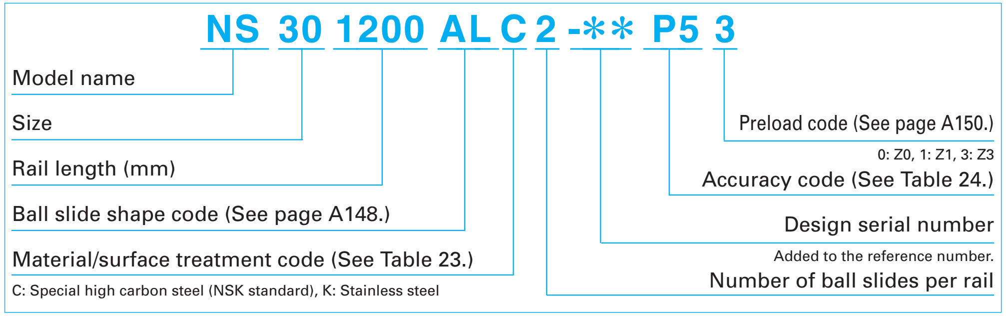
Note: The values of an odd number BL quantity (3, 5, 7, ...) can be obtained by adding two values of even number BL on both sides, then by dividing the sum by 2.

10. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.

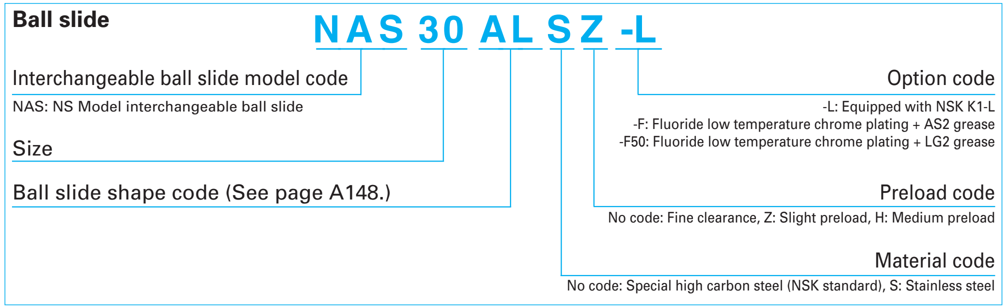
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for preloaded assembly

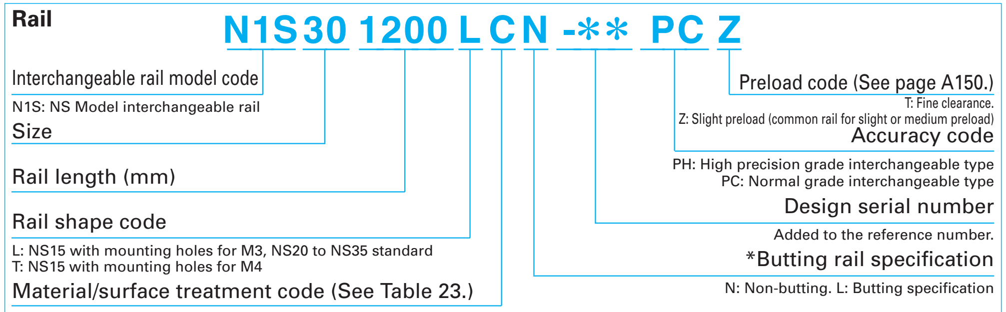


(2) Reference number for interchangeable type

Ball slide



Rail



*Please consult with NSK for butting rail specification.

When interchangeable rails and slides are assembled, reference number coding is the same as that for preloaded assemblies. However, only preload codes T (fine clearance), Z (slight preload), and H (medium preload) may be used (Refer to Page A150.)

Click!Speedy™ NSK Linear Guide Quick Delivery System uses a new numbering system. For details, please refer to the Click!Speedy general catalog CAT. No. E3191.

Table 23 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 interchangeable types are not available in stainless steel.

Table 24 Accuracy code

Accuracy	Standard (Without NSK K1-L)	With NSK K1-L	With NSK K1 for food and medical equipment	Standard (Without NSK K1-L)	With NSK K1-L
				With smooth motion specification	
Ultra precision grade	P3	L3	F3	S3	T3
Super precision grade	P4	L4	F4	S4	T4
High precision grade	P5	L5	F5	S5	T5
Precision grade	P6	L6	F6	S6	T6
Normal grade	PN	LN	FN	SN	TN
High precision grade (interchangeable type)	PH	LH	FH	SH	TH
Normal grade (interchangeable type)	PC	LC	FC	SC	TC

Notes:1) Refer to page A58 for details on NSK K1-L lubrication units and to page A73 for details on NSK K1 lubricaiton units for food processing machinery/medical equipment.

2) Refer to page A153 for option for smooth motion operation.

11. Dimensions
NS-CL (Medium-load / Short)
NS-AL (High-load / Standard)

NS 30 1200 AL C 2 - PC Z**

Model name

Size

Rail length (mm)

Ball slide shape code (See page A148.)

Material/surface treatment code (See Table 23.)
C: Special high carbon steel (NSK standard), K: Stainless steel

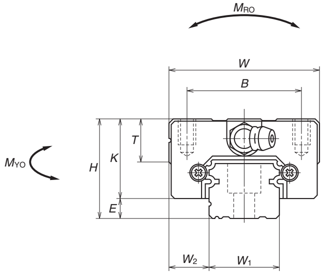
Preload code (See page A150.)
0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ, H: ZH

Accuracy code (See Table 24.)

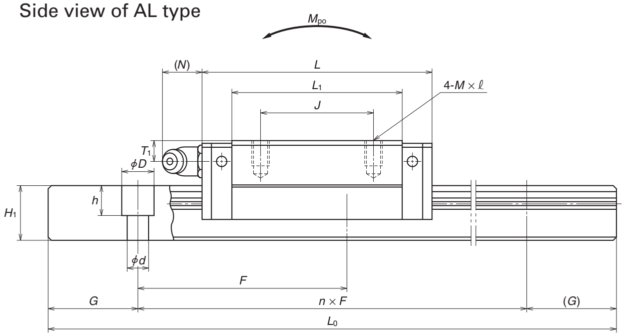
Design serial number
Added to the reference number.

Number of ball slides per rail

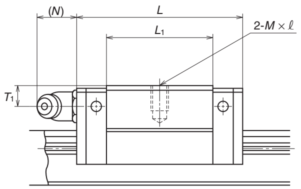
Front view of AL and CL type



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 **NS15AL**	24	4.6	9.5	34	40.4 56.8	26	— 26	M4×0.7×6	23.6 40	19.4	10	ϕ3	6	3	15	12.5
NS20CL **NS20AL**	28	6	11	42	47.2 65.2	32	— 32	M5×0.8×7	30 48	22	12	M6×0.75	5.5	11	20	15.5
NS25CL **NS25AL**	33	7	12.5	48	59.6 81.6	35	— 35	M6×1×9	38 60	26	12	M6×0.75	7	11	23	18
NS30CL **NS30AL**	42	9	16	60	67.4 96.4	40	— 40	M8×1.25×12	42 71	33	13	M6×0.75	8	11	28	23
NS35CL **NS35AL**	48	10.5	18	70	77 108	50	— 50	M8×1.25×12	49 80	37.5	14	M6×0.75	8.5	11	34	27.5

Notes: 1) The external appearance of stainless steel ball slides differs slightly from that of carbon steel ball slides.

Reference number for ball slide of interchangeable type

Ball slide **NAS 30 AL S Z -L**

Interchangeable ball slide model code
NAS: NS Model interchangeable ball slide

Size

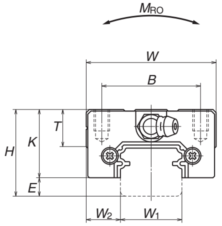
Ball slide shape code (See page A148.)

Option code
-L: Equipped with NSK K1-L
-F: Fluoride low temperature chrome plating + AS2 grease
-F50: Fluoride low temperature chrome plating + LG2 grease

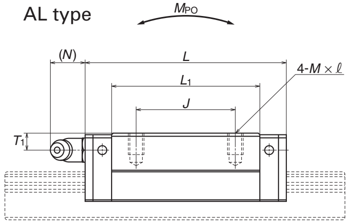
Preload code
No code: Fine clearance, Z: Slight preload, H: Medium preload

Material code
No code: Special high carbon steel (NSK standard), S: Stainless steel

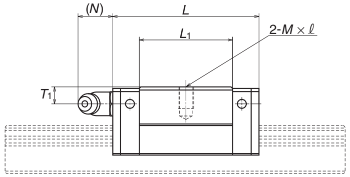
AL and CL types



AL type



CL type



Reference number for rail of interchangeable type

Rail **N1S 30 1200 L C N -** PC Z**

Interchangeable rail model code
N1S: NS Model interchangeable rail

Size

Rail length (mm)

Rail shape code
L: NS15 with mounting holes for M3, NS20 to NS35 standard
T: NS15 with mounting holes for M4

Material/surface treatment code (See Table 23.)

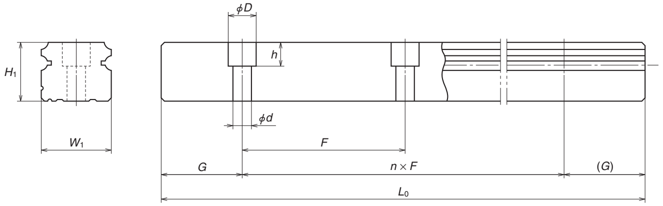
Preload code (See page A150.)
T: Fine clearance.
Z: Slight preload(common rail for medium preload)

Accuracy code
PH: High-precision grade
PC: Normal grade

Design serial number
Added to the reference number.

*Butting rail specification
N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Rail Pitch F	Mounting bolt hole d×D×h	G (reference)	Max. length L_{0max}. ( ) for stainless	Basic load ratings [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)
NS15CL **NS15AL**	60	*4.5×7.5×5.3 3.5×6×4.5	20	2 920 (1 800)	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
NS20CL **NS20AL**	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
NS25CL **NS25AL**	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
NS30CL **NS30AL**	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
NS35CL **NS35AL**	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) Basic load ratings comply with ISO standards (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.In case of being applied option for smooth motion operation, basic load ratings are shown in Table 12.

3) High-precision grade and medium preload interchangeable types are available for special high carbon steel products.

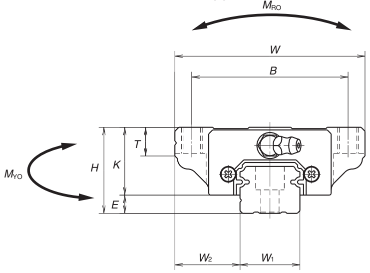
* Standard mounting hole of NS15 rail is for M4 bolts (Hole size: 4.5 × 7.5 × 5.3).
If you require mounting hole for M3 bolts (Hole size: 3.5 × 6 × 4.5), please specify when ordering.

NS-JM (Medium-load / Short)
NS-EM (High-load / Standard)

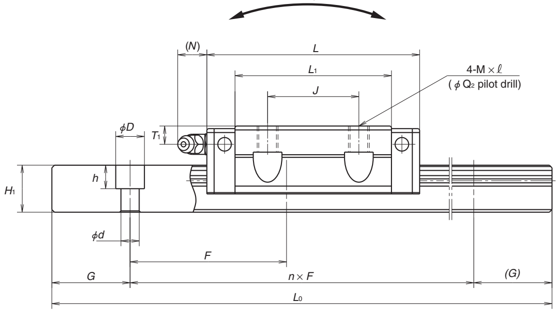
NS 30 1200 EM C 2 -＊＊ PC Z

Model name
Size
Rail length (mm)
Ball slide shape code (See page A148.)
Material/surface treatment code (See Table 23.)
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 24.)
Preload code (See page A150.)
0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ, H: ZH

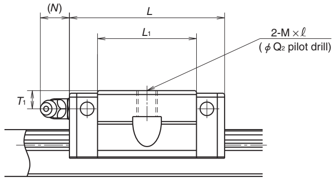
Front view of EM and JM type



Side view of EM type



Side view of JM type

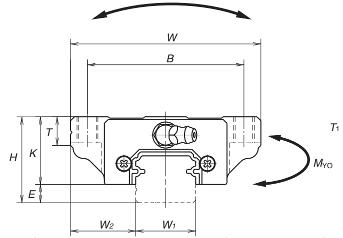


Reference number for ball slide of interchangeable type

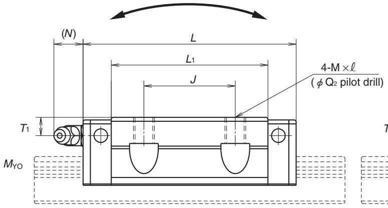
Ball slide **NAS 30 EM S Z -L**

Interchangeable ball slide model code
NAS: NS Model interchangeable ball slide
Size
Ball slide shape code (See page A148.)
Option code
-L: Equipped with NSK K1-L
-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

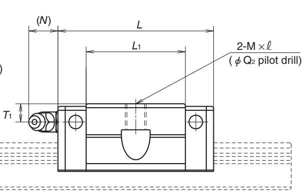
EM and JM types



EM type



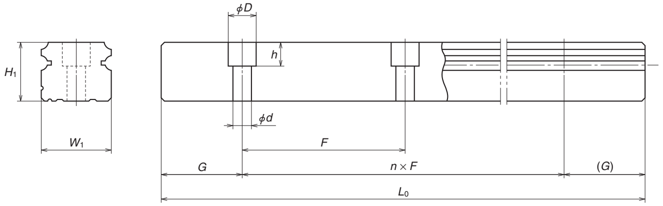
JM type



Reference number for rail of interchangeable type

Rail **N1S 30 1200 L C N -＊＊ PC Z**

Interchangeable rail model code
N1S: NS Model interchangeable rail
Size
Rail length (mm)
Rail shape code
L: NS15 with mounting holes for M3, NS20 to NS35 standard
T: NS15 with mounting holes for M4
Material/surface treatment code (See Table 23.)
Preload code (See page A150.)
T: Fine clearance.
Z: Slight preload(common rail for medium preload)
Accuracy code
PH: High-precision grade
PC: Normal grade
Design serial number
Added to the reference number.
＊Butting rail specification
N: Non-butting. L: Butting specification
＊Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide													
	Height			Width	Length	Mounting hole							Grease fitting			Width	Height
	H	E	W_2	W	L	B	J	M × pitch × ℓ	Q_2	L_1	K	T	Hole size	T_1	N	W_1	H_1
NS15JM **NS15EM**	24	4.6	18.5	52	40.4 56.8	41	— 26	M5×0.8×7	4.4	23.6 40	19.4	8	ϕ3	6	3	15	12.5
NS20JM **NS20EM**	28	6	19.5	59	47.2 65.2	49	— 32	M6×1×9 (M6×1×9.5)	5.3	30 48	22	10	M6×0.75	5.5	11	20	15.5
NS25JM **NS25EM**	33	7	25	73	59.6 81.6	60	— 35	M8×1.25×10 (M8×1.25×11.5)	6.8	38 60	26	11 (12)	M6×0.75	7	11	23	18
NS30JM **NS30EM**	42	9	31	90	67.4 96.4	72	— 40	M10×1.5×12 (M10×1.5×14.5)	8.6	42 71	33	11 (15)	M6×0.75	8	11	28	23
NS35JM **NS35EM**	48	10.5	33	100	77 108	82	— 50	M10×1.5×13 (M10×1.5×14.5)	8.6	49 80	37.5	12 (15)	M6×0.75	8.5	11	34	27.5

Model No.	Rail				Basic load ratings								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)
NS15JM **NS15EM**	60	＊4.5×7.5×5.3 3.5×6×4.5	20	2 920 (1 800)	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	0.17 0.26	1.4
NS20JM **NS20EM**	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	0.24 0.35	2.3
NS25JM **NS25EM**	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	0.44 0.66	3.1
NS30JM **NS30EM**	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	0.76 1.2	4.8
NS35JM **NS35EM**	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	1.2 1.7	7

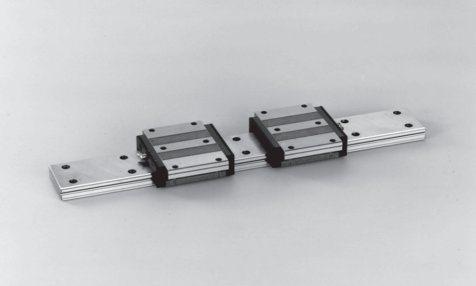
Notes: 1) The external appearance of stainless steel ball slides differs slightly from that of carbon steel ball slides.
2) Parenthesized dimensions are for items made of stainless steel.

3) Basic load ratings comply with ISO standards (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.In case of being applied option for smooth motion operation, basic load ratings are shown in Table 12.

4) High-precision grade and medium preload interchangeable types are available for special high carbon steel products.

＊ Standard mounting hole of NS15 rail is for M4 bolts (Hole size: 4.5 × 7.5 × 5.3).
If you require mounting hole for M3 bolts (Hole size: 3.5 × 6 × 4.5), please specify when ordering.

A-4-1.4 LW Model



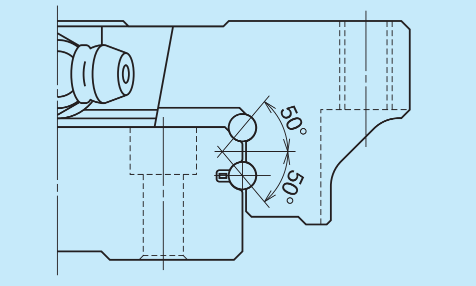


Fig. 1 Balls in contact

1. Features

(1) Ideal for use of single rail

Thanks to the wide rail, rigidity and load carrying capacity are high against moment load in the rolling direction. This makes the LW Model ideal for a single rail, compact linear guideway system.

(2) High vertical load carrying capacity

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

(3) High resistance against impact load

Same as NH and NS models 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 for easy and accurate measuring of ball grooves.

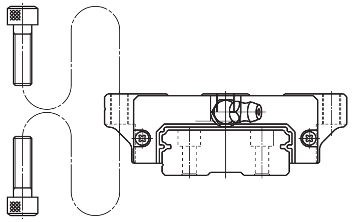
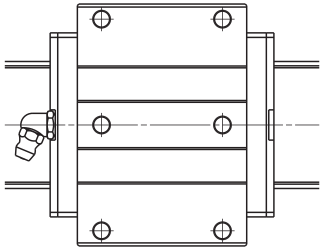
(5) Easy to handle, and designed with safety in mind.

Balls are retained in the retainer and do not fall out when a ball slide is withdrawn from the rail.

(6) Fast delivery

A lineup of interchangeable rails and ball slides supports and facilitates fast delivery.

2. Ball slide shape

Ball slide shape code	Shape / installation method	Type
EL		EL 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Accuracy grade Rail length (mm)		Preloaded assembly (not interchangeable)			Interchangeable type
		High precision P5	Precision grade P6	Normal grade PN	Normal grade PC
over	or less				
–	50	2	4	5	5
50 –	80	3	4	5	5
80 –	125	3	4	5	5
125 –	200	3.5	5	6	6
200 –	250	4.5	6	7.5	7.5
250 –	315	5	6.5	8.5	8.5
315 –	400	5.5	7	9.5	9.5
400 –	500	6	7.5	11	11
500 –	630	6.5	8.5	12	12
630 –	800	7	9.5	13	13
800 –	1 000	7.5	10	15	15
1 000 –	1 250	8.5	12	16	16
1 250 –	1 600	9.5	13	17	17
1 600 –	2 000	11	14	19	19
2 000 –	2 500	12	16	21	21
2 500 –	3 150	13	18	23	23
3 150 –	4 000	14	19	25	25

(2) Accuracy standard

The preloaded assembly has three accuracy grades; High precision P5, Precision P6, and Normal PN grades, while the interchangeable type has Normal PC grade only.

- **Tolerance of preloaded assembly type**

Table 2

Unit: μm

Accuracy grade Characteristics	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 interchangeable type: Normal grade PC**

Table 3

Unit: μm

Model No. Characteristics	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

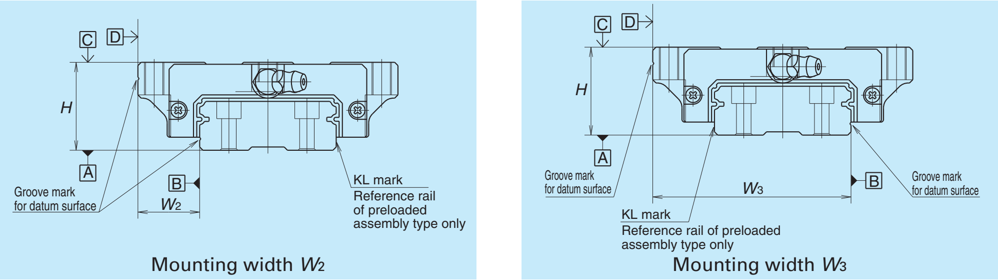
(3) Combination of accuracy and preload

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	○	○	—	—
	Interchangeable type with fine clearance ZT	—	—	—	○
	Interchangeable type with slight preload ZZ	—	—	—	○

Note: Z3 medium preload is only applicable to models of LW35 and LW50.

(4) Assembled accuracy



Mounting width W_2

Mounting width W_3

Fig. 2

(5) Preload and rigidity

We offer five levels of preload: Slight preload Z1, Medium preload Z3 and Fine clearance Z0, along with Interchangeable type 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 interchangeable type**

Table 6 Unit: μm

Model No.	Fine clearance	Slight preload
	ZT	ZZ
LW17	–3 to 15	–3.5 to 0
LW21	–3 to 15	–3.5 to 0
LW27	–4 to 15	–4 to 0
LW35	–5 to 15	–5 to 0
LW50	–5 to 15	–7 to 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

Model	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 requirements exceed the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

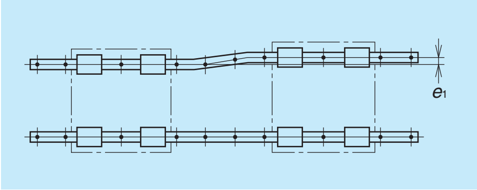


Fig. 3

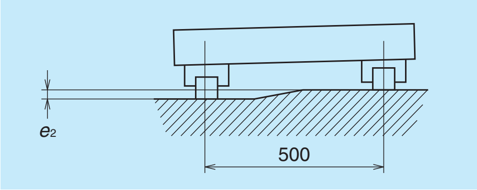


Fig. 4

Table 8 Unit: μm

Value	Preload	Model No.				
		LW17	LW21	LW27	LW35	LW50
Permissible values for parallelism error of two rails e_1	Z0, ZT	20	20	25	38	50
	Z1, ZZ	9	9	13	23	34
Permissible values for height error of 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

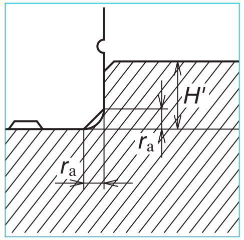


Fig. 5 Shoulder for the rail datum surface

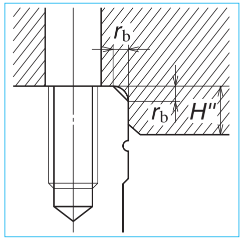


Fig. 6 Shoulder for the ball slide datum surface

Table 9 Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	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 A58 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 an extended thread body length (*L*) for the addition of dust-resistant accessories such as NSK K1 lubrication units, double seals and protectors.

We provide suitable lubrication accesories for special dust-resistant requirements upon request.

NSK can also provide extended length threads for ease of replenishment.

Please contact NSK if stainless lubrication accessories are required.

Table 10 Unit: mm

Model No.	Dust-resistant specification	Dimension *L*		
		Grease fitting /Drive-in type	Tube fitting	
			SF type	LF type
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	5
	With NSK K1	12	12	12
	Double seal	10	9	9
	Protector	10	9	9
LW35	Standard	5	6	6
	With NSK K1	14	14	13
	Double seal	10	10	9
	Protector	10	10	9
LW50	Standard	8	13.5	17
	With NSK K1	18	18	19
	Double seal	14	16	17
	Protector	14	13.5	17

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

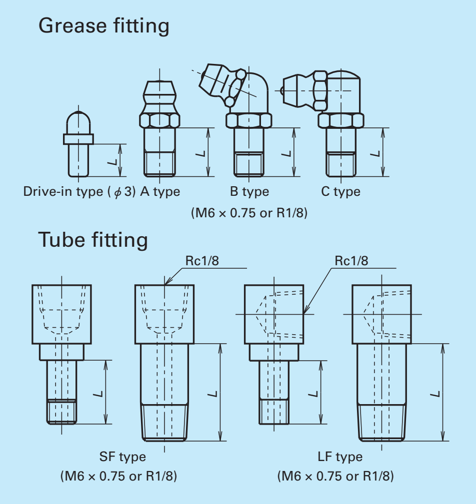


Fig. 7 Grease fitting and tube fitting

(2) Mounting position of lubrication accessories

The standard position for grease fittings is at the end face of the ball slide, but we can mount them on the side of the end cap for LW27, 35, and 50 as an option. (**Fig. 8**)

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

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

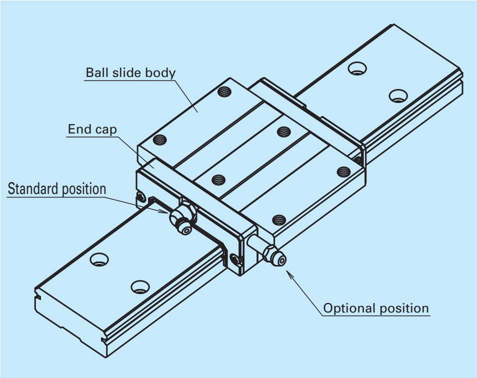


Fig. 8 Mounting position of lubrication accessories

7. Dust-resistant components

(1) Standard Specification

Under normal applications, the LW model can be used without modification thanks to its dust resistance. As standard equipment, the model has an end seal on both ends and bottom seals at the bottom.

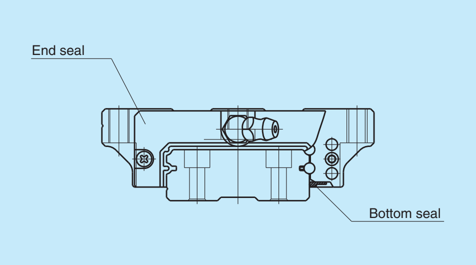


Fig. 9

Table 11 Seal friction per ball slide (maximum value) Unit: N

Size / Model	17	21	27	35	50
LW	6	8	12	16	20

(2) NSK K1^{TM} lubrication unit

Table 12 shows the dimensions of linear guides equipped with NSK K1 lubrication units.

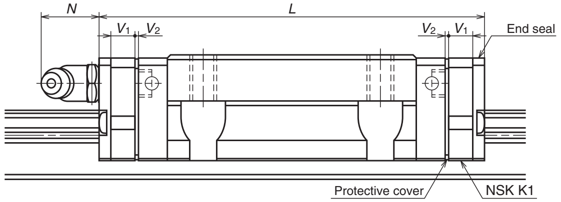


Table 12 Dimensions when equipped with NSK K1 lubrication units Unit: mm

Model No.	Ball slide length	Ball slide shape code	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)

Notes: 1) NSK K1 for food processing machinery/medical equipment are available for models LW17 to LW35.
2) Slide length when equipped with NSK K1 = (standard ball slide length) + (V_1 thickness of single K1 unit) × (number of K1 units) + (V_2 thickness of the protective cover) × 2.

(3) Double seal

Use a double seal set as shown 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 shown in **Fig.10** is required.

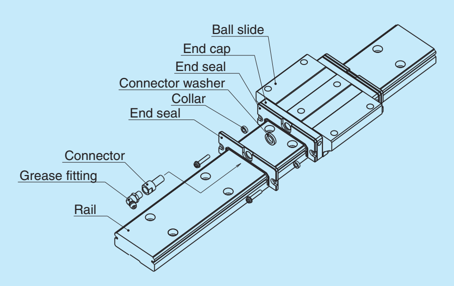


Fig. 10 Double seal

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 grease fitting, contact NSK.

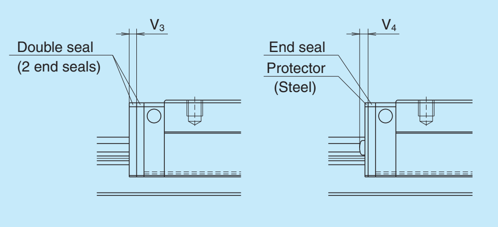


Fig. 12

(4) Protector

Use a protector set as shown in **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 shown in **Fig.11** is required.

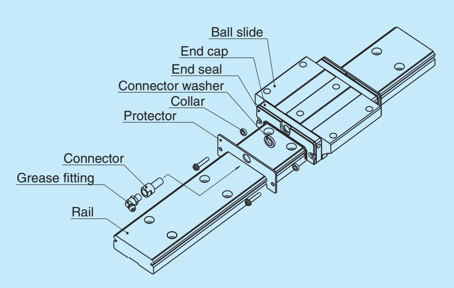


Fig. 11 Protector seal

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 grease fitting, contact NSK.

(5) Caps 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 for bellows
LW model

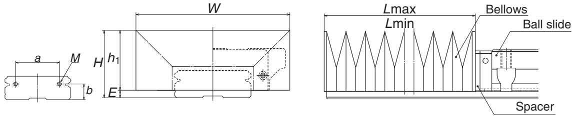


Fig. 13

Bellows reference number

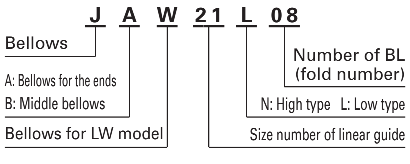


Table 16 Dimensions of bellows

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

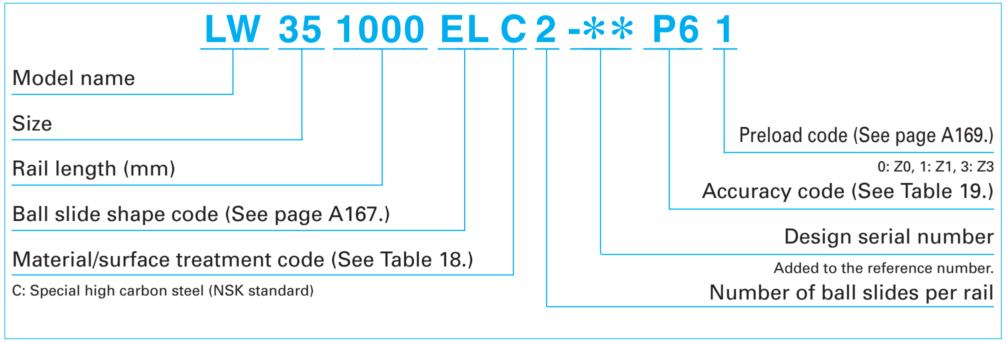
Model No.	Number of BL	2	4	6	8	10	12	14	16	18	20
	*L*min	34	68	102	136	170	204	238	272	306	340
JAW17N	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	*L*max	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
JAW21N	Stroke	204	408	612	816	1 020	1 224	1 428	1 632	1 836	2 040
	*L*max	238	476	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 both sides, then by dividing the sum by 2.

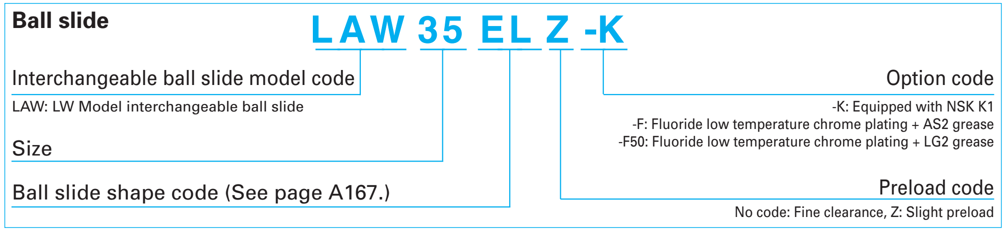
8. Reference number

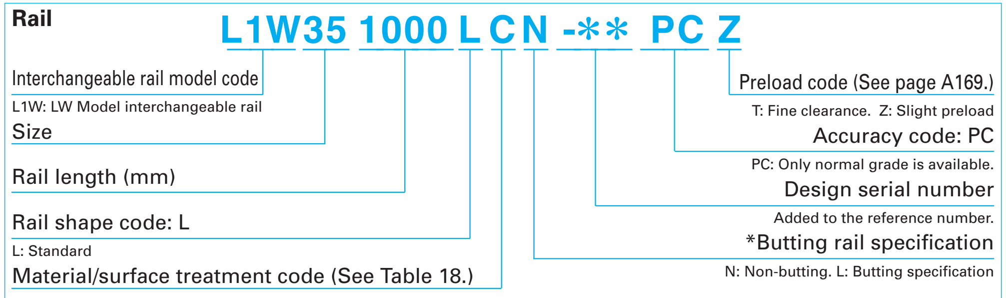
A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for preloaded assembly



(2) Reference number for interchangeable type





*Please consult with NSK for butting rail specification.

When interchangeable rails and slides are assembled, reference number coding is the same as that for preloaded assemblies. However, only preload codes T (fine clearance) and Z (slight preload) may be used (Refer to Page A169.)
Click!Speedy™ NSK Linear Guide Quick Delivery System uses a new numbering system. For details, please refer to the Click!Speedy general catalog CAT. No. E3191.

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 (interchangeable type)	PC	KC	FC

Note: Refer to pages A58 and A73 for details on NSK K1 lubrication units.

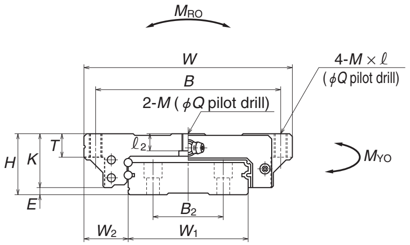
(9) Dimensions

LW-EL

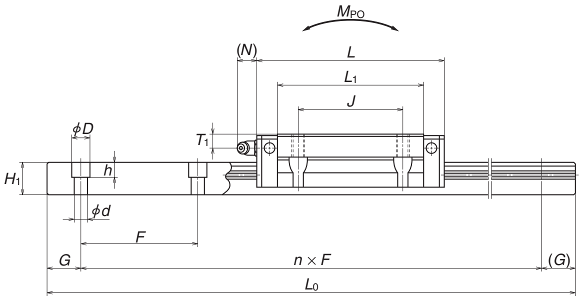
LW 35 1000 EL C 2 -✻✻ PC Z

Model name
Size
Rail length (mm)
Ball slide shape code (See page A167.)
Material/surface treatment code (See Table 18.)
C: Special high carbon steel (NSK standard)
Number of ball slides per rail
Design serial number
Added to the reference number.
Accuracy code (See Table 19.)
Preload code (See page A169.)
0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ

Front view



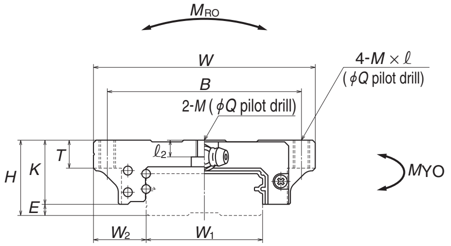
Side view

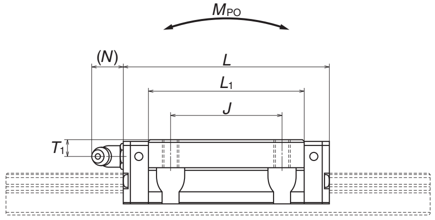


Reference number for ball slide of interchangeable type

LAW 35 EL Z -K

Interchangeable ball slide model code
LAW: LW Model interchangeable ball slide
Size
Ball slide shape code (See page A167.)
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



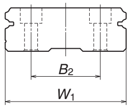


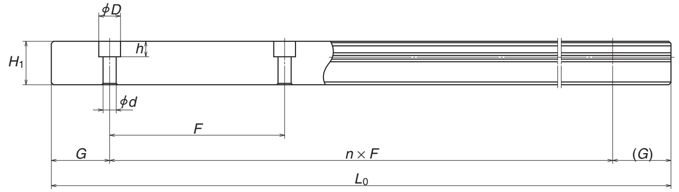
Reference number for rail of interchangeable type

Rail **L1W35 1000 L C N -✻✻ PC Z**

Interchangeable rail model code
L1W: LW Model interchangeable rail
Size
Rail length (mm)
Rail shape code: L
L: Standard
Material/surface treatment code (See Table 18.)
Preload code (See page A169.)
T: Fine clearance. Z: Slight preload
Accuracy code: PC
PC: Only normal grade is available.
Design serial number
Added to the reference number.
*Butting rail specification
N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.





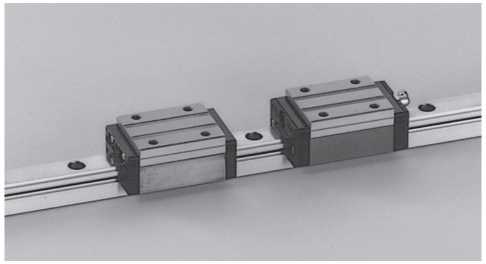
Unit: mm

Model No.	Assembly			Ball slide														Rail					Basic load ratings								Weight	
	Height			Width	Length	Mounting hole								Grease fitting			Width	Height		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}			
	H	E	W_2	W	L	B	J	M × pitch × ℓ	$ℓ_2$	Q	L_1	K	T	Hole size	T_1	N	W_1	H_1	B_2	F	d × D × h	(reference)		C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
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	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
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	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
LW27EL	27	4	19	80	74	70	40	M6×1×10	6	5.3	56	23	10	M6×0.75	6	11	42	15	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
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	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
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	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: Basic load ratings comply with ISO standards (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-4-2 Long-Life Series

A-4-2.1 DH Model



1. Features

(1) Double the life of standard linear guides

DH model is based on our proven, highly reliable standard NH model that feature an optimized groove shape. Applying our special TF heat treatment achieves even longer life.

What is TF (Tough) Technology?

NSK's TF technology is an exclusive heat treatment developed and cultivated over years of experience with rolling bearings and materials. TF technology helps suppress surface flaking on the raceway.

Load ratings are 1.25 times higher and service life is doubled compared to conventional NH model[*1]. DH linear guide offers greatly improved life at the same size and equal or longer life to the next smallest conventional model, allowing for equipment downsizing.

[*1] Representative values for model.

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

By reexamining the design for the ball circulation path, we have attained smooth ball circulation and reduced noise. DH models are suited for high-speed applications same as NH models.

(3) All mounting dimensions are the same as the NH Model

The dimensions surrounding the mounting (assembled dimensions), such as mounting height, width, mounting hole diameter/pitch, etc. of the DH model are identical to the NH model, allowing for easy replacement without design changes.

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

Similar to a DF arrangement of angular contact bearings, DH models offer large self-aligning capability with the internal intersection of the contact lines of the balls and grooves reducing moment rigidity. This increases the capacity to absorb errors in installation.

(5) High vertical load carrying capacity

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

(6) High resistance against impact load

The bottom ball groove forms a Gothic arch and the center of the top and bottom grooves are offset as shown in **Fig. 2**.

Vertical load is generally carried by the top rows at two contact points, but with this design, the bottom rows also carry load when a large impact load is applied vertically as shown in **Fig. 3**. This assures high resistance to 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 for easy and accurate measuring of ball grooves.

(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 variations and sizes

The DH model comes in several sizes and ball slide shapes, allowing for use in a variety of applications.

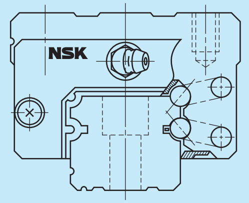


Fig. 1 DH Model

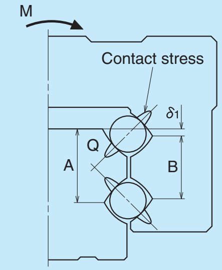


Fig. 2 Enlarged illustration of the offset Gothic arch groove

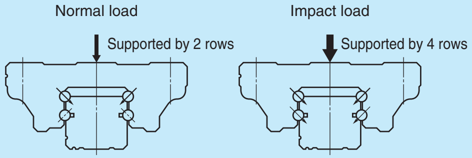
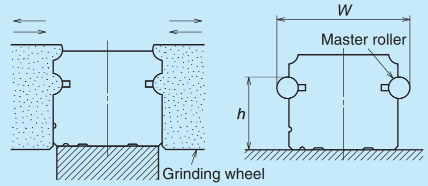


Fig. 3 When load is applied

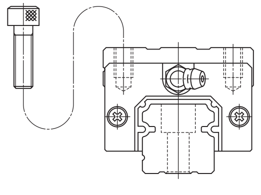
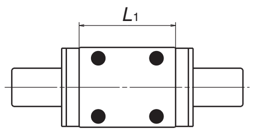
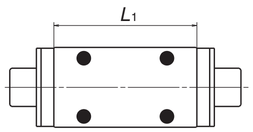
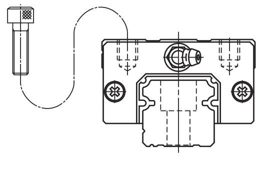
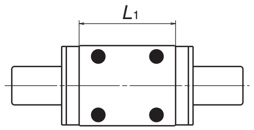
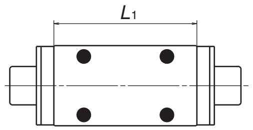
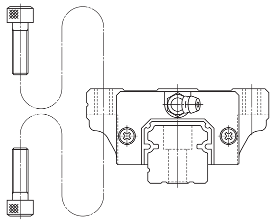
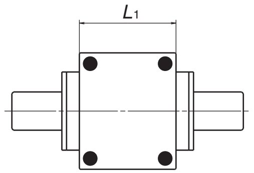
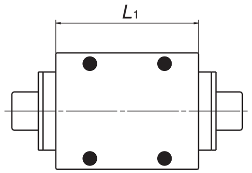


Grinding of datum surface and ball grooves

Measuring of ball grooves

Fig. 4 Rail grinding and measuring

2. Ball slide shape

Ball slide shape code	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		High-load	Super-high-load
		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 Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
–	50	2	2	2	4	5
50 –	80	2	2	3	4	5
80 –	125	2	2	3	4	5
125 –	200	2	2	3.5	5	6
200 –	250	2	2.5	4.5	6	7.5
250 –	315	2	2.5	5	6.5	8.5
315 –	400	2	3	5.5	7	9.5
400 –	500	2	3	6	7.5	11
500 –	630	2	3.5	6.5	8.5	12
630 –	800	2	4	7	9.5	13
800 –	1 000	2.5	4.5	7.5	10	15
1 000 –	1 250	3	5	8.5	12	16
1 250 –	1 600	3.5	5.5	9.5	13	17
1 600 –	2 000	4	6.5	11	14	19
2 000 –	2 500	4.5	7.5	12	16	21
2 500 –	3 150	5.5	8.5	13	18	23
3 150 –	4 000	6	9.5	14	19	25

Accuracy grade

(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

Table 2

Unit: µm

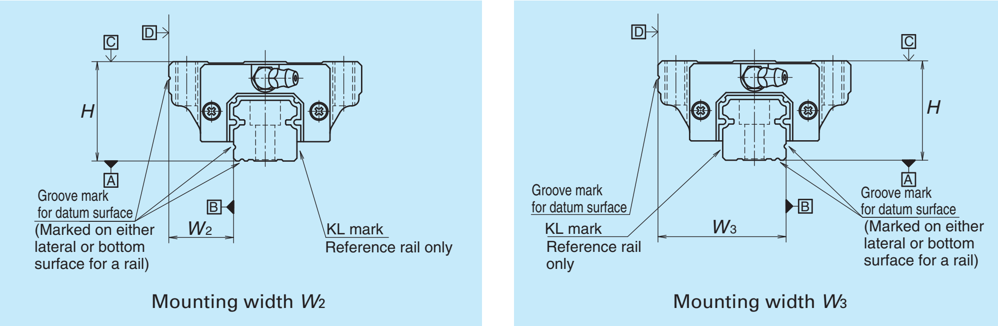
Characteristics \ Accuracy grade	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height *H* Variation of *H* (All ball slides on a set of rails)	±8 3	±10 5	±20 7	±40 15	±80 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±10 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**				

(3) Combinations of accuracy and preload

Table 3

		Accuracy grade Ultra precision	Super precision	High precision	Precision grade	Normal grade
Without NSK K1-L lubrication unit		P3	P4	P5	P6	PN
With NSK K1-L lubrication unit		L3	L4	L5	L6	LN
With NSK K1 for food and medical equipment		F3	F4	F5	F6	FN
Preload	Fine clearance Z0	○	○	○	○	○
	Slight preload Z1	○	○	○	○	○
	Medium preload Z3	○	○	○	○	—

(4) Assembled accuracy



Mounting width W_2

Mounting width W_3

Fig. 5

(5) Preload and rigidity

We offer three levels of preload: Slight preload Z1, Medium preload Z3 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	Medium preload Z3	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3
High-load	DH15 AN, EM	78	490	137	226	98	186
	DH20 AN, EM	147	835	186	335	137	245
	DH25 AL, AN, EM	196	1 270	206	380	147	284
	DH30 AL, AN	245	1 570	216	400	157	294
	DH30 EM	294	1 770	265	480	186	355
	DH35 AL, AN, EM	390	2 350	305	560	216	390
	DH45 AL, AN, EM	635	3 900	400	745	284	540
	DH55 AL, AN, EM	980	5 900	490	910	345	645
	DH65 AN, EM	1 470	8 900	580	1 070	400	755
Super-high-load	DH15 BN, GM	98	685	196	345	137	284
	DH20 BN, GM	196	1 080	265	480	196	355
	DH25 BL, BN, GM	245	1 570	294	560	216	400
	DH30 BL, BN, GM	390	2 260	360	665	265	480
	DH35 BL, BN, GM	490	2 940	430	795	305	570
	DH45 BL, BN, GM	785	4 800	520	960	370	695
	DH55 BL, BN, GM	1 180	7 050	635	1 170	440	835
	DH65 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.

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

Model	Size / Material	15	20	25	30	35	45	55	65
DH	Special high carbon steel	2 980	3 960	3 960	4 000	4 000	3 990	3 960	3 900

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

5. Installation

(1) Permissible values of mounting error

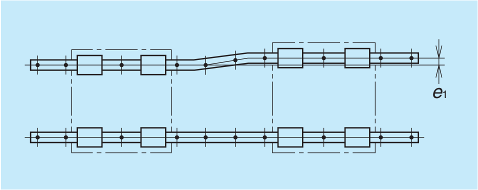


Fig. 6

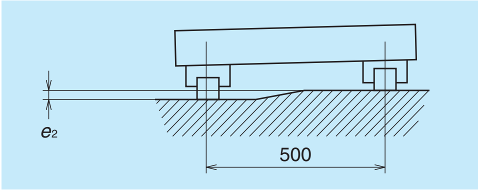


Fig. 7

Table 6

Unit: μm

Value	Preload	Model No.							
		DH15	DH20	DH25	DH30	DH35	DH45	DH55	DH65
Permissible values for parallelism error of two rails e_1	Z0	22	30	40	45	55	65	80	110
	Z1	18	20	25	30	35	45	55	70
	Z3	13	15	20	25	30	40	45	60
Permissible values for height error of two rails e_2	Z0	375μm/500mm							
	Z1, Z3	330μm/500mm							

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

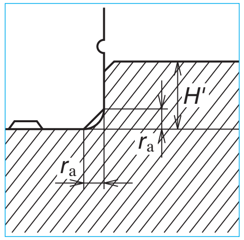


Fig. 8 Shoulder for the rail datum surface

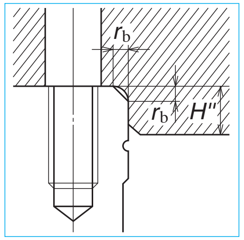


Fig. 9 Shoulder for the ball slide datum surface

Table 7

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
DH15	0.5	0.5	4	4
DH20	0.5	0.5	4.5	5
DH25	0.5	0.5	5	5
DH30	0.5	0.5	6	6
DH35	0.5	0.5	6	6
DH45	0.7	0.7	8	8
DH55	0.7	0.7	10	10
DH65	1	1	11	11

6. Maximum allowable speed

Table 8 indicates the maximum allowable speed for 10,000 km operation when using an DH model under normal conditions. 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 8 Maximum allowable speed

Unit: m/min

Size / Model	15	20	25	30	35	45	55	65
DH	300					200		150

7. Lubrication components

Refer to pages A58 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 10 and **Table 9** show grease fittings and tube fittings.

We provide lubrication accessories with an extended thread body length (*L*) for the addition of dust-resistant accessories such as NSK K1-L lubrication units, double seals and protectors.

We provide suitable lubrication accesories for special dust-resistant requirements upon request.

NSK can also provide extended length threads for ease of replenishment.

Please contact NSK if stainless lubrication accessories are required.

(2) Mounting position of lubrication accessories

The standard position for grease fittings is at the end face of the ball slide, but we can mount them on the side of the end cap as an option. (**Fig. 11**)

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

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

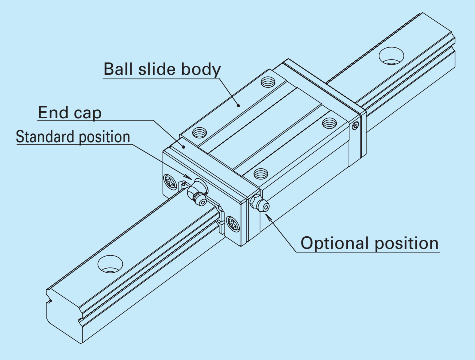


Fig. 11 Mounting position of lubrication accessories

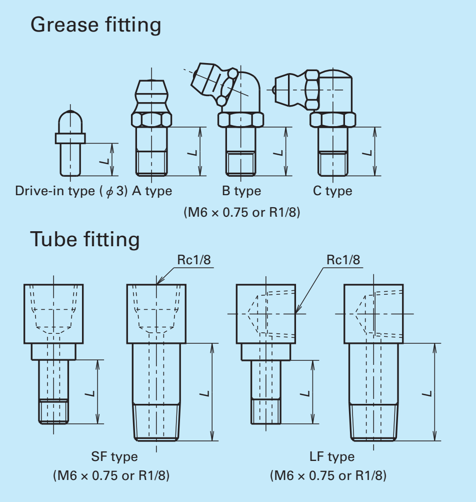


Fig. 10 Grease fitting and tube fitting

Table 9 Unit: mm

Model No.	Dust-resistant specification	Dimension *L*		
		Grease fitting /Drive-in type	Tube fitting	
			SF type	LF type
DH15	Standard	5	–	–
	With NSK K1-L	10	–	–
	Double seal	*	–	–
	Protector	*	–	–
DH20	Standard	5	–	–
	With NSK K1-L	12	–	–
	Double seal	10	–	–
	Protector	10	–	–
DH25	Standard	5	5	5
	With NSK K1-L	12	12	12
	Double seal	10	9	9
	Protector	10	9	9
DH30	Standard	5	6	6
	With NSK K1-L	14	12	13
	Double seal	12	10	11
	Protector	12	10	11
DH35	Standard	5	6	6
	With NSK K1-L	14	12	13
	Double seal	12	10	11
	Protector	12	10	11
DH45	Standard	8	13.5	17
	With NSK K1-L	18	20	21.5
	Double seal	14	16	17
	Protector	14	13.5	17
DH55	Standard	8	13.5	17
	With NSK K1-L	18	20	21.5
	Double seal	14	16	17
	Protector	14	13.5	17
DH65	Standard	8	13.5	17
	With NSK K1-L	20	22	25.5
	Double seal	16	18	19
	Protector	16	13.5	17

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

8. Dust-resistant components

(1) Standard specification

Under normal applications, the DH model can be used without modification thanks to its dust resistance. These ball slides come standard with an end seal on both ends and bottom seals on the bottom.

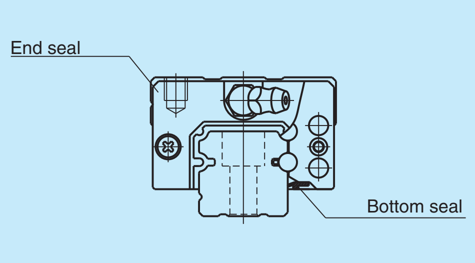


Fig. 12

Table 10 Seal friction per ball slide (maximum value) Unit: N

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

(2) NSK K1-L™ and NSK K1™ lubrication units for food processing machinery/ medical equipment

Table 11 shows linear guide dimensions when equipped with NSK K1-L lubrication units.

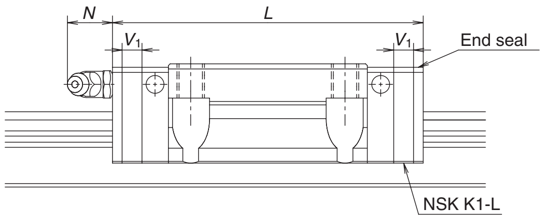


Table 11 Dimensions when equipped with NSK K1-L lubrication units Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1-L units *L*	Thickness of single NSK K1-L unit V_1	Protrusion of grease fitting *N*
DH15	Standard	AN, EM	55	65.6	5.3	(5)
	Long	BN, GM	74	84.6		
DH20	Standard	AN, EM	69.8	80.4	5.3	(14)
	Long	BN, GM	91.8	102.4		
DH25	Standard	AL, AN, EM	79	90.6	5.8	(14)
	Long	BL, BN, GM	107	118.6		
DH30	Standard	AL, AN	85.6	97.6	6	(14)
		EM	98.6	110.6		
	Long	BL, BN, GM	124.6	136.6		
DH35	Standard	AL, AN, EM	109	122	6.5	(14)
	Long	BL, BN, GM	143	156		
DH45	Standard	AL, AN, EM	139	154	7.5	(15)
	Long	BL, BN, GM	171	186		
DH55	Standard	AL, AN, EM	163	178	7.5	(15)
	Long	BL, BN, GM	201	216		
DH65	Standard	AN, EM	193	211	9	(16)
	Long	BN, GM	253	271		

Notes: 1) When using NSK K1 for food processing machinery/medical equipment, refer toTable 12.
2) Slide length when equipped with NSK K1-L = (standard ball slide length) + (V_1 thickness of single NSK K1-L unit) × (number of K1-L units).

Table 12 shows linear guide dimensions when equipped with NSK K1 for food processing machinery/medical equipment.

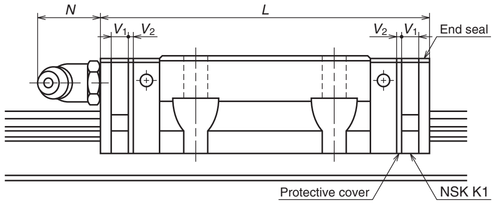


Table 12 Dimensions when equipped with NSK K1 for food processing machinery/medical equipment

Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1 V_1	Protective cover thickness V_2	Protrusion of grease fitting N
DH15	Standard	AN, EM	55	65.6	4.5	0.8	(5)
	Long	BN, GM	74	84.6			
DH20	Standard	AN, EM	69.8	80.4	4.5	0.8	(14)
	Long	BN, GM	91.8	102.4			
DH25	Standard	AL, AN, EM	79.0	90.6	5.0	0.8	(14)
	Long	BL, BN, GM	107	118.6			
DH30	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			
DH35	Standard	AL, AN, EM	109	122	5.5	1.0	(14)
	Long	BL, BN, GM	143	156			

Note: Slide length when equipped with NSK K1 for food processing machinery/medical equipment = (standard ball slide length) + (V_1 thickness of single NSK K1 unit) × (number of K1 units) + (V_2 thickness of the protective cover) × 2.

(3) Double seal

Use a double seal set as shown in **Table 13** when installing an extra seal to completed standard products. (**Fig. 13**)

When installing a grease fitting after the installation of double seals, a connector as shown in **Fig.13** is required.

(4) Protector

Use a protector set as shown in **Table 14** when installing a protector to completed standard products. (**Fig.14**)

When installing a grease fitting after the installation of protectors, a connector as shown in **Fig.14** is required.

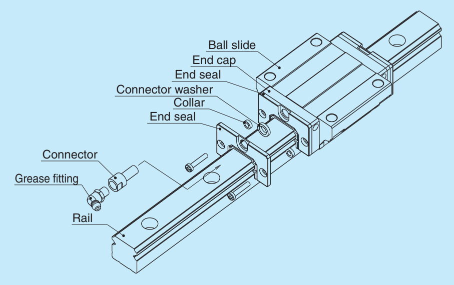


Fig. 13 Double seal

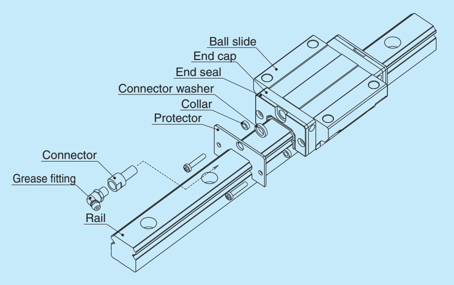


Fig. 14 Protector

Table 13 Double seal set

Model No.	Reference No.		Increased thickness V_3 (mm)
	Without connector	With connector	
DH15	LH15WS-01	*	2.5
DH20	LH20WS-01	LH20WSC-01	2.5
DH25	LH25WS-01	LH25WSC-01	2.8
DH30	LH30WS-01	LH30WSC-01	3.6
DH35	LH35WS-01	LH35WSC-01	3.6
DH45	LH45WS-01	LH45WSC-01	4.3
DH55	LH55WS-01	LH55WSC-01	4.3
DH65	LH65WS-01	LH65WSC-01	4.9

Table 14 Protector set

Model No.	Reference No.		Increased thickness V_4 (mm)
	Without connector	With connector	
DH15	LH15PT-01	*	2.7
DH20	LH20PT-01	LH20PTC-01	2.9
DH25	LH25PT-01	LH25PTC-01	3.2
DH30	LH30PT-01	LH30PTC-01	4.2
DH35	LH35PT-01	LH35PTC-01	4.2
DH45	LH45PT-01	LH45PTC-01	4.9
DH55	LH55PT-01	LH55PTC-01	4.9
DH65	LH65PT-01	LH65PTC-01	5.5

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

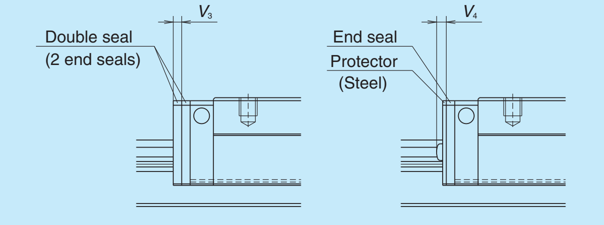


Fig. 15

(5) Caps 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
DH15	M4	LG-CAP/M4	20
DH20	M5	LG-CAP/M5	20
DH25	M6	LG-CAP/M6	20
DH30, DH35	M8	LG-CAP/M8	20
DH45	M12	LG-CAP/M12	20
DH55	M14	LG-CAP/M14	20
DH65	M16	LG-CAP/M16	20

(6) Inner seal

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

Table 16

Model	Model No.
DH	DH20, DH25, DH30, DH35, DH45, DH55, DH65

(7) Bellows

- A bellows fastener kit, which includes one bellows fastener, two M_1 set screws, two M_2 set screws, and two collars for M_2 set screws as shown in Fig. 7.7 on page A69, is supplied with bellows for the ends.
- Middle bellows are supplied with four set screws and four collars.
- Use a bellows fastener kit as shown in **Table 17**, when installing bellows to completed standard products.
- When NSK K1-L units, NSK K1 for food and medical equipment, double seals, or protectors are used, the set screws of bellows fastener kits cannot be used.

  Please contact NSK for details.
- Bellows fasteners are available only for horizontal mounting positions; other mounting positions require a sliding plate (see **Fig. 7.10** on page A70).

  To fix the bellows to the rail, make tap holes on the rail end surface. Fix the bellows mounting plate to the rail end surface through these tap holes with a machine screw. NSK prepares tap holes on the rail end surface when bellows are ordered with a linear guide.

Table 17 Bellows fastner kit reference No.

Model No.	Kit reference No.
DH20	LH20FS-01
DH25	LH25FS-01
DH30	LH30FS-01
DH35	LH35FS-01
DH45	LH45FS-01
DH55	LH55FS-01
DH65	LH65FS-01

Dimension tables for bellows
DH Model

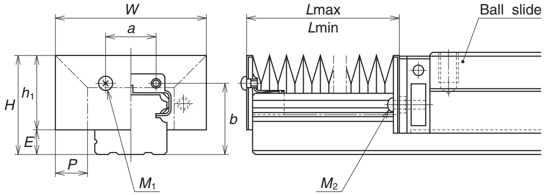


Fig. 16 Dimensions of bellows

Bellows reference number

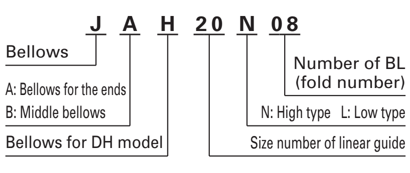


Table 18 Dimensions of bellows

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 19 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
	Lmin	34	68	102	136	170	204	238	272	306	340
JAH20N	Stroke	106	212	318	424	530	636	742	848	954	1 060
	Lmax	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
	Lmax	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
	Lmax	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
	Lmax	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
	Lmax	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
	Lmax	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
	Lmax	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
JAH45L	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	Lmax	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
	Lmax	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
	Lmax	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
	Lmax	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
	Lmax	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 both sides, then by dividing the sum by 2.

9. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.

Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

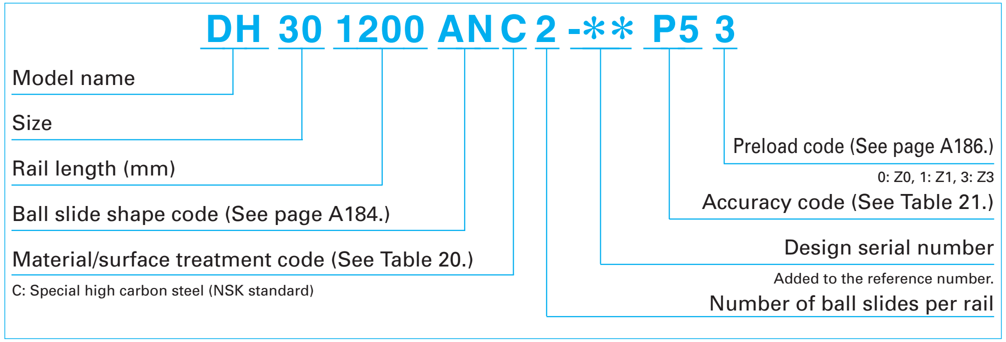


Table 20 Material/surface treatment code

Code	Description
C	Special high carbon steel
D	Special high carbon steel with surface treatment
Z	Other, special

Table 21 Accuracy code

Accuracy	Standard (Without NSK K1-L)	With NSK K1-L	With NSK K1 for food and medical equipment
Ultra precision grade	P3	L3	F3
Super precision grade	P4	L4	F4
High precision grade	P5	L5	F5
Precision grade	P6	L6	F6
Normal grade	PN	LN	FN

Note: Refer to page A58 for details on NSK K1-L lubrication units and to page A73 for details on NSK K1 lubricaiton units for food processing machinery/medical equipment.

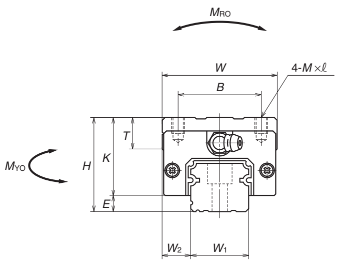
10. Dimensions
DH-AN (High-load / Standard)
DH-BN (Super-high-load / Long)

DH 30 1200 AN C 2 -✻✻ P5 3

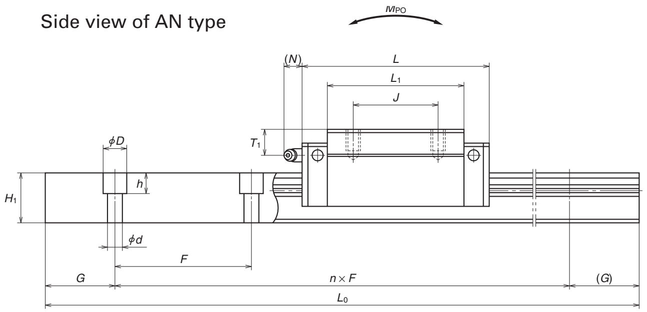
Model name
Size
Rail length (mm)
Ball slide shape code (See page A184.)
Material/surface treatment code (See Table 20.)
C: Special high carbon steel

Preload code (See page A186.)
0: Z0, 1: Z1, 3: Z3
Accuracy code (See Table 21.)
Design serial number
Added to the reference number.
Number of ball slides per rail

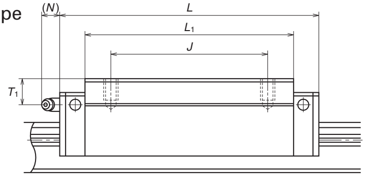
Front view of AN and BN types



Side view of AN type



Side view of BN type



Unit: mm

Model No.	Assembly			Ball slide												
	Height			Width	Length	Mounting hole						Grease fitting			Width	Height
	H	E	W_2	W	L	B	J	M × pitch × ℓ	L_1	K	T	Hole size	T_1	N	W_1	H_1
DH15AN **DH15BN**	28	4.6	9.5	34	55 74	26	26	M4×0.7×6	39 58	23.4	8	ϕ3	8.5	3.3	15	15
DH20AN **DH20BN**	30	5	12	44	69.8 91.8	32	36 50	M5×0.8×6	50 72	25	12	M6×0.75	5	11	20	18
DH25AN **DH25BN**	40	7	12.5	48	79 107	35	35 50	M6×1×9	58 86	33	12	M6×0.75	10	11	23	22
DH30AN **DH30BN**	45	9	16	60	85.6 124.6	40	40 60	M8×1.25×10	59 98	36	14	M6×0.75	10	11	28	26
DH35AN **DH35BN**	55	9.5	18	70	109 143	50	50 72	M8×1.25×12	80 114	45.5	15	M6×0.75	15	11	34	29
DH45AN **DH45BN**	70	14	20.5	86	139 171	60	60 80	M10×1.5×17	105 137	56	17	Rc1/8	20	13	45	38
DH55AN **DH55BN**	80	15	23.5	100	163 201	75	75 95	M12×1.75×18	126 164	65	18	Rc1/8	21	13	53	44
DH65AN **DH65BN**	90	16	31.5	126	193 253	76	70 120	M16×2×20	147 207	74	23	Rc1/8	19	13	63	53

Model No.	Rail				Basic load ratings								Weight	
	Pitch	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}			
	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)
DH15AN **DH15BN**	60	4.5×7.5×5.3	20	2 980	17 800 22 800	14 200 18 100	20 700 32 000	108 166	94.5 216	575 1 150	79.5 181	480 965	0.18 0.26	1.6
DH20AN **DH20BN**	60	6×9.5×8.5	20	3 960	29 800 38 000	23 700 30 000	32 500 50 500	219 340	185 420	1 140 2 230	155 355	955 1 870	0.33 0.48	2.6
DH25AN **DH25BN**	60	7×11×9	20	3 960	42 500 57 500	33 500 45 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.55 0.82	3.6
DH30AN **DH30BN**	80	9×14×12	20	4 000	51 500 77 000	41 000 61 000	51 500 91 500	490 870	350 1 030	2 290 5 600	292 865	1 920 4 700	0.77 1.3	5.2
DH35AN **DH35BN**	80	9×14×12	20	4 000	78 500 102 000	62 500 81 000	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.5 2.1	7.2
DH45AN **DH45BN**	105	14×20×17	22.5	3 990	135 000 164 000	107 000 131 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	3.0 3.9	12.3
DH55AN **DH55BN**	120	16×23×20	30	3 960	199 000 243 000	158 000 193 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	4.7 6.1	16.9
DH65AN **DH65BN**	150	18×26×22	35	3 900	300 000 390 000	239 000 310 000	281 000 410 000	6 150 8 950	4 950 10 100	27 900 51 500	4 150 8 450	23 400 43 500	7.7 10.8	24.3

Note : 1) The basic load ratings comply with the ISO standard. (ISO 14728-1, 14728-2) For long-life DH model, the rated load is multiplied by a coefficient that reflects the effect of life improvement technologies based on these ISO standards.
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.

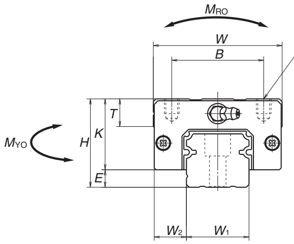
DH-AL (High-load / Standard)
DH-BL (Super-high-load / Long)

DH 30 1200 AL C 2 -＊＊ P5 3

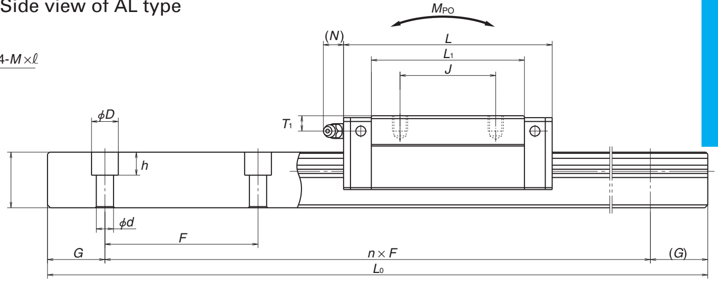
Model name
Size
Rail length (mm)
Ball slide shape code (See page A184.)
Material/surface treatment code (See Table 20.)
C: Special high carbon steel

Preload code (See page A186.)
0: Z0, 1: Z1, 3: Z3
Accuracy code (See Table 21.)
Design serial number
Added to the reference number.
Number of ball slides per rail

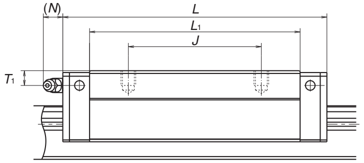
Front view of AL and BL types



Side view of AL type



Side view of BL type



Unit: mm

Model No.	Assembly			Ball slide												Rail				Basic load ratings									Weight	
	Height			Width	Length	Mounting hole						Grease fitting			Width	Height	Pitch	Mounting bolt hole	G	Max. length	[1]Dynamic		Static	Static moment (N·m)					Ball slide	Rail
																					[50km] C_{50}(N)	[100km] C_{100}(N)	C_0 (N)	M_{RO}	M_{PO}		M_{YO}			
																									One slide	Two slides	One slide	Two slides		
	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)
DH25AL **DH25BL**	36	7	12.5	48	79 107	35	35 50	M6×1×6	58 86	29	12	M6×0.75	6	11	23	22	60	7×11×9	20	3 960	42 500 57 500	33 500 45 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.46 0.69	3.6
DH30AL **DH30BL**	42	9	16	60	85.6 124.6	40	40 60	M8×1.25×8	59 98	33	14	M6×0.75	7	11	28	26	80	9×14×12	20	4 000	51 500 77 000	41 000 61 000	51 500 91 500	490 870	350 1 030	2 290 5 600	292 865	1 920 4 700	0.69 1.16	5.2
DH35AL **DH35BL**	48	9.5	18	70	109 143	50	50 72	M8×1.25×8	80 114	38.5	15	M6×0.75	8	11	34	29	80	9×14×12	20	4 000	78 500 102 000	62 500 81 000	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.2 1.7	7.2
DH45AL **DH45BL**	60	14	20.5	86	139 171	60	60 80	M10×1.5×10	105 137	46	17	Rc1/8	10	13	45	38	105	14×20×17	22.5	3 990	135 000 164 000	107 000 131 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	2.2 2.9	12.3
DH55AL **DH55BL**	70	15	23.5	100	163 201	75	75 95	M12×1.75×13	126 164	55	15	Rc1/8	11	13	53	44	120	16×23×20	30	3 960	199 000 243 000	158 000 193 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	3.7 4.7	16.9

Note : 1) The basic load ratings comply with the ISO standard. (ISO 14728-1, 14728-2) For long-life DH model, the rated load is multiplied by a coefficient that reflects the effect of life improvement technologies based on these ISO standards.
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.

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

DH 30 1200 EM C 2 -✻✻ P5 3

Model name: DH

Size: 30

Rail length (mm): 1200

Ball slide shape code (See page A184.): EM

Material/surface treatment code (See Table 20.): C

C: Special high carbon steel

Number of ball slides per rail: 2

Design serial number: -✻✻

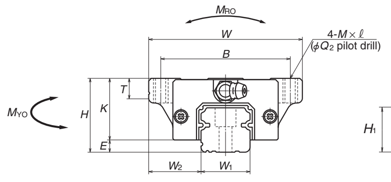
Added to the reference number.

Accuracy code (See Table 21.): P5

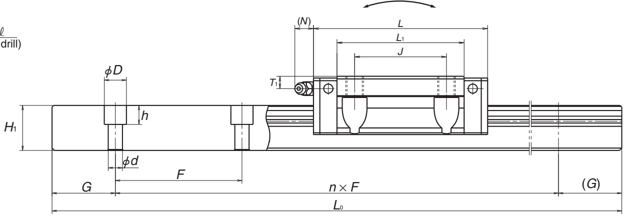
Preload code (See page A186.): 3

0: Z0, 1: Z1, 3: Z3

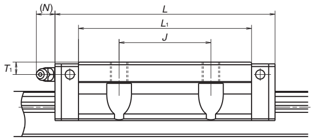
Front view of EM and GM types



Side view of EM type



Side view of GM type

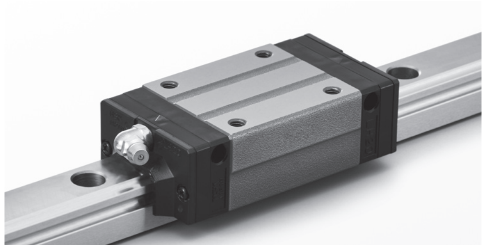


Unit: mm

Model No.	Assembly			Ball slide												Rail						Basic load ratings								Weight	
	Height			Width	Length	Mounting hole							Grease fitting			Width	Height	Pitch	Mounting bolt hole	G	Max. length	[1]Dynamic		Static	Static moment (N·m)					Ball slide	Rail
	H	E	W_2	W	L	B	J	M × pitch × ℓ	Q_2	L_1	K	T	Hole size	T_1	N	W_1	H_1	F	$d \times D \times h$	(reference)	L_{0max}	[50km] C_{50}(N)	[100km] C_{100}(N)	C_0 (N)	M_{RO}	M_{PO}		M_{YO}		(kg)	(kg/m)
																										One slide	Two slides	One slide	Two slides		
DH15EM **DH15GM**	24	4.6	16	47	55 74	38	30	M5×0.8×7	4.4	39 58	19.4	8	ϕ3	4.5	3.3	15	15	60	4.5×7.5×5.3	20	2 980	17 800 22 800	14 200 18 100	20 700 32 000	108 166	94.5 216	575 1 150	79.5 181	480 965	0.17 0.25	1.6
DH20EM **DH20GM**	30	5	21.5	63	69.8 91.8	53	40	M6×1×9.5	5.3	50 72	25	10	M6×0.75	5	11	20	18	60	6×9.5×8.5	20	3 960	29 800 38 000	23 700 30 000	32 500 50 500	219 340	185 420	1 140 2 230	155 355	955 1 870	0.45 0.65	2.6
DH25EM **DH25GM**	36	7	23.5	70	79 107	57	45	M8×1.25×10	6.8	58 86	29	11	M6×0.75	6	11	23	22	60	7×11×9	20	3 960	42 500 57 500	33 500 45 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.63 0.93	3.6
DH30EM **DH30GM**	42	9	31	90	98.6 124.6	72	52	M10×1.5×12	8.6	72 98	33	11	M6×0.75	7	11	28	26	80	9×14×12	20	4 000	59 000 77 000	47 000 61 000	63 000 91 500	600 870	505 1 030	3 150 5 600	425 865	2 650 4 700	1.2 1.6	5.2
DH35EM **DH35GM**	48	9.5	33	100	109 143	82	62	M10×1.5×13	8.6	80 114	38.5	12	M6×0.75	8	11	34	29	80	9×14×12	20	4 000	78 500 102 000	62 500 81 000	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.7 2.4	7.2
DH45EM **DH45GM**	60	14	37.5	120	139 171	100	80	M12×1.75×15	10.5	105 137	46	13	Rc1/8	10	13	45	38	105	14×20×17	22.5	3 990	135 000 164 000	107 000 131 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	3 3.9	12.3
DH55EM **DH55GM**	70	15	43.5	140	163 201	116	95	M14×2×18	12.5	126 164	55	15	Rc1/8	11	13	53	44	120	16×23×20	30	3 960	199 000 243 000	158 000 193 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	5 6.5	16.9
DH65EM **DH65GM**	90	16	53.5	170	193 253	142	110	M16×2×24	14.6	147 207	74	23	Rc1/8	19	13	63	53	150	18×26×22	35	3 900	300 000 390 000	239 000 310 000	281 000 410 000	6 150 8 950	4 950 10 100	27 900 51 500	4 150 8 450	23 400 43 500	10 14.1	24.3

Note : 1) The basic load ratings comply with the ISO standard. (ISO 14728-1, 14728-2) For long-life DH model, the rated load is multiplied by a coefficient that reflects the effect of life improvement technologies based on these ISO standards.
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-4-2.2 DV Model



1. Features

(1) High-performance end seals

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

(2) NSK K1-L™ lubrication unit (standard)

The outstanding lubrication support provided by NSK K1-L units further improves resistance to dust and durability. Additional NSK K1-L units can be mounted for specific usage conditions and environments.

(3) Double the life of standard linear guides

DV model is based on our proven, highly reliable standard VH model that feature an optimized groove shape. Applying our special TF heat treatment achieves even longer life.

What is TF (Tough) Technology?

NSK's TF technology is an exclusive heat treatment developed and cultivated over years of experience with rolling bearings and materials. TF technology helps suppress surface flaking on the raceway.

Load ratings are 1.25 times higher and service life is doubled compared to conventional VH model[*1]. DV linear guide offers greatly improved life at the same size and equal or longer life to the next smallest conventional model, allowing for equipment downsizing.

*1: Representative values for model.

(4) All mounting dimensions are the same as the VH Model

The dimensions surrounding the mounting (assembled dimensions), such as mounting height, width, mounting hole diameter/pitch, etc. of the DV model are identical to the VH model, allowing for easy replacement without design changes.

(5) High vertical load carrying capacity

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

(6) High resistance against impact load

The bottom ball groove forms a Gothic arch and the center of the top and bottom grooves are offset as shown in Fig. 2.

Vertical load is generally carried by the top rows at two contact points, but with this design, the bottom rows also carry load when a large impact load is applied vertically as shown in Fig. 3. This assures high resistance to impact load.

(7) High accuracy

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

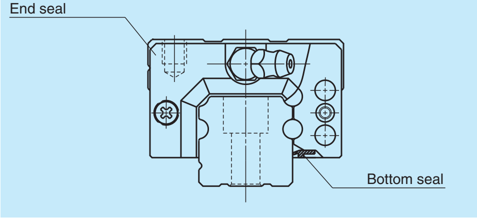


Fig. 1 DV Model

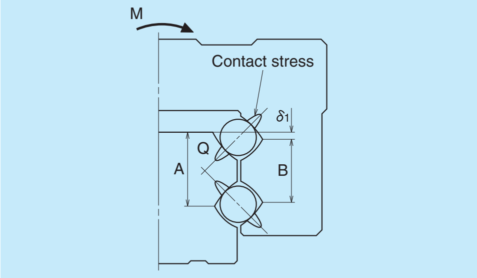


Fig. 2 Enlarged illustration of the offset Gothic arch groove

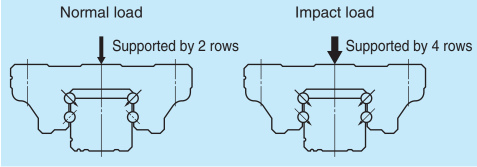
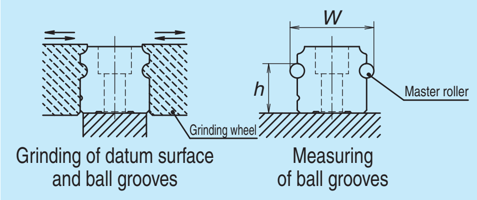


Fig. 3 When load is applied



Grinding of datum surface and ball grooves

Measuring of ball grooves

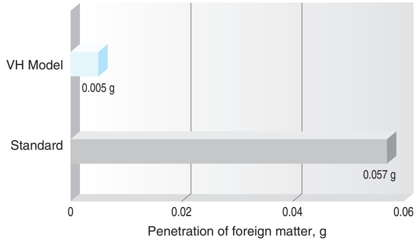
Fig. 4 Rail grinding and measuring

●Comparison with NSK standard products

Level of fine contaminants reduced by 90% or more.

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

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

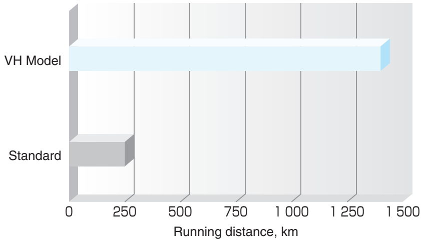


Operating life under contaminated environments is more than 5 times longer

Durability test with rubber fragments

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

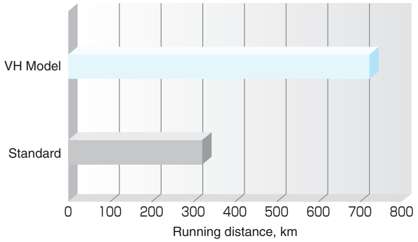
Test sample	: VH30AN, preload code Z1 (preload of 245 N)
Rail orientation	: Horizontal (wall mount)
Speed	: 500 mm/sec
Lubrication	: AS2 grease (prepacked AS2 only)
Contaminant	: Rubber fragments



Durability test with fine wood particles

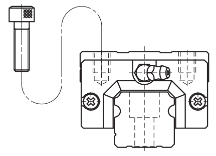
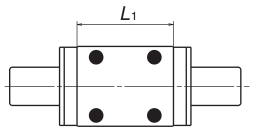
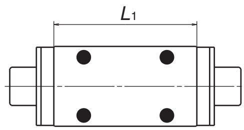
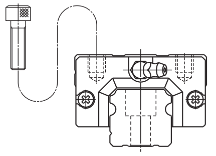
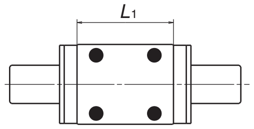
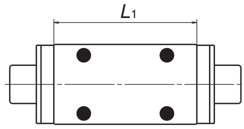
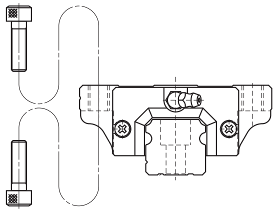
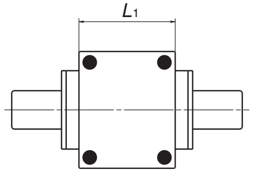
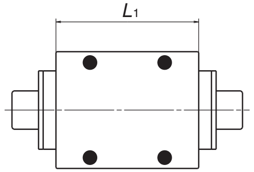
Extreme durability tests in a contaminated environment with fine wood particles show that durability of the VH Model is more than double that of the standard model, as shown in the graph.

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



The data shown in the catalog are the results of our tests, and no warranty is given to sealing performance in actual machine usage. 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 shape code	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		High-load	Super-high-load
		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)		Preloaded assembly				
over	or less	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
–	50	2	2	2	4	5
50 –	80	2	2	3	4	5
80 –	125	2	2	3	4	5
125 –	200	2	2	3.5	5	6
200 –	250	2	2.5	4.5	6	7.5
250 –	315	2	2.5	5	6.5	8.5
315 –	400	2	3	5.5	7	9.5
400 –	500	2	3	6	7.5	11
500 –	630	2	3.5	6.5	8.5	12
630 –	800	2	4	7	9.5	13
800 –	1 000	2.5	4.5	7.5	10	15
1 000 –	1 250	3	5	8.5	12	16
1 250 –	1 600	3.5	5.5	9.5	13	17
1 600 –	2 000	4	6.5	11	14	19
2 000 –	2 500	4.5	7.5	12	16	21
2 500 –	3 150	5.5	8.5	13	18	23
3 150 –	4 000	6	9.5	14	19	25

(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.

- **Tolerance of preloaded assembly**

Table 2

Unit: µm

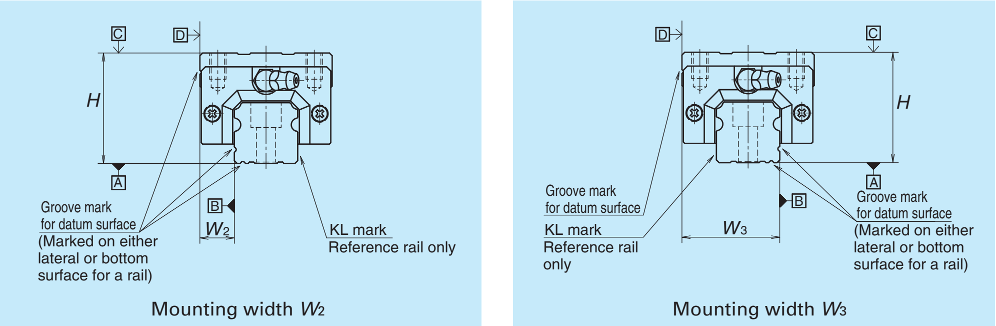
Characteristics / Accuracy grade	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height *H* Variation of *H* (All ball slides on a set of rails)	±8 3	±10 5	±20 7	±40 15	±80 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±10 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**				

(3) Combinations of accuracy and preload

Table 3

		Accuracy grade				
		Ultra precision	Super precision	High Precision	Precision grade	Normal grade
With NSK K1-L lubrication unit		L3	L4	L5	L6	LN
Preload	Fine clearance Z0	○	○	○	○	○
	Slight preload Z1	○	○	○	○	○
	Medium preload Z3	○	○	○	○	—

(4) Assembled accuracy



Mounting width W_2

Mounting width W_3

Fig. 5

(5) Preload and rigidity

We offer three levels of preload: Slight preload Z1, Medium preload Z3 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	Medium preload Z3	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3
High-load	DV15 AN, EM	78	490	137	226	98	186
	DV20 AN, EM	147	835	186	335	137	245
	DV25 AN, AL, EM	196	1 270	206	380	147	284
	DV30 AN, AL	245	1 570	216	400	157	294
	DV30 EM	294	1 770	265	480	186	355
	DV35 AN, AL, EM	390	2 350	305	560	216	390
	DV45 AN, AL, EM	635	3 900	400	745	284	540
	DV55 AN, AL, EM	980	5 900	490	910	345	645
Super-high-load	DV15 BN, GM	98	685	196	345	137	284
	DV20 BN, GM	196	1 080	265	480	196	355
	DV25 BN, BL, GM	245	1 570	294	560	216	400
	DV30 BN, BL, GM	390	2 260	360	665	265	480
	DV35 BN, BL, GM	490	2 940	430	795	305	570
	DV45 BN, BL, GM	785	4 800	520	960	370	695
	DV55 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.

4. Maximum rail length

Table 5 shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grade.

Table 5 Length limitations of rails

Unit: mm

Model	Size / Material	15	20	25	30	35	45	55
DV	Special high carbon steel	2 000	3 960	3 960	4 000	4 000	3 990	3 960

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

5. Installation

(1) Permissible values of mounting error

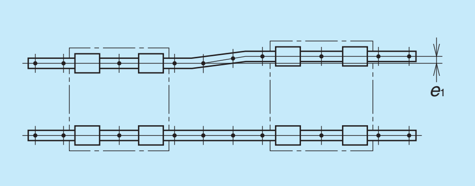


Fig. 6

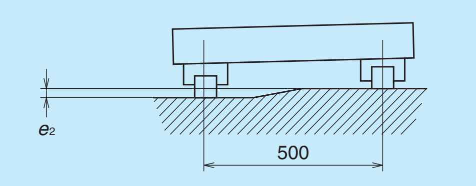


Fig. 7

Table 6

Unit: μm

Value	Preload	Model No.						
		DV15	DV20	DV25	DV30	DV35	DV45	DV55
Permissible values for parallelism error of two rails e_1	Z0	22	30	40	45	55	65	80
	Z1	18	20	25	30	35	45	55
	Z3	13	15	20	25	30	40	45
Permissible values for height error of two rails e_2	Z0	375 μm/500 mm						
	Z1, Z3	330 μm/500 mm						

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

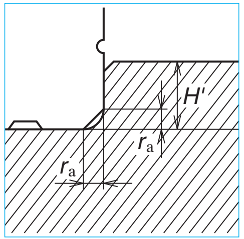


Fig. 8 Shoulder for the rail datum surface

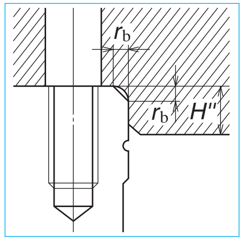


Fig. 9 Shoulder for the ball slide datum surface

Table 7

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H"
DV15	0.5	0.5	4	4
DV20	0.5	0.5	4.5	5
DV25	0.5	0.5	5	5
DV30	0.5	0.5	6	6
DV35	0.5	0.5	6	6
DV45	0.7	0.7	8	8
DV55	0.7	0.7	10	10

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

- Applicable accuracy grades are precision grade (P6) and normal grades (PN) 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.

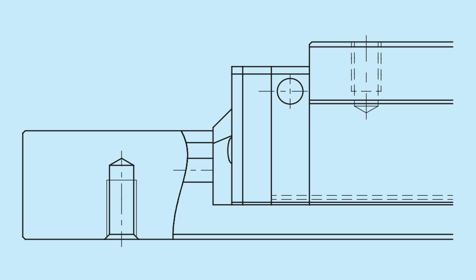


Fig. 10

6. Lubrication components

Refer to pages A58 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 11 and **Table 8** show grease fittings and tube fittings.

We provide lubrication accessories with an extended thread body length (*L*) for the addition of dust-resistant accessories such as NSK K1-L lubrication units, double seals and protectors.

We provide suitable lubrication accesories for special dust-resistant requirements upon request.

NSK can also provide extended length threads for ease of replenishment.

Please contact NSK if stainless lubrication accessories are required.

(2) Mounting position of lubrication accessories

The standard position for grease fittings is at the end face of the ball slide, but we can mount them on the side of the end cap as an option. (**Fig. 12**)

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

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

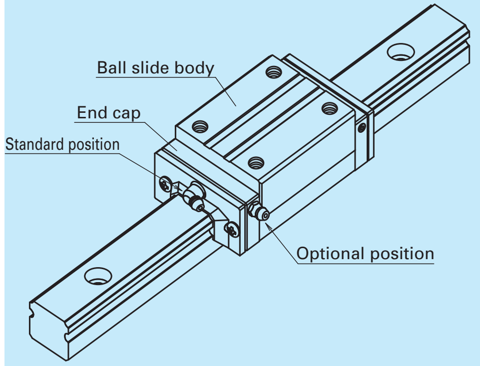


Fig. 12 Mounting position of lubrication accessories

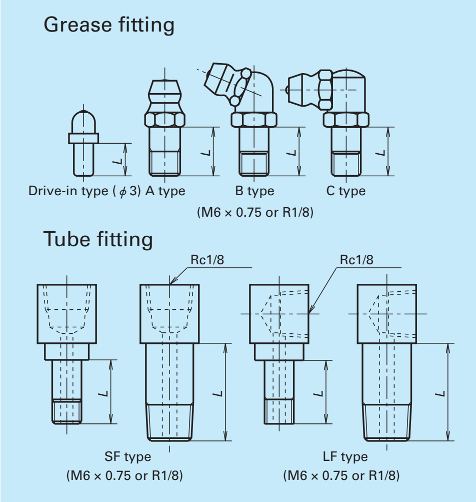


Fig. 11 Grease fitting and tube fitting

Table 8

Unit: mm

Model No.	Dust-resistant specification	Dimension *L*		
		Grease fitting /Drive-in type	Tube fitting	
			SF type	LF type
DV15	Standard*	10	–	–
	Double seal	**	–	–
	Protector	**	–	–
DV20	Standard*	12	–	–
	Double seal	18	–	–
	Protector	18	–	–
DV25	Standard*	12	15	16
	Double seal	18	23	24.5***
	Protector	18	17	18
DV30	Standard*	14	18	17.5
	Double seal	22	25	24.5
	Protector	22	19.5	19
DV35	Standard*	14	15	15
	Double seal	22	25	24.5
	Protector	22	21.5	22
DV45	Standard*	18	22	21.5
	Double seal	22	32	32
	Protector	28	28	30
DV55	Standard*	18	20	20
	Double seal	22	32	32
	Protector	28	28	30

*) NSK K1-L units are mounted as a standard specification for DV models.

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

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

7. Dust-resistant components

(1) Standard specification

Under normal applications, the DV model can be used without modification thanks to its dust resistance. To keep foreign matter from entering inside the ball slide, the DV model has an end seal on both ends and bottom seals at the bottom.
Two NSK K1-L lubrication units, one at each end, are installed as standard.

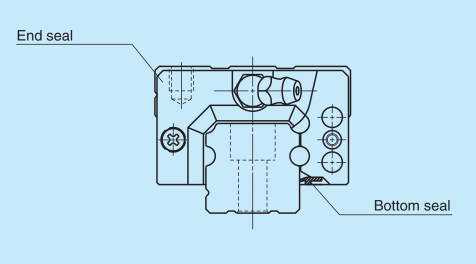


Fig. 13

Table 9 Seal friction per ball slide (maximum value)

Unit: N

Size Model	15	20	25	30	35	45	55
DV	11	13	14	17	23	33	44

(2) Double seal and protector

For DV Models, double-seals and protectors can be installed only before shipping from the factory. Please consult with NSK when double seals or protectors are required.

Table 10 shows the ball slide length when a double seal set and a protector are installed.

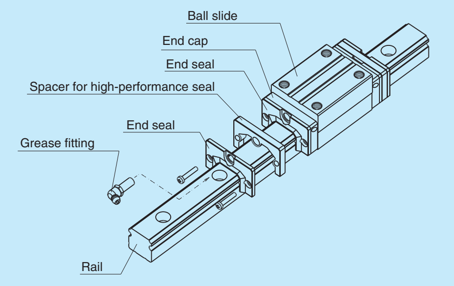


Fig. 14 Double seal

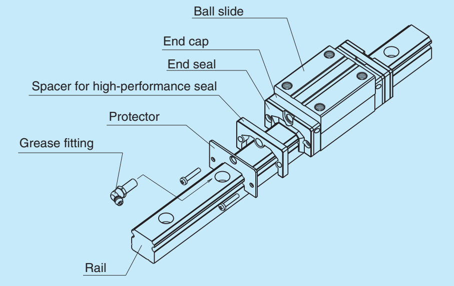


Fig. 15 Protector

Table 10 Dimensions with optional dust-resistant components installed

Unit: mm

Model No.	Ball slide length	Ball slide shape code	Ball slide length *L*		
			Standard	Double seal installation	Protector installation
DV15	Standard type	AN, EM	70.6	81.6	77
	Long type	BN, GM	89.6	100.6	96
DV20	Standard type	AN, EM	87.4	100.4	94.2
	Long type	BN, GM	109.4	122.4	116.2
DV25	Standard type	AN, AL, EM	97	110	104.4
	Long type	BN, BL, GM	125	138	132.4
DV30	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
DV35	Standard type	AN, AL, EM	128.8	144.8	139.2
	Long type	BN, BL, GM	162.8	178.8	173.2
DV45	Standard type	AN, AL, EM	161.4	180.4	174.2
	Long type	BN, BL, GM	193.4	212.4	206.2
DV55	Standard type	AN, AL, EM	185.4	204.4	198.2
	Long type	BN, BL, GM	223.4	242.4	236.2

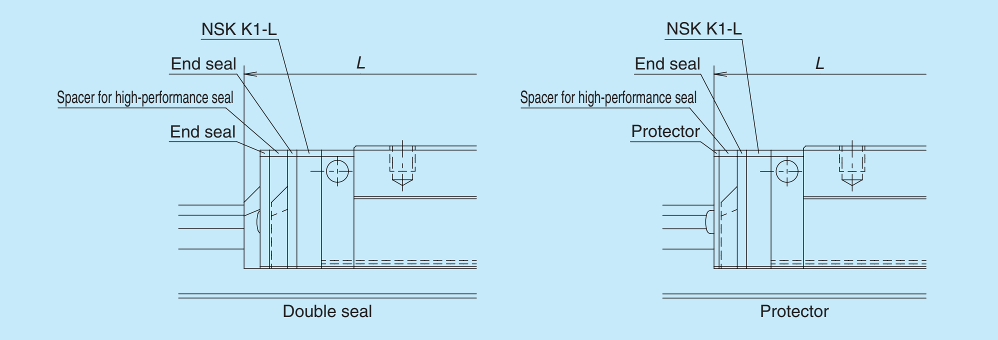


Fig. 16

(3) 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
DV15	M4	LG-CAP/M4	20
DV20	M5	LG-CAP/M5	20
DV25	M6	LG-CAP/M6	20
DV30, DV35	M8	LG-CAP/M8	20
DV45	M12	LG-CAP/M12	20
DV55	M14	LG-CAP/M14	20

(4) Inner seal

Inner seals are only available for the models shown below.

Table 12

Model	Model No.
DV	DV20, DV25, DV30, DV35, DV45, DV55

8. Design Precautions

Because the product is used under severe operating conditions that require high-performance end seals, please inform NSK about your service conditions using the technical data sheet on page A146.

9. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.

Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

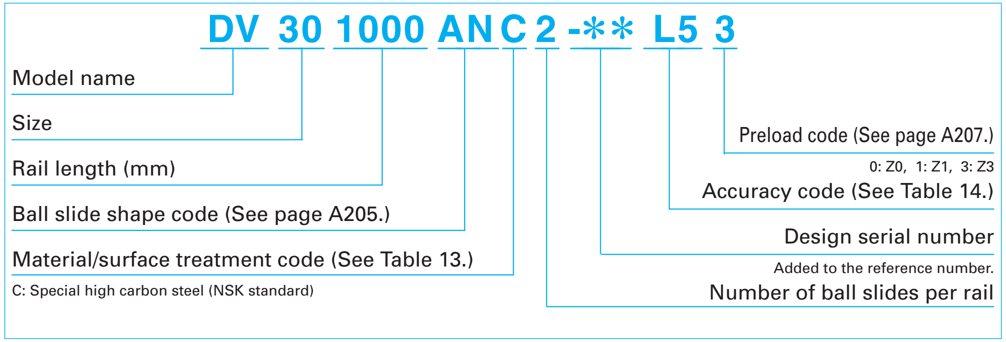


Table 13 Material/surface treatment code

Code	Description
C	Special high carbon steel + counterbores on a rail top surface
D	Special high carbon steel with surface treatment + counterbores on a rail top surface
V	Special high carbon steel + tapped holes on a rail bottom surface
W	Special high carbon steel with surface treatment + tapped holes on a rail bottom surface
Z	Other, special

Table 14 Accuracy code

Accuracy	With NSK K1-L
Ultra precision grade	L3
Super precision grade	L4
High precision grade	L5
Precision grade	L6
Normal grade	LN

Note: Refer to page A58 for details on NSK K1-L lubrication units.

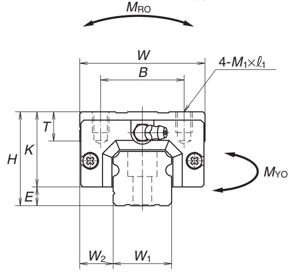
10. Dimensions
DV-AN (High-load / Standard)
DV-BN (Super-high-load / Long)

DV 30 1000 AN C 2 -✻✻ L5 3

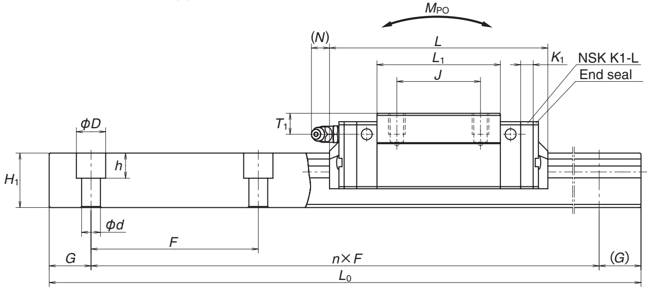
Model name
Size
Rail length (mm)
Ball slide shape code (See page A205.)
Material/surface treatment code (See Table 13.)
C: Special high carbon steel

Preload code (See page A207.)
0: Z0, 1: Z1, 3: Z3
Accuracy code (See Table 14.)
Design serial number
Added to the reference number.
Number of ball slides per rail

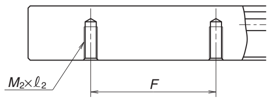
Front view of AN and BN type



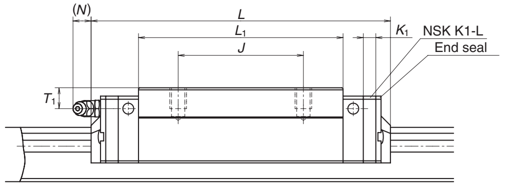
Side view of AN type



Specification for tapped holes on a rail bottom face



Side view of BN type



Unit: mm

Model No.	Assembly			Ball slide												Rail							Basic load ratings								Weight	
	Height			Width	Length	Mounting hole							Grease fitting			Width	Height	Pitch	Mounting bolt hole	Tapped hole	G	Max. length	[3]Dynamic		Static	Static moment (N·m)					Ball slide	Rail
																							[50km]	[100km]		M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	M_1 × pitch × ℓ_1	L_1	K	T	K_1	Hole size	T_1	N	W_1	H_1	F	d × D × h	M_2 × pitch × ℓ_2	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	C_0 (N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
DV15AN **DV15BN**	28	4.6	9.5	34	70.6 ⟨ 77⟩ 89.6 ⟨ 96⟩	26	26	M4×0.7×6	39 58	23.4	8	5.3	ϕ3	8.5	1 ⟨ 8.2⟩	15	15	60	4.5×7.5×5.3	M5×0.8×8	20	2 000	17 800 22 800	14 200 18 100	20 700 32 000	108 166	94.5 216	575 1 150	79.5 181	480 965	0.18 0.26	1.6
DV20AN **DV20BN**	30	5	12	44	87.4 ⟨ 94.2⟩ 109.4 ⟨116.2⟩	32	36 50	M5×0.8×6	50 72	25	12	5.3	M6×0.75	5	11.1 ⟨12.3⟩	20	18	60	6×9.5×8.5	M6×1×10	20	3 960	29 800 38 000	23 700 30 000	32 500 50 500	219 340	185 420	1 140 2 230	155 355	955 1 870	0.33 0.48	2.6
DV25AN **DV25BN**	40	7	12.5	48	97 ⟨104.4⟩ 125 ⟨132.4⟩	35	35 50	M6×1×9	58 86	33	12	5.8	M6×0.75	10	9.6 ⟨12.9⟩	23	22	60	7×11×9	M6×1×12	20	3 960	42 500 57 500	33 500 45 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.55 0.82	3.6
DV30AN **DV30BN**	45	9	16	60	104.4 ⟨114.8⟩ 143.4 ⟨153.8⟩	40	40 60	M8×1.25×10	59 98	36	14	6	M6×0.75	10	11.4 ⟨14.2⟩	28	26	80	9×14×12	M8×1.25×15	20	4 000	51 500 77 000	41 000 61 000	51 500 91 500	490 870	350 1 030	2 290 5 600	292 865	1 920 4 700	0.77 1.3	5.2
DV35AN **DV35BN**	55	9.5	18	70	128.8 ⟨139.2⟩ 162.8 ⟨173.2⟩	50	50 72	M8×1.25×12	80 114	45.5	15	6.5	M6×0.75	15	10.9 ⟨13.7⟩	34	29	80	9×14×12	M8×1.25×17	20	4 000	78 500 102 000	62 500 81 000	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.5 2.1	7.2
DV45AN **DV45BN**	70	14	20.5	86	161.4 ⟨174.2⟩ 193.4 ⟨206.2⟩	60	60 80	M10×1.5×17	105 137	56	17	7.5	Rc1/8	20	12.5 ⟨14.1⟩	45	38	105	14×20×17	M12×1.75×24	22.5	3 990	135 000 164 000	107 000 131 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	3.0 3.9	12.3
DV55AN **DV55BN**	80	15	23.5	100	185.4 ⟨198.2⟩ 223.4 ⟨236.2⟩	75	75 95	M12×1.75×18	126 164	65	18	7.5	Rc1/8	21	12.5 ⟨14.1⟩	53	44	120	16×23×20	M14×2×24	30	3 960	199 000 243 000	158 000 193 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	4.7 6.1	16.9

Notes: 1) Figures inside ⟨ ⟩ apply when equipped with a protector.
2) DV models do not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

3) The basic load ratings comply with the ISO standard. (ISO 14728-1, 14728-2) For long-life DV model, the rated load is multiplied by a coefficient that reflects the effect of life improvement technologies based on these ISO standards.
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.

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

DV 30 1000 AL C 2 -＊＊ L5 3

Model name

Size

Rail length (mm)

Ball slide shape code (See page A205.)

Material/surface treatment code (See Table 13.)

C: Special high carbon steel

Preload code (See page A207.)

0: Z0, 1: Z1, 3: Z3

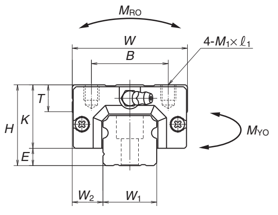
Accuracy code (See Table 14.)

Design serial number

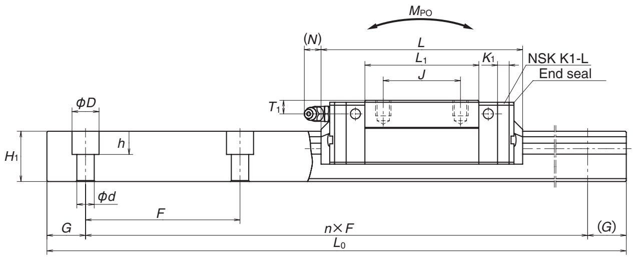
Added to the reference number.

Number of ball slides per rail

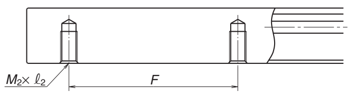
Front view of AL and BL type



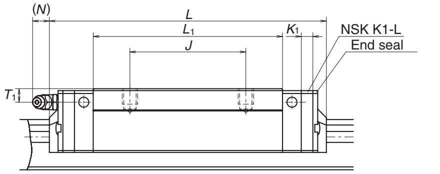
Side view of AL type



Specification for tapped holes on a rail bottom face



Side view of BL type



Unit: mm

Model No.	Assembly			Ball slide													
	Height			Width	Length	Mounting hole							Grease fitting			Width	Height
	H	E	W_2	W	L	B	J	M_1 × pitch × ℓ_1	L_1	K	T	K_1	Hole size	T_1	N	W_1	H_1
DV25AL	36	7	12.5	48	97 〈104.4〉	35	35	M6×1×6	58	29	12	5.8	M6×0.75	6	9.6〈12.9〉	23	22
DV25BL					125 〈132.4〉		50		86								
DV30AL	42	9	16	60	104.4〈114.8〉	40	40	M8×1.25×8	59	33	14	6	M6×0.75	7	11.4〈14.2〉	28	26
DV30BL					143.4〈153.8〉		60		98								
DV35AL	48	9.5	18	70	128.8〈139.2〉	50	50	M8×1.25×8	80	38.5	15	6.5	M6×0.75	8	10.9〈13.7〉	34	29
DV35BL					162.8〈173.2〉		72		114								
DV45AL	60	14	20.5	86	161.4〈174.2〉	60	60	M10×1.5×10	105	46	17	7.5	Rc1/8	10	12.5〈14.1〉	45	38
DV45BL					193.4〈206.2〉		80		137								
DV55AL	70	15	23.5	100	185.4〈198.2〉	75	75	M12×1.75×13	126	55	15	7.5	Rc1/8	11	12.5〈14.1〉	53	44
DV55BL					223.4〈236.2〉		95		164								

Model No.	Rail					Basic load ratings								Weight	
	Pitch	Mounting bolt hole	Tapped hole	G	Max. length	[3] Dynamic		Static	Static moment (N·m)					Ball slide	Rail
						[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}			
	F	d × D × h	M_2 × pitch × ℓ_2	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
DV25AL	60	7×11×9	M6×1×12	20	3 960	42 500	33 500	46 000	360	320	1 840	267	1 540	0.46	3.6
DV25BL						57 500	45 500	71 000	555	725	3 700	610	3 100	0.69	
DV30AL	80	9×14×12	M8×1.25×15	20	4 000	51 500	41 000	51 500	490	350	2 290	292	1 920	0.69	5.2
DV30BL						77 000	61 000	91 500	870	1 030	5 600	865	4 700	1.16	
DV35AL	80	9×14×12	M8×1.25×17	20	4 000	78 500	62 500	80 500	950	755	4 500	630	3 800	1.2	7.2
DV35BL						102 000	81 000	117 000	1 380	1 530	8 350	1 280	7 000	1.7	
DV45AL	105	14×20×17	M12×1.75×24	22.5	3 990	135 000	107 000	140 000	2 140	1 740	9 750	1 460	8 150	2.2	12.3
DV45BL						164 000	131 000	187 000	2 860	3 000	15 600	2 520	13 100	2.9	
DV55AL	120	16×23×20	M14×2×24	30	3 960	199 000	158 000	198 000	3 600	3 000	16 300	2 510	13 700	3.7	16.9
DV55BL						243 000	193 000	264 000	4 850	5 150	26 300	4 350	22 100	4.7	

Notes: 1) Figures inside 〈 〉 apply when equipped with a protector.
2) DV models do not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

[3] The basic load ratings comply with the ISO standard. (ISO 14728-1, 14728-2) For long-life DV model, the rated load is multiplied by a coefficient that reflects the effect of life improvement technologies based on these ISO standards.
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.

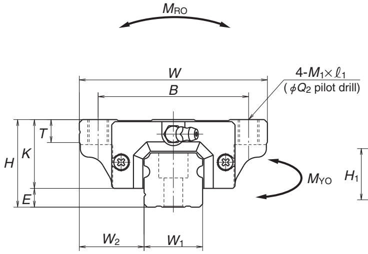
DV-EM (High-load / Standard)
DV-GM (Super-high-load / Long)

DV 30 1000 EM C 2 - L5 3**

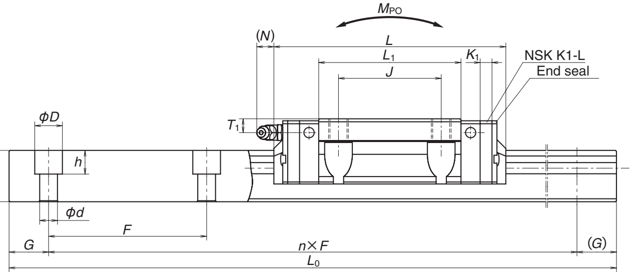
Model name
Size
Rail length (mm)
Ball slide shape code (See page A205.)
Material/surface treatment code (See Table 13.)
C: Special high carbon steel

Preload code (See page A207.)
0: Z0, 1: Z1, 3: Z3
Accuracy code (See Table 14.)
Design serial number
Added to the reference number.
Number of ball slides per rail

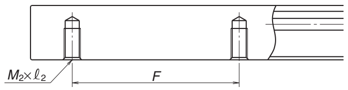
Front view of EM and GM type



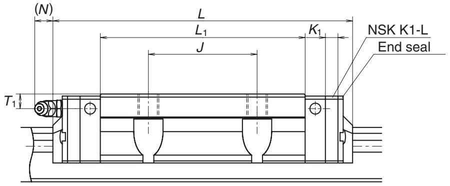
Side view of EM type



Specification for tapped holes on a rail bottom face



Side view of GM type



Unit: mm

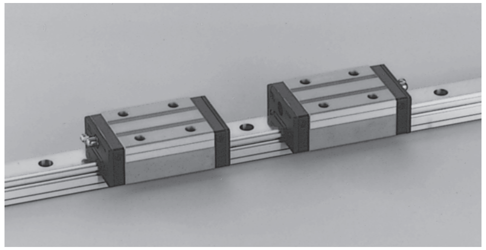
Model No.	Assembly			Ball slide														
	Height			Width	Length	Mounting hole								Grease fitting			Width	Height
	H	E	W_2	W	L	B	J	M_1×pitch×ℓ_1	Q_2	L_1	K	T	K_1	Hole size	T_1	N	W_1	H_1
DV15EM **DV15GM**	24	4.6	16	47	70.6〈 77〉 89.6〈 96〉	38	30	M5×0.8×7	4.4	39 58	19.4	8	5.3	ϕ3	4.5	1 〈 8.2〉	15	15
DV20EM **DV20GM**	30	5	21.5	63	87.4〈 94.2〉 109.4〈116.2〉	53	40	M6×1×9.5	5.3	50 72	25	10	5.3	M6×0.75	5	11.1〈12.3〉	20	18
DV25EM **DV25GM**	36	7	23.5	70	97 〈104.4〉 125 〈132.4〉	57	45	M8×1.25×10	6.8	58 86	29	11	5.8	M6×0.75	6	9.6〈12.9〉	23	22
DV30EM **DV30GM**	42	9	31	90	117.4〈127.8〉 143.4〈153.8〉	72	52	M10×1.5×12	8.6	72 98	33	11	6	M6×0.75	7	11.4〈14.2〉	28	26
DV35EM **DV35GM**	48	9.5	33	100	128.8〈139.2〉 162.8〈173.2〉	82	62	M10×1.5×13	8.6	80 114	38.5	12	6.5	M6×0.75	8	10.9〈13.7〉	34	29
DV45EM **DV45GM**	60	14	37.5	120	161.4〈174.2〉 193.4〈206.2〉	100	80	M12×1.75×15	10.5	105 137	46	13	7.5	Rc1/8	10	12.5〈14.1〉	45	38
DV55EM **DV55GM**	70	15	43.5	140	185.4〈198.2〉 223.4〈236.2〉	116	95	M14×2×18	12.5	126 164	55	15	7.5	Rc1/8	11	12.5〈14.1〉	53	44

Model No.	Rail					Basic load ratings								Weight	
	Pitch	Mounting bolt hole	Tapped hole	G	Max. length	3)Dynamic		Static	Static moment (N·m)					Ball slide	Rail
	F	d×D×h	M_2×pitch×ℓ_2	(reference)	L_{0max}	[50km] C_{50}(N)	[100km] C_{100}(N)	C_0 (N)	M_{RO}	M_{PO}		M_{YO}		(kg)	(kg/m)
										One slide	Two slides	One slide	Two slides		
DV15EM **DV15GM**	60	4.5×7.5×5.3	M5×0.8×8	20	2 000	17 800 22 800	14 200 18 100	20 700 32 000	108 166	94.5 216	575 1 150	79.5 181	480 965	0.17 0.25	1.6
DV20EM **DV20GM**	60	6×9.5×8.5	M6×1×10	20	3 960	29 800 38 000	23 700 30 000	32 500 50 500	219 340	185 420	1 140 2 230	155 355	955 1 870	0.45 0.65	2.6
DV25EM **DV25GM**	60	7×11×9	M6×1×12	20	3 960	42 500 57 500	33 500 45 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.63 0.93	3.6
DV30EM **DV30GM**	80	9×14×12	M8×1.25×15	20	4 000	59 000 77 000	47 000 61 000	63 000 91 500	600 870	505 1 030	3 150 5 600	425 865	2 650 4 700	1.2 1.6	5.2
DV35EM **DV35GM**	80	9×14×12	M8×1.25×17	20	4 000	78 500 102 000	62 500 81 000	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.7 2.4	7.2
DV45EM **DV45GM**	105	14×20×17	M12×1.75×24	22.5	3 990	135 000 164 000	107 000 131 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	3.0 3.9	12.3
DV55EM **DV55GM**	120	16×23×20	M14×2×24	30	3 960	199 000 243 000	158 000 193 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	5.0 6.5	16.9

Notes: 1) Figures inside 〈 〉 apply when equipped with a protector.
2) DV models do not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

3) The basic load ratings comply with the ISO standard. (ISO 14728-1, 14728-2) For long-life DV model, the rated load is multiplied by a coefficient that reflects the effect of life improvement technologies based on these ISO standards.
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-4-2.3 DS Model



1. Features

(1) Double the life of standard linear guides

DS model is based on our proven, highly reliable standard NS model that feature an optimized groove shape. Applying our special TF heat treatment achieves even longer life.

What is TF (Tough) Technology?

NSK's TF technology is an exclusive heat treatment developed and cultivated over years of experience with rolling bearings and materials. TF technology helps suppress surface flaking on the raceway.

Load ratings are 1.25 times higher and service life is doubled compared to conventional NS model[*1]. DS linear guide offers greatly improved life at the same size and equal or longer life to the next smallest conventional model, allowing for equipment downsizing.

*1: Representative values for model.

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

By reexamining the design for the ball circulation path, we have attained smooth ball circulation and reduced noise. DS models are suited for high-speed applications same as NS models.

(3) All mounting dimensions are the same as the NS Model

The dimensions surrounding the mounting (assembled dimensions), such as mounting height, width, mounting hole diameter/pitch, etc. of the DS model are identical to the NS model, allowing for easy replacement without design changes.

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

Similar to a DF arrangement of angular contact bearings, DS models offer large self-aligning capability with the internal intersection of the contact lines of the balls and grooves reducing moment rigidity.

This increases the capacity to absorb errors in installation.

(5) High vertical load carrying capacity

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

(6) High resistance against impact load

The bottom ball groove forms a Gothic arch and the center of the top and bottom grooves are offset as shown in **Fig. 2**.

Vertical load is generally carried by the top rows at two contact points, but with this design, the bottom rows also carry load when a large impact load is applied vertically as shown in **Fig. 3**. This assures high resistance to impact load.

(7) High accuracy

As shown in **Fig. 4**, fixing the measuring rollers to the ball grooves is simple thanks to the Gothic arch groove. This makes for 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 variations and sizes

The DS model comes in several sizes and ball slide shapes, allowing for use in a variety of applications.

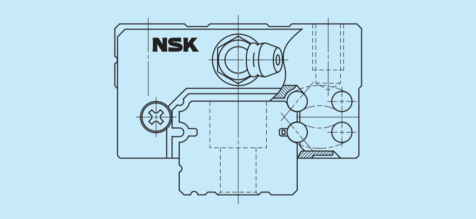


Fig. 1 DS Model

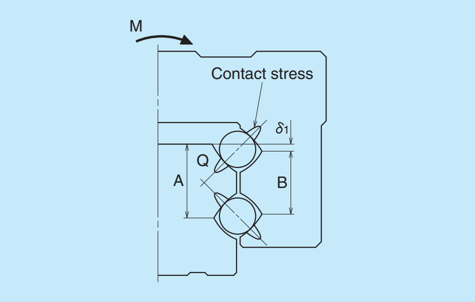


Fig. 2 Enlarged illustration of the offset Gothic arch groove

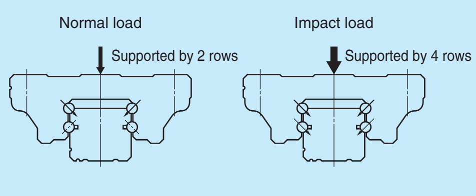


Fig. 3 When load is applied

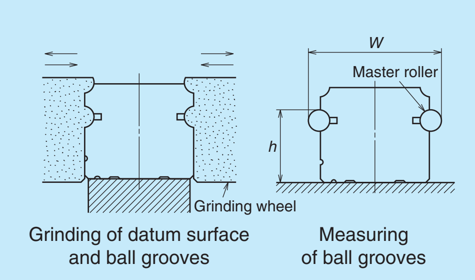
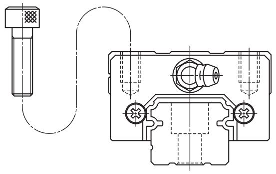
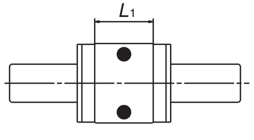
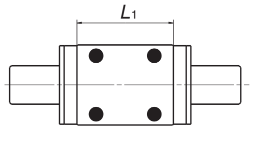
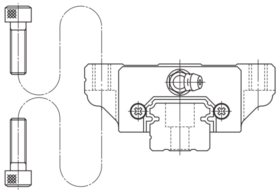
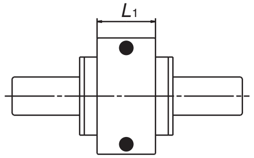
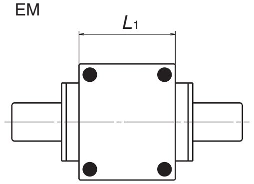


Fig. 4 Rail-grinding and measuring

2. Ball slide shape

Ball slide shape code	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		Medium-load	High-load
		Standard	Long
AL CL		CL 	AL 
EM JM		JM 	EM 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm) over	Rail length (mm) or less	Preloaded assembly: Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
–	50	2	2	2	4	5
50 –	80	2	2	3	4	5
80 –	125	2	2	3	4	5
125 –	200	2	2	3.5	5	6
200 –	250	2	2.5	4.5	6	7.5
250 –	315	2	2.5	5	6.5	8.5
315 –	400	2	3	5.5	7	9.5
400 –	500	2	3	6	7.5	11
500 –	630	2	3.5	6.5	8.5	12
630 –	800	2	4	7	9.5	13
800 –	1 000	2.5	4.5	7.5	10	15
1 000 –	1 250	3	5	8.5	12	16
1 250 –	1 600	3.5	5.5	9.5	13	17
1 600 –	2 000	4	6.5	11	14	19
2 000 –	2 500	4.5	7.5	12	16	21
2 500 –	3 150	5.5	8.5	13	18	23
3 150 –	4 000	6	9.5	14	19	25

(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.

- **Tolerance of preloaded assembly**

Table 2

Unit: μm

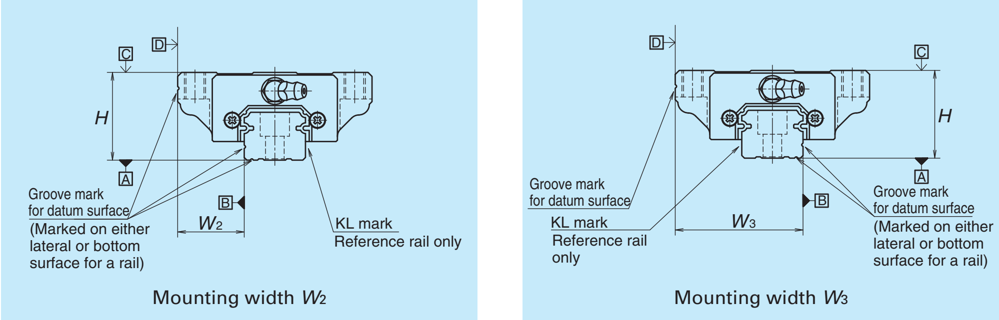
Characteristics \ Accuracy grade	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height H Variation of H (All ball slides on a set of rails)	±8 3	±10 5	±20 7	±40 15	±80 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±10 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**				

(3) Combinations of accuracy and preload

Table 3

		Accuracy grade: Ultra precision	Super precision	High precision	Precision grade	Normal grade
Without NSK K1-L lubrication unit		P3	P4	P5	P6	PN
With NSK K1-L lubrication unit		L3	L4	L5	L6	LN
With NSK K1 for food and medical equipment		F3	F4	F5	F6	FN
Preload	Fine clearance Z0	○	○	○	○	○
	Slight preload Z1	○	○	○	○	○
	Medium preload Z3	○	○	○	○	—

(4) Assembled accuracy



Mounting width W_2

Mounting width W_3

Fig. 5

(5) Preload and rigidity

We offer three levels of preload: Slight preload Z1, Medium preload Z3 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	Medium preload Z3	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3
High-load	DS15 AL, EM	69	390	127	226	88	167
	DS20 AL, EM	88	540	147	284	108	206
	DS25 AL, EM	147	880	206	370	147	275
	DS30 AL, EM	245	1 370	255	460	186	345
	DS35 AL, EM	345	1 960	305	550	216	400
Medium-load	DS15 CL, JM	49	294	78	147	59	108
	DS20 CL, JM	69	390	108	186	78	137
	DS25 CL, JM	98	635	127	235	88	177
	DS30 CL, JM	147	980	147	275	108	206
	DS35 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.

4. Maximum rail length

Table 5 shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grade.

Table 5 Length limitations of rails

Unit: mm

Model	Size / Material	15	20	25	30	35
DS	Special high carbon steel	2 920	3 960	3 960	4 000	4 000

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

5. Installation

(1) Permissible values of mounting error

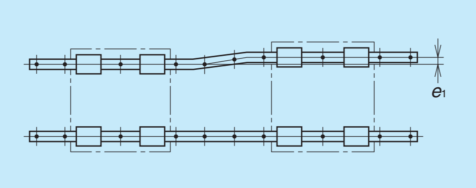


Fig. 6

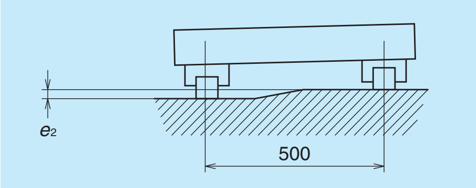


Fig. 7

Table 6

Unit: μm

Value	Preload	Model No.				
		DS15	DS20	DS25	DS30	DS35
Permissible values for parallelism error of two rails e_1	Z0	20	22	30	35	40
	Z1	15	17	20	25	30
	Z3	12	15	15	20	25
Permissible values for height error of two rails e_2	Z0	375 μm/500 mm				
	Z1, Z3	330 μm/500 mm				

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

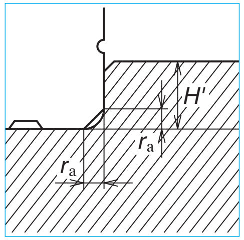


Fig. 8 **Shoulder for the rail datum surface**

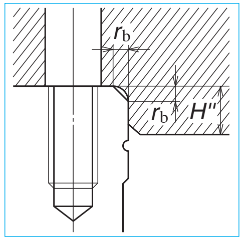


Fig. 9 **Shoulder for the ball slide datum surface**

Table 7

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
DS15	0.5	0.5	4	4
DS20	0.5	0.5	4.5	5
DS25	0.5	0.5	5	5
DS30	0.5	0.5	6	6
DS35	0.5	0.5	6	6

6. Maximum allowable speed

Table 8 indicates the maximum allowable speed for 10,000 km operation when using an DS model under normal conditions. 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 8 Maximum allowable speed

Unit: m/min

Model / Size	15	20	25	30	35
DS	300				

7. Lubrication components

Refer to pages A58 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 10 and **Table 9** show grease fittings and tube fittings.

We provide lubrication accessories with an extended thread body length (*L*) for the addition of dust-resistant accessories such as NSK K1-L lubrication units, double seals and protectors.

We provide suitable lubrication accesories for special dust-resistant requirements upon request.

NSK can also provide extended length threads for ease of replenishment.

Please contact NSK if stainless lubrication accessories are required.

(2) Mounting position of lubrication accessories

The standard position for grease fittings is at the end face of the ball slide, but we can mount them on the side of the end cap as an option. (**Fig. 11**)

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

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

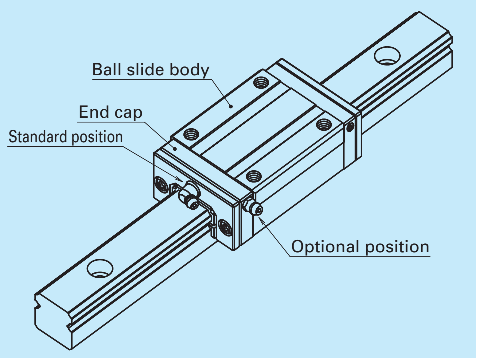


Fig. 11 Mounting position of lubrication accessories

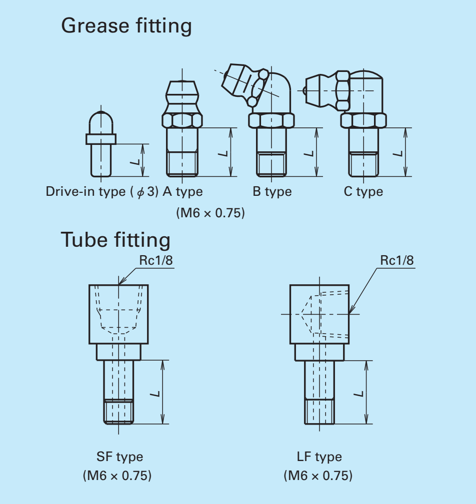


Fig. 10 Grease fitting and tube fitting

Table 9 Unit: mm

Model No.	Dust-resistant specification	Dimension *L*		
		Grease fitting /Drive-in type	Tube fitting	
			SF type	LF type
DS15	Standard	5	–	–
	With NSK K1-L	10	–	–
	Double seal	*	–	–
	Protector	*	–	–
DS20	Standard	5	–	–
	With NSK K1-L	10	–	–
	Double seal	8	–	–
	Protector	8	–	–
DS25	Standard	5	6	6
	With NSK K1-L	12	11	11
	Double seal	10	9	9
	Protector	10	9	9
DS30	Standard	5	6	6
	With NSK K1-L	14	12	13
	Double seal	12	10	11
	Protector	12	10	11
DS35	Standard	5	6	6
	With NSK K1-L	14	12	13
	Double seal	12	10	11
	Protector	12	10	11

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

8. Dust-resistant components

(1) Standard specification

Under normal applications, the DS model can be used without modification thanks to its dust resistance. As standard equipment, the ball slides have an end seal on both ends, and bottom seals at the bottom.

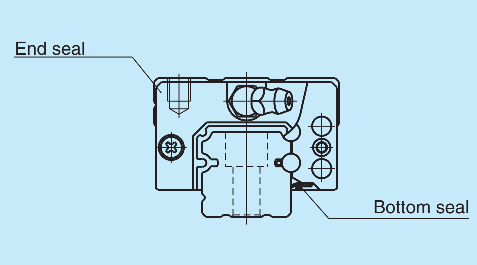


Fig. 12

Table 10 Seal friction per ball slide (maximum value)
Unit: N

Model \ Size	15	20	25	30	35
DS	8	9	9	9	10

(2) NSK K1-L™ and NSK K1™ lubrication units for food processing machinery/ medical equipment

Table 11 shows linear guide dimensions when equipped with NSK K1-L lubrication units.

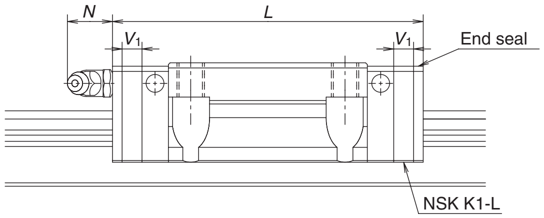


Table 11 Dimensions when equipped with NSK K1-L lubrication units Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1-L units *L*	Thickness of single NSK K1-L unit V_1	Protrusion of grease fitting *N*
DS15	Standard	AL, EM	56.8	66.4	4.8	(5)
	Short	CL, JM	40.4	50		
DS20	Standard	AL, EM	65.2	75.8	5.3	(14)
	Short	CL, JM	47.2	57.8		
DS25	Standard	AL, EM	81.6	92.2	5.3	(14)
	Short	CL, JM	59.6	70.2		
DS30	Standard	AL, EM	96.4	108.4	6	(14)
	Short	CL, JM	67.4	79.4		
DS35	Standard	AL, EM	108	121	6.5	(14)
	Short	CL, JM	77	90		

Notes: 1) When using NSK K1 for food processing machinery/medical equipment, refer toTable 12.
2) Slide length when equipped with NSK K1-L = (standard ball slide length) + (V_1 thickness of single NSK K1-L unit) × (number of K1-L units).

Table 12 shows linear guide dimensions when equipped with NSK K1 for food processing machinery/medical equipment.

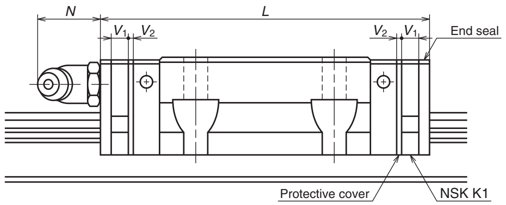


Table 12 Dimensions when equipped with NSK K1 for food processing machinery/medical equipment

Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1 V_1	Protective cover thickness V_2	Protrusion of grease fitting N
DS15	Standard	AL, EM	56.8	66.4	4.0	0.8	(5)
	Short	CL, JM	40.4	50			
DS20	Standard	AL, EM	65.2	75.8	4.5	0.8	(14)
	Short	CL, JM	47.2	57.8			
DS25	Standard	AL, EM	81.6	92.2	4.5	0.8	(14)
	Short	CL, JM	59.6	70.2			
DS30	Standard	AL, EM	96.4	108.4	5.0	1.0	(14)
	Short	CL, JM	67.4	79.4			
DS35	Standard	AL, EM	108	121	5.5	1.0	(14)
	Short	CL, JM	77	90			

Note: Slide length when equipped with NSK K1 for food processing machinery/medical equipment = (standard ball slide length) + (V_1 thickness of single NSK K1 unit) × (number of K1 units) + (V_2 thickness of the protective cover) × 2.

(3) Double seal

Use a double seal set as shown in **Table 13** when installing an extra seal to completed standard products. (**Fig. 13**)

When installing a grease fitting after the installation of double seals, a connector as shown in **Fig.14** is required.

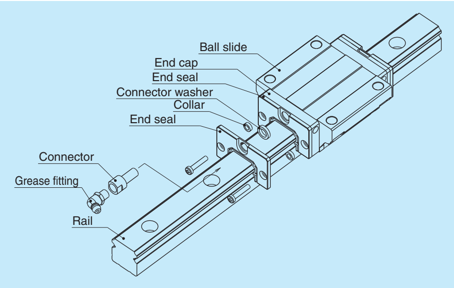


Fig. 13 Double seal

(4) Protector

Use a protector set as shown in **Table 14** when installing a protector to completed standard products. (**Fig. 14**)

When installing a grease fitting after the installation of protectors, a connector as shown in **Fig. 14** is required.

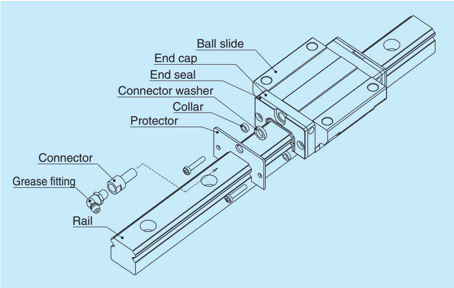


Fig. 14 Protector

Table 13 Double seal set

Model No.	Reference No.		Increased thickness V_3 (mm)
	Without connector	With connector	
DS15	LS15WS-01	*	2.8
DS20	LS20WS-01	LS20WSC-01	2.5
DS25	LS25WS-01	LS25WSC-01	2.8
DS30	LS30WS-01	LS30WSC-01	3.6
DS35	LS35WS-01	LS35WSC-01	3.6

Table 14 Protector set

Model No.	Reference No.		Increased thickness V_4 (mm)
	Without connector	With connector	
DS15	LS15PT-01	*	3
DS20	LS20PT-01	LS20PTC-01	2.7
DS25	LS25PT-01	LS25PTC-01	3.2
DS30	LS30PT-01	LS30PTC-01	4.2
DS35	LS35PT-01	LS35PTC-01	4.2

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

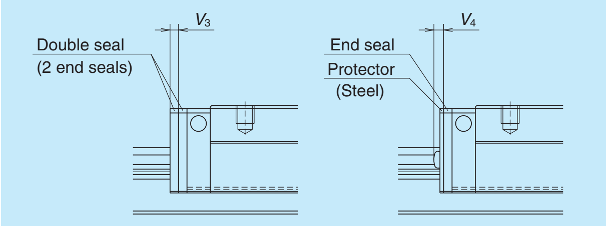


Fig. 15

(5) Caps 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
DS15	M3	LG-CAP/M3	20
DS15	M4	LG-CAP/M4	20
DS20	M5	LG-CAP/M5	20
DS25, DS30	M6	LG-CAP/M6	20
DS35	M8	LG-CAP/M8	20

(6) Bellows

- A bellows fastener kit, which includes one bellows faster, two M_1 set screws, two M_2 set screws, and two collars for M_2 set screws as shown in Fig. 7.7 on page A69, is supplied with bellows for the ends.
- Middle bellows are supplied with four set screws and four collars.
- Use a bellows fastener kit as shown in **Table 16**, when installing bellows to completed standard products.
- When NSK K1-L units, NSK K1 for food and medical equipment, double seals, or protectors are used, the set screws of bellows fastener kits cannot be used.
  Please contact NSK for details.
- Bellows fasteners are available only for horizontal mounting positions; other mounting positions require a sliding plate (see **Fig. 7.10** on page A70).

To fix the bellows to the rail, make tap holes on the rail end surface. Fix the bellows mounting plate to the rail end surface through these tap holes with a machine screw. NSK prepares tap holes on the rail end surface when bellows are ordered with a linear guide.

Table 16 Bellows fastner kit reference No.

Model No.	Kit reference No.
DS15	LS15FS-01
DS20	LS20FS-01
DS25	LS25FS-01
DS30	LS30FS-01
DS35	LS35FS-01

Dimension tables for bellows
DS Model

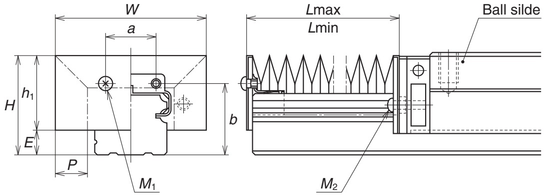


Fig. 16 Dimensions of bellows

Bellows reference number

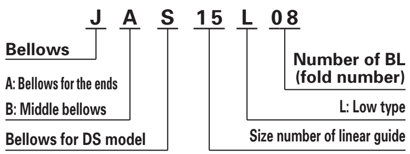


Table 17 Dimensions of bellows

Unit: mm

Model No.	H	h_1	E	W	P	a	b	BL minimum length	M_1Tap x depth	M_2Tap x depth
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 18 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 both sides, then by dividing the sum by 2.

9. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.

Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

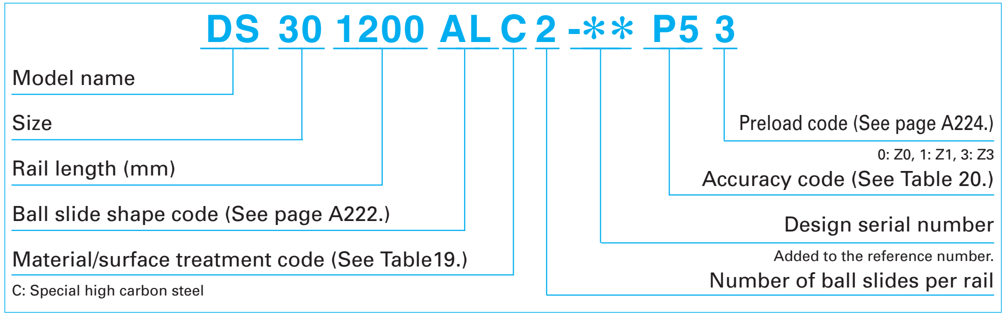


Table 19 Material/surface treatment code

Code	Description
C	Special high carbon steel
D	Special high carbon steel with surface treatment
Z	Other, special

Table 20 Accuracy code

Accuracy	Standard (Without NSK K1-L)	With NSK K1-L	With NSK K1 for food and medical equipment
Ultra precision grade	P3	L3	F3
Super precision grade	P4	L4	F4
High precision grade	P5	L5	F5
Precision grade	P6	L6	F6
Normal grade	PN	LN	FN

Note: Refer to page A58 for details on NSK K1-L lubrication units and to page A73 for details on NSK K1 lubricaiton units for food processing machinery/medical equipment.

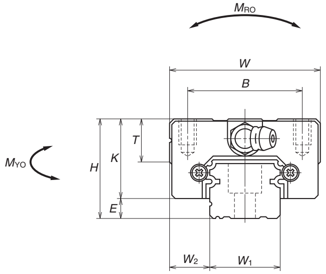
10. Dimensions
DS-CL (Medium-load / Short)
DS-AL (High-load / Standard)

DS 30 1200 AL C 2 -** P5 3

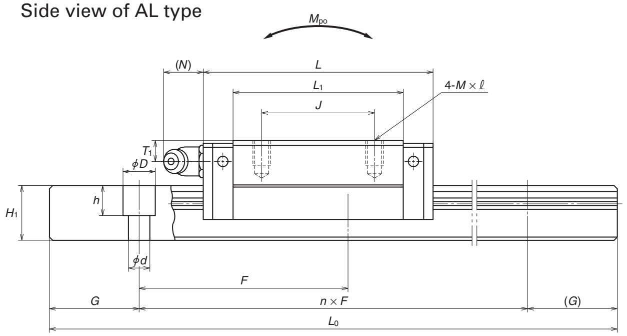
Model name
Size
Rail length (mm)
Ball slide shape code (See page A222.)
Material/surface treatment code (See Table 19.)
C: Special high carbon steel

Preload code (See page A224.)
0: Z0, 1: Z1, 3: Z3
Accuracy code (See Table 20.)
Design serial number
Added to the reference number.
Number of ball slides per rail

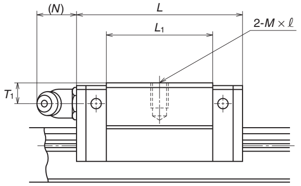
Front view of AL and CL type



Side view of AL type



Side view of CL type



Unit: mm

Model No.	Assembly			Ball slide													Rail				Basic load ratings								Weight	
	Height			Width	Length	Mounting hole						Grease fitting			Width	Height	Pitch	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}			
	H	E	W_2	W	L	B	J	M × pitch × ℓ	L_1	K	T	Hole size	T_1	N	W_1	H_1	F	d × D × h	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
DS15CL **DS15AL**	24	4.6	9.5	34	40.4 56.8	26	— 26	M4×0.7×6	23.6 40	19.4	10	ϕ3	6	3	15	12.5	60	*4.5×7.5×5.3 3.5×6×4.5	20	2 920	9 150 14 100	7 250 11 200	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
DS20CL **DS20AL**	28	6	11	42	47.2 65.2	32	— 32	M5×0.8×7	30 48	22	12	M6×0.75	5.5	11	20	15.5	60	6×9.5×8.5	20	3 960	13 400 19 700	10 600 15 600	13 400 23 500	91.5 160	46.5 133	330 755	39 111	279 630	0.19 0.28	2.3
DS25CL **DS25AL**	33	7	12.5	48	59.6 81.6	35	— 35	M6×1×9	38 60	26	12	M6×0.75	7	11	23	18	60	7×11×9	20	3 960	22 300 33 000	17 700 26 100	20 800 36 500	164 286	91 258	655 1 470	76 217	550 1 230	0.34 0.51	3.1
DS30CL **DS30AL**	42	9	16	60	67.4 96.4	40	— 40	M8×1.25×12	42 71	33	13	M6×0.75	8	11	28	23	80	7×11×9	20	4 000	31 000 48 000	24 700 38 000	29 600 55 000	282 520	139 435	1 080 2 650	116 365	905 2 220	0.58 0.85	4.8
DS35CL **DS35AL**	48	10.5	18	70	77 108	50	— 50	M8×1.25×12	49 80	37.5	14	M6×0.75	8.5	11	34	27.5	80	9×14×12	20	4 000	43 000 66 500	34 500 52 500	40 000 74 500	465 865	220 695	1 670 4 000	185 580	1 400 3 350	0.86 1.3	7.0

Note: 1) The basic load ratings comply with the ISO standard. (ISO 14728-1, 14728-2) For long-life DS model, the rated load is multiplied by a coefficient that reflects the effect of life improvement technologies based on these ISO standards.
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.

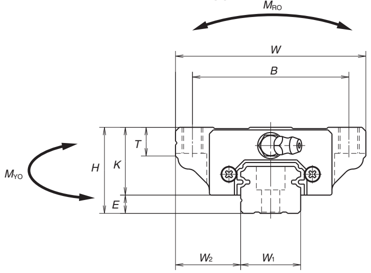
* Standard mounting hole of DS15 rail is for M4 bolts (Hole size: 4.5 × 7.5 × 5.3).
If you require mounting hole for M3 bolts (Hole size: 3.5 × 6 × 4.5), please specify when ordering.

DS-JM (Medium-load / Short)
DS-EM (High-load / Standard)

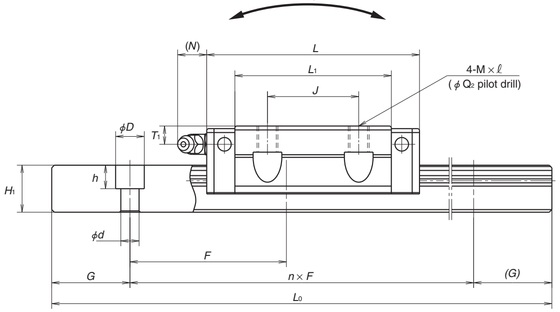
DS 30 1200 EM C 2 -＊＊ P5 3

Model name: DS
Size: 30
Rail length (mm): 1200
Ball slide shape code (See page A222.): EM
Material/surface treatment code (See Table 19.): C
C: Special high carbon steel
Number of ball slides per rail: 2
Design serial number: -＊＊
Added to the reference number.
Accuracy code (See Table 20.): P5
Preload code (See page A224.): 3
0: Z0, 1: Z1, 3: Z3

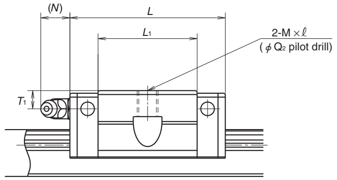
Front view of EM and JM type



Side view of EM type



Side view of JM type



Unit: mm

Model No.	Assembly			Ball slide													
	Height			Width	Length	Mounting hole							Grease fitting			Width	Height
	H	E	W_2	W	L	B	J	M × pitch × ℓ	Q_2	L_1	K	T	Hole size	T_1	N	W_1	H_1
DS15JM **DS15EM**	24	4.6	18.5	52	40.4 56.8	41	— 26	M5×0.8×7	4.4	23.6 40	19.4	8	φ3	6	3	15	12.5
DS20JM **DS20EM**	28	6	19.5	59	47.2 65.2	49	— 32	M6×1×9	5.3	30 48	22	10	M6×0.75	5.5	11	20	15.5
DS25JM **DS25EM**	33	7	25	73	59.6 81.6	60	— 35	M8×1.25×10	6.8	38 60	26	11	M6×0.75	7	11	23	18
DS30JM **DS30EM**	42	9	31	90	67.4 96.4	72	— 40	M10×1.5×12	8.6	42 71	33	11	M6×0.75	8	11	28	23
DS35JM **DS35EM**	48	10.5	33	100	77 108	82	— 50	M10×1.5×13	8.6	49 80	37.5	12	M6×0.75	8.5	11	34	27.5

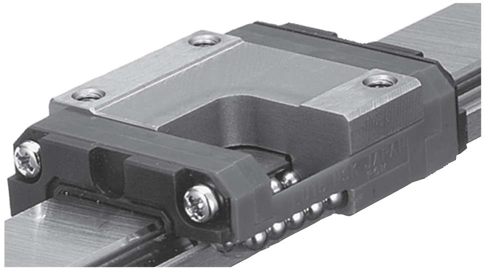
Model No.	Rail				Basic load ratings								Weight	
	Pitch	Mounting bolt hole	G	Max. length	1)Dynamic		Static	Static moment (N·m)					Ball slide	Rail
					[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}			
	F	d × D × h	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
DS15JM **DS15EM**	60	＊4.5×7.5×5.3 3.5×6×4.5	20	2 920	9 150 14 100	7 250 11 200	9 100 16 900	45.5 84.5	24.5 77	196 470	20.5 64.5	165 395	0.17 0.26	1.4
DS20JM **DS20EM**	60	6×9.5×8.5	20	3 960	13 400 19 700	10 600 15 600	13 400 23 500	91.5 160	46.5 133	330 755	39 111	279 630	0.24 0.35	2.3
DS25JM **DS25EM**	60	7×11×9	20	3 960	22 300 33 000	17 700 26 100	20 800 36 500	164 286	91 258	655 1 470	76 217	550 1 230	0.44 0.66	3.1
DS30JM **DS30EM**	80	7×11×9	20	4 000	31 000 48 000	24 700 38 000	29 600 55 000	282 520	139 435	1 080 2 650	116 365	905 2 220	0.76 1.2	4.8
DS35JM **DS35EM**	80	9×14×12	20	4 000	43 000 66 500	34 500 52 500	40 000 74 500	465 865	220 695	1 670 4 000	185 580	1 400 3 350	1.2 1.7	7

Note: 1) The basic load ratings comply with the ISO standard. (ISO 14728-1, 14728-2) For long-life DS model, the rated load is multiplied by a coefficient that reflects the effect of life improvement technologies based on these ISO standards.
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.

＊ Standard mounting hole of DS15 rail is for M4 bolts (Hole size: 4.5 × 7.5 × 5.3).
If you require mounting hole for M3 bolts (Hole size: 3.5 × 6 × 4.5), please specify when ordering.

A-4-3 Miniature Series

A-4-3.1 PU Model (Miniature type)



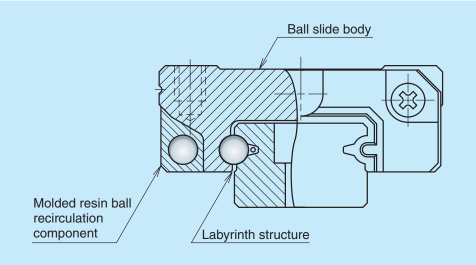


Fig. 1

1. Features

(1) Motion performance

A newly designed recirculation component facilitates smooth circulation of steel balls.

(2) Lightweight

The ball slide is approximately 20% lighter than the LU Model thanks to resin parts incorporated into its design.

(3) Reduced noise intensity

Resin parts used in ball recirculation components reduce collision noise between the steel balls and inner wall.

(4) Excellent dust resistance

PU model linear guides are designed to minimize the clearance between the rail sides and slide inner walls to help prevent foreign matter from entering.

(5) High corrosion resistance

Highly corrosion-resistant martensite stainless steel comes standard, providing excellent resistance to corrosion.

(6) Easy to handle

Designed for safety with a retainer that prevents steel balls from dropping out of the ball slide even when the slide is removed from the rail.

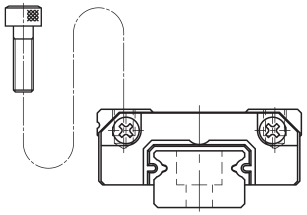
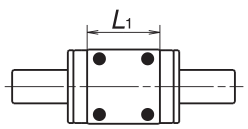
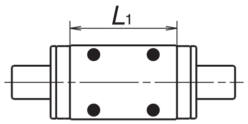
(7) Long-term, maintenance-free operation

PU model guides equipped with the NSK K1 lubrication units realize long term, maintenance-free operation.

(8) Fast delivery

A lineup of interchangeable rails and ball slides facilitates fast delivery.

2. Ball slide shape

Ball slide shape code	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		Standard load	High-load
		Standard	Long
AR TR AL UR BL		TR, AR, AL  	UR, BL 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm)		Preloaded assembly type (not interchangeable)				Interchangeable type
		Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC
over	or less					
–	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 interchangeable 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 interchangeable 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	Shown in **Table 1** and **Fig. 2**			

• Tolerance of interchangeable 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

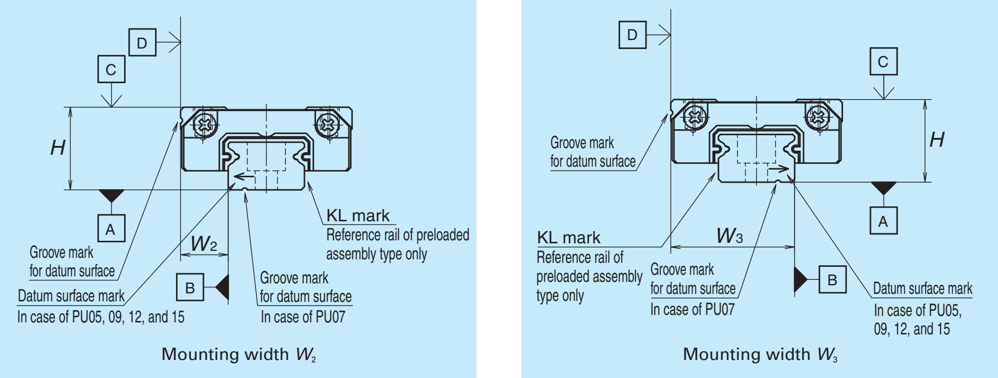


Fig. 2

Note: Please refer to page A77 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 interchangeable 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	PU09TR	0 – 10	30
	PU12TR	0 – 17	33
	PU15AL	0 – 33	45
High-load	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 interchangeable type

Table 5

Unit: μm

	Model No.	Fine clearance ZT
Standard	PU09TR	3 or less
	PU12TR	
	PU15AL	
High-load	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

Model	Material \ Size	09	12	15
PU	Stainless steel	600	800	1 000

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

5. Installation

(1) Permissible values of mounting error

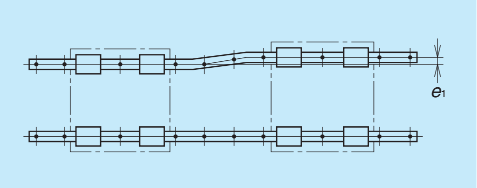


Fig. 3

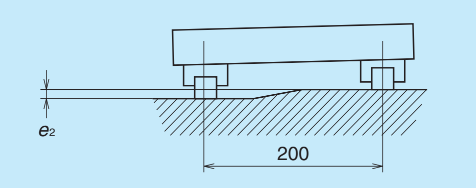


Fig. 4

Table 7 Unit: µm

Value	Preload	Model No.		
		PU09	PU12	PU15
Permissible values for parallelism error of two rails e_1	Z0, ZT	15	20	25
	Z1	13	15	21
Permissible values for height error of 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

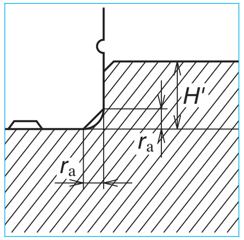


Fig. 5 Shoulder for the rail datum surface

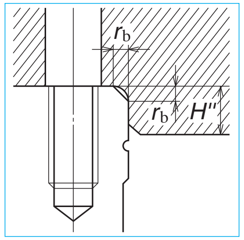


Fig. 6 Shoulder for the ball slide datum surface

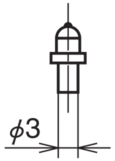
Table 8 Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''*
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 dimension T in the dimension tables.

6. Lubrication accessories

A drive-in grease fitting can be selected as an option for model PU15.
For models PU09 to PU12, apply grease directly to the rail ball grooves using a point nozzle.



Drive-in type

7. Dust-resistant components

(1) Standard specification

An end seal is provided on 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

Size Model	09	12	15
PU	0.5	0.5	0.5

(2) NSK K1$^{\text{TM}}$ lubrication unit

Table 10 shows the dimensions of linear guides equipped with NSK K1 lubrication units.

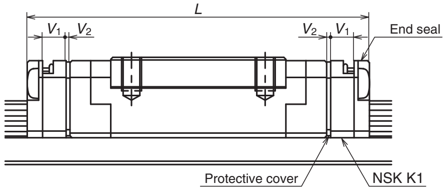


Table 10 Dimensions when equipped with NSK K1 lubrication units Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1, V_1	Thickness of protective cover, V_2
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: Slide length when equipped with NSK K1 = (standard ball slide length) + (V_1 thickness of single NSK K1 unit) × (number of K1 units) + (V_2 thickness of the protective cover) × 2.

8. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.

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

PU 15 0470 AL K 2 -＊＊ P5 1

Model name

Size

Rail length (mm)

Ball slide shape code (See page A242.)

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 A244.)

0: Z0, 1: Z1

(2) Reference number for interchangeable type

Ball slide

PAU 15 AL S -K

Interchangeable ball slide model code

PAU: PU Model interchangeable ball slide

Size

Ball slide shape code (See page A242.)

Material code

S: Stainless steel

Option code

-K: Equipped with NSK K1

Rail

P1U 15 0470 R K N -＊＊ PC T

Interchangeable rail model code

P1U: PU Model interchangeable 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: Only normal grade is available.

Preload code (See page A244.)

T: Fine clearance

＊Please consult with NSK for butting rail specification.

When interchangeable rails and slides are assembled, reference number coding is the same as that for preloaded assemblies. However, only preload code T (fine clearance) may be used (Refer to Page A244.)

Click!Speedy™ NSK Linear Guide Quick Delivery System uses a new numbering system. For details, please refer to the Click!Speedy general catalog CAT. No. E3191.

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 (interchangeable type)	PC	KC	FC

Note: Refer to pages A58 and A73 for details on NSK K1 lubrication units.

9. Dimensions

PU-TR, AL (Standard load / Standard)
PU-UR, BL (High-load / Long)

PU 15 0470 AL K 2 -＊＊ PC T

Model name

Size

Rail length (mm)

Ball slide shape code (See page A242.)

Material/surface treatment code (See Table 11.)
K: Stainless steel

Preload code (See page A244.)
0: Z0, 1: Z1, T: ZT

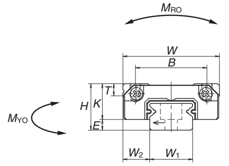
Accuracy code (See Table 12.)

Design serial number
Added to the reference number.

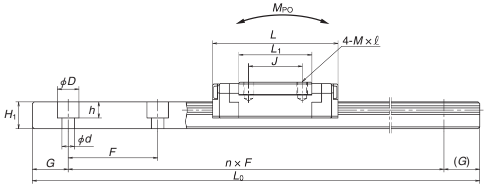
Number of ball slides per rail

Front view

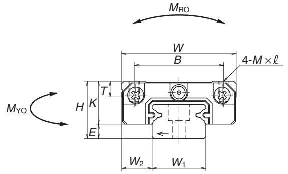
Side view



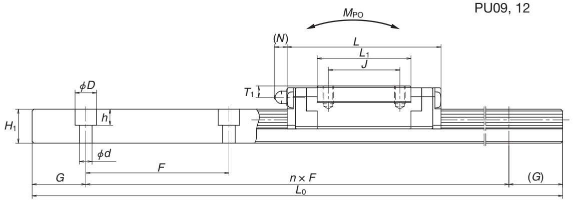
PU09, 12



PU09, 12



PU15



PU15

Model No.	Assembly			Ball slide												
	Height			Width	Length	Mounting hole						Oil hole			Width	Height
	H	E	W_2	W	L	B	J	M×pitch×ℓ	L_1	K	T	Hole size	T_1	N	W_1	H_1
PU09TR **PU09UR**	10	2.2	5.5	20	30 41	15	10 16	M3×0.5×3	19.6 30.6	7.8	2.6	—	—	—	9	5.5
PU12TR **PU12UR**	13	3	7.5	27	35 48.7	20	15 20	M3×0.5×3.5	20.4 34.1	10	3.4	—	—	—	12	7.5
PU15AL **PU15BL**	16	4	8.5	32	43 61	25	20 25	M3×0.5×5	26.2 44.2	12	4.4	ϕ3	3.2	(3.6)	15	9.5

Reference number for ball slide of interchangeable type

PAU 15 AL S -K

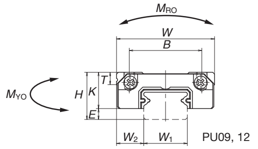
Interchangeable ball slide model code
PAU: PU Model interchangeable ball slide

Size

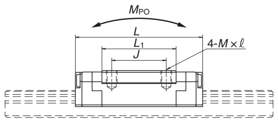
Ball slide shape code (See page A242.)

Option code
-K: Equipped with NSK K1

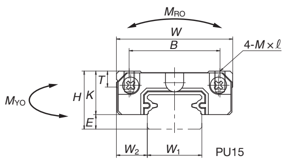
Material code
S: Stainless steel



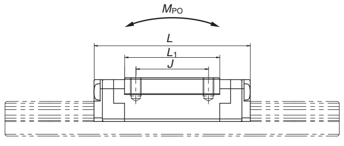
PU09, 12



PU09, 12



PU15



PU15

Reference number for rail of interchangeable type

Rail **P1U 15 0470 R K N -＊＊ PC T**

Interchangeable rail model code
P1U: PU Model interchangeable rail

Size

Rail length (mm)

Rail shape code
S: PU09, 12. R: PU15

Material/surface treatment code (See Table 11.)

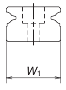
Preload code (See page A244.)
T: Fine clearance

Accuracy code: PC
PC: Only normal grade is available.

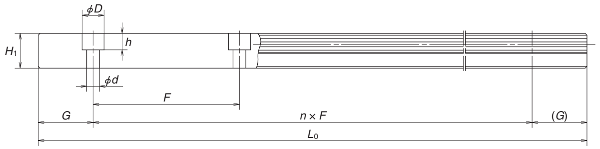
Design serial number
Added to the reference number.

*Butting rail specification
N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.



PU09,12,15

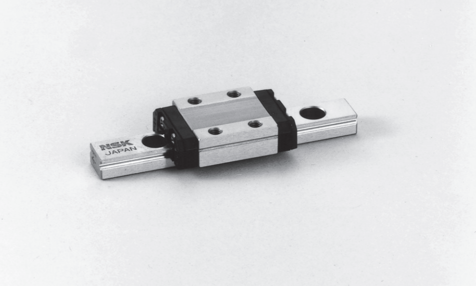


Unit: mm

Model No.	Rail				Basic load ratings								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	(g)	(g/100mm)
PU09TR **PU09UR**	20	3.5×6×4.5	7.5	600	1 490 2 100	1 180 1 670	2 150 3 500	9.90 16.2	6.10 15.6	41.0 88.0	6.10 15.6	41.0 88.0	16 25	35
PU12TR **PU12UR**	25	3.5×6×4.5	10	800	2 830 4 000	2 250 3 150	3 500 5 700	21.1 34.5	11.4 28.3	73.5 174	11.4 28.3	73.5 174	32 53	65
PU15AL **PU15BL**	40	3.5×6×4.5	15	1 000	5 550 8 100	4 400 6 400	6 600 11 300	49.5 84.5	25.6 69.5	190 435	25.6 69.5	190 435	59 100	105

Note: Basic load ratings comply with ISO standards (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-4-3.2 LU Model (Miniature type)



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 equal load carrying capacity in vertical and lateral directions. This also provides equal rigidity in both directions.

(3) Stainless steel also available as standard

Items made of martensitic stainless steel also available as standard.

(4) Models with ball retainers available

Ball retaining models (slide shape code AR and TR), including interchangeable types and LU15, come with a ball retainer to prevent balls from falling out when the slide is removed from the rail.

(5) Fast delivery

Interchangeable rails and ball slides are available. (LU09 to LU15)

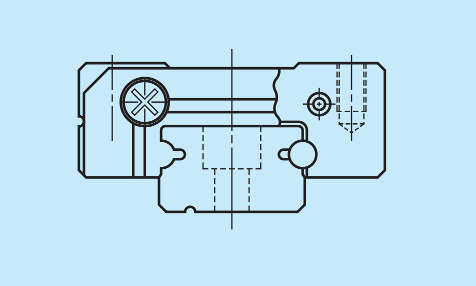


Fig. 1 LU Model

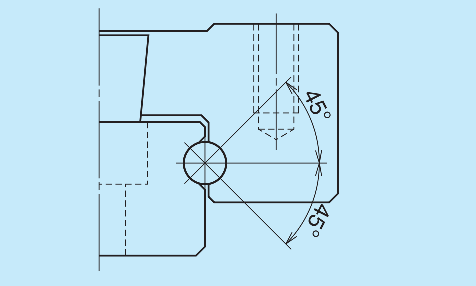
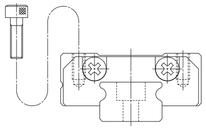
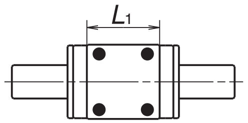
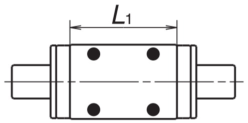


Fig. 2 Ball contact

2. Ball slide shape

Ball slide shape code	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		Standard	High-load
		Standard	Long
AL TL AR TR BL UL		AL, TL, TR, AR  	BL, UL 

Specification	Detail	Type	
Mounting hole	Normal	AL, AR	BL
	Large	TL, TR	UL
Ball retainer	Without	AL*, TL	BL*, UL
	With	AR, TR	–

*) LU15 is equipped with ball retainer

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm)		Preloaded assembly type (not interchangeable)				Interchangeable type
		Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC
over	or less					
–	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 interchangeable 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 interchangeable 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**			

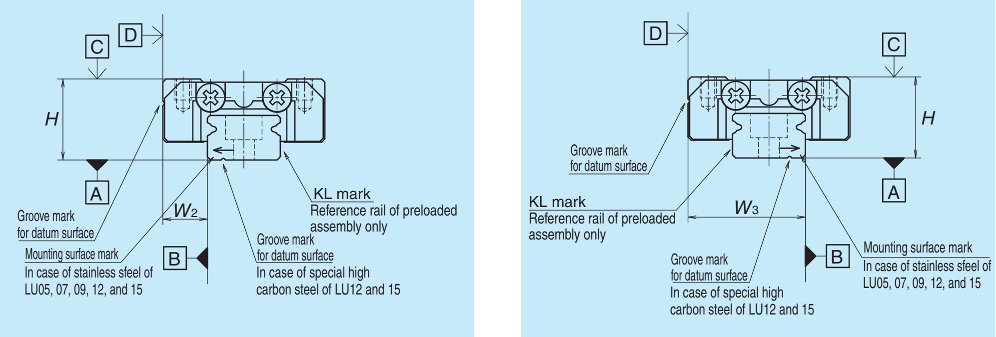
• Tolerance of interchangeable type: Normal grade PC

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 A77 for marks on the datum surfaces.

(4) Preload and rigidity

We offer three levels of preload: Slight preload Z1 and Fine clearance Z0 for the preloaded assembly type and Fine clearance ZT for the interchangeable 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	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 interchangeable 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

Model	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 requirements exceed the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

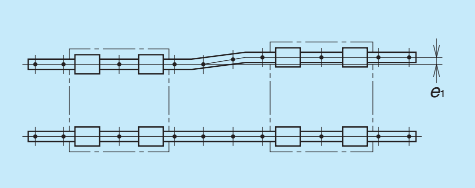


Fig. 4

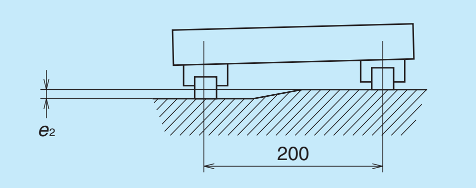


Fig. 5

Table 7 Unit: μm

Value	Preload	Model No.				
		LU05	LU07	LU09	LU12	LU15
Permissible values for parallelism error of two rails e_1	Z0, ZT	10	12	15	20	25
	Z1	7	10	13	15	21
Permissible values for height error of 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

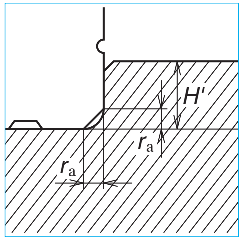


Fig. 6 Shoulder for the rail datum surface

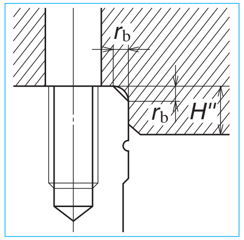


Fig. 7 Shoulder for the ball slide datum surface

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 Model, apply grease directly to the rail ball grooves using a point nozzle.

7. Dust-resistant components

(1) Standard specification

An end seal is provided on both ends of the ball slide as a standard feature.

LU05TL, LU07AL, LU09AL, and LU09TL can install the end 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

Model \ Size	05	07	09	12	15
LU	0.3	0.3	0.5	0.5	0.5

(2) NSK K1™ lubrication unit

Table 10 shows dimensions when installed with NSK K1 lubrication units.

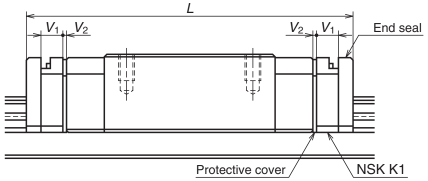


Table 10 Dimensions when equipped with NSK K1 lubrication units Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1 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: 1) Slide length when equipped with NSK K1 = (standard ball slide length) + (V_1 thickness of single NSK K1 unit) × (number of K1 units) + (V_2 thickness of the protective cover) × 2.

8. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.

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

LU 12 0270 AR K 2 - P5 1**

Model name

Size

Rail length (mm)

Ball slide shape code (See page A252.)

Material/surface treatment code (See Table 11.)

C: Special high carbon steel (NSK standard), K: Stainless steel

Preload code (See page A254.)

0: Z0, 1: Z1

Accuracy code (See Table 12.)

Design serial number

Added to the reference number.

Number of ball slides per rail

(2) Reference number for interchangeable type

Ball slide

LAU 12 AR S -K

Interchangeable ball slide model code

LAU: LU Model interchangeable ball slide

Size

Ball slide shape code (See page A252.)

Option code

-K: Equipped with NSK K1

Material code

No code: Special high carbon steel (NSK standard), S: Stainless steel

Rail

L1U 12 0270 R K N - PC T**

Interchangeable rail model code

L1U: LU Model interchangeable 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.)

Preload code (See page A254.)

T: Fine clearance

Accuracy code: PC

PC: Only normal grade is available.

Design serial number

Added to the reference number.

*Butting rail specification

N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.

When interchangeable rails and slides are assembled, reference number coding is the same as that for preloaded assemblies. However, only preload code T (fine clearance) may be used (Refer to Page A250.)

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 (interchangeable type)	PC	KC

Note: Refer to page A58 for details on NSK K1 lubrication units.

9. Dimensions

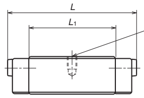
LU-AL (Standard load, Standard, Only LU15 is equipped with ball retainer)
LU-TL (Standard load, Standard, Large mounting hole)
LU-AR (Standard load, Standard, With ball retainer)
LU-TR (Standard load, Standard, Large mounting hole, with ball retainer)

LU 12 0270 AR K 2 -＊＊ PC T

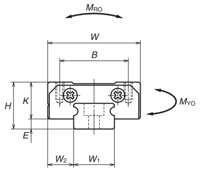
- LU: Model name
- 12: Size
- 0270: Rail length (mm)
- AR: Ball slide shape code (See page A252.)
- K: Material/surface treatment code (See Table 11.)
  - C: Special high carbon steel (NSK standard), K: Stainless steel
- 2: Number of ball slides per rail
- -＊＊: Design serial number
  - Added to the reference number.
- PC: Accuracy code (See Table 12.)
- T: Preload code (See page A254.)
  - 0: Z0, 1: Z1, T: ZT

Front view

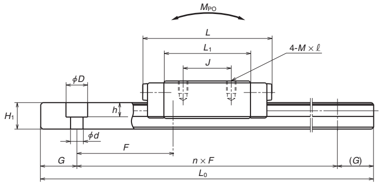
Side view



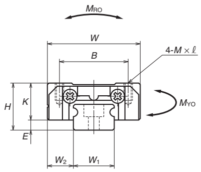
LU05TL



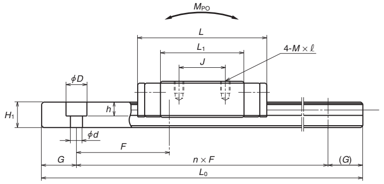
LU05TL, LU07AL
LU09AL, TL



LU07AL
LU09AL, TL



LU09AR, TR
LU12AL, TL, AR, TR
LU15AL



LU09AR, TR
LU12AL, TL, AR, TR
LU15AL

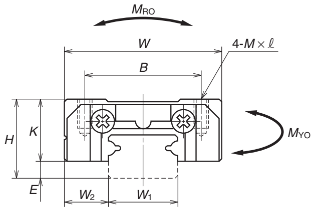
Reference number for ball slide of interchangeable type

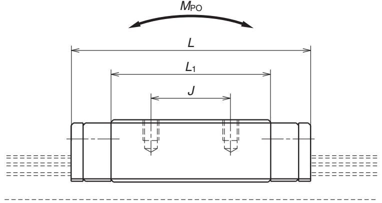
Interchangeable with retainer: LU09 - 12 are AR/TR, LU15 is AL.

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

- LAU: Interchangeable ball slide model code
  - LAU: LU Model interchangeable ball slide
- 12: Size
- AR: Ball slide shape code (See page A252.)
- S: Material code
  - No code: Special high carbon steel (NSK standard), S: Stainless steel
- -K: Option code
  - -K: Equipped with NSK K1



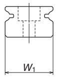


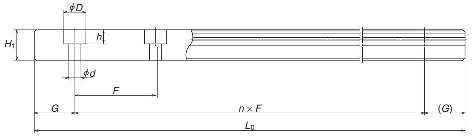
Reference number for rail of interchangeable type

L1U 12 0270 R K N -＊＊ PC T

- L1U: Interchangeable rail model code
  - L1U: LU Model interchangeable rail
- 12: Size
- 0270: Rail length (mm)
- R: 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
- K: Material/surface treatment code (See Table 11.)
- N: *Butting rail specification
  - N: Non-butting. L: Butting specification
- -＊＊: Design serial number
  - Added to the reference number.
- PC: Accuracy code: PC
  - PC: Only normal grade is available.
- T: Preload code (See page A254.)
  - T: Fine clearance

*Please consult with NSK for butting rail specification.





Unit: mm

Model No.	Assembly			Ball slide								Rail						Basic load ratings								Weight	
	Height			Width	Length	Mounting hole					Width	Height	Pitch	Mounting bolt hole	G	Max. length L_{0max}. ( ) for stainless	5)Dynamic [50km]	5)Dynamic [100km]	Static	Static moment (N·m)					Ball slide	Rail
																				M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides		
	H	E	W_2	W	L	B	J	M × pitch × ℓ	L_1	K	W_1	H_1	F	d × D × h	(reference)		C_{50}(N)	C_{100}(N)	C_0 (N)						(g)	(g/100 mm)
LU05TL	6	1	3.5	12	18	8	—	M2×0.4×1.5	12	5	5	3.2	15	2.3×3.3×1.5	5	— (210)	545	435	740	1.93	1.22	8.85	1.22	8.85	4	11
LU07AL	8	1.5	5	17	20.4	12	8	M2×0.4×2.4	13.6	6.5	7	4.7	15	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
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	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
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	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
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	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
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	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
LU15AL	16	4	8.5	32	43.6	25	20	M3×0.5×4	27	12	15	9.5	40	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

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.

4) To fix rail of LU05TL, use M2 × 0.4 cross-recessed pan head machine screws for precision instruments.
(JCIS 10-70 No. 0 pan head machine screw No.1.)
(JCIS: Japanese Camera Industrial Standard.)
5) Basic load ratings comply with ISO standards (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 / Long)
LU-UL (High-load / Long, large mounting hole)

LU 12 0270 BL K 2 - P5 1**

Model name

Size

Rail length (mm)

Ball slide shape code (See page A252.)

Material/surface treatment code (See Table 11.)

C: Special high carbon steel (NSK standard), K: Stainless steel

Preload code (See page A254.)

0: Z0, 1: Z1

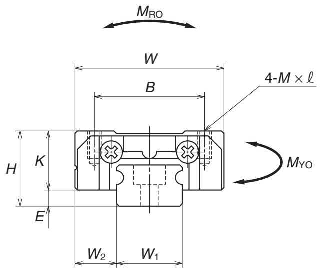
Accuracy code (See Table 12.)

Design serial number

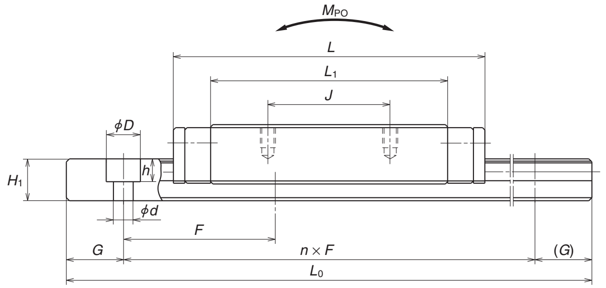
Added to the reference number.

Number of ball slides per rail

Front view



Side view



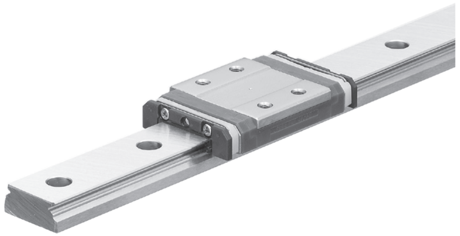
Unit: mm

Model No.	Assembly			Ball slide							Rail						Basic load ratings								Weight	
	Height			Width	Length	Mounting hole					Width	Height	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}			
	H	E	W_2	W	L	B	J	M × pitch × ℓ	L_1	K	W_1	H_1	F	d × D × h	(reference)		C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(g)	(g/100 mm)
LU09BL **LU09UL**	10	2.2	5.5	20	41	15	16	M2×0.4×2.5 M3×0.5×3	31.2	7.8	9	5.5	20	2.6×4.5×3 3.5×6×4.5	7.5	1 200 (600)	2 600	2 070	3 900	17.9	17.2	98.0	17.2	98.0	29	35
LU12BL **LU12UL**	13	3	7.5	27	47.5	20	20	M2.5×0.45×3 M3×0.5×3.5	35.3	10	12	7.5	25	3×5.5×3.5 3.5×6×4.5	10	1 800 (800)	4 000	3 150	5 700	34.5	28.3	169	28.3	169	59	65
LU15BL	16	4	8.5	32	61	25	25	M3×0.5×4	44.4	12	15	9.5	40	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

Notes 1) LU09UL is available only in stainless steel.
2) LU15BL is equipped with ball retainer.

3) Basic load ratings comply with ISO standards (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-4-3.3 PE Model (Miniature wide type)



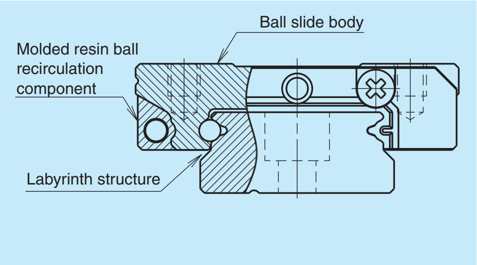


Fig. 1

1. Features

(1) Ideal for use of single rail

PE model miniature linear guides feature a wide rail, allowing for high load carrying capacity against moment loads in the rolling direction.

(2) Motion performance

A newly designed recirculation component facilitates smooth circulation of steel balls.

(3) Lightweight

The ball slide is approximately 20% lighter than the LE Model thanks to resin parts incorporated into its design.

(4) Reduced noise intensity

Resin parts used in ball recirculation components reduce collision noise between the steel balls and inner wall.

(5) Excellent dust resistance

PE model linear guides are designed to minimize the clearance between the rail sides and slide inner walls to help prevent foreign matter from entering.

(6) High corrosion resistance

Highly corrosion-resistant martensite stainless steel comes standard, providing excellent resistance to corrosion.

(7) Easy to handle

Designed for safety with a retainer that prevents steel balls from dropping out of the ball slide even when the slide is removed from the rail.

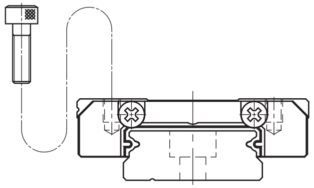
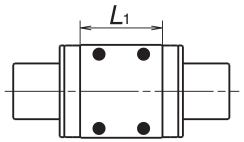
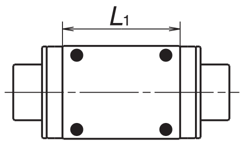
(8) Long-term, maintenance-free operation

PE model guides equipped with the NSK K1 lubrication units realize long-term, maintenance-free operation.

(9) Fast delivery

A lineup of interchangeable rails and ball slides facilitates fast delivery.

2. Ball slide shape

Ball slide shape code	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  L_1	UR, BR  L_1

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm)		Preloaded assembly type (not interchangeable)				Interchangeable type
over	or less	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	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 interchangeable 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 interchangeable type.

- **Tolerance of preloaded assembly**

Table 2

Unit: μm

Accuracy grade Characteristics	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 interchangeable type: Normal grade PC**

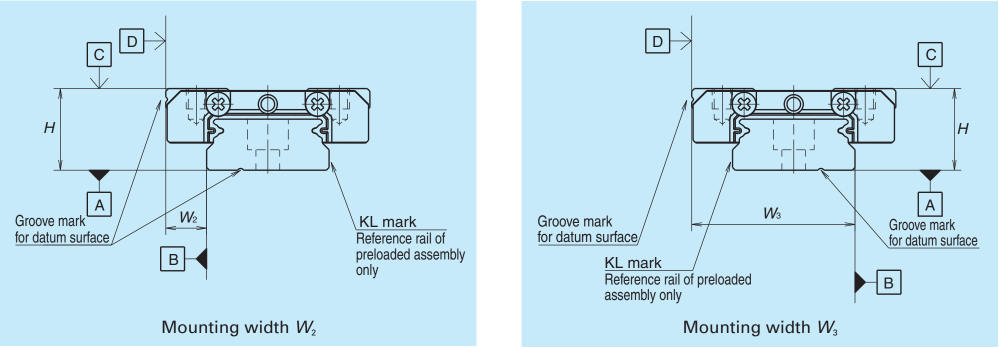
Table 3

Unit: μm

Model No. Characteristics	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 and Fine clearance ZT for the interchangeable type. 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) Slight preload (Z1)	Rigidity (N/μm) Slight preload (Z1)
Standard	PE09TR	0 – 37	61
	PE12AR	0 – 40	63
	PE15AR	0 – 49	66
High-load	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 interchangeable type**

Table 5

Unit: μm

	Model No.	Fine clearance ZT
Standard	PE09TR	3 or less
	PE12AR	
	PE15AR	
High-load	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

Model	Size Material	09	12	15
PE	Stainless steel	800	1 000	1 200

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

5. Installation

(1) Permissible values of mounting error

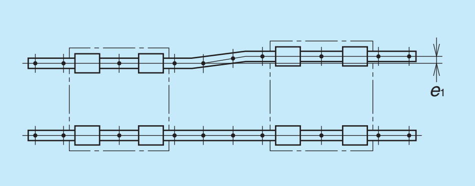


Fig. 3

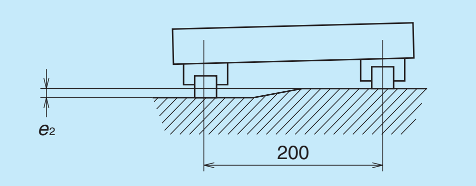


Fig. 4

Table 7 Unit: µm

Value	Preload	Model No.		
		PE09	PE12	PE15
Permissible values for parallelism error of two rails e_1	Z0, ZT	15	18	22
	Z1	10	13	17
Permissible values for height error of 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

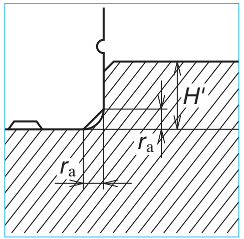


Fig. 5 Shoulder for the rail datum surface

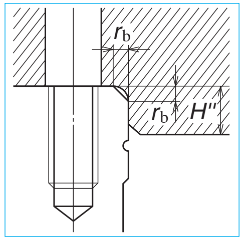


Fig. 6 Shoulder for the ball slide datum surface

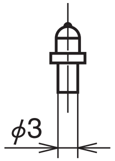
Table 8 Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''*
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 accessories

A drive-in grease fitting can be selected as an option for model PE15.
For models PE09 to PE12, apply grease directly to the rail ball grooves using a point nozzle.



Drive-in type

7. Dust-resistant components

(1) Standard specification

An end seal is provided on 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

Model \ Size	09	12	15
PE	0.8	1	1.2

(2) NSK K1™ lubrication unit

Table 10 shows the dimensions of linear guides equipped with NSK K1 lubrication units.

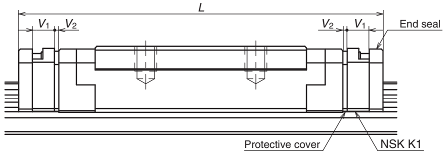


Table 10 Dimensions when equipped with NSK K1 lubrication units Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1 V_1	Thickness of protective cover V_2
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: Slide length when equipped with NSK K1 = (standard ball slide length) + (V_1 thickness of single NSK K1 unit) × (number of K1 units) + (V_2 thickness of the protective cover) × 2.

8. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.
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

PE 15 0470 AR K 2 -＊＊ P5 1

Model name

Size

Rail length (mm)

Ball slide shape code (See page A264.)

Material/surface treatment code (See Table 11.)
K: Stainless steel

Preload code (See page A266.)
0: Z0, 1: Z1

Accuracy code (See Table 12.)

Design serial number
Added to the reference number.

Number of ball slides per rail

(2) Reference number for interchangeable type

Ball slide

PAE 15 AR S -K

Interchangeable ball slide model code
PAE: PE Model interchangeable ball slide

Size

Ball slide shape code (See page A264.)

Option code
-K: Equipped with NSK K1

Material code
S: Stainless steel

Rail

P1E 15 0470 P K N -＊＊ PC T

Interchangeable rail model code
P1E: PE Model interchangeable rail

Size

Rail length (mm)

Rail shape code
R: PE09, 12. P: PE15

Material/surface treatment code (See Table 11.)

Preload code (See page A266.)
T: Fine clearance

Accuracy code: PC
PC: Only normal grade is available.

Design serial number
Added to the reference number.

*Butting rail specification
N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.

When interchangeable rails and slides are assembled, reference number coding is the same as that for preloaded assemblies. However, only preload code T (fine clearance) may be used (Refer to Page A266.)
Click!Speedy™ NSK Linear Guide Quick Delivery System uses a new numbering system. For details, please refer to the Click!Speedy general catalog CAT. No. E3191.

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 (interchangeable type)	PC	KC	FC

Note: Refer to pages A58 and A73 for details on NSK K1 lubrication units.

9. Dimensions
PE-AR, TR (Standard load / Standard)
PE-UR, BR (High-load / Long)

PE 15 0470 AR K 2 - PC T**

Model name

Size

Rail length (mm)

Ball slide shape code (See page A264.)

Material/surface treatment code (See Table 11.)

K: Stainless steel

Preload code (See page A266.)

0: Z0, 1: Z1, T: ZT

Accuracy code (See Table 12.)

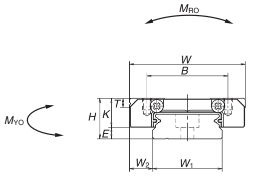
Design serial number

Added to the reference number.

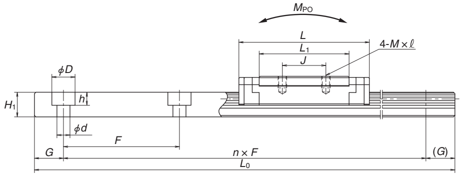
Number of ball slides per rail

Front view

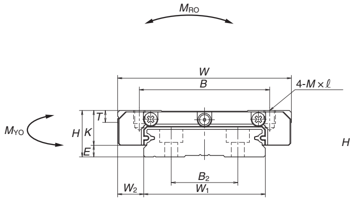
Side view



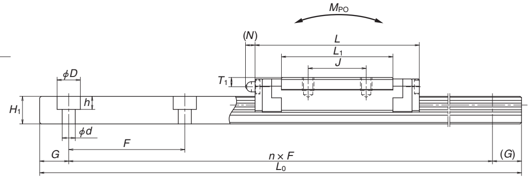
PE09, 12



PE09, 12



PE15



PE15

Reference number for ball slide of interchangeable type

PAE 15 AR S -K

Interchangeable ball slide model code

PAE: PE Model interchangeable ball slide

Size

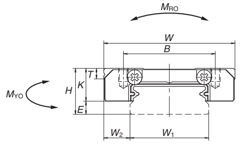
Ball slide shape code (See page A264.)

Option code

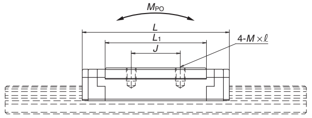
-K: Equipped with NSK K1

Material code

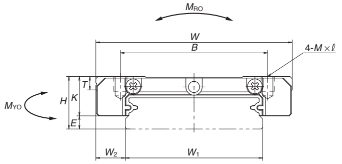
S: Stainless steel



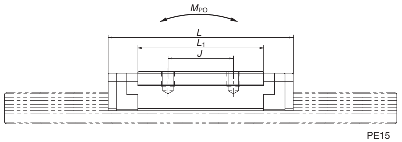
PE09, 12



PE09, 12



PE15



PE15

Reference number for rail of interchangeable type

P1E 15 0470 P K N - PC T**

Interchangeable rail model code

P1E: PE Model interchangeable rail

Size

Rail length (mm)

Rail shape code

R: PE09, 12. P: PE15

Material/surface treatment code (See Table 11.)

Preload code (See page A266.)

T: Fine clearance

Accuracy code: PC

PC: Only normal grade is available.

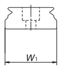
Design serial number

Added to the reference number.

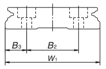
*Butting rail specification

N: Non-butting. L: Butting specification

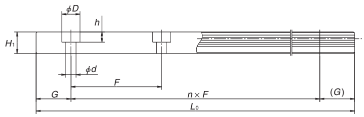
*Please consult with NSK for butting rail specification.



PE09,12



PE15

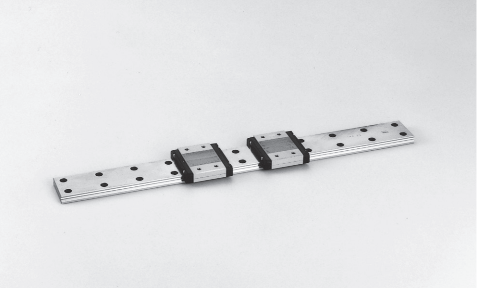


Unit: mm

Model No.	Assembly			Ball slide											Rail							Basic load ratings								Weight	
	Height			Width	Length	Mounting hole						Oil hole			Width	Height		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}			
	H	E	W_2	W	L	B	J	M × pitch × ℓ	L_1	K	T	Hole size	T_1	N	W_1	H_1	B_2	F	d × D × h	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(g)	(g/100 mm)
PE09TR **PE09UR**	12	4	6	30	39.8 51.2	21 23	12 24	M3×0.5×3	26.6 38	8	2.8	ϕ 2	2.3	—	18	7.5	—	30	3.5×6×4.5	10	800	3 000 4 000	2 390 3 150	4 500 6 700	36.5 54.5	17.3 37.5	113 210	17.3 37.5	113 210	35 50	95
PE12AR **PE12BR**	14	4	8	40	45 60	28	15 28	M3×0.5×4	31 46	10	3.2	ϕ 2.5	2.7	—	24	8.5	—	40	4.5×8×4.5	15	1 000	4 350 5 800	3 450 4 600	6 350 9 550	70.5 106	29.3 63.5	180 345	29.3 63.5	180 345	66 98	140
PE15AR **PE15BR**	16	4	9	60	56.6 76	45	20 35	M4×0.7×4.5	38.4 57.8	12	4.1	ϕ 3	3.2	(3.3)	42	9.5	23	40	4.5×8×4.5	15	1 200	7 600 10 300	6 050 8 200	10 400 16 000	207 320	59.0 135	370 740	59.0 135	370 740	140 211	275

Note: Basic load ratings comply with ISO standards (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-4-3.4 LE Model (Miniature wide type)



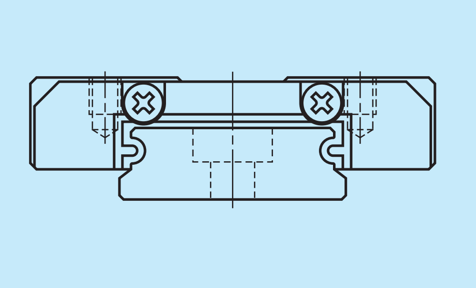


Fig. 1 LE Model

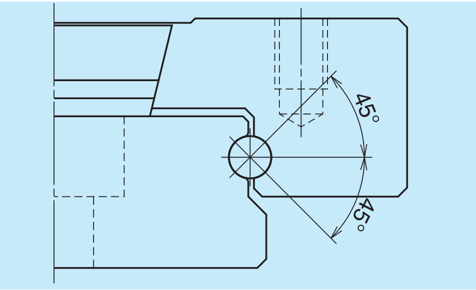


Fig. 2 Ball contact

1. Features

(1) Ideal for use of single rail

LE model miniature linear guides feature a wide rail, allowing for high load carrying capacity against moment loads in the 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) 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 for easy and accurate measuring of ball grooves.

(5) Stainless steel standard

Rails and ball slides are made of martensitic stainless steel.

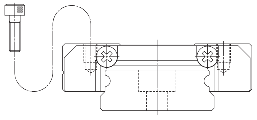
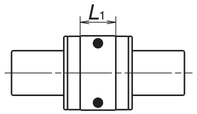
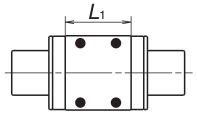
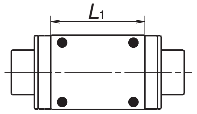
(6) Models with ball retainers available

Ball retaining models (slide shape code AR and TR), including interchangeable types, come with a ball retainer to prevent balls from falling out when the slide is removed from the rail.

(7) Fast delivery

Interchangeable rails and ball slides available. (LE09 to LE15)

2. Ball slide shape

Ball slide shape code	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)		
		Medium-load	Standard	High-load
		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)		Preloaded assembly type (not interchangeable)			Interchangeable type
over	or less	High precision P5	Precision grade P6	Normal grade PN	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 interchangeable 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 interchangeable type.

- **Tolerance of preloaded assembly**

Table 2 Unit: μm

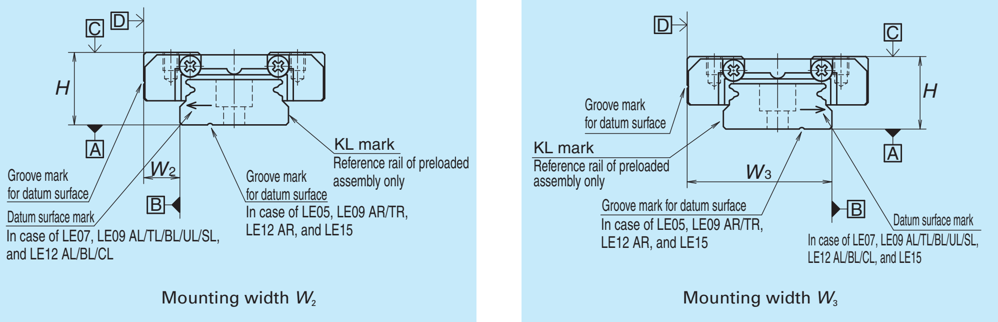
Characteristics \ Accuracy grade	High precision P5	Precision grade P6	Normal grade PN
Mounting height H Variation of H (All ball slides on a set of rails)	±15 7	±20 15	±40 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±20 10	±30 20	±50 30
Running parallelism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

- **Tolerance of interchangeable 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



Mounting width W_2

Mounting width W_3

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 interchangeable 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	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	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	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 interchangeable 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

Model	Material \ Size	05	07	09	12	15
LE	Stainless steel	150	600	800	1 000	1 200

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

5. Installation

(1) Permissible values of mounting error

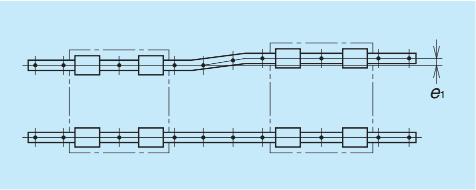


Fig. 4

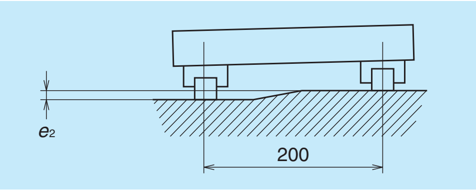


Fig. 5

Table 7 Unit: μm

Value	Preload	Model No.				
		LE05	LE07	LE09	LE12	LE15
Permissible values for parallelism error of two rails e_1	Z0, ZT	10	12	15	18	22
	Z1	5	7	10	13	17
Permissible values for height error of 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

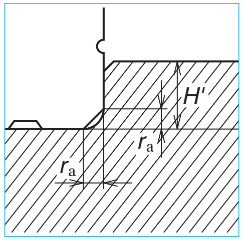


Fig. 6 Shoulder for the rail datum surface

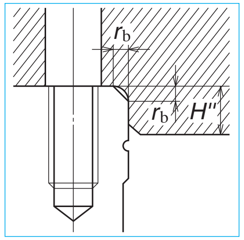


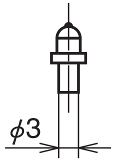
Fig. 7 Shoulder for the ball slide datum surface

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 LE15AR can select drive-in 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-resistant components

(1) Standard specification

An end seal is provided on 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

Model \ 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 units are shown in **Table 10**.

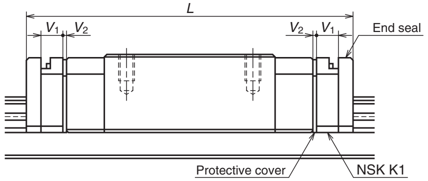


Table 10 Dimensions when equipped with NSK K1 lubrication units Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1 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: Slide length when equipped with NSK K1 = (standard ball slide length) + (V_1 thickness of single NSK K1 unit) × (number of K1 units) + (V_2 thickness of the protective cover) × 2.

8. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.
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

LE 15 0310 AR K 2 - P5 1**

Model name

Size

Rail length (mm)

Ball slide shape code (See page A274.)

Material/surface treatment code (See Table 11.)
K: Stainless steel

Preload code (See page A276.)
0: Z0, 1: Z1

Accuracy code (See Table 12.)

Design serial number
Added to the reference number.

Number of ball slides per rail

(2) Reference number for interchangeable type

Ball slide

LAE 15 AR S -K

Interchangeable ball slide model code
LAE: LE Model interchangeable ball slide

Size

Ball slide shape code (See page A274.)

Option code
-K: Equipped with NSK K1

Material code
S: Stainless steel

Rail

L1E 15 0310 R K N - PC T**

Interchangeable rail model code
L1E: LE Model interchangeable rail

Size

Rail length (mm)

Rail shape code
R: LE09 and LE12 standard, equipped with ball retainer

Material/surface treatment code (See Table 11.)

Preload code (See page A276.)
T: Fine clearance

Accuracy code: PC
PC: Only normal grade is available.

Design serial number
Added to the reference number.

*Butting rail specification
N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.

When interchangeable rails and slides are assembled, reference number coding is the same as that for preloaded assemblies. However, only preload code T (fine clearance) may be used (Refer to Page A276.)

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 (interchangeable type)	PC	KC

Note: Refer to page A58 for details on NSK K1 lubrication units.

9. Dimensions

LE-AL (Standard load / Standard)
LE-TL (Standard load / Standard, large mounting hole)
LE-AR (Standard load / Standard, with ball retainer)
LE-TR (Standard load / Standard, large mounting hole, with ball retainer)

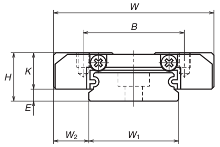
LE 15 0310 AR K 2 -∗∗ PC T

Model name
Size
Rail length (mm)
Ball slide shape code (See page A274.)
Material/surface treatment code (See Table 11.)
K: Stainless steel

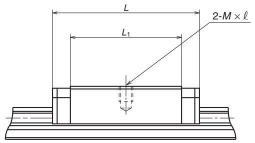
Preload code (See page A276.)
0: Z0, 1: Z1, T: ZT
Accuracy code (See Table 12.)
Design serial number
Added to the reference number.
Number of ball slides per rail

Front view

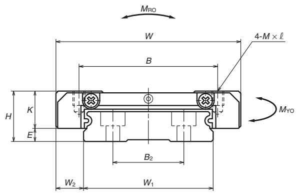
Side view



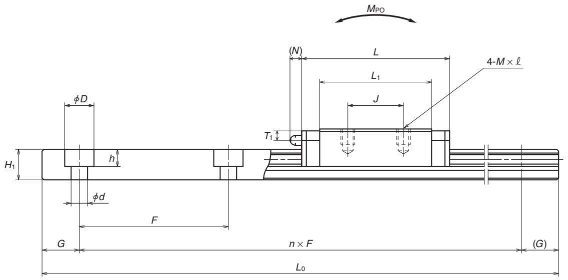
LE05, 07, 09, 12



LE05



LE15



LE07, 09, 12, 15

Model No.	Assembly			Ball slide							Grease fitting						
	Height			Width	Length	Mounting hole								Width	Height		Pitch
	H	E	W_2	W	L	B	J	M × pitch × ℓ	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 LE05 has only two mounting tap holes.

Reference number for ball slide of interchangeable type

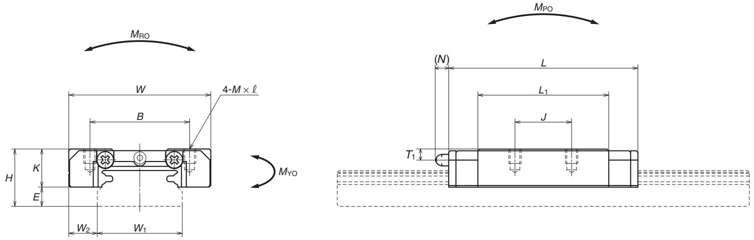
Interchangeable with retainer: LAE09AR/TR, LAE12AR, LAE15AR

LAE-AR (With ball retainer)
LAE-TR (Large mounting hole with ball retainer)

LAE 15 AR S -K

Interchangeable ball slide model code
LAE: LE Model interchangeable ball slide
Size
Ball slide shape code (See page A274.)

Option code
-K: Equipped with NSK K1
Material code
S: Stainless steel



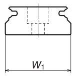
Reference number for rail of interchangeable type

Rail **L1E 15 0310 R K N -∗∗ PC T**

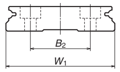
Interchangeable rail model code
L1E: LE Model interchangeable rail
Size
Rail length (mm)
Rail shape code
R: LE09 and LE12 standard equipped with ball retainer
Material/surface treatment code (See Table 11.)

Preload code (See page A276.)
T: Fine clearance
Accuracy code: PC
PC: Only normal grade is available.
Design serial number
Added to the reference number.
*Butting rail specification
N: Non-butting. L: Butting specification

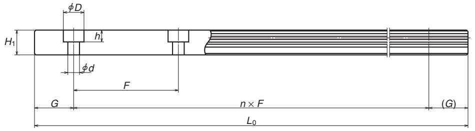
*Please consult with NSK for butting rail specification.



LE09, 12



LE15



Unit: mm

Model No.	Rail			Basic load ratings								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)
LE05AL	3×5×1.6	7.5	150	725	575	1 110	5.65	2.58	16.9	2.58	16.9	11	34
LE07TL	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
LE09AL **LE09TL**	3.5×6×4.5	10	800	3 000	2 400	4 500	36.5	17.3	110	17.3	110	40	95
LE09AR **LE09TR**	3.5×6×4.5	10	800	3 000	2 400	4 500	36.5	17.3	113	17.3	113	40	95
LE12AL **LE12AR**	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
LE15AL **LE15AR**	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

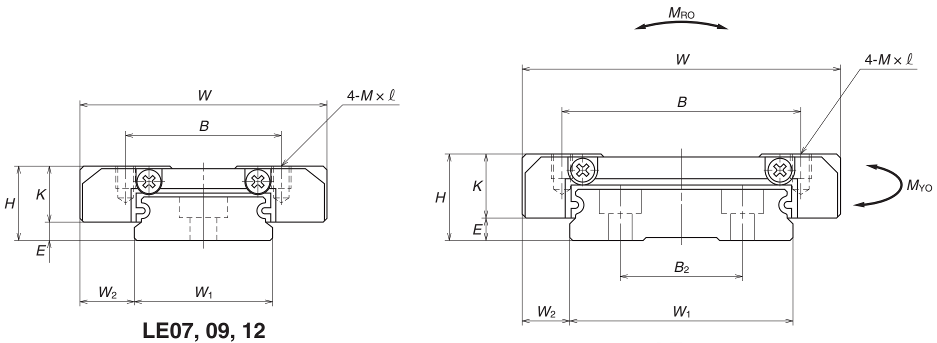
2) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
C_{50}; the basic dynamic load rating for 50 km rated fatigue life C_{100}; the basic dynamic load rating for 100 km rated fatigue life
3) For fixing a rail of LE05AL, use M2.5 × 0.45 cross-recessed pan head machine screw for precision instruments.
(JCIS 10-70: No.0 pan head machine screw No.3) (JCIS: Japanese Camera Industrial Standard)

LE-BL (High-load / Long)
LE-UL (High-load / Long, large mounting hole)

LE 15 0310 BL K 2 - P5 1**

- Model name
- Size
- Rail length (mm)
- Ball slide shape code (See page A274.)
- 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 A276.)
  0: Z0, 1: Z1

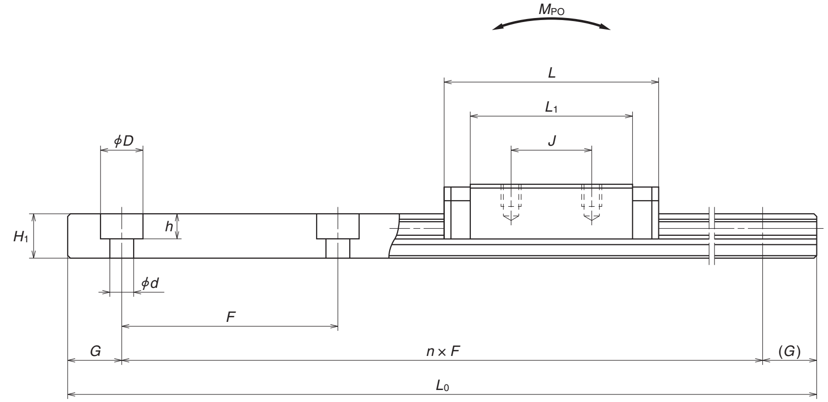
Front view



LE07, 09, 12

LE15

Side view

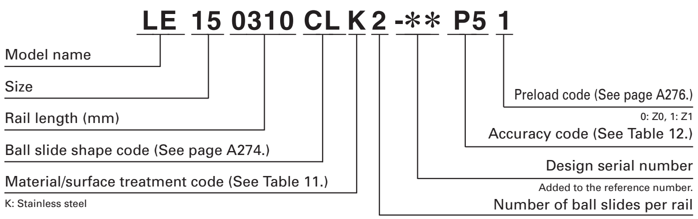


Unit: mm

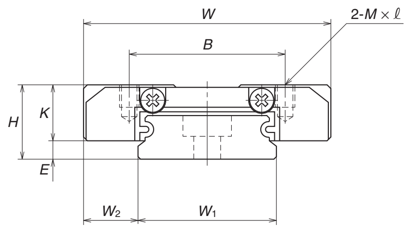
Model No.	Assembly			Ball slide											Rail			Basic load ratings								Weight	
	Height			Width	Length	Mounting hole					Width	Height		Pitch	Mounting bolt hole	G	Max. length	[1]Dynamic		Static	Static moment (N·m)					Ball slide	Rail
																		[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	$M \times$ pitch $\times \ell$	L_1	K	W_1	H_1	B_2	F	$d \times D \times h$	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(g)	(g/100 mm)
LE07UL	9	2	5.5	25	42	19	19	M3×0.5×3	32.2	7	14	5.2	—	30	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
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	3.5×6×4.5	10	800	4 000	3 150	6 700	54.5	37.5	206	37.5	206	58	95
LE12BL	14	4	8	40	59	28	28	M3×0.5×4	46	10	24	8.5	—	40	4.5×8×4.5	15	1 000	5 800	4 600	9 550	106	63.5	340	63.5	340	115	140
LE15BL	16	4	9	60	74.4	45	35	M4×0.7×4.5	57.8	12	42	9.5	23	40	4.5×8×4.5	15	1 200	10 300	8 200	16 000	320	135	725	135	725	235	275

Note: 1) Basic load ratings comply with ISO standards (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

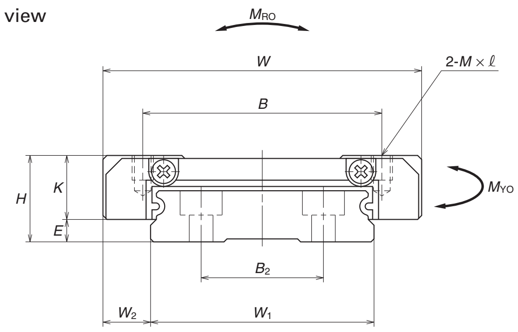
LE-CL (Medium-load / Short)
LE-SL (Medium-load / Short, large mounting hole)



Front view

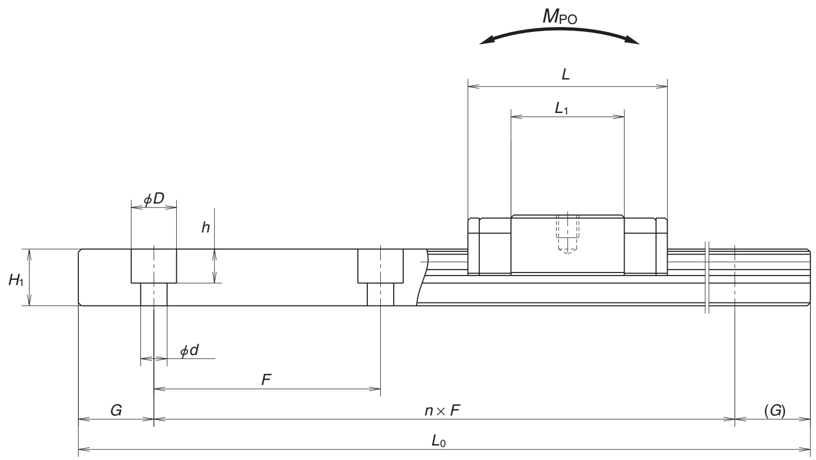


LE05, 07, 09, 12



LE15

Side view



Unit: mm

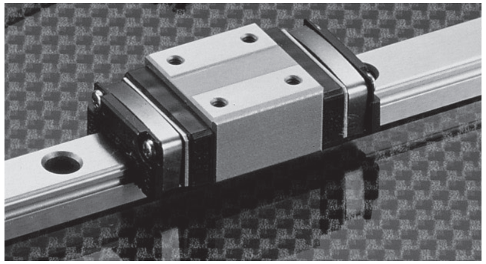
Model No.	Assembly			Ball slide							Rail							Basic load ratings								Weight	
	Height			Width	Length	Mounting hole					Width	Height		Pitch	Mounting bolt hole	G	Max. length	[2]Dynamic		Static	Static moment (N·m)					Ball slide	Rail
																		[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	M × pitch × ℓ	L_1	K	W_1	H_1	B_2	F	d × D × h	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(g)	(g/100 mm)
LE05CL	6.5	1.4	3.5	17	20	13	—	M2.5×0.45×2	13	5.1	10	4	—	20	3×5×1.6	7.5	150	595	470	835	4.25	1.51	10.0	1.51	10.0	8	34
LE07SL	9	2	5.5	25	22.4	19	—	M3×0.5×3	12.6	7	14	5.2	—	30	3.5×6×3.2	10	600	980	775	1 170	8.35	2.01	18.5	2.01	18.5	17	55
LE09CL **LE09SL**	12	4	6	30	26.4	21	—	M2.6×0.45×3 M3×0.5×3	15	8	18	7.5	—	30	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
LE12CL	14	4	8	40	30.5	28	—	M3×0.5×4	17.5	10	24	8.5	—	40	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
LE15CL	16	4	9	60	41.4	45	—	M4×0.7×4.5	24.8	12	42	9.5	23	40	4.5×8×4.5	15	1 200	5 000	3 950	5 650	113	19.4	162	19.4	162	110	275

Notes: 1) Ball slide CL and SL types have only two mounting tap holes in the center.

2) Basic load ratings comply with ISO standards (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-4-3.5 Miniature LH Model



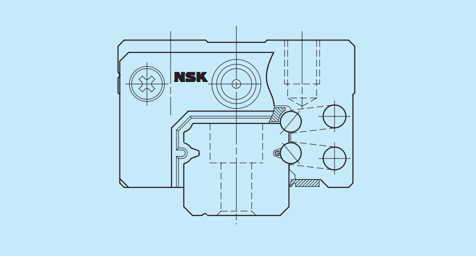


Fig. 1 LH Model

1. Features

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

Similar to a DF arrangement of angular contact bearings, Miniature LH models offer large self-aligning capability with the internal intersection of the contact lines of the balls and grooves reducing moment rigidity.

This increases the capacity to absorb errors in installation.

(2) High vertical load carrying capacity

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

(3) High resistance against impact load

The bottom ball groove forms a Gothic arch and the center of the top and bottom grooves are offset as shown in **Fig. 2**.

Vertical load is generally carried by the top rows at two contact points, but with this design, the bottom rows also carry load when a large impact load is applied vertically as shown in **Fig. 3**. This assures high resistance to impact load.

(4) High accuracy

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

(5) High corrosion resistance

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

(6) Easy to handle

Safe 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 the NSK K1 lubrication unit realize long-term, maintenance-free operation.

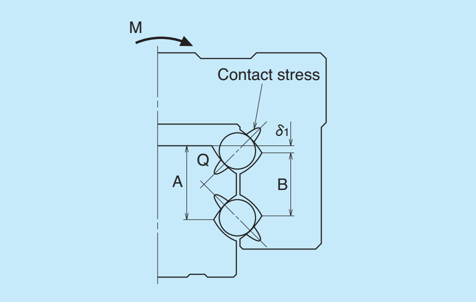


Fig. 2 Enlarged illustration of the offset Gothic arch groove

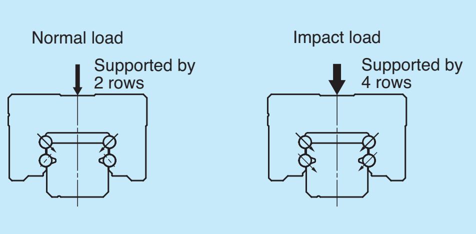


Fig. 3 When load is applied

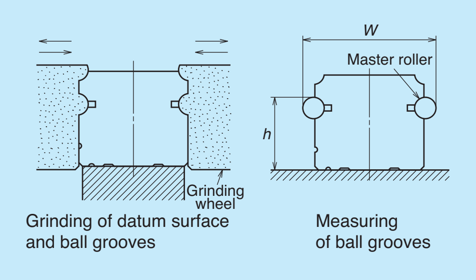
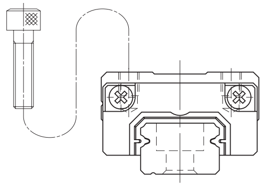
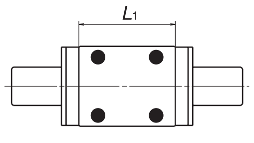


Fig. 4 Rail grinding and measuring

2. Ball slide shape

Ball slide shape code	Shape/installation method	Type
AN		AN  L_1

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1 Unit: μm

Rail length (mm)		Preloaded assembly			
over	or less	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* Variation of *H* (All ball slides on a set of rails)	±10 3	±20 5	±40 7	±80 15
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±10 5	±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**, **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

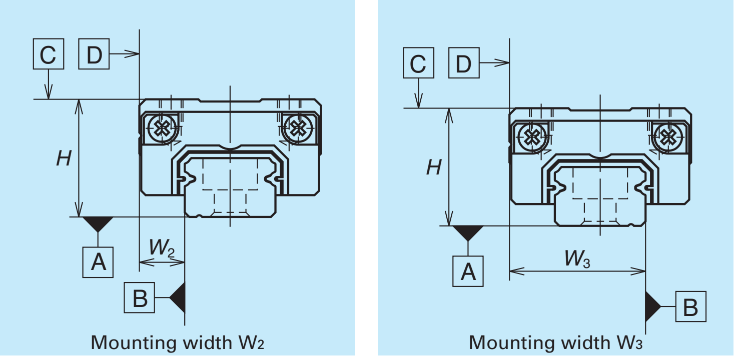


Fig. 5

(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

Model	Size / Material	08	10	12
LH	Stainless steel	375	600	800

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

5. Installation

(1) Permissible values of mounting error

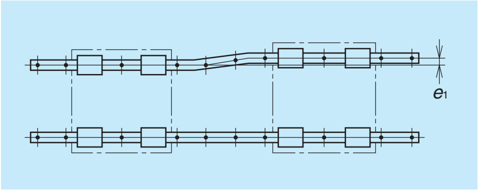


Fig. 6

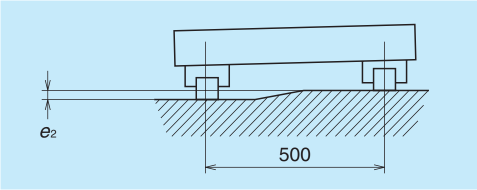


Fig. 7

Table 6

Unit: μm

Value	Preload	Model No.		
		LH08	LH10	LH12
Permissible values for parallelism error of two rails e_1	Z0	9	12	19
	Z1	8	11	18
Permissible values for height error of two rails e_2	Z0	375μm/500mm		
	Z1	330μm/500mm		

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

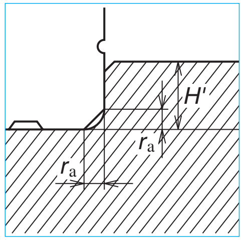


Fig. 8 Shoulder for the rail datum surface

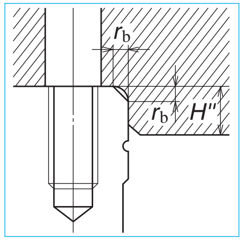


Fig. 9 Shoulder for the ball slide datum surface

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 LH12 can use drive-in grease fittings as an option.
For models LH08 to LH10, apply grease directly to the ball grooves of rail using a point nozzle.

Fig. 10

7. Dust-resistant components

(1) Standard specification

Under normal applications, the LH model can be used without modification thanks to its dust resistance. As standard equipment, the ball slides have an end seal on both ends and bottom seals at the bottom.
However, bottom seals are not used with LH08 and 10.

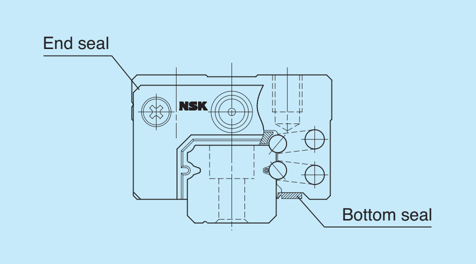


Fig. 11

Table 8 Seal friction per ball slide (maximum value)

Unit: N

Model \ Size	08	10	12
LH	0.5	1	1.5

(2) NSK K1™ lubrication unit

Table 9 shows the dimensions of linear guides equipped with NSK K1 lubrication units.

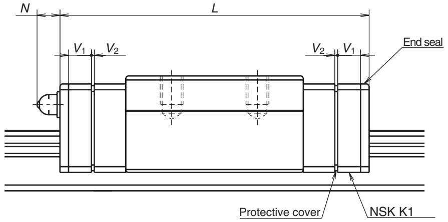


Table 9 Dimensions when equipped with NSK K1 lubrication units Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1 V_1	Protective cover thickness V_2	Protrusion of 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 processing machinery/medical equipment are available for LH12.
2) Slide length when equipped with NSK K1 = (standard ball slide length) + (V_1 thickness of single NSK K1 unit) × (number of K1 units) + (V_2 thickness of the protective cover) × 2.

(3) Caps 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

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.
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

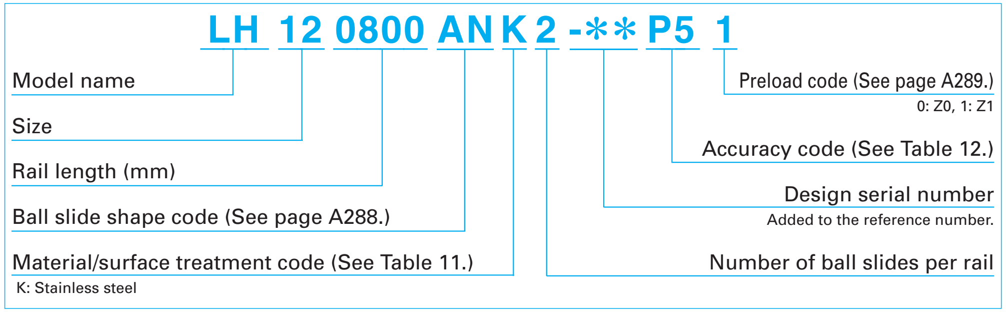


Table 11 Material/surface treatment code

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

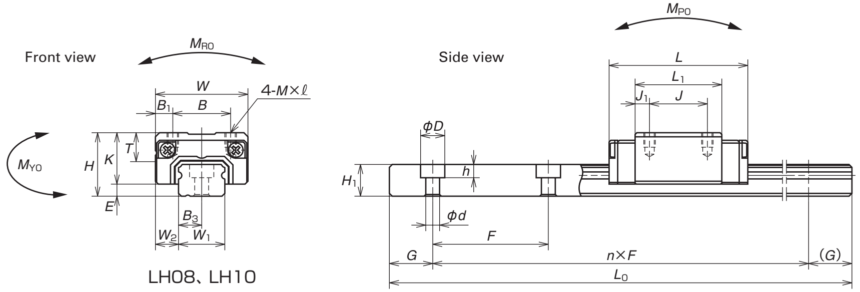
Note: Refer to pages A58 and A73 for details on NSK K1 lubrication units.

9. Dimensions

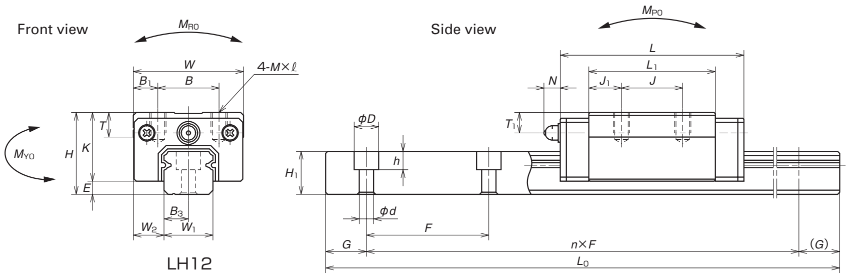
LH 12 0800 AN K 2 - P5 1**

Model name
Size
Rail length (mm)
Ball slide shape code (See page A288.)
Material/surface treatment code (See Table 11.)
K: Stainless steel

Preload code (See page A289.)
0: Z0, 1: Z1
Accuracy code (See Table 12.)
Design serial number
Added to the reference number.
Number of ball slides per rail



LH08、LH10



LH12

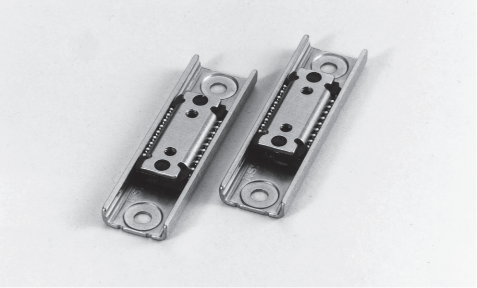
Unit: mm

Model No.	Assembly			Ball slide													Rail				Basic load ratings								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]	C_0	M_{RO}	M_{PO}		M_{YO}			
	H	E	W2	W	L	B	J	M× pitch × ℓ	L1	K	T	Hole size	T1	N	W1	H1	F	d× D× h	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	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. Note that balls will fall out when the ball slide is removed from the rail.

2) Basic load ratings comply with ISO standards (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-4-3.6 LL Model



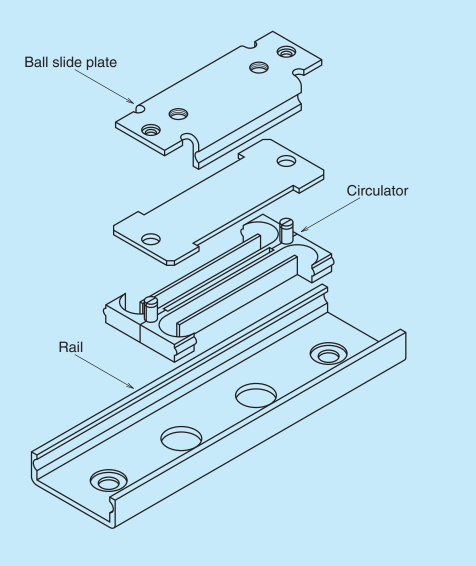


Fig. 1 LL Model structure

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.

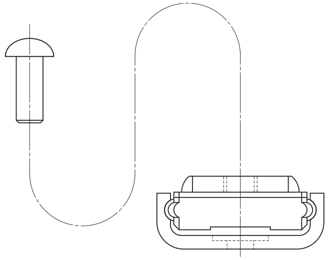
(2) Compact

The ball groove is made outside the ball slide to reduce overall size and obtain high speed.

(3) High corrosion resistance

Highly corrosion resistant martensitic stainless steel is used as standard material.

2. Ball slide shape

Ball slide shape code	Shape/installation method
PL	

3. Accuracy and preload

(1) Accuracy standard

The LL Model has a Normal grade PN as the accuracy grade.

Table 1 shows the tolerance.

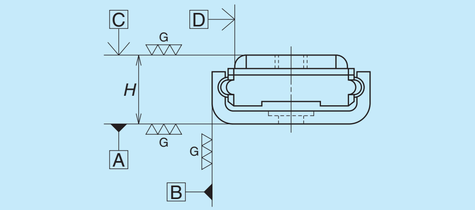


Fig. 2 Standard LL

Table 1 Tolerance of Normal grade (PN)

Unit: μm

Model No. / Characteristic	LL15
Mounting height	±20
Running parallelism of surface C to surface A	20
Running parallelism of surface D to surface B	(See **Fig. 2.**)

(2) Preload

We offer clearance for the LL Model.

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

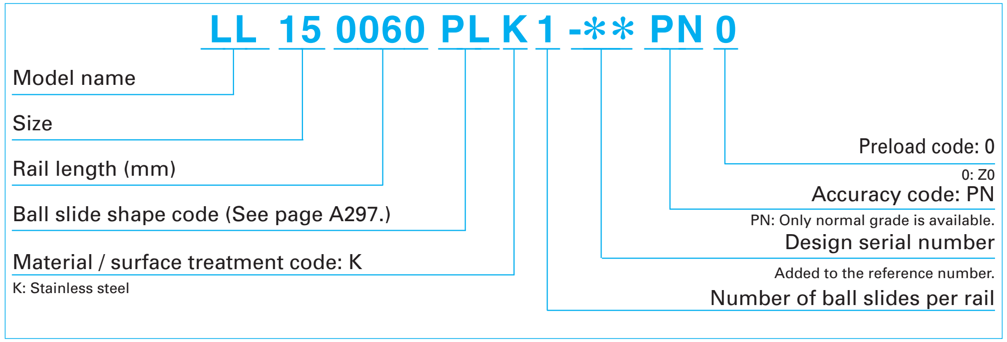
Unit: mm

Model	Size / Material	15				
LL	Stainless steel	40	60	75	90	120

5. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.

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

Model name

Size

Rail length (mm)

Ball slide shape code (See page A297.)

Material / surface treatment code: K

K: Stainless steel

Preload code: 0

0: Z0

Accuracy code: PN

PN: Only normal grade is available.

Design serial number

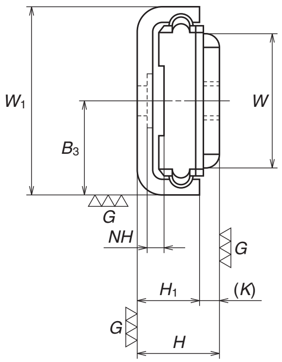
Added to the reference number.

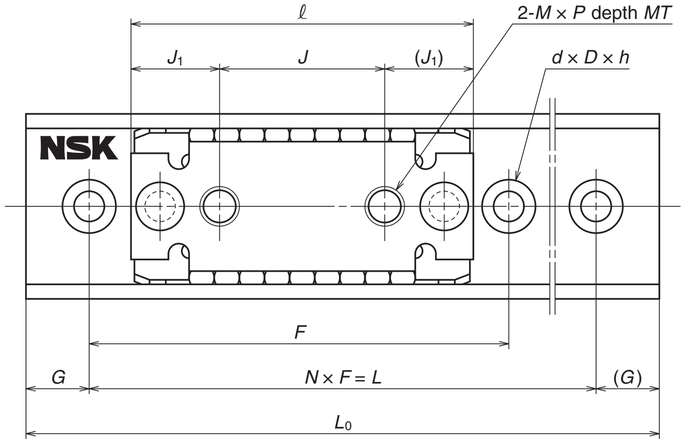
Number of ball slides per rail

6. Dimensions

LL 15 0060 PL K 1 - ✻✻ **PN 0**

Model name: LL
Size: 15
Rail length (mm): 0060
Ball slide shape code (See page A297.): PL
Material / surface treatment code: K
K: Stainless steel
Number of ball slides per rail: 1
Design serial number: -✻✻
Added to the reference number.
Accuracy code: PN
PN: Only normal grade is available.
Preload code: 0
0: Z0





Model No.	Assembly		Ball slide									
	Height		Width	Length	Mounting hole					Height	Pitch	
	H	W_1	W	ℓ	J	M × pitch	MT	J_1	K	H_1	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

Unit: mm

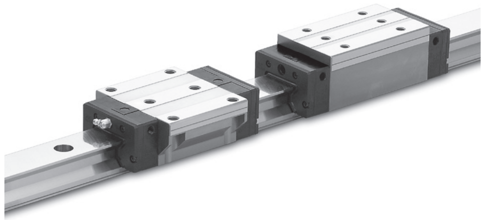
Rail					Basic load ratings						Ball dia.	Weight	
Mounting bolt hole				Length	[5] Dynamic		Static	Static moment				Ball slide	Rail
					[50km]	[100km]	C_0	M_{RO}	M_{PO}	M_{YO}	D_W		
d × D × h	NH	B_3	G	L_0	C_{50}(N)	C_{100}(N)	(N)	(N·m)	(N·m)	(N·m)		(g)	(g)
2.4×5×0.4	1.2	7.5	5	40	880	700	785	7	3	3	2	6	9
			10	60									11
			7.5	75									13
			5	90									16
			10	120									21

Notes:
1) The LL model does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.
2) Seals are not available. Please provide dust-prevention measures on the equipment.
3) Do not use an installation screw on the ball slide which exceeds dimension MT (maximum screw-in depth) in the dimension table.
4) To fix the rail, use M2 × 0.4 cross recessed machine screws for precision instruments.
(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-4-4 High Rigidity Series

A-4-4.1 RA Model



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 extremely high load capacity. Super-long life is achieved and impact load can be sufficiently handled.

(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 model.

(4) Smooth motion

Installation of a retaining piece between rollers restrains roller skew peculiar to roller slides, thereby achieving smooth motion.

(5) Low friction

Using rollers for rolling elements helps minimize dynamic friction.

(6) Interchangeability

Interchangeable rails and roller slides are available. (RA25 to RA65)

(7) Specification with highly dust-resistant V1 seals

Specifications featuring highly dust-resistant V1 end seals with enhanced abrasion resistance are also available (RA 25–65).

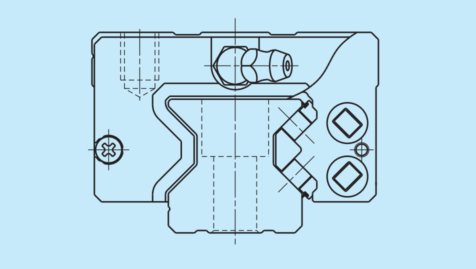


Fig. 1 RA Model

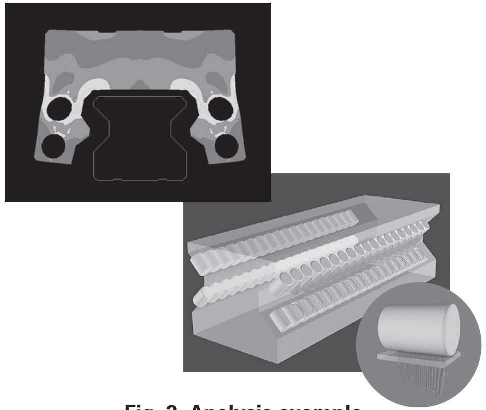


Fig. 2 Analysis example

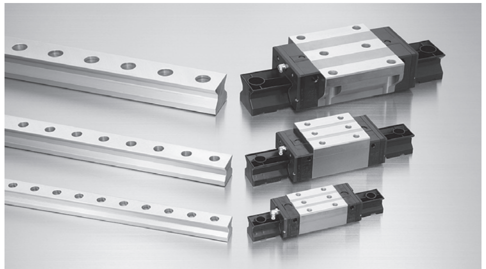
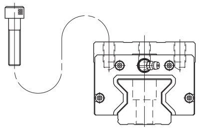
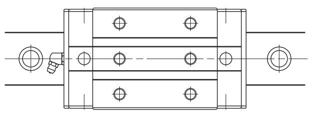
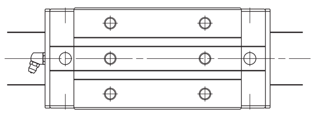
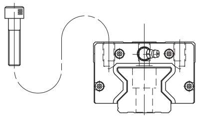
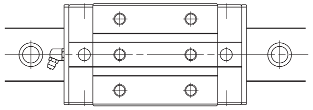
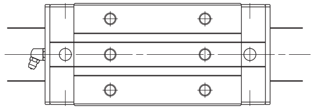
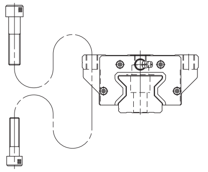
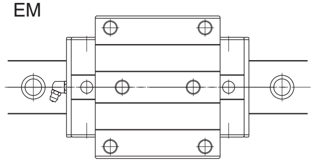
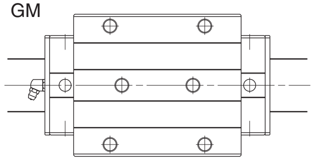


Fig. 3 Interchangeable type

2. Roller slide shape

Roller slide shape code	Shape/installation method	Type (Upper row, Rating: Lower row, Roller slide length) High-load Standard	 Super-high-load 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)	Accuracy grade	Preloaded assembly (not interchangeable)				Interchangeable type
over	or less	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	High precision PH
–	50	2	2	2	4	2
50 –	80	2	2	3	4	3
80 –	125	2	2	3	4	3
125 –	200	2	2	3.5	5	3.5
200 –	250	2	2.5	4.5	6	4.5
250 –	315	2	2.5	5	6.5	5
315 –	400	2	3	5.5	7	5.5
400 –	500	2	3	6	7.5	6
500 –	630	2	3.5	6.5	8.5	6.5
630 –	800	2	4	7	9.5	7
800 –	1 000	2.5	4.5	7.5	10	7.5
1 000 –	1 250	3	5	8.5	12	8.5
1 250 –	1 600	3.5	5.5	9.5	13	9.5
1 600 –	2 000	4	6.5	11	14	11
2 000 –	2 500	4.5	7.5	12	16	12
2 500 –	3 150	5.5	8.5	13	18	13
3 150 –	4 000	6	9.5	14	19	14

(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 interchangeable 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 interchangeable 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**

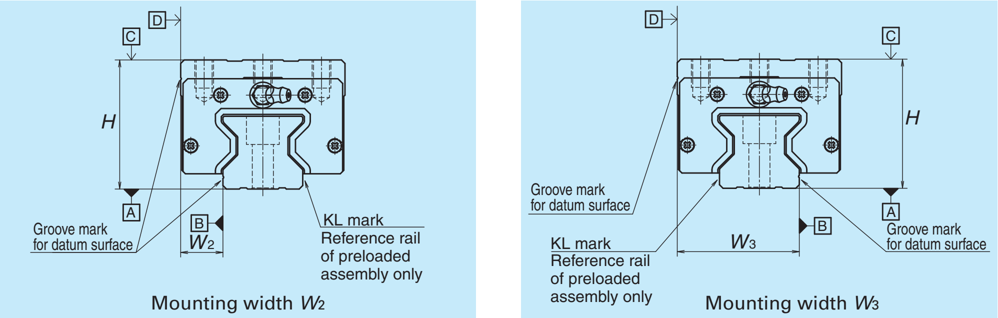
Note: ① Variation on the same rail ② Variation on multiple rails

(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	○	○	○	○	—
	Interchangeable type with slight preload ZZ	—	—	—	—	○
	Interchangeable type with medium preload ZH	—	—	—	—	○

(4) Assembled accuracy



Mounting width W_2

Mounting width W_3

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 Interchangeable types.

- **Preload of preloaded assembly**

Table 5

	Model No.	Preload (N)	
		Slight preload (Z1)	Medium preload (Z3)
High-load	RA15 AN, AL, EM	520	1 030
	RA20 AN, EM	960	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	3 800	12 900
	RA65 AN, EM	6 500	21 000
Super-high-load	RA15 BN, BL, GM	650	1 300
	RA20 BN, GM	1 200	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	3 500	11 600
	RA55 BN, BL, GM	5 000	16 800
	RA65 BN, GM	8 500	28 800

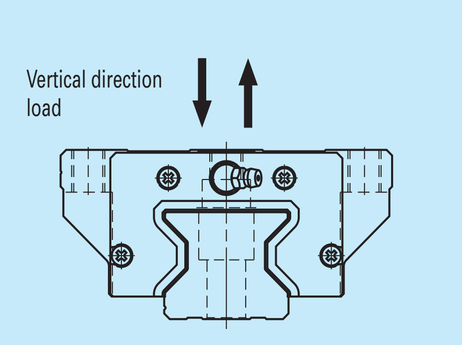


Fig. 5 Direction of load

- **Rigidity of medium preload**

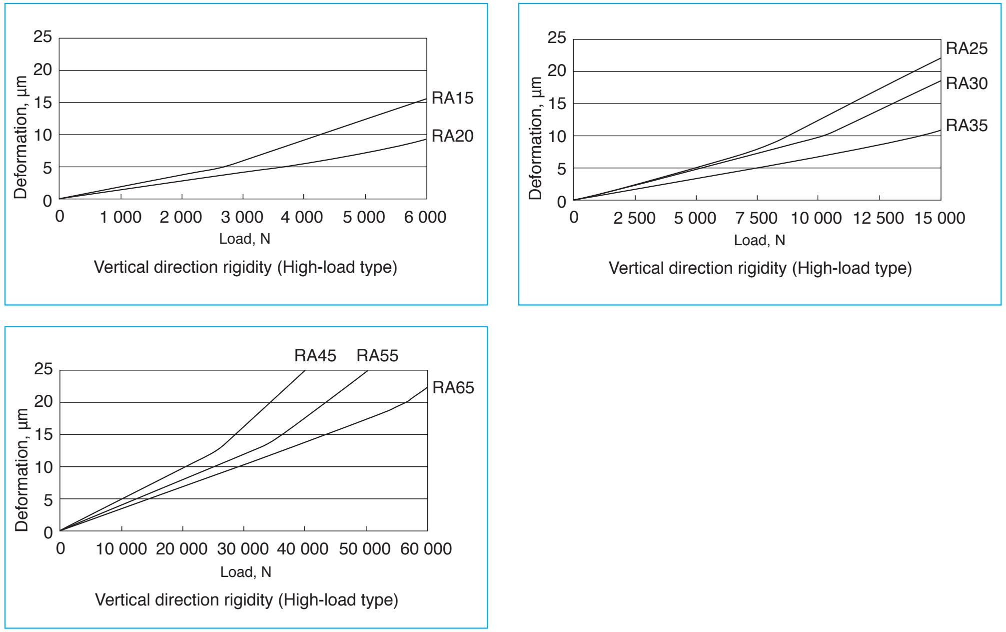


Fig. 6 Vertical direction theoretical rigidity line: High-load type (Roller slide shape: AN, AL, EM)

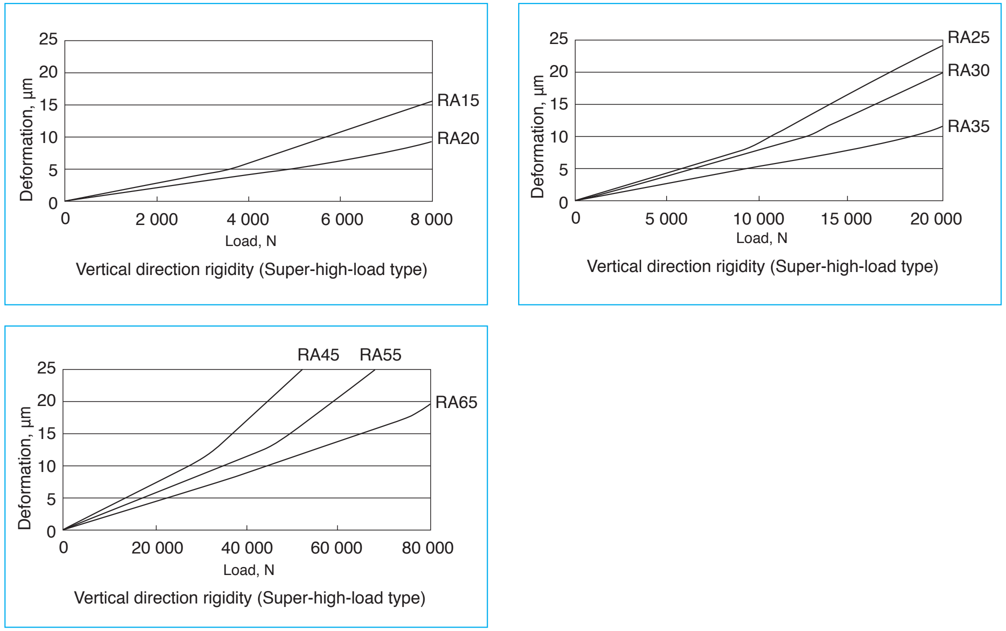


Fig. 7 Vertical direction theoretical rigidity line: Super-high-load type (Roller slide shape: BN, BL, GM)

4. Maximum rail length

Table 6 shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grades.

Table 6 Length limitation of rails

Unit: mm

Model \ 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 requirements exceed the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

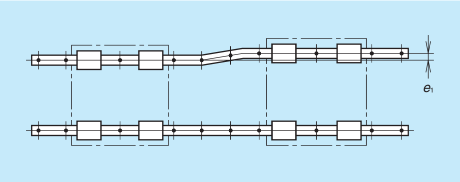


Fig. 8

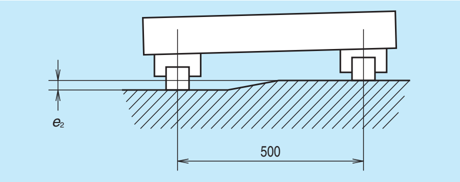


Fig. 9

Table 7

Unit: µm

Value	Preload	Model No.							
		RA15	RA20	RA25	RA30	RA35	RA45	RA55	RA65
Permissible values for parallelism error of two rails e_1	Z1, ZZ	7	10	14	18	21	27	31	49
	Z3 , ZH	5	7	9	11	13	17	19	30
Permissible values for height error of 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

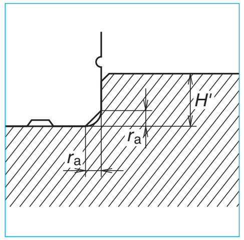


Fig. 10 Shoulder for the rail datum surface

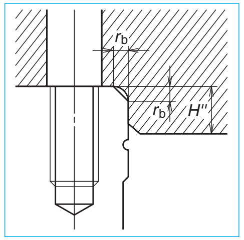


Fig. 11 Shoulder for the roller slide datum surface

Table 8

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	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 A58 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 for grease fittings is at the end face of the roller slide, but we can mount them on the side of the end cap for as an option. (**Fig. 12**) Please consult NSK for the installation of grease or tube fittings to the roller slide body.
- 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 O-ring, and spacer requirements. A spacer is required for some roller slides. The spacers are available from NSK.
- Using a piping unit with thread of M6 × 1 requires a connector to connect it to a grease fitting mounting hole with M6 × 0.75. The connectors are available from NSK.

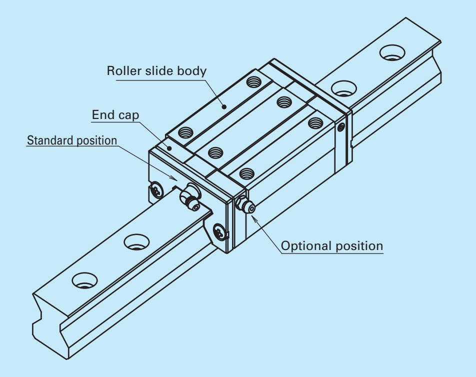


Fig. 12 Mounting position of lubrication accessories

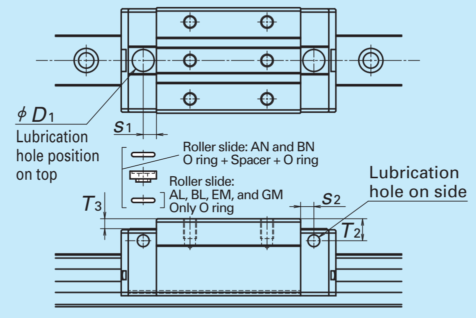


Fig.13 Top and side lubrication hole positions

Table 9 Top and side lubrication hole positions

Unit: mm

Model No.	Roller slide shape code	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	6	4.5
RA30		M6×0.75	5	10	P7+P5	Necessary	10.4	6	3.5
RA35		M6×0.75	5.5	15	P7+P5	Necessary	10.4	7	7.4
RA45		Rc 1/8	7.2	20	P7+P5	Necessary	10.4	7.2	10.4
RA55		Rc 1/8	7.2	21	P7+P5	Necessary	10.4	7.2	10.4
RA65		Rc 1/8	7.2	19	P7	—	10.4	7.2	0.4

Note: Grease fittings and tube fittings cannot be mounted on the top of the end cap.

Table 10 Top and side lubrication hole positions

Unit: mm

Model No.	Roller slide shape code	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	6	0.5
RA30		M6×0.75	5	7	P7	10.4	6	0.5
RA35		M6×0.75	5.5	8	P7	10.4	7	0.4
RA45		Rc 1/8	7.2	10	P7	10.4	7.2	0.4
RA55		Rc 1/8	7.2	11	P7	10.4	7.2	0.4
RA65	EM, GM	Rc 1/8	7.2	19	P7	10.4	7.2	0.4

Note: Grease fittings and tube fittings cannot be mounted on the top of the end cap.

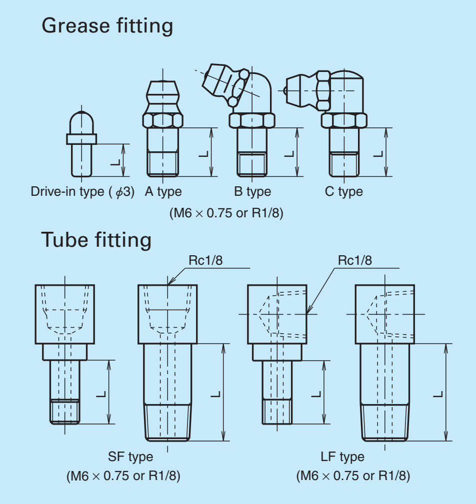


Fig. 14 Grease fitting and tube fitting

7. Dust-resistant components

(1) Standard specification

The RA model 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 model 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 models RA15 and RA20 are available as options.

**) Rail covers are available for models RA25 to RA65.

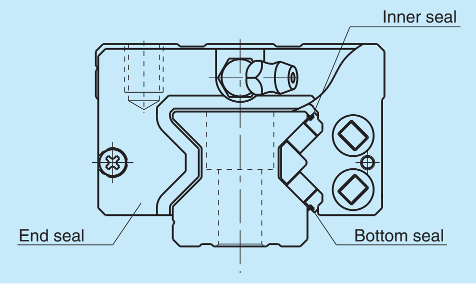


Fig. 15

Table 11

Unit: mm

Model No.	Dust-resistant specification	Dimension L		
		Grease fitting /Drive-in type	Tube fitting	
			SF type	LF type
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	5
	With NSK K1	12	12	12
	Double seal	10	9	9
	Protector	10	9	9
RA30	Standard	5	6	6
	With NSK K1	14	14	15
	Double seal	12	12	11
	Protector	12	10	11
RA35	Standard	5	6	6
	With NSK K1	14	14	15
	Double seal	12	12	11
	Protector	12	10	11
RA45	Standard	8	13.5	17
	With NSK K1	18	20	21.5
	Double seal	14	16	17
	Protector	14	16	17
RA55	Standard	8	13.5	17
	With NSK K1	18	20	21.5
	Double seal	14	16	17
	Protector	14	16	17
RA65	Standard	8	13.5	17
	With NSK K1	20	20	20
	Double seal	14	18	17
	Protector	14	16	17

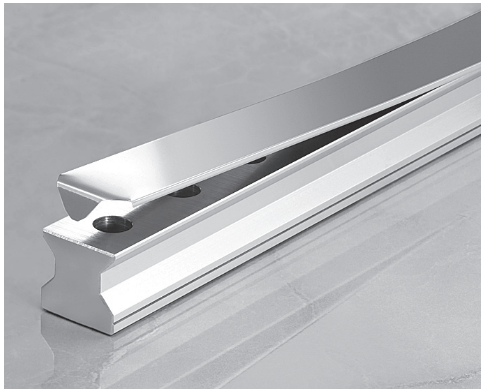


Fig. 16 Rail cover

Table 12 Seal friction per roller slide (maximum value)

Unit: N

Size / Model	15	20	25	30	35	45	55	65
RA	4	5.5	5	5	6	8	8	14

(2) NSK K1™ lubrication unit

Table 13 shows the dimensions of linear guides equipped with NSK K1 lubrication units.

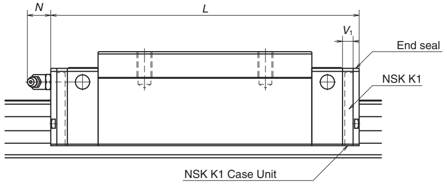


Table 13 Dimensions when equipped with NSK K1 lubrication units

Unit: mm

Model No.	Roller slide length	Roller slide shape code	Standard roller slide length	Roller slide length with two NSK K1 installed L	Thickness of single NSK K1 V_1	Protrusion of 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: Slide length when equipped with NSK K1 = (standard roller slide length) + (V_1 thickness of single NSK K1 unit) × (number of K1 units) + (V_2 thickness of the protective cover) × 2.

(3) Double seal and protector

For the RA Model, double seals and protectors can be installed only before shipping from the factory.

Table 14 shows the increased thickness when end seals and protectors 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

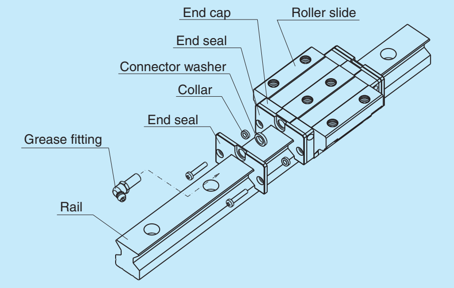


Fig. 17 Double seal

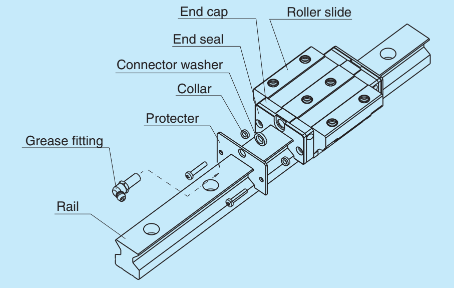


Fig. 18 Protector

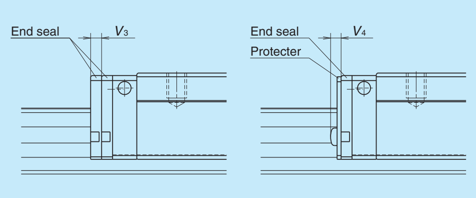


Fig. 19

(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**.

Table 15 Height of rails equipped with rail cover

Unit: mm

Model No.	Standard height H_1	Cover installation
RA25	24	24.2
RA30	28	28.2
RA35	31	31.25
RA45	38	38.3
RA55	43.5	43.8
RA65	55	55.3

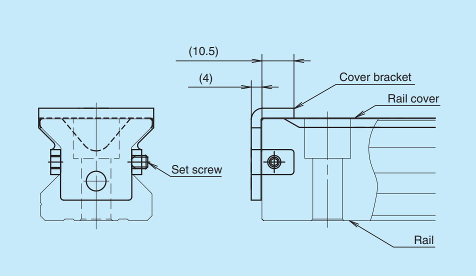


Fig. 20 End configuration of rail equipped with the rail cover

(5) Caps 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

(6) Specification with highly dust-resistant V1 seals and V1 bottom seals

RA25, RA30, RA35, RA45, RA55, and RA65 have specifications featuring dust-resistant V1 end seals with enhanced abrasion resistance.

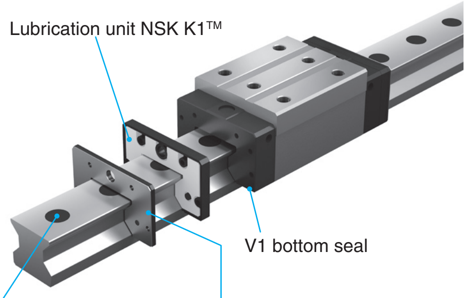
Highly dust-resistant V1 seals feature new materials in a new shape for better abrasion resistance and prevent foreign matter getting into the roller slide for a long period.

RA35, RA45, RA55, and RA65 also have V1 bottom seals. In addition, outstanding lubrication effects by NSK K1 further improves the durability.

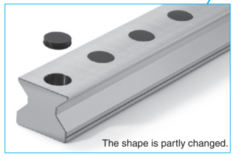
V1 bottom seals and NSK K1 can be selected individually according to the application.

Bolt hole caps with an improved shape eliminate the buildup of foreign matter in and around the rail mounting holes and prevent foreign matter from entering the inside of the slide. Additionally, a rail cover with higher dust resistance can be selected.

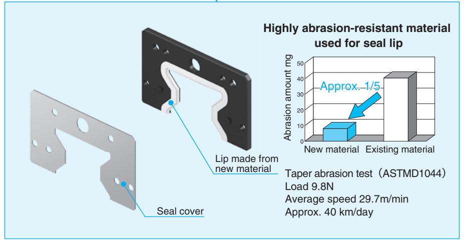
See A310 for the details of the rail cover.



Bolt-hole caps



Highly dust-resistant V1 seal



●Durability test under extreme conditions - no lubrication

The durability of the seal lip has been greatly improved by adopting new materials and optimizing the seal lip shape.

Test sample: RA35

Lubrication: No lubrication (on the seal)

Travel speed: 30 m/min Travel distance: 40 km

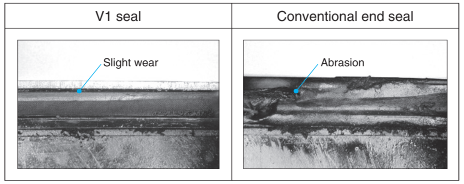
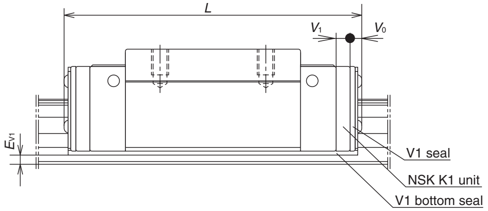


Table 17 shows dimensions for roller slides with highly dust-resistant V1 seals.



Since the sealing property (resistance to foreign matter) is affected by usage or the lubrication environment, please conduct an evaluation test for your particular application.

Table 17

Unit: mm

Model No.	Roller slide length	Roller slide shape code	Standard roller slide length L	Roller slide length equipped with V1 seal and NSK K1 L	Slide bottom face height equipped with V1 bottom seal E_{V1}	Thickness of V1 seal V_0	Thickness of K1 case unit V_1
RA25	Standard	AN, AL, EM	97.5	111.3	—	5.1	5
	Long	BN, BL, GM	115.5	129.3			
RA30	Standard	AN, AL, EM	110.8	126.8	—	5.4	6
	Long	BN, BL, GM	135.4	151.4			
RA35	Standard	AN, AL, EM	123.8	140.8	min 3.7	5.4	6.5
	Long	BN, BL, GM	152	169			
RA45	Standard	AN, AL, EM	154	173.2	min 5.2	6.6	7
	Long	BN, BL, GM	190	209.2			
RA55	Standard	AN, AL, EM	184	203.2	min 6.2	6.6	7
	Long	BN, BL, GM	234	253.2			
RA65	Standard	AN, EM	228.4	251.2	min 10.2	8.9	7.5
	Long	BN, GM	302.5	325.3			

●Design Precautions

Because the product is used under severe operating conditions that require highly dust-resistant V1 seals, please inform NSK about your service conditions using the technical data sheet on page A146.

(7) Bellows

Installation of bellows

*** Fixing to the roller slide**

- Remove two machine screws which secure the end seal. (For RA15, hold the end cap by hand. Otherwise, the end cap is detached from the slide, and the roller inside may spill over.)
- Insert a spacer to the securing hole of the end seal, fasten the mounting plate at the end of the bellows using a slightly longer machine screw. (For RA15, insert a flat spacer between the end seal and the mounting plate at the end of the bellows.)

*** Fixing to the rail**

- For fixing to the rail, make 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.

Calculating length of bellows

- The formulas for calculating length of bellows for the end are as follows.

Stroke $St = L_{max} - L_{min}$

Length when stretched to the maximum length

$$L_{max} = f_b \cdot P \times \text{Number of folds}$$

Length when contracted to the minimum length

$$L_{min} = 2.5 \times \text{Number of folds} + 3$$

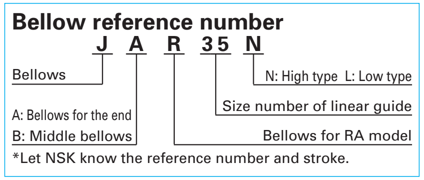
Values of f_b and P are shown in the bellows dimension table. Based on these above formulas, calculate the number of folds as follows.

$$\text{Number of folds} = \frac{St - 3}{f_b \cdot P - 2.5}$$

Round up the calculated value so that the number of folds will be n + 0.5 (n: the natural number).

For the length of a middle bellows, please ask NSK.

Bellow reference number



*Let NSK know the reference number and stroke.

Dimension table of bellows
RA model

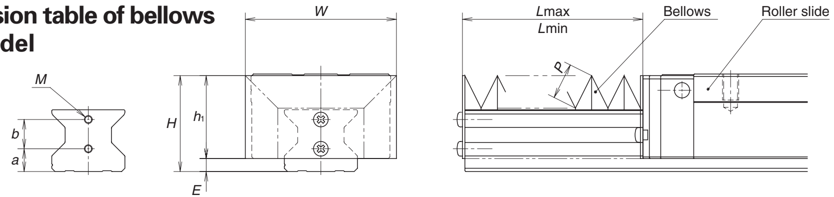


Fig. 21 Dimensions of bellows

Table 18 Dimensions of bellows

Unit: mm (excluding f_b)

Model No.	*H*	h_1	*E*	*W*	*P*	f_b	*a*	*b*	Tap (*M*) × depth
JAR15L	23.5	19.5	4	33	7	1.2	7	6.3	M3 × 5
JAR15N	27	23		39	10	1.3			
JAR20N	29	24	5	43	8	1.3	8.5	9	M3 × 5
JAR25L	35	30	5	51	10	1.3	8.5	12	M3 × 5
JAR25N	39	34		61	14	1.4			
JAR30L	41	34.5	6.5	60	12	1.3	11	12.5	M4 × 6
JAR30N	44	37.5		66	15	1.4			
JAR35L	47	40.5	6.5	72	15	1.4	11	15	M4 × 6
JAR35N	54	47.5		82	20	1.5			
JAR45L	59	51	8	93	20	1.5	14	18	M5 × 8
JAR45N	69	61		113	30	1.5			
JAR55L	69	60	9	101	20	1.5	15	22	M5 × 8
JAR55N	79	70		121	30	1.5			
JAR65N	89	76	13	131	30	1.5	21	26	M6 × 10

Note: f_b is a dimensionless number

8. Dynamic friction force

- Dynamic friction force indications per roller slide are shown in Table 19.
- In assuming actual usage conditions, the dynamic friction force of the standard product is the value when the dust-resistant specification of the slide is standard (with two end seals, inner seal and bottom seal) and standard grease (AS2 grease) is packed.

  However, since the inner seal of RA15 and RA20 is optional, the inner seal is not attached to the standard dust-resistant specification.
- When using options, the dynamic friction force of each option (or, in the case of highly dust-resistant V1 seals, the difference from standard end seals) is added to that of the standard product.
- Dynamic friction force varies with grease.

Table 19 Dynamic friction force

Unit: N

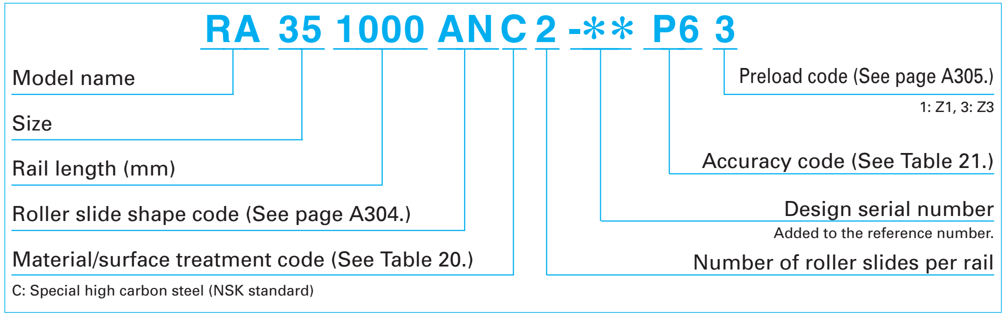
Model. No.	Roller slide		Of standard products (when packed with AS2 grease)		Of V1 seals	Of V1 bottom seals	Of NSK K1 units
	Rating	Shape code		Portion from standard seals			
RA15	High-load type	AN, AL, EM	21	3	—	—	3
	Super-high-load type	BN, BL, GM	24				
RA20	High-load type	AN, EM	22	3.5	—	—	3
	Super-high-load type	BN, GM	28				
RA25	High-load type	AN, AL, EM	27	5	6	—	4
	Super-high-load type	BN, BL, GM	34				
RA30	High-load type	AN, AL, EM	33	5	8	—	4
	Super-high-load type	BN, BL, GM	42				
RA35	High-load type	AN, AL, EM	42	6	10	17	5
	Super-high-load type	BN, BL, GM	53			21	
RA45	High-load type	AN, AL, EM	56	8	15	21	7
	Super-high-load type	BN, BL, GM	69			26	
RA55	High-load type	AN, AL, EM	80	8	20	25	8
	Super-high-load type	BN, BL, GM	95			32	
RA65	High-load type	AN, EM	120	14	25	31	8
	Super-high-load type	BN, GM	138			41	

Notes: 1) Values in the columns to the right of "For standard products" show the increase in dynamic friction force when two of the components listed are mounted on a slide.
2) These are indication values. Please use them as a reference.

9. Reference number

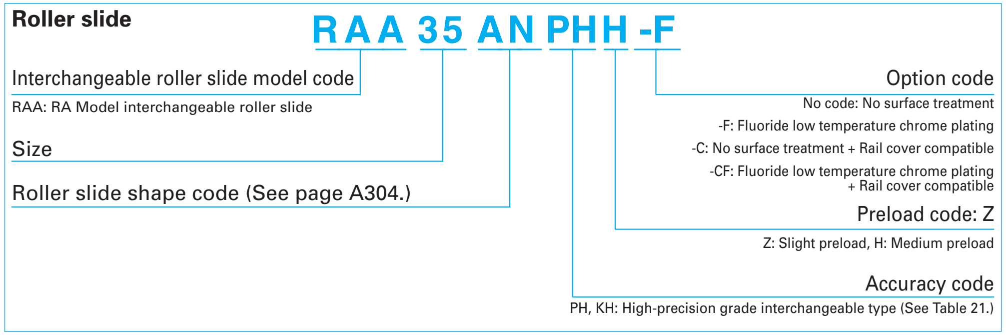
A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

(1) Reference number for preloaded assembly


RA 35 1000 AN C 2 -** P6 3

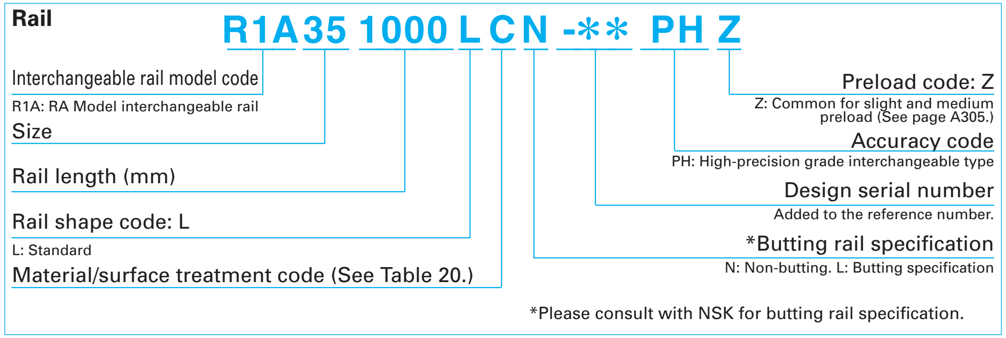
- Model name
- Size
- Rail length (mm)
- Roller slide shape code (See page A304.)
- Material/surface treatment code (See Table 20.)
  C: Special high carbon steel (NSK standard)
- Number of roller slides per rail
- Design serial number
  Added to the reference number.
- Accuracy code (See Table 21.)
- Preload code (See page A305.)
  1: Z1, 3: Z3

(2) Reference number for interchangeable type


Roller slide

RAA 35 AN PH H -F

- Interchangeable roller slide model code
  RAA: RA Model interchangeable roller slide
- Size
- Roller slide shape code (See page A304.)
- Accuracy code
  PH, KH: High-precision grade interchangeable type (See Table 21.)
- 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 compatible
  -CF: Fluoride low temperature chrome plating + Rail cover compatible


Rail

R1A35 1000 L C N -** PH Z

- Interchangeable rail model code
  R1A: RA Model interchangeable rail
- Size
- Rail length (mm)
- Rail shape code: L
  L: Standard
- Material/surface treatment code (See Table 20.)
- *Butting rail specification
  N: Non-butting. L: Butting specification
- Design serial number
  Added to the reference number.
- Accuracy code
  PH: High-precision grade interchangeable type
- Preload code: Z
  Z: Common for slight and medium preload (See page A305.)

*Please consult with NSK for butting rail specification.

When interchangeable rails and slides are assembled, reference number coding is the same as that for preloaded assemblies. However, only preload codes Z (slight preload) and H (medium preload) may be used (Refer to Page A305.)
Click!Speedy™ NSK Linear Guide Quick Delivery System uses a new numbering system. For details, please refer to the Click!Speedy general catalog CAT. No. E3191.

Table 20 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
P	Special high carbon steel with V1 seal
R	Special high carbon steel with surface treatment and V1 seal
Z	Other, special

Note : P and R are not available for interchangeable slides and rails.

Table 21 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 (Interchangeable type)	PH	KH

Note: Refer to pages A58 for details on NSK K1 lubrication units.

10. Dimensions

RA-AN (High-load / Standard)

RA-BN (Super-high-load / Long)

RA 35 1000 AN C 2 - PH H**

Model name: RA

Size: 35

Rail length (mm): 1000

Roller slide shape code (See page A304.): AN

Material/surface treatment code (See Table 20.): C
C: Special high carbon steel (NSK standard)

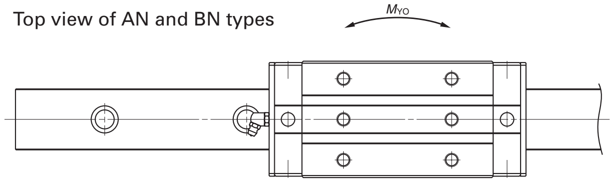
Number of roller slides per rail: 2

Design serial number: -**
Added to the reference number.

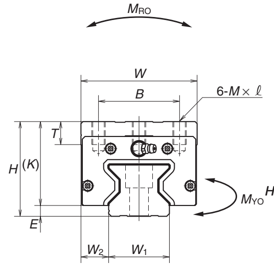
Accuracy code (See Table 21.): PH

Preload code (See page A305.): H
1: Z1, 3: Z3, Z: ZZ, H: ZH

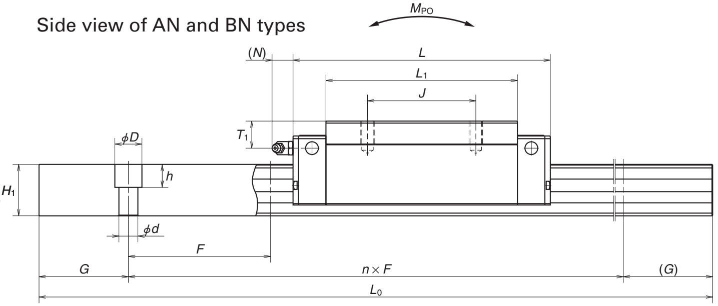
Top view of AN and BN types



Front view of AN and BN types



Side view of AN and BN types



Reference number for roller slide of interchangeable type

Roller slide **RAA 35 AN PH H -F**

Interchangeable roller slide model code: RAA
RAA: RA Model interchangeable roller slide

Size: 35

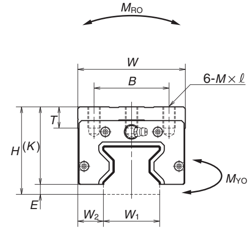
Roller slide shape code (See page A304.): AN

Accuracy code: PH
PH, KH: High-precision grade interchangeable type (See Table 21.)

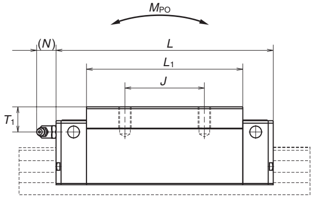
Preload code: Z
Z: Slight preload, H: Medium preload

Option code: -F
No code: No surface treatment
-F: Fluoride low temperature chrome plating
-C: No surface treatment + Rail cover compatible
-CF:Fluoride low temperature chrome plating + Rail cover compatible

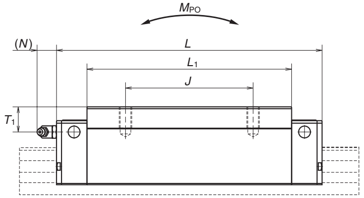
AN and BN types



AN type



BN type



Reference number for rail of interchangeable type

Rail **R1A 35 1000 L C N -** PH Z**

Interchangeable rail model code: R1A
R1A: RA Model interchangeable rail

Size: 35

Rail length (mm): 1000

Rail shape code: L
L: Standard

Material/surface treatment code (See Table 20.): C

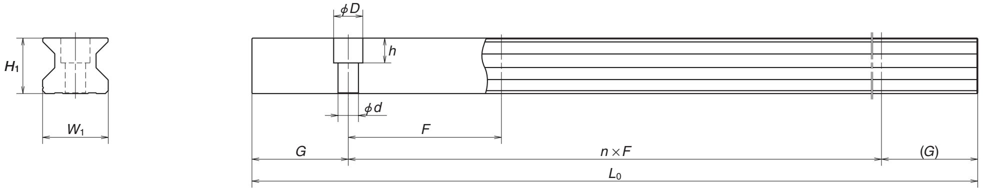
*Butting rail specification: N
N: Non-butting. L: Butting specification

Design serial number: -**
Added to the reference number.

Accuracy code: PH
PH: High-precision grade interchangeable type

Preload code: Z
Z: Common for slight and medium preload (See A305.)

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Roller slide													Rail				Basic load ratings								Weight	
	Height			Width	Length	Mounting hole						Grease fitting			Width	Height	Pitch	Mounting bolt hole	G	Maximum length	3)Dynamic		Static	Static moment (N·m)					Roller slide	Rail
																					[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	M × pitch × ℓ	L_1	K	T	Hole size	T_1	N	W_1	H_1	F	d × D × h	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
RA15AN RA15BN	28	4	9.5	34	70 85.4	26	26	M4×0.7×6	44.8 60.2	24	8	ϕ3	8	3	15	16.3	60 (30)	4.5×7.5×5.3	20	2 000	12 600 16 000	10 300 13 000	27 500 37 000	260 350	210 375	1 320 2 130	210 375	1 320 2 130	0.21 0.30	1.6
RA20AN RA20BN	30	5	12	44	86.5 106.3	32	36 50	M5×0.8×6	57.5 77.3	25	12	ϕ3	4	3	20	20.8	60 (30)	6×9.5×8.5	20	3 000	23 600 29 500	19 200 24 000	52 500 70 000	665 890	505 900	3 100 5 000	505 900	3 100 5 000	0.38 0.50	2.6
RA25AN RA25BN	40	5	12.5	48	97.5 115.5	35	35 50	M6×1×9	65.5 83.5	35	12	M6×0.75	10	11	23	24	30 (60)	7×11×9	20	3 900	36 000 43 500	29 200 35 400	72 700 92 900	970 1 240	760 1 240	4 850 7 200	760 1 240	4 850 7 200	0.60 0.91	3.4
RA30AN RA30BN	45	6.5	16	60	110.8 135.4	40	40 60	M8×1.25×11	74 98.6	38.5	14	M6×0.75	10	11	28	28	40 (80)	9×14×12	20	3 900	47 800 58 500	38 900 47 600	93 500 121 000	1 670 2 170	1 140 1 950	7 100 11 500	1 140 1 950	7 100 11 500	1.0 1.3	4.9
RA35AN RA35BN	55	6.5	18	70	123.8 152	50	50 72	M8×1.25×12	83.2 111.4	48.5	15	M6×0.75	15	11	34	31	40 (80)	9×14×12	20	3 900	65 500 82 900	53 300 67 400	129 000 175 000	2 810 3 810	1 800 3 250	11 000 17 800	1 800 3 250	11 000 17 800	1.6 2.1	6.8
RA45AN RA45BN	70	8	20.5	86	154 190	60	60 80	M10×1.5×17	105.4 141.4	62	17	Rc1/8	20	14	45	38	52.5 (105)	14×20×17	22.5	3 650	114 000 143 000	92 800 116 000	229 000 305 000	6 180 8 240	4 080 7 150	24 000 39 000	4 080 7 150	24 000 39 000	3.0 4.1	10.9
RA55AN RA55BN	80	9	23.5	100	184 234	75	75 95	M12×1.75×18	128 178	71	18	Rc1/8	21	14	53	43.5	60 (120)	16×23×20	30	3 600	159 000 207 000	129 000 168 000	330 000 462 000	10 200 14 300	7 060 13 600	41 000 72 000	7 060 13 600	41 000 72 000	4.9 6.7	14.6
RA65AN RA65BN	90	13	31.5	126	228.4 302.5	76	70 120	M16×2×20	155.4 229.5	77	22	Rc1/8	19	14	63	55	75 (150)	18×26×22	35	3 600	259 000 355 000	210 000 288 000	504 000 756 000	19 200 28 700	12 700 28 600	78 500 153 000	12 700 28 600	78 500 153 000	9.3 12.2	22.0

Notes: 1) Select either the standard dimension for pitch *F* as shown without parentheses or the semi-standard dimension as shown inside parentheses. If not specified, the standard dimension for *F* will be applied.

2) The interchangeable type is available for models RA25 to RA65.

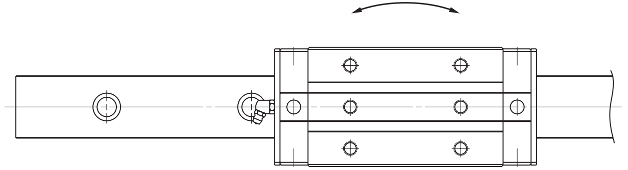
3) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
C_{50}; the basic dynamic load rating for 50 km rated fatigue life
C_{100}; the basic dynamic load rating for 100 km rated fatigue life

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

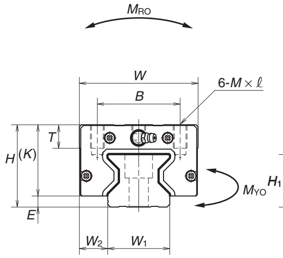
RA 35 1000 AL C 2 - PH H**

Model name
Size
Rail length (mm)
Roller slide shape code (See page A304.)
Material/surface treatment code (See Table 20.)
C: Special high carbon steel (NSK standard)
Preload code (See page A305.)
1: Z1, 3: Z3, Z: ZZ, H: ZH
Accuracy code (See Table 21.)
Design serial number
Added to the reference number.
Number of roller slides per rail

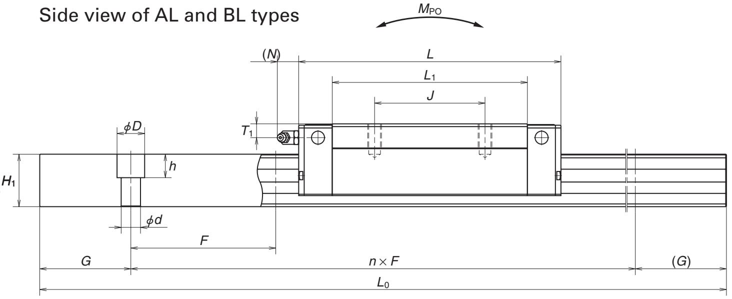
Top view of AL and BL types



Front view of AL and BL types



Side view of AL and BL types

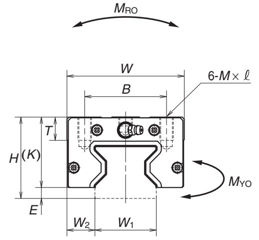


Reference number for roller slide of interchangeable type

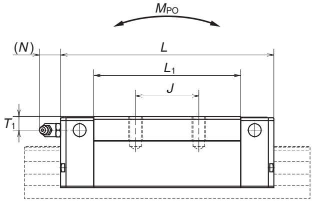
Roller slide **RAA 35 AL PH H -F**

Interchangeable roller slide model code
RAA: RA Model interchangeable roller slide
Size
Roller slide shape code (See page A304.)
Option code
No code: No surface treatment
-F: Fluoride low temperature chrome plating
-C: No surface treatment + Rail cover compatible
-CF: Fluoride low temperature chrome plating + Rail cover compatible
Preload code: Z
Z: Slight preload, H: Medium preload
Accuracy code
PH, KH: High-precision grade interchangeable type (See Table 21.)

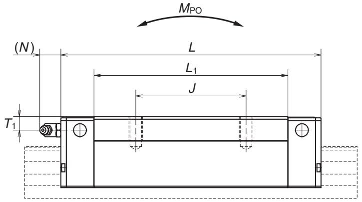
AL and BL types



AL type



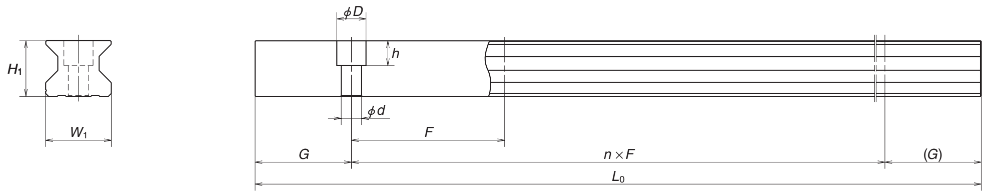
BL type



Reference number for rail of interchangeable type

Rail **R1A 35 1000 L C N -** PH Z**

Interchangeable rail model code
R1A: RA Model interchangeable rail
Size
Rail length (mm)
Rail shape code: L
L: Standard
Material/surface treatment code (See Table 20.)
Preload code: Z
Z: Common for slight and medium preload (See A305.)
Accuracy code
PH: High-precision grade interchangeable type.
Design serial number
Added to the reference number.
*Butting rail specification
N: Non-butting. L: Butting specification
*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Roller slide											Rail						Basic load ratings								Weight	
	Height			Width	Length	Mounting hole						Grease fitting			Width	Height	Pitch	Mounting bolt hole	G	Maximum length	$^{3)}$Dynamic		Static	Static moment (N·m)					Roller slide	Rail
																					[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	M × pitch × ℓ	L_1	K	T	Hole size	T_1	N	W_1	H_1	F	d × D × h	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
RA15AL **RA15BL**	24	4	9.5	34	70 85.4	26	26	M4×0.7×5.5	44.8 60.2	20	8	ϕ3	4	3	15	16.3	60 (30)	4.5×7.5×5.3	20	2 000	12 600 16 000	10 300 13 000	27 500 37 000	260 350	210 375	1 320 2 130	210 375	1 320 2 130	0.17 0.25	1.6
RA25AL **RA25BL**	36	5	12.5	48	97.5 115.5	35	35 50	M6×1×8	65.5 83.5	31	12	M6×0.75	6	11	23	24	30 (60)	7×11×9	20	3 900	36 000 43 500	29 200 35 400	72 700 92 900	970 1 240	760 1 240	4 850 7 200	760 1 240	4 850 7 200	0.45 0.80	3.4
RA30AL **RA30BL**	42	6.5	16	60	110.8 135.4	40	40 60	M8×1.25×11	74 98.6	35.5	14	M6×0.75	7	11	28	28	40 (80)	9×14×12	20	3 900	47 800 58 500	38 900 47 600	93 500 121 000	1 670 2 170	1 140 1 950	7 100 11 500	1 140 1 950	7 100 11 500	0.85 1.1	4.9
RA35AL **RA35BL**	48	6.5	18	70	123.8 152	50	50 72	M8×1.25×12	83.2 111.4	41.5	15	M6×0.75	8	11	34	31	40 (80)	9×14×12	20	3 900	65 500 82 900	53 300 67 400	129 000 175 000	2 810 3 810	1 800 3 250	11 000 17 800	1 800 3 250	11 000 17 800	1.2 1.7	6.8
RA45AL **RA45BL**	60	8	20.5	86	154 190	60	60 80	M10×1.5×16	105.4 141.4	52	17	Rc1/8	10	14	45	38	52.5 (105)	14×20×17	22.5	3 650	114 000 143 000	92 800 116 000	229 000 305 000	6 180 8 240	4 080 7 150	24 000 39 000	4 080 7 150	24 000 39 000	2.5 3.4	10.9
RA55AL **RA55BL**	70	9	23.5	100	184 234	75	75 95	M12×1.75×18	128 178	61	18	Rc1/8	11	14	53	43.5	60 (120)	16×23×20	30	3 600	159 000 207 000	129 000 168 000	330 000 462 000	10 200 14 300	7 060 13 600	41 000 72 000	7 060 13 600	41 000 72 000	4.1 5.7	14.6

Notes: 1) Select either the standard dimension for pitch *F* as shown without parentheses or the semi-standard dimension as shown inside parentheses. If not specified, the standard dimension for *F* will be applied.

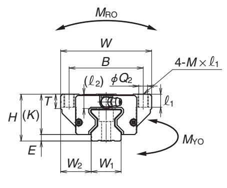
2) The interchangeable type is available for models RA25 to RA55.
3) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
C_{50}; the basic dynamic load rating for 50 km rated fatigue life
C_{100}; the basic dynamic load rating for 100 km rated fatigue life

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

RA 35 1000 EM C 2 - PH H**

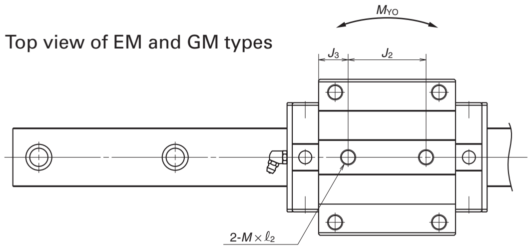
- Model name: RA
- Size: 35
- Rail length (mm): 1000
- Roller slide shape code (See page A304.): EM
- Material/surface treatment code (See Table 20.): C
  - C: Special high carbon steel (NSK standard)
- Number of roller slides per rail: 2
- Design serial number: -**
  - Added to the reference number.
- Accuracy code (See Table 21.): PH
- Preload code (See page A305.): H
  - 1: Z1, 3: Z3, Z: ZZ, H: ZH

Front view of EM and GM types

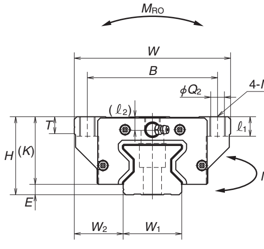


RA15, 20, 25, 30

Top view of EM and GM types

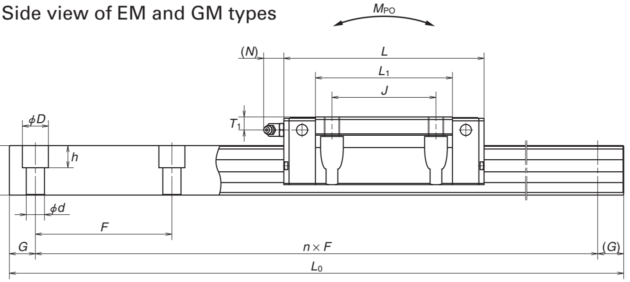


RA15, 20, 25 and 30: Bolts cannot be installed from the underside.



RA35, 45, 55, 65

Side view of EM and GM types

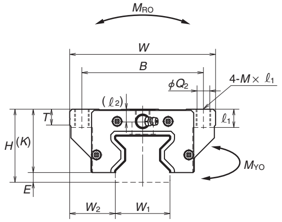


Reference number for roller slide of interchangeable type

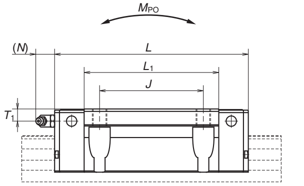
Roller slide **RAA 35 EM PH H -F**

- Interchangeable roller slide model code: RAA
  - RAA: RA Model interchangeable roller slide
- Size: 35
- Roller slide shape code (See page A304.): EM
- Accuracy code: PH
  - PH, KH: High-precision grade interchangeable type (See table 21.)
- Preload code: Z: 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 compatible
  - -CF: Fluoride low temperature chrome plating + Rail cover compatible

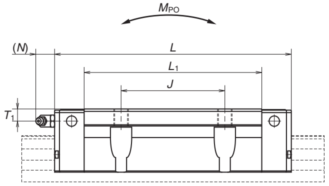
EM and GM types



EM type



GM type

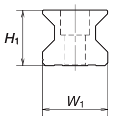


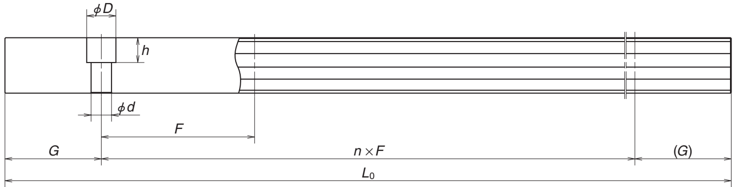
Reference number for rail of interchangeable type

Rail **R1A 35 1000 L C N -** PH Z**

- Interchangeable rail model code: R1A
  - R1A: RA Model interchangeable rail
- Size: 35
- Rail length (mm): 1000
- Rail shape code: L
  - L: Standard
- Material/surface treatment code (See Table 20.): 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 interchangeable type.
- Preload code: Z
  - Z: Common for slight and medium preload (See A305)

*Please consult with NSK for butting rail specification.





Unit: mm

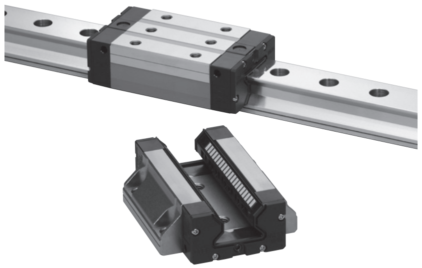
Model No.	Assembly			Roller slide													Rail						Basic load ratings								Weight	
	Height			Width	Length	Mounting hole								Grease fitting			Width	Height	Pitch	Mounting bolt hole	G	Maximum length	3)Dynamic [50km]	[100km]	Static	Static moment (N·m)					Roller slide	Rail
	H	E	W_2	W	L	B	J	J_2	M × pitch × ℓ_1(ℓ_2)	Q_2	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	(kg)	(kg/m)
RA15EM **RA15GM**	24	4	16	47	70 85.4	38	30	26	M5×0.8×8.5 (6.5)	4.4	44.8 60.2	20	8	ϕ3	4	3	15	16.3	60 (30)	4.5x7.5x5.3	20	2 000	12 600 16 000	10 300 13 000	27 500 37 000	260 350	210 375	1 320 2 130	210 375	1 320 2 130	0.21 0.28	1.6
RA20EM **RA20GM**	30	5	21.5	63	86.5 106.3	53	40	35	M6×1×9.5 (8)	5.3	57.5 77.3	25	10	ϕ3	4	3	20	20.8	60 (30)	6x9.5x8.5	20	3 000	23 600 29 500	19 200 24 000	52 500 70 000	665 890	505 900	3 100 5 000	505 900	3 100 5 000	0.45 0.65	2.6
RA25EM **RA25GM**	36	5	23.5	70	97.5 115.5	57	45	40	M8×1.25×10 (11)	6.8	65.5 83.5	31	11	M6x0.75	6	11	23	24	30 (60)	7x11x9	20	3 900	36 000 43 500	29 200 35 400	72 700 92 900	970 1 240	760 1 240	4 850 7 200	760 1 240	4 850 7 200	0.80 1.1	3.4
RA30EM **RA30GM**	42	6.5	31	90	110.8 135.4	72	52	44	M10×1.5×12 (12.5)	8.6	74 98.6	35.5	11	M6x0.75	7	11	28	28	40 (80)	9x14x12	20	3 900	47 800 58 500	38 900 47 600	93 500 121 000	1 670 2 170	1 140 1 950	7 100 11 500	1 140 1 950	7 100 11 500	1.3 1.7	4.9
RA35EM **RA35GM**	48	6.5	33	100	123.8 152	82	62	52	M10×1.5×13 (7)	8.6	83.2 111.4	41.5	12	M6x0.75	8	11	34	31	40 (80)	9x14x12	20	3 900	65 500 82 900	53 300 67 400	129 000 175 000	2 810 3 810	1 800 3 250	11 000 17 800	1 800 3 250	11 000 17 800	1.7 2.3	6.8
RA45EM **RA45GM**	60	8	37.5	120	154 190	100	80	60	M12×1.75×15 (10.5)	10.5	105.4 141.4	52	13	Rc1/8	10	14	45	38	52.5 (105)	14x20x17	22.5	3 650	114 000 143 000	92 800 116 000	229 000 305 000	6 180 8 240	4 080 7 150	24 000 39 000	4 080 7 150	24 000 39 000	3.2 4.3	10.9
RA55EM **RA55GM**	70	9	43.5	140	184 234	116	95	70	M14×2×18 (13)	12.5	128 178	61	15	Rc1/8	11	14	53	43.5	60 (120)	16x23x20	30	3 600	159 000 207 000	129 000 168 000	330 000 462 000	10 200 14 300	7 060 13 600	41 000 72 000	7 060 13 600	41 000 72 000	5.4 7.5	14.6
RA65EM **RA65GM**	90	13	53.5	170	228.4 302.5	142	110	82	M16×2×24 (18.5)	14.6	155.4 229.5	77	22	Rc1/8	19	14	63	55	75 (150)	18x26x22	35	3 600	259 000 355 000	210 000 288 000	504 000 756 000	19 200 28 700	12 700 28 600	78 500 153 000	12 700 28 600	78 500 153 000	12.2 16.5	22.0

Notes: 1) Select either the standard dimension for pitch F as shown without parentheses or the semi-standard dimension as shown inside parentheses. If not specified, the standard dimension for F will be applied.

2) The interchangeable type is available for models RA25 to RA65.

3) Basic load ratings comply with ISO standards (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-4-4.2 RB Model



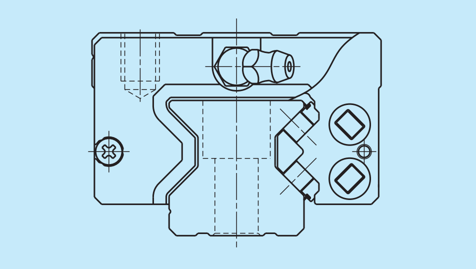


Fig. 1 RB Model

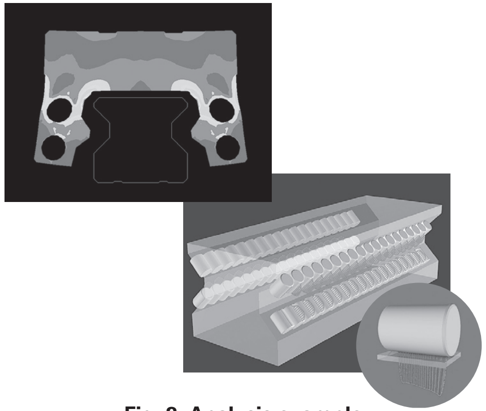


Fig. 2 Analysis example

1. Features

(1) Super-low type

With low mounting height, the RB model is effective for compact machine design.

(2) Super-high load capacity

The RB model can contribute to lower center of gravity of machines, while maintaining the load capacity of the RA model.

(3) 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.

(4) 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 RB model.

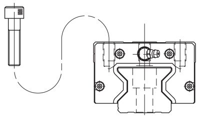
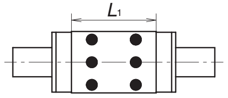
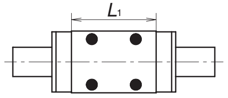
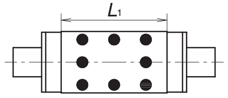
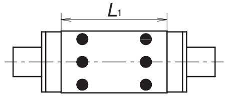
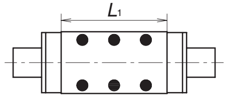
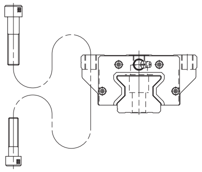
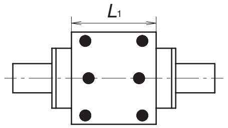
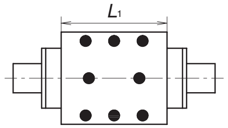
(5) Smooth motion

Installation of a retaining piece between rollers restrains roller skew peculiar to roller slides, thereby achieving smooth motion.

(6) Low friction

Using rollers for rolling elements helps minimize dynamic friction.

2. Roller slide shape

Roller slide shape code	Shape/installation method	Type (Upper row, Rating: Lower row, Roller slide length)	
		High-load	Super-high-load
		Standard	Long
AL TL BL UL		AL·TL (excluding RB55AL)  RB55AL 	BL (excluding RB55 and RB65)  UL  RB55BL·RB65BL 
EM GM		EM 	GM 

3. Accuracy and preload

(1) Running parallelism of roller slide

Table 1

Unit: μm

Rail length(mm) over	Rail length(mm) or less	Accuracy grade: Preloaded assembly (not interchangeable) Ultra precision P3	Super precision P4	High precision P5	Precision grade P6
–	50	2	2	2	4
50 –	80	2	2	3	4
80 –	125	2	2	3	4
125 –	200	2	2	3.5	5
200 –	250	2	2.5	4.5	6
250 –	315	2	2.5	5	6.5
315 –	400	2	3	5.5	7
400 –	500	2	3	6	7.5
500 –	630	2	3.5	6.5	8.5
630 –	800	2	4	7	9.5
800 –	1 000	2.5	4.5	7.5	10
1 000 –	1 250	3	5	8.5	12
1 250 –	1 600	3.5	5.5	9.5	13
1 600 –	2 000	4	6.5	11	14
2 000 –	2 500	4.5	7.5	12	16
2 500 –	3 150	5.5	8.5	13	18
3 150 –	4 000	6	9.5	14	19

(2) Accuracy standard

The preloaded assembly has four accuracy grades; Ultra precision P3, Super precision P4, High precision P5, and Precision P6 grades.

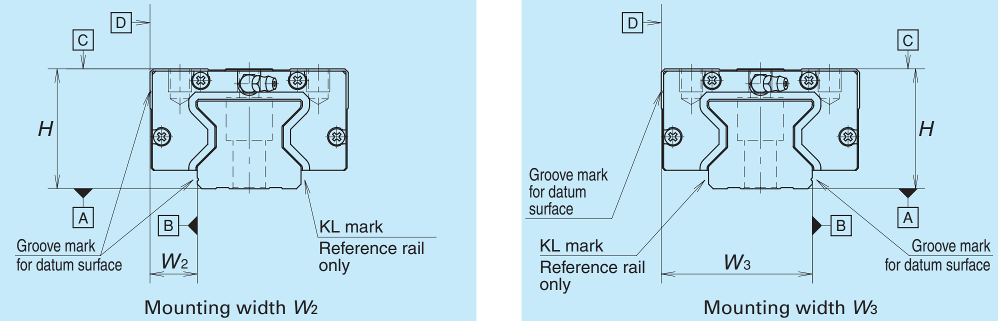
- **Tolerance of preloaded assembly**

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**			

(3) Assembled accuracy



Mounting width W_2

Mounting width W_3

Fig. 3

(4) Preload and rigidity

One type of preload is available: Medium preload Z3 for preloaded assembly.

Table 3

Model No.		Preload (N)
		Medium preload (Z3)
High-load	RB30 AL, EM	3 890
	RB35 AL, EM	5 330
	RB45 AL, EM	9 280
	RB55 AL, TL, EM	12 900
	RB65 AL, EM	21 000
Super-high-load	RB30 BL, GM	4 760
	RB35 BL, GM	6 740
	RB45 BL, GM	11 600
	RB55 BL, UL, GM	16 800
	RB65 BL, UL, GM	28 800

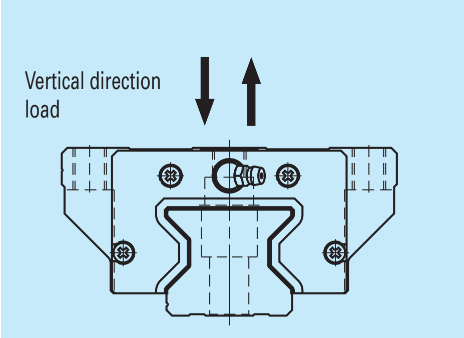


Fig. 4 Direction of load

- **Rigidity of medium preload**

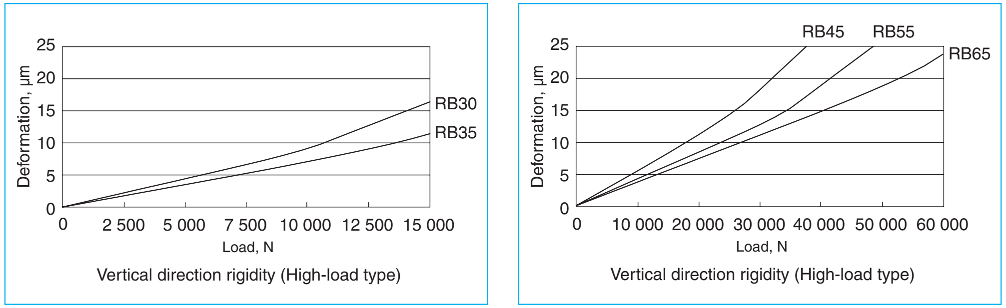


Fig. 5 Vertical direction theoretical rigidity line: High-load type (Roller slide shape: AL, TL, EM)

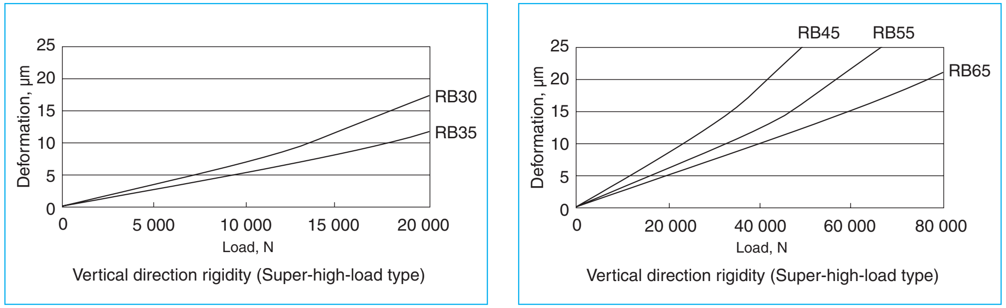


Fig. 6 Vertical direction theoretical rigidity line: Super-high-load type (Roller slide shape: BL, UL, GM)

4. Maximum rail length

Table 4 shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grades.

Table 4 Length limitation of rails

Unit: mm

Model \ Size	30	35	45	55	65
RB	3 900	3 900	3 650	3 600	3 600

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

5. Installation

(1) Permissible values of mounting error

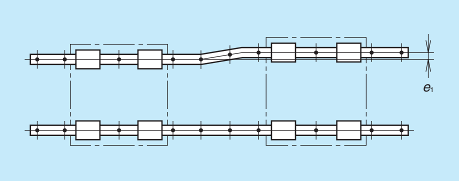


Fig. 7

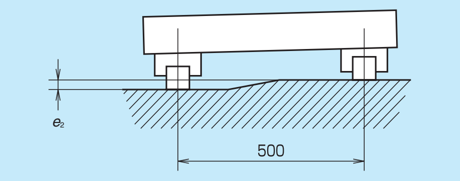


Fig. 8

Table 5

Unit: μm

Value	Model No.				
	RB30	RB35	RB45	RB55	RB65
Permissible values for parallelism error of two rails e_1	11	13	17	19	30
Permissible values for height error of two rails e_2	150 μm / 500 mm				

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

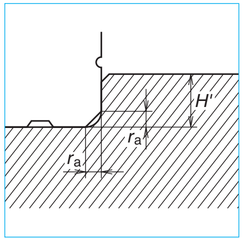


Fig. 9 Shoulder for the rail datum surface

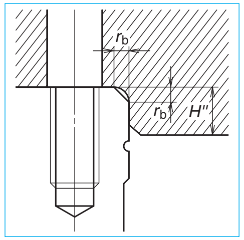


Fig. 10 Shoulder for the roller slide datum surface

Table 6

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H′	H″
RB30	1	1	5	6
RB35	1	1	5	6
RB45	1.5	1	6	8
RB55	1.5	1.5	7	10
RB65	1.5	1.5	8	11

6. Lubrication components

Refer to pages A58 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 13 and **Table 8** show grease fittings and tube fittings.

(2) Mounting position of lubrication accessories

- The standard position for grease fittings is at the end face of the roller slide, but we can mount them on the side of the end cap for as an option. (**Fig. 11**) Please consult NSK for the installation of grease or tube fittings to the roller slide body.
- A lubrication hole can also be provided on the top of the end cap. **Fig.12** and **Table 7** show the mounting position.
- Using a piping unit with thread of M6 × 1 requires a connector to connect it to a grease fitting mounting hole with M6 × 0.75. The connectors are available from NSK.

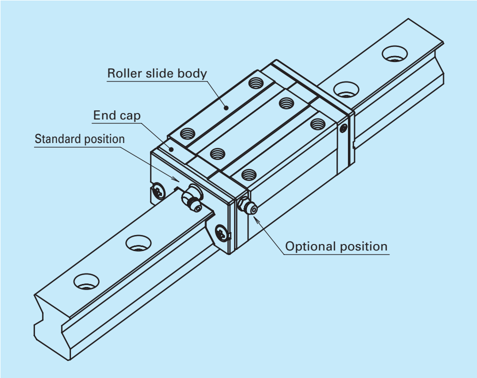


Fig. 11 Mounting position of lubrication accessories

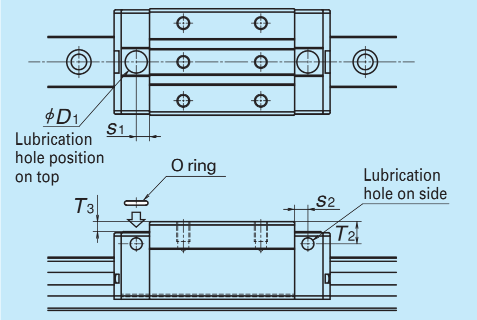


Fig.12 Top and side lubrication hole positions

Table 7 Top and side lubrication hole positions

Unit: mm

Model No.	Grease fitting size	S_2	T_2	O ring (JIS)	D_1	S_1	T_3
RB30	M6×0.75	5	6.5	P7	10.4	6	0.5
RB35	M6×0.75	5.5	6.5	P7	10.4	7	0.4
RB45	M6×0.75	7.2	6.5	P7	10.4	7.2	0.4
RB55	M6×0.75	7.2	8	P7	10.4	7.2	0.4
RB65	M6×0.75	7.2	10	P7	10.4	7.2	0.4

Note: Grease fittings and tube fittings cannot be mounted on the top of the end cap.

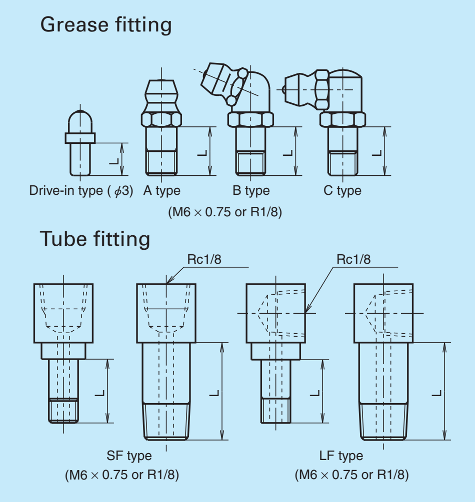


Fig. 13 Grease fitting and tube fitting

Table 8 Unit: mm

Model No.	Dust-resistant specification	Dimension *L*		
		Grease fitting /Drive-in type	Tube fitting	
			SF type	LF type
RB30	Standard	5	–	–
	With NSK K1	10	–	–
	Double seal	8	–	–
	Protector	8	–	–
RB35	Standard	5	5	5
	With NSK K1	14	15	16
	Double seal	12	12	12
	Protector	12	12	12
RB45	Standard	5	5	5
	With NSK K1	14	15	16
	Double seal	12	12	12
	Protector	12	12	12
RB55	Standard	8	13.5	17
	With NSK K1	18	20	21.5
	Double seal	14	16	17
	Protector	14	16	17
RB65	Standard	8	13.5	17
	With NSK K1	20	20	20
	Double seal	14	18	17
	Protector	14	16	17

7. Dust-resistant components

(1) Standard specification

The RB model is equipped with end, inner and bottom seals to prevent foreign matter from entering the inside of the roller slide. Under normal applications, the RB model can be used without modification.

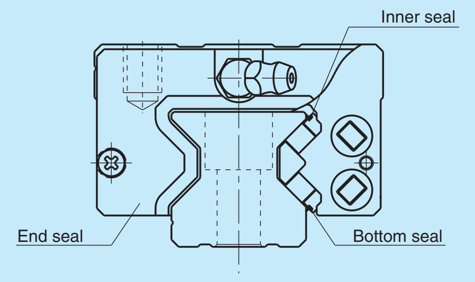


Fig. 14

Table 9 Seal friction per roller slide (maximum value) Unit: N

Model \ Size	30	35	45	55	65
RB	5	6	8	8	14

(2) NSK K1™ lubrication unit

Table 10 shows the dimensions of linear guides equipped with NSK K1 lubrication units.

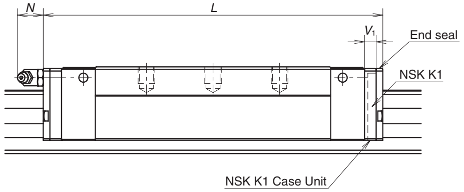


Table 10 Dimensions when equipped with NSK K1 lubrication units Unit: mm

Model No.	Roller slide length	Roller slide model	Standard roller slide length	Roller slide length with two NSK K1 installed *L*	Thickness of single NSK K1 V_1	Protrusion of grease fitting *N*
RB30	Standard	AL, EM	110.8	122.8	6	(11)
	Long	BL, GM	135.4	147.4		
RB35	Standard	AL, EM	123.8	136.8	6.5	(11)
	Long	BL, GM	152	165		
RB45	Standard	AL, EM	154	168	7	(14)
	Long	BL, GM	190	204		
RB55	Standard	AL, TL, EM	184	198	7	(14)
	Long	BL, UL, GM	234	248		
RB65	Standard	AL, EM	228.4	243.4	7.5	(14)
	Long	BL, UL, GM	302.5	317.5		

Note: Slide length when equipped with NSK K1 = (standard roller slide length) + (V_1 thickness of single NSK K1 unit) × (number of K1 units) + (V_2 thickness of the protective cover) × 2.

(3) Double seal and protector

For the RB Model, double seals and protectors can be installed only before shipping from the factory.

Table 11 shows the increased thickness when end seals and protectors are installed.

Table 11 Unit: mm

Model No.	Thickness of end seal V_3	Thickness of protector V_4
RB30	3.4	3.6
RB35	3.4	3.6
RB45	4	4.2
RB55	4	4.2
RB65	5	5.5

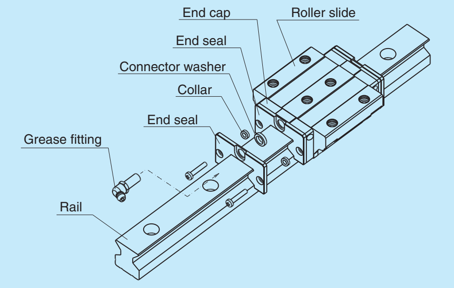


Fig. 15 Double seal

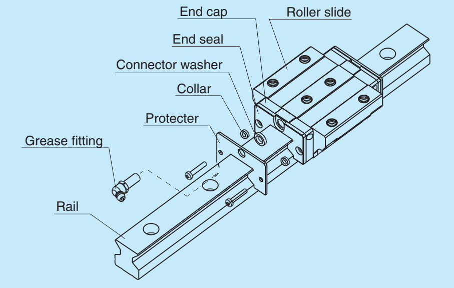


Fig. 16 Protector

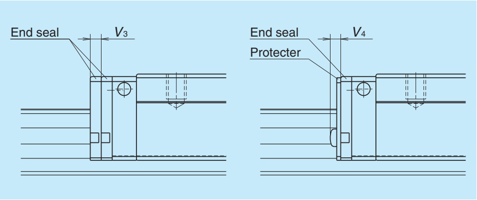


Fig. 17

(4) Caps to plug the rail mounting bolt hole

Table 12 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
RB30, RB35	M8	LG-CAP/M8	20
RB45	M12	LG-CAP/M12	20
RB55	M14	LG-CAP/M14	20
RB65	M16	LG-CAP/M16	20

(5) Bellows

Consult NSK when attaching bellows.

8. Dynamic friction force

- Dynamic friction force indications per roller slide are shown in **Table 13**.
- These values are assumed under actual conditions with standard specifications (two end seals, inner seal and bottom seal equipped) packed with standard grease (NSK Grease AS2)
- Dynamic friction force varies with grease.

Table 13 Dynamic friction force

Unit: N

Model No.	High-load type	Super-high-load type
RB30	33	42
RB35	42	53
RB45	56	69
RB55	80	95
RB65	120	138

Note: Values in Table 13 are indications.
Please refer to them.

9. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

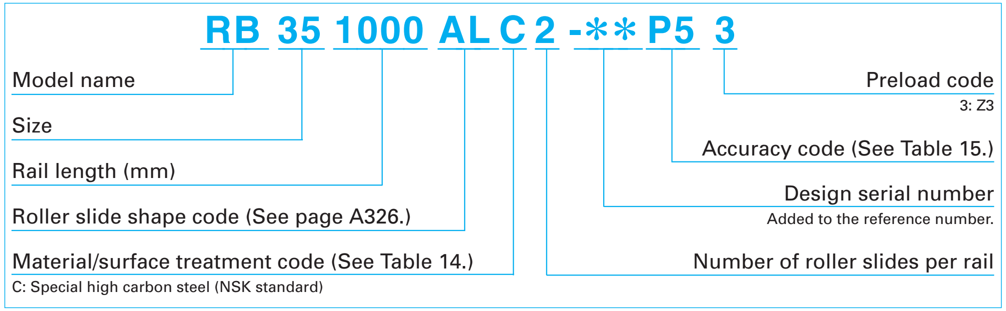


Table 14 Material/surface treatment code

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 A58 for details on NSK K1 lubrication units.

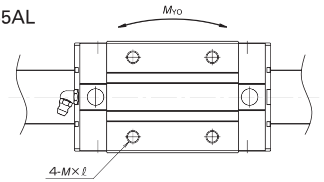
10. Dimensions
RB-AL·TL (High-load / Standard)
RB-BL·UL (Super-high-load / Long)

RB 35 1000 AL C 2 - P5 3**

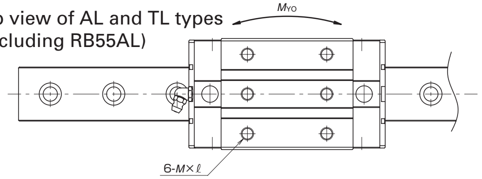
Model name
Size
Rail length (mm)
Roller slide shape code (See page A326.)
Material/surface treatment code (See Table 14.)
C: Special high carbon steel (NSK standard)

Preload code
3: Z3
Accuracy code (See Table 15.)
Design serial number
Added to the reference number.
Number of roller slides per rail

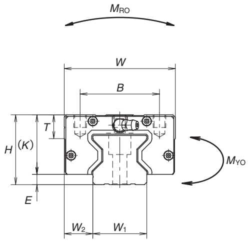
Top view of RB55AL



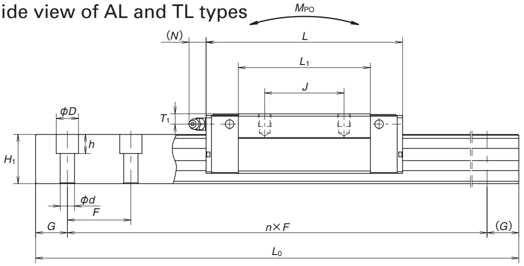
Top view of AL and TL types (excluding RB55AL)



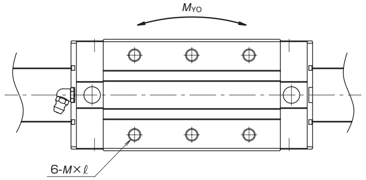
Front view



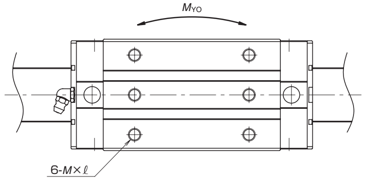
Side view of AL and TL types



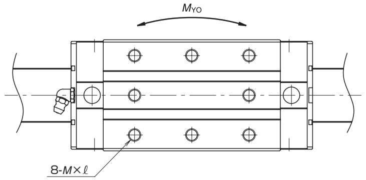
Top view of RB55BL and RB65BL



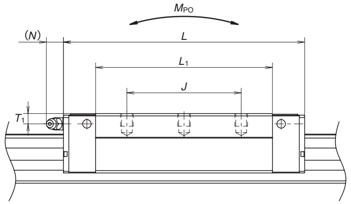
Top view of UL type



Top view of BL type (excluding RB55 and RB65)



Side view of BL type



Unit: mm

Model No.	Assembly			Roller slide													Rail					Basic load ratings								Weight	
	Height			Width	Length	Mounting hole							Grease fitting			Width	Height	Pitch	Mounting bolt hole	G	Maximum length	[2]Dynamic		Static	Static moment (N·m)					Roller slide	Rail
								Number of holes														[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J		M×pitch×ℓ	L_1	K	T	Hole size	T_1	N	W_1	H_1	F	d×D×h	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
RB30AL	38	6.5	16	60	110.8	40	40	6	M8×1.25×7	74	31.5	14	ϕ3	5	2.6	28	28	40 (80)	9×14×12	20	3 900	47 800	38 900	93 500	1 670	1 140	7 100	1 140	7 100	0.71	4.9
RB30BL					135.4		60	8		98.6												58 500	47 600	121 000	2 170	1 950	11 500	1 950	11 500	0.91	
RB35AL	44	6.5	18	70	123.8	50	50	6	M8×1.25×8	83.2	37.5	15	M6×0.75	6.5	11	34	31	40 (80)	9×14×12	20	3 900	65 500	53 300	129 000	2 810	1 800	11 000	1 800	11 000	1.0	6.8
RB35BL					152		72	8		111.4												82 900	67 400	175 000	3 810	3 250	17 800	3 250	17 800	1.5	
RB45AL	52	8	20.5	86	154	60	60	6	M10×1.5×10	105.4	44	17	M6×0.75	6.5	14	45	38	52.5 (105)	14×20×17	22.5	3 650	114 000	92 800	229 000	6 180	4 080	24 000	4 080	24 000	1.9	10.9
RB45BL					190		80	8		141.4												143 000	116 000	305 000	8 240	7 150	39 000	7 150	39 000	2.6	
RB55AL	63	9	23.5	100	184	65	75	4	M12×1.75×12	128	54	18	Rc1/8	8.5	14	53	43.5	60 (120)	16×23×20	30	3 600	159 000	129 000	330 000	10 200	7 060	41 000	7 060	41 000	3.4	14.6
RB55TL						75		6																							
RB55BL					234	65	95			178												207 000	168 000	462 000	14 300	13 600	72 000	13 600	72 000	4.7	
RB55UL						75																									
RB65AL	75	10	31.5	126	228.4	76	70	6	M16×2×16	155.4	65	22	Rc1/8	10	14	63	52	75 (150)	18×26×22	35	3 600	259 000	210 000	504 000	19 200	12 700	78 500	12 700	78 500	7.2	20.5
RB65BL					302.5		110			229.5												355 000	288 000	756 000	28 700	28 600	153 000	28 600	153 000	9.5	
RB65UL							120																								

Notes: 1) Select either the standard dimension for pitch *F* as shown without parentheses or the semi-standard dimension as shown inside parentheses. If not specified, the standard dimension for *F* will be applied.

2) Basic load ratings comply with ISO standards (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

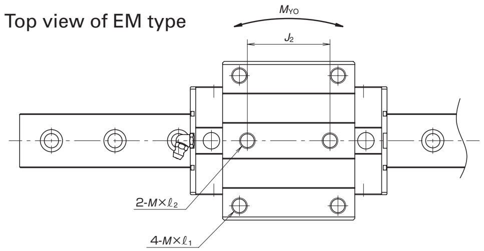
RB-EM (High-load / Standard)
RB-GM (Super-high-load / Long)

RB 35 1000 EM C 2 -** P5 3

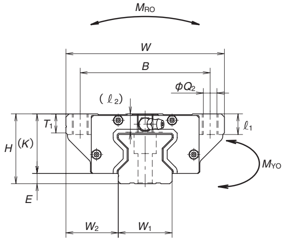
Model name
Size
Rail length (mm)
Roller slide shape code (See page A326.)
Material/surface treatment code (See Table 14.)
C: Special high carbon steel (NSK standard)

Preload code
3: Z3
Accuracy code (See Table 15.)
Design serial number
Added to the reference number.
Number of roller slides per rail

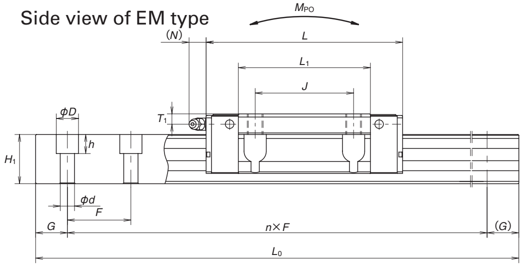
Top view of EM type



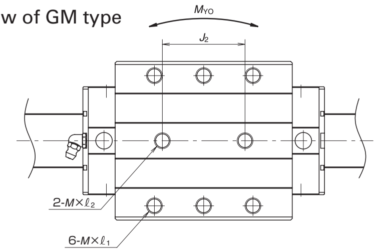
Front view of EM and GM types



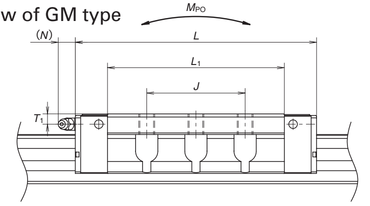
Side view of EM type



Top view of GM type



Side view of GM type



Unit: mm

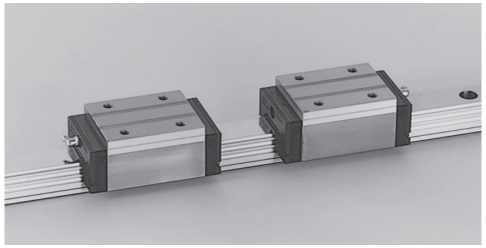
Model No.	Assembly			Roller slide														
	Height			Width	Length	Mounting hole									Grease fitting			Width
	H	E	W_2	W	L	B	J	J_2	Number of holes	M×pitch×$\ell_1(\ell_2)$	Q	L_1	K	T	Hole size	T_1	N	W_1
RB30EM RB30GM	38	6.5	31	90	110.8 135.4	72	52	44	6 8	M10×1.5×12 (8.5)	8.6	74 98.6	31.5	11	φ3	5	2.6	28
RB35EM RB35GM	44	6.5	33	100	123.8 152	82	62	52	6 8	M10×1.5×13 (11.5)	8.6	83.2 111.4	37.5	12	M6×0.75	6.5	11	34
RB45EM RB45GM	52	8	37.5	120	154 190	100	80	60	6 8	M12×1.75×15 (12.5)	10.5	105.4 141.4	44	13	M6×0.75	6.5	14	45
RB55EM RB55GM	63	9	43.5	140	184 234	116	95	70	6 8	M14×2×18 (18)	12.5	128 178	54	15	Rc1/8	8.5	14	53
RB65EM RB65GM	75	10	53.5	170	228.4 302.5	142	110	82	6 8	M16×2×24 (21)	14.6	155.4 229.5	65	15	Rc1/8	10	14	63

Model No.	Rail					Basic load ratings								Weight	
	Height	Pitch	Mounting bolt hole	G	Maximum length	2)Dynamic		Static	Static moment (N·m)					Roller slide	Rail
						[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}			
	H_1	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)
RB30EM RB30GM	28	40 (80)	9×14×12	20	3900	47 800 58 500	38 900 47 600	93 500 121 000	1 670 2 170	1 140 1 950	7 100 11 500	1 140 1 950	7 100 11 500	1.1 1.5	4.9
RB35EM RB35GM	31	40 (80)	9×14×12	20	3900	65 500 82 900	53 300 67 400	129 000 175 000	2 810 3 810	1 800 3 250	11 000 17 800	1 800 3 250	11 000 17 800	1.5 2.0	6.8
RB45EM RB45GM	38	52.5 (105)	14×20×17	22.5	3650	114 000 143 000	92 800 116 000	229 000 305 000	6 180 8 240	4 080 7 150	24 000 39 000	4 080 7 150	24 000 39 000	2.5 3.4	10.9
RB55EM RB55GM	43.5	60 (120)	16×23×20	30	3600	159 000 207 000	129 000 168 000	330 000 462 000	10 200 14 300	7 060 13 600	41 000 72 000	7 060 13 600	41 000 72 000	4.7 6.6	14.6
RB65EM RB65GM	52	75 (150)	18×26×22	35	3600	259 000 355 000	210 000 288 000	504 000 756 000	19 200 28 700	12 700 28 600	78 500 153 000	12 700 28 600	78 500 153 000	9.7 13.2	20.5

Notes: 1) Select either the standard dimension for pitch F as shown without parentheses or the semi-standard dimension as shown inside parentheses. If not specified, the standard dimension for F will be applied.

2) Basic load ratings comply with ISO standards (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-4-4.3 LA Model



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 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. Since the LA model receives load on more ball rows than other linear guides, it is stronger against shock loads.

(5) High accuracy

As shown in **Fig. 4**, fixing the measuring rollers is easy thanks to the Gothic arch groove of the central ball groove. This allows accurate measuring of ball grooves for highly precise and stable manufacturing.

(6) Dust-resistant design

The rail's cross section is designed to be as simple as possible, thereby improving sealing efficiency combined with the enhanced sealing. In addition, optional inner seals are available.

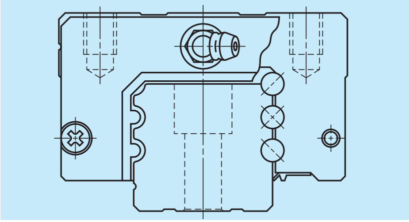


Fig. 1 LA Model

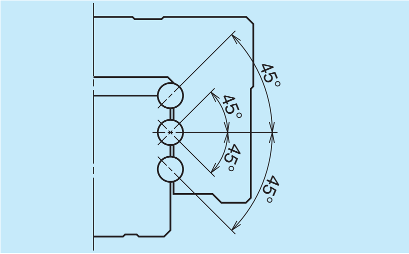


Fig. 2 Super rigidity design

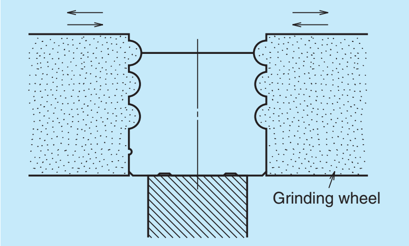


Fig. 3 Rail grinding

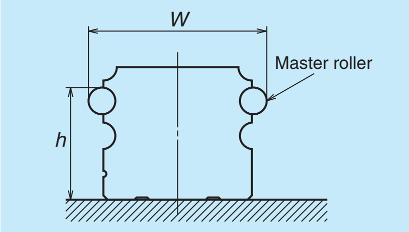
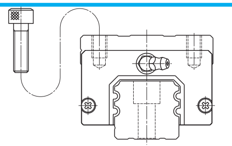
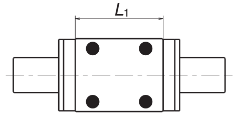
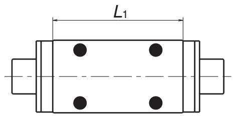
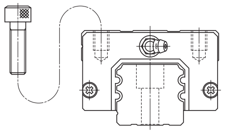
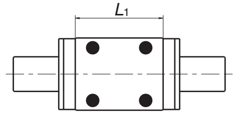
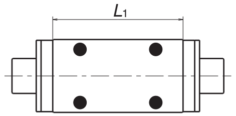
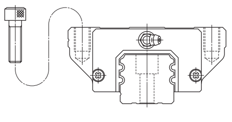
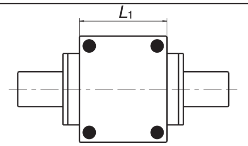
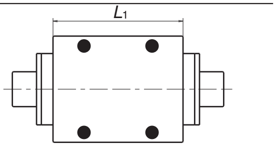
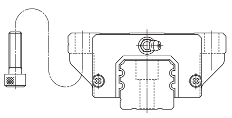
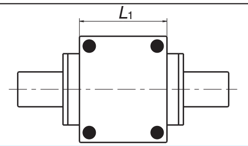
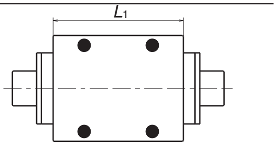


Fig. 4 Measuring groove accuracy

2. Ball slide shape

Ball slide shape code	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		High-load	Super-high-load
		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

Accuracy grade / Rail length(mm)		Preloaded assembly (not interchangeable)			
over	or less	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6
–	50	2	2	2	4
50 –	80	2	2	3	4
80 –	125	2	2	3	4
125 –	200	2	2	3.5	5
200 –	250	2	2.5	4.5	6
250 –	315	2	2.5	5	6.5
315 –	400	2	3	5.5	7
400 –	500	2	3	6	7.5
500 –	630	2	3.5	6.5	8.5
630 –	800	2	4	7	9.5
800 –	1 000	2.5	4.5	7.5	10
1 000 –	1 250	3	5	8.5	12
1 250 –	1 600	3.5	5.5	9.5	13
1 600 –	2 000	4	6.5	11	14
2 000 –	2 500	4.5	7.5	12	16
2 500 –	3 150	5.5	8.5	13	18
3 150 –	4 000	6	9.5	14	19

(2) Accuracy standard

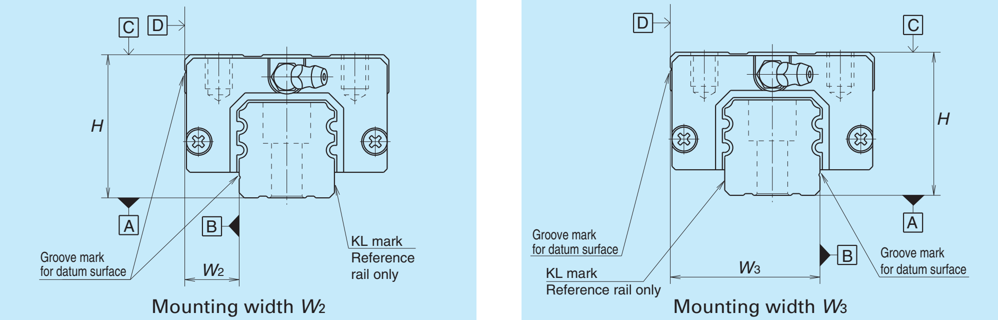
The LA Model has four accuracy grades: Ultra precision P3, Super precision P4, High precision P5, and Precision grade P6.

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)	±8 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)	±10 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



Mounting width W_2

Mounting width W_3

Fig. 5

4. Preload and rigidity

Table 3 shows preload and rigidity for the LA Model.

The LA Model has two types of preload specifications: 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	LA25 AL, AN, EL, FL	1 670	2 110	475	550
	LA30 AL, AN, EL, FL	2 450	3 150	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	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

Model \ 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 requirements exceed the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

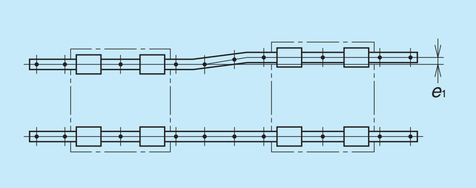


Fig. 6

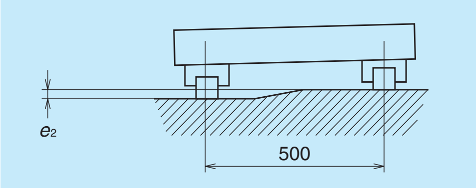


Fig. 7

Table 5

Unit: μm

Value	Preload	Model No.					
		LA25	LA30	LA35	LA45	LA55	LA65
Permissible values for parallelism error of two rails e_1	Z3	15	17	20	25	30	40
	Z4	13	15	17	20	25	30
Permissible values for height error of two rails e_2	Z3, Z4	185 μm/500 mm					

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

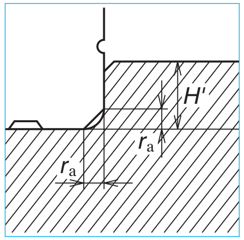


Fig. 8 Shoulder for the rail datum surface

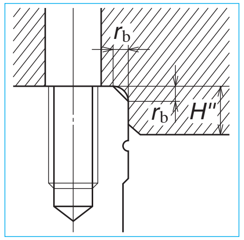


Fig. 9 Shoulder for the ball slide datum surface

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 A58 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 10 and **Table 7** show grease fittings and tube fittings.

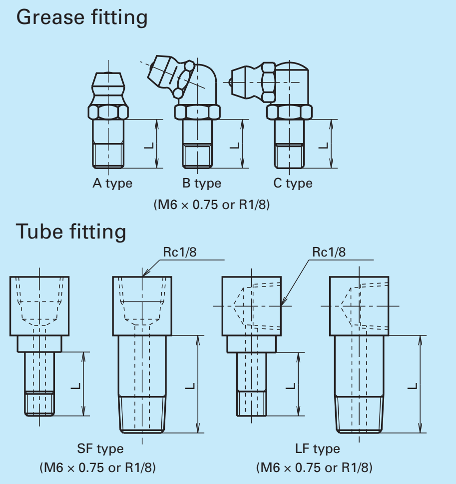


Fig. 10 Grease fitting and tube fitting

(2) Mounting position of lubrication accessories

- The standard position for grease fittings is at the end face of the ball slide, but we can mount them on the side of the end cap as an option. (**Fig. 11**)
- Please consult NSK for the installation of grease or tube fittings to the ball slide body.
- Using a piping unit with thread of M6 × 1 requires 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-resistant specification	Dimension L		
		Grease fitting	Tube fitting	
			SF type	LF type
LA25	Standard	5	5	5
	With NSK K1	14	12	12
	Double seal	10	9	9
	Protector	10	9	9
LA30	Standard	5	6	6
	With NSK K1	14	12	13
	Double seal	12	10	11
	Protector	12	11	11
LA35	Standard	5	6	6
	With NSK K1	14	12	13
	Double seal	12	10	11
	Protector	12	11	11
LA45	Standard	8	13.5	17
	With NSK K1	18	22	21.5
	Double seal	14	18	17
	Protector	14	16	17
LA55	Standard	8	13.5	17
	With NSK K1	18	22	21.5
	Double seal	14	18	17
	Protector	14	16	17
LA65	Standard	8	13.5	17
	With NSK K1	22	24	25.5
	Double seal	16	20	19
	Protector	16	16	17

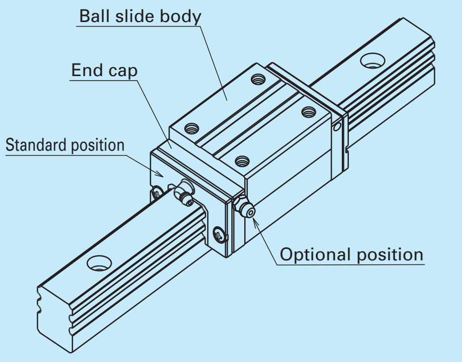


Fig. 11 Mounting position of lubrication accessories

7. Dust-resistant components

(1) Standard Specification

Under normal applications, the LA model can be used without modification thanks to its dust resistance. As standard equipment, the ball slides have an end seal on both ends, and bottom seals at the bottom.

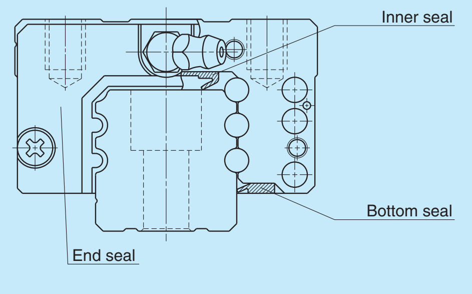


Fig. 12

Table 8 Seal friction per ball slide (maximum value) Unit: N

Model \ Size	25	30	35	45	55	65
LA	11	11	12	17	17	23

(2) NSK K1™ lubrication unit

Table 9 shows the dimensions of linear guides equipped with NSK K1 lubrication units.

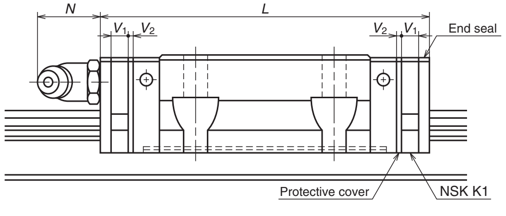


Table 9 Dimensions when equipped with NSK K1 lubrication units Unit: mm

Model No.	Ball slide length	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1 V_1	Protective cover thickness V_2	Protrusion of 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: Slide length when equipped with NSK K1 = (standard ball slide length) + (V_1 thickness of single NSK K1 unit) × (number of K1 units) + (V_2 thickness of the protective cover) × 2.

(3) Double seal and protector

For the LA Model double seals and protectors 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

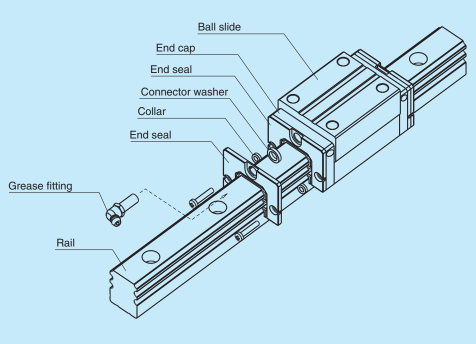


Fig. 13 Double seal

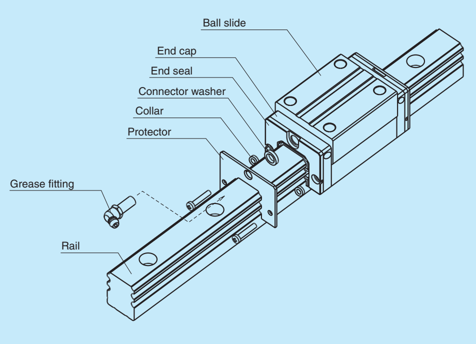


Fig. 14 Protector

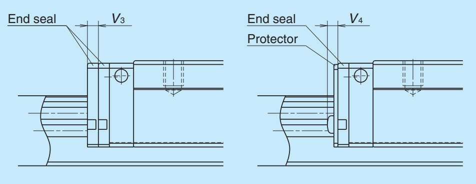


Fig. 15

(4) 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
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 for bellows
LA Model

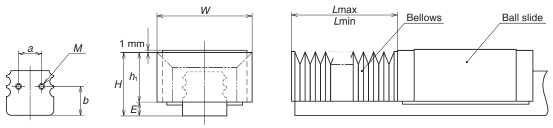


Fig. 16 Dimensions of bellows

Bellows reference number

J A A 30 L 08

Bellows: J
A: Bellows for the ends
B: Middle bellows
Bellows for LA model: A
Size number of linear guide: 30
N: High type L: Low type
Number of BL (fold number): 08

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 both sides, then by dividing the sum by 2.

8. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

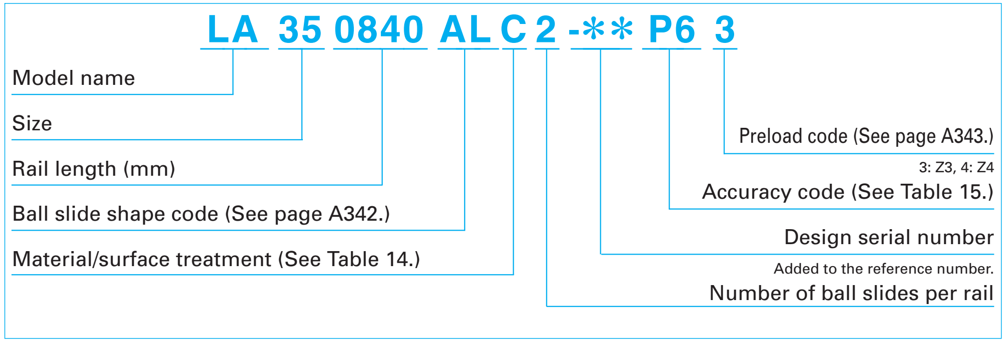


Table 14 Material/surface treatment code

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 A58 for details on NSK K1 lubrication units.

9. Dimensions

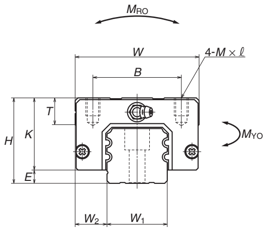
LA-AL (High-load / Standard)
LA-BL (Super-high-load / Long)

LA 35 0840 AL C 2 -∗∗ P6 3

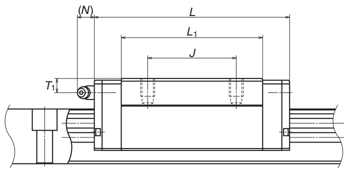
Model name
Size
Rail length (mm)
Ball slide shape code (See page A342.)
Material/surface treatment (See Table 14.)

Preload code (See page A343.)
3: Z3, 4: Z4
Accuracy code (See Table 15.)
Design serial number
Added to the reference number.
Number of ball slides per rail

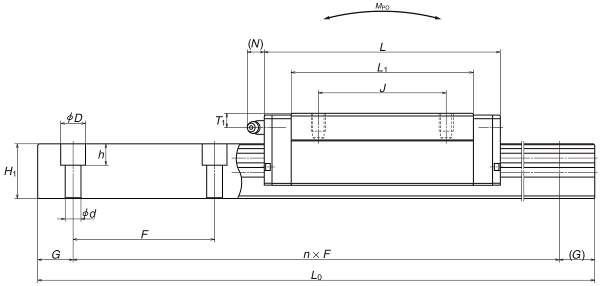
Front view of AL and BL types



Side view of AL type



Side view of BL type



Unit: mm

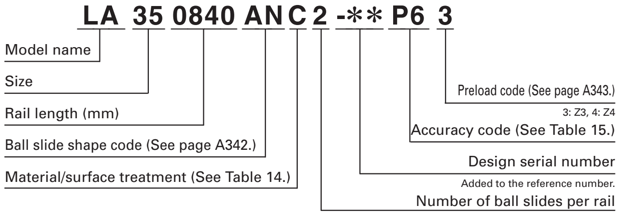
Model No.	Assembly			Ball slide												
	Height			Width	Length	Mounting hole						Grease fitting			Width	Height
	H	E	W_2	W	L	B	J	$M \times$ pitch $\times \ell$	L_1	K	T	Hole size	T_1	N	W_1	H_1
LA25AL	36	5.5	12.5	48	79.8	35	35	M6×1×7	58	30.5	8	M6×0.75	6	11	23	22
LA25BL					107.8		50		86							
LA30AL	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) The LA model does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

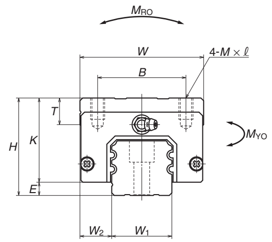
Model No.	Rail				Basic load ratings								Weight	
	Pitch	Mounting bolt hole	G	Max. length	2)Dynamic		Static	Static moment (N·m)					Ball slide	Rail
					[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}			
	F	$d \times D \times h$	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
LA25AL	60	7×11×9	20	3 960	30 000	23 900	50 000	290	410	2 490	410	2 490	0.5	3.7
LA25BL					40 500	32 500	77 000	445	935	5 000	935	5 000	0.8	
LA30AL	80	9×14×12	20	4 000	47 000	37 000	77 500	535	820	4 800	820	4 800	0.8	5.8
LA30BL					58 000	46 000	105 000	725	1 470	8 050	1 470	8 050	1.2	
LA35AL	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
LA35BL					80 500	64 000	143 000	1 240	2 330	12 500	2 330	12 500	1.6	
LA45AL	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
LA45BL					111 000	88 000	197 000	2 460	3 850	20 600	3 850	20 600	3.2	
LA55AL	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
LA55BL					172 000	137 000	292 000	4 250	6 800	36 000	6 800	36 000	5.1	

2) Basic load ratings comply with ISO standards (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

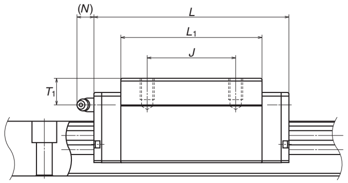
LA-AN (High-load / Standard)
LA-BN (Super-high-load / Long)



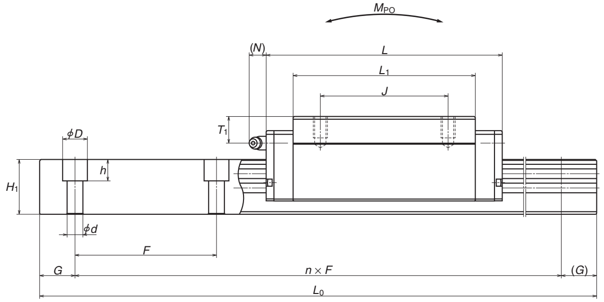
Front view of AN and BN types



Side view of AN type



Side view of BN type



Unit: mm

Model No.	Assembly			Ball slide								Grease fitting			Width	Height
	Height			Width	Length	Mounting hole										
	H	E	W_2	W	L	B	J	M × pitch × ℓ	L_1	K	T	Hole size	T_1	N	W_1	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							

Model No.	Rail				Basic load ratings								Weight	
	Pitch	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}			
	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)
LA25AN	60	7×11×9	20	3 960	30 000	23 900	50 000	290	410	2 490	410	2 490	0.6	3.7
LA25BN					40 500	32 500	77 000	445	935	5 000	935	5 000	0.9	
LA30AN	80	9×14×12	20	4 000	47 000	37 000	77 500	535	820	4 800	820	4 800	0.9	5.8
LA30BN					58 000	46 000	105 000	725	1 470	8 050	1 470	8 050	1.3	
LA35AN	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
LA35BN					80 500	64 000	143 000	1 240	2 330	12 500	2 330	12 500	2.1	
LA45AN	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
LA45BN					111 000	88 000	197 000	2 460	3 850	20 600	3 850	20 600	3.9	
LA55AN	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
LA55BN					172 000	137 000	292 000	4 250	6 800	36 000	6 800	36 000	6.1	
LA65AN	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
LA65BN					340 000	269 000	615 000	10 700	18 700	95 000	18 700	95 000	10.8	

Notes: 1) The LA model does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

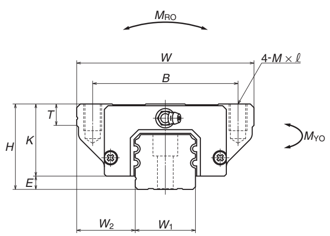
2) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
C_{50}; the basic dynamic load rating for 50 km rated fatigue life
C_{100}; the basic dynamic load rating for 100 km rated fatigue life

LA-EL (High-load / Standard)
LA-GL (Super-high-load / Long)

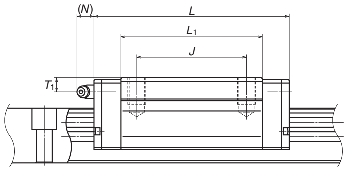
LA 35 0840 EL C 2 -＊＊ P6 3

- Model name: LA
- Size: 35
- Rail length (mm): 0840
- Ball slide shape code (See page A342.): EL
- Material/surface treatment (See Table 14.): C
- Number of ball slides per rail: 2
- Design serial number: -＊＊ (Added to the reference number.)
- Accuracy code (See Table 15.): P6
- Preload code (See page A343.): 3 (3: Z3, 4: Z4)

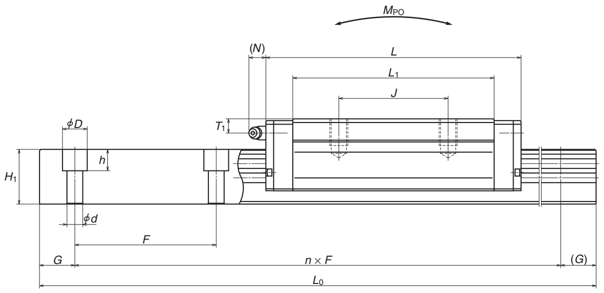
Front view of EL and GL types



Side view of EL type



Side view of GL type



Unit: mm

Model No.	Assembly			Ball slide												
	Height			Width	Length	Mounting hole						Grease fitting			Width	Height
	H	E	W_2	W	L	B	J	M × pitch × ℓ	L_1	K	T	Hole size	T_1	N	W_1	H_1
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
LA25GL					107.8				86							
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
LA30GL					126.2				98							
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
LA35GL					144.6				114							
LA45EL	60	10	37.5	120	141.4	100	80	M12×1.75×18	105	50	13	Rc1/8	10	13	45	36
LA45GL					173.4				137							
LA55EL	70	12	43.5	140	165.4	116	95	M14×2×21	126	58	15	Rc1/8	11	13	53	43.2
LA55GL					203.4				164							
LA65EL	90	14	53.5	170	196.2	142	110	M16×2×24	147	76	22	Rc1/8	19	13	63	55
LA65GL					256.2				207							

Notes: 1) The LA model does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

Model No.	Rail				Basic load ratings								Weight	
	Pitch	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}			
	F	$d \times D \times h$	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
LA25EL	60	7×11×9	20	3 960	30 000	23 900	50 000	290	410	2 490	410	2 490	0.8	3.7
LA25GL					40 500	32 500	77 000	445	935	5 000	935	5 000	1.1	
LA30EL	80	9×14×12	20	4 000	47 000	37 000	77 500	535	820	4 800	820	4 800	1.3	5.8
LA30GL					58 000	46 000	105 000	725	1 470	8 050	1 470	8 050	1.8	
LA35EL	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
LA35GL					80 500	64 000	143 000	1 240	2 330	12 500	2 330	12 500	2.6	
LA45EL	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
LA45GL					111 000	88 000	197 000	2 460	3 850	20 600	3 850	20 600	4.3	
LA55EL	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
LA55GL					172 000	137 000	292 000	4 250	6 800	36 000	6 800	36 000	7.2	
LA65EL	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
LA65GL					340 000	269 000	615 000	10 700	18 700	95 000	18 700	95 000	15.5	

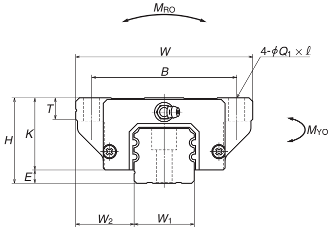
2) Basic load ratings comply with ISO standards (ISO 14728-1, 14728-2).
C_{50}; the basic dynamic load rating for 50 km rated fatigue life
C_{100}; the basic dynamic load rating for 100 km rated fatigue life

LA-FL (High-load / Standard)
LA-HL (Super-high-load / Long)

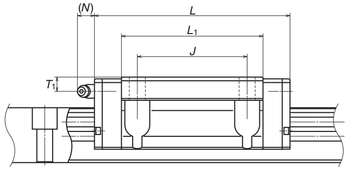
LA 35 0840 FL C 2 - P6 3**

- LA: Model name
- 35: Size
- 0840: Rail length (mm)
- FL: Ball slide shape code (See page A342.)
- C: Material/surface treatment (See Table 14.)
- 2: Number of ball slides per rail
- -**: Design serial number. Added to the reference number.
- P6: Accuracy code (See Table 15.)
- 3: Preload code (See page A343.) 3: Z3, 4: Z4

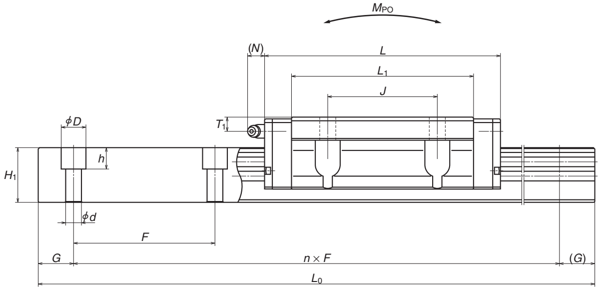
Front view of FL and HL types



Side view of FL type



Side view of HL type



Unit: mm

Model No.	Assembly			Ball slide											Rail						Basic load ratings								Weight	
	Height			Width	Length	Mounting hole						Grease fitting			Width	Height	Pitch	Mounting bolt hole	G	Max. length	[2]Dynamic [50km]	[100km]	Static	Static moment (N·m)					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	$d \times D \times h$	(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	(kg)	(kg/m)
LA25FL	36	5.5	23.5	70	79.8	57	45	7×10	58	30.5	11	M6×0.75	6	11	23	22	60	7×11×9	20	3 960	30 000	23 900	50 000	290	410	2 490	410	2 490	0.8	3.7
LA25HL					107.8				86												40 500	32 500	77 000	445	935	5 000	935	5 000	1.1	
LA30FL	42	7.5	31	90	100.2	72	52	9×12	72	34.5	11	M6×0.75	6.5	11	28	28	80	9×14×12	20	4 000	47 000	37 000	77 500	535	820	4 800	820	4 800	1.3	5.8
LA30HL					126.2				98												58 000	46 000	105 000	725	1 470	8 050	1 470	8 050	1.8	
LA35FL	48	7.5	33	100	110.6	82	62	9×13	80	40.5	12	M6×0.75	8	11	34	30.8	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
LA35HL					144.6				114												80 500	64 000	143 000	1 240	2 330	12 500	2 330	12 500	2.6	
LA45FL	60	10	37.5	120	141.4	100	80	11×15	105	50	13	Rc1/8	10	13	45	36	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
LA45HL					173.4				137												111 000	88 000	197 000	2 460	3 850	20 600	3 850	20 600	4.3	
LA55FL	70	12	43.5	140	165.4	116	95	14×18	126	58	15	Rc1/8	11	13	53	43.2	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
LA55HL					203.4				164												172 000	137 000	292 000	4 250	6 800	36 000	6 800	36 000	7.2	
LA65FL	90	14	53.5	170	196.2	142	110	16×23	147	76	22	Rc1/8	19	13	63	55	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
LA65HL					256.2				207												340 000	269 000	615 000	10 700	18 700	95 000	18 700	95 000	15.5	

Notes: 1) The LA model does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

2) Basic load ratings comply with ISO standards (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-4-5 High-Accuracy Series

A-4-5.1 HA Model

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 units.

(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 the mounting hole pitch.

In addition, the length of mounting hole pitch has been reduced by one-half of 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. Since the HA model receives load on more ball rows than other linear guides, it is stronger against shock loads.

(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 allows for highly precise and stable manufacturing.

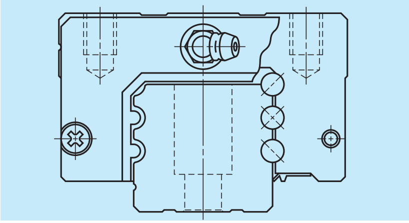


Fig. 1 HA Model

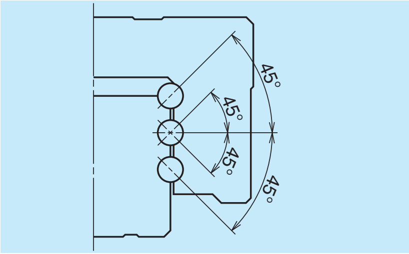


Fig. 2 Super rigidity design

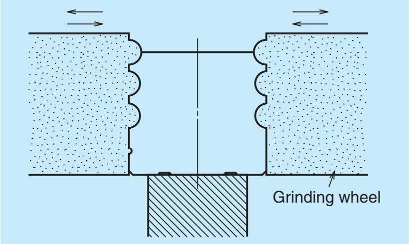


Fig. 3 Rail grinding

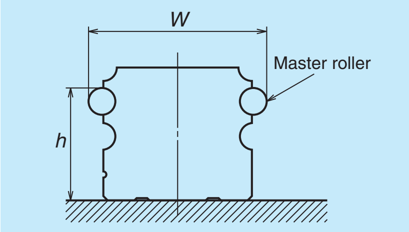


Fig. 4 Measuring groove accuracy

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 Model, this vibration has been substantially reduced to one-third of conventional models.

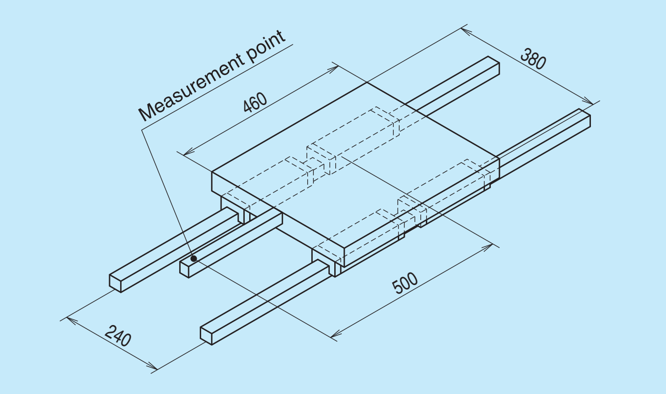


Fig. 5 Schematic view of measurement of ball passage vibration

HA Model

Model No.: HA30
Preload: Z3
Table dimensions: 460 mm × 380 mm

Conventional Model

Model No.: LA30
Preload: Z3
Table dimensions: 460 mm × 380 mm

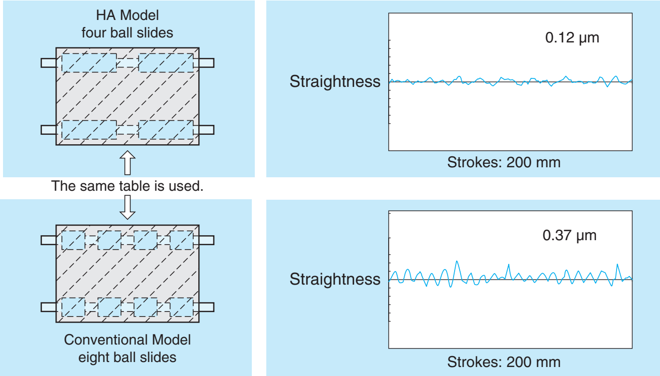
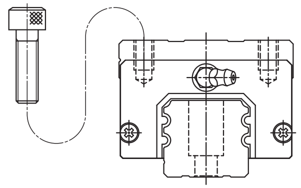
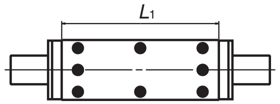
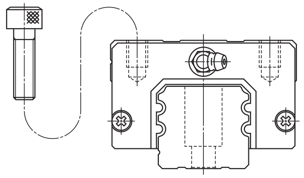
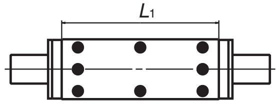
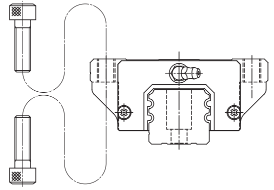
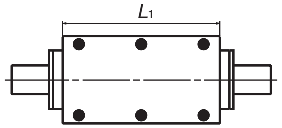


Fig. 6 Measurement results for the HA model vs. conventional model

2. Ball slide shape

Ball slide Shape code	Shape/installation method	Type
AN		AN 
AL		AL 
EM		EM 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Accuracy grade Rail length(mm)		Preloaded assembly		
over	or less	Ultra precision P3	Super precision P4	High precision P5
–	200	2	2	3.5
200 –	250	2	2.5	4.5
250 –	315	2	2.5	5
315 –	400	2	3	5.5
400 –	500	2	3	6
500 –	630	2	3.5	6.5
630 –	800	2	4	7
800 –	1 000	2.5	4.5	7.5
1 000 –	1 250	3	5	8.5
1 250 –	1 600	3.5	5.5	9.5
1 600 –	2 000	4	6.5	11
2 000 –	2 500	4.5	7.5	12
2 500 –	3 150	5.5	8.5	13
3 150 –	4 000	6	9.5	14

(2) Accuracy standard

Three accuracy grades are available: Ultra precision P3, Super precision P4 and High precision P5.

Table 2

Unit: μm

Accuracy grade Characteristics	Ultra precision P3	Super precision P4	High precision P5
Mounting height H Variation of H (All ball slides on a set of rails)	±8 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)	±10 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

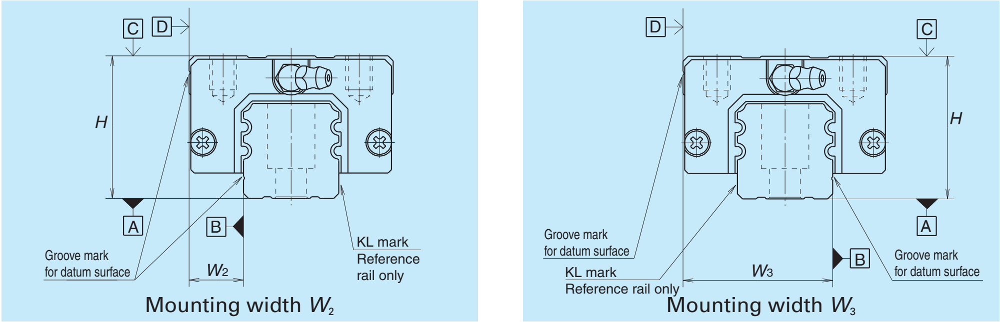


Fig. 7

(4) Preload and rigidity

Slight preload Z1 and Medium preload Z3 are available, which can be selected for specific applications.

Table 3

Model No.	Preload (N)		Rigidity (N/μm)	
	Slight preload (Z1)	Medium preload (Z3)	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

Size Model	25	30	35	45	55
HA	3 960	4 000	4 000	3 990	3 960

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

5. Installation

(1) Permissible values of mounting error

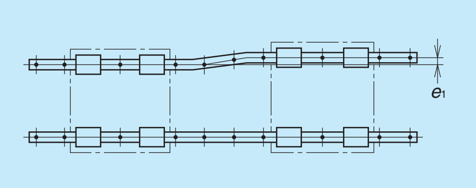


Fig. 8

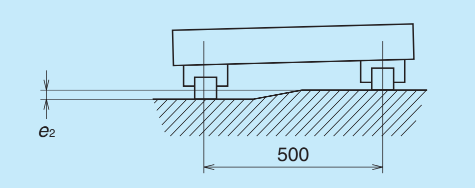


Fig. 9

Table 5

Unit: μm

Value	Preload	Model No.				
		HA25	HA30	HA35	HA45	HA55
Permissible values for parallelism error of two rails e_1	Z1	20	20	23	26	34
	Z3	15	14	17	19	25
Permissible values for height error of two rails e_2	Z1,Z3	250 μm/500 mm				

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

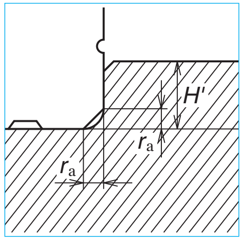


Fig. 10 Shoulder for the rail datum surface

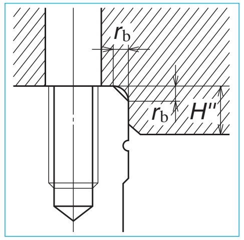


Fig. 11 Shoulder for the ball slide datum surface

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 A58 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 an extended thread body length (L) for the addition of dust-resistant accessories such as NSK K1 lubrication units, double seals and protectors.

We provide suitable lubrication accesories for special dust-resistant requirements upon request.

NSK can also provide extended length threads for ease of replenishment.

Please contact NSK if stainless lubrication accessories are required.

(2) Mounting position of lubrication accessories

The standard position for grease fittings is at the end face of the ball slide, but we can mount them on the side of the end cap as an option. (**Fig. 13**)

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

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

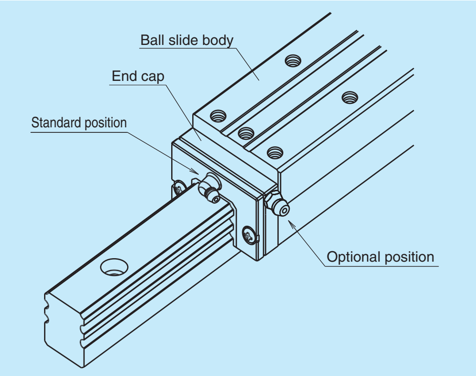


Fig. 13 Mounting position of lubrication accessories

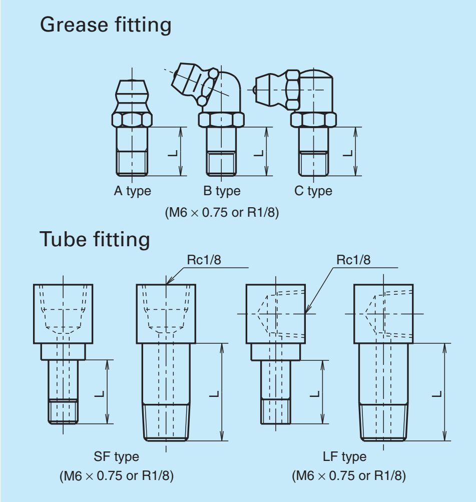


Fig. 12 Grease fitting and tube fitting

Table 7

Unit: mm

Model No.	Dust-resistant specification	Dimension L		
		Grease fitting	Tube fitting	
			SF type	LF type
HA25	Standard	5	5	5
	With NSK K1	14	12	12
	Double seal	10	9	9
	Protector	10	9	9
HA30	Standard	5	6	6
	With NSK K1	14	12	13
	Double seal	12	10	11
	Protector	12	11	11
HA35	Standard	5	6	6
	With NSK K1	14	12	13
	Double seal	12	10	11
	Protector	12	11	11
HA45	Standard	8	13.5	17
	With NSK K1	18	22	21.5
	Double seal	14	18	17
	Protector	14	16	17
HA55	Standard	8	13.5	17
	With NSK K1	18	22	21.5
	Double seal	14	18	17
	Protector	14	16	17

7. Dust-resistant components

(1) Standard Specification

Under normal applications, the HA model can be used without modification thanks to its dust resistance. As standard equipment, the ball slides have an end seal on both ends, bottom seals at the bottom, and an inner seal in inside.

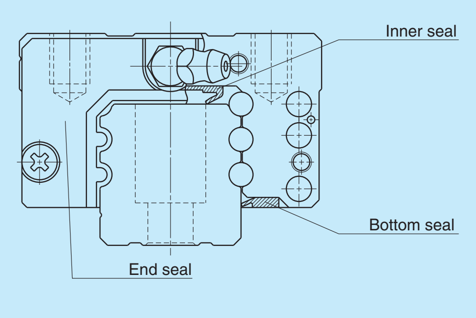


Fig. 14

Table 8 Seal friction per ball slide (maximum value)

Unit: N

Size Model	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 NSK K1 lubrication units.

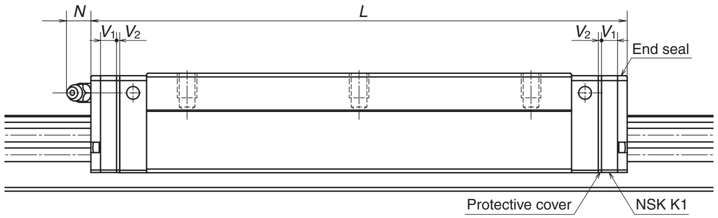


Table 9 Dimensions when equipped with NSK K1 lubrication units

Unit: mm

Model No.	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1 installed L	Thickness of single NSK K1 V_1	Protective cover thickness V_2	Protrusion of 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: Slide length when equipped with NSK K1 = (standard ball slide length) + (V_1 thickness of single NSK K1 unit) × (number of K1 units) + (V_2 thickness of the protective cover) × 2.

(3) Double seal and protector

For the HA Model, double seals and protectors can be installed only before shipping from the factory. Please consult with NSK when double seals or protectors are required.

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

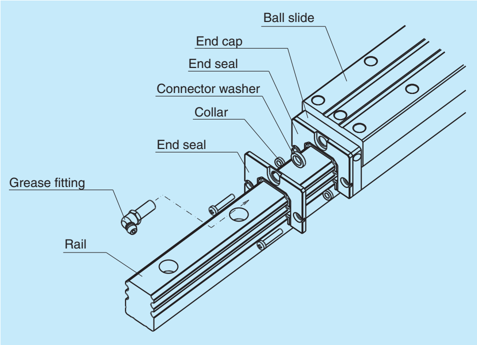


Fig. 15 Double seal

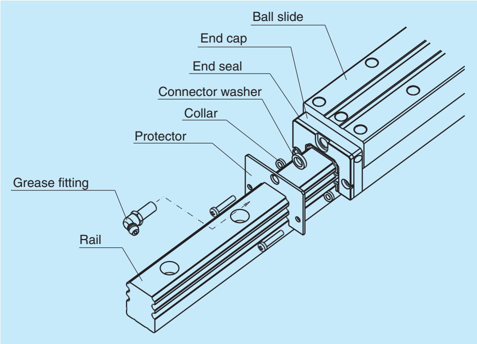


Fig. 16 Protector

(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

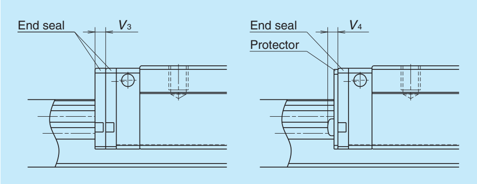


Fig. 17

8. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

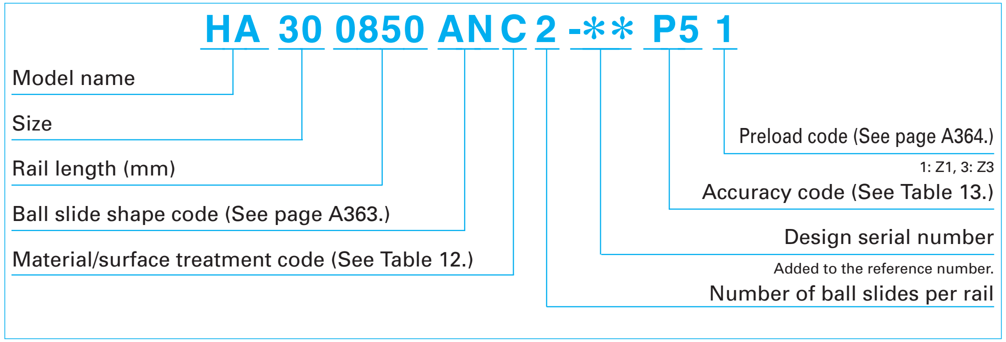


Table 12 Material/surface treatment code

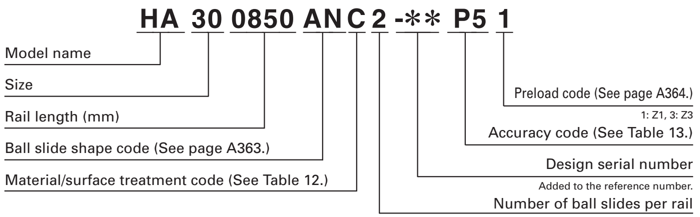
Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
Z	Other, special

Table 13 Accuracy code

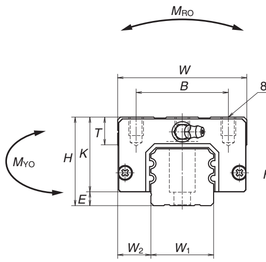
Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5

Note: Refer to page A58 for details on NSK K1 lubrication units.

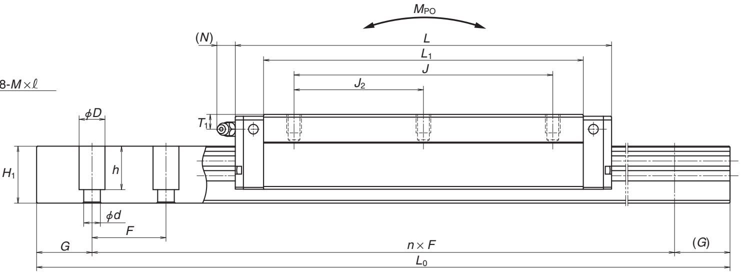
9. Dimensions
HA-AN
HA-AL



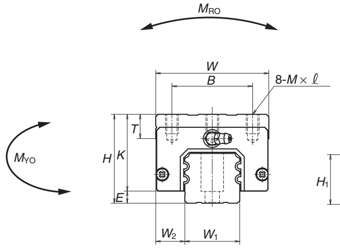
Front view of AL type



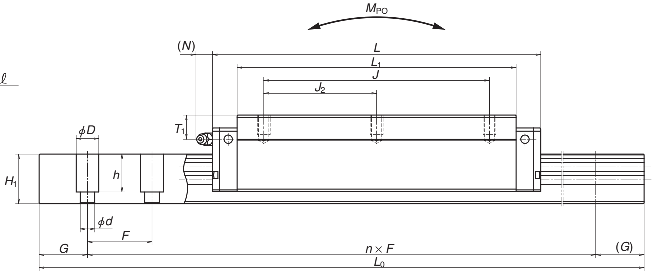
Side view of AL type



Front view of AN type



Side view of AN type



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								M12×1.75×16		58			11			

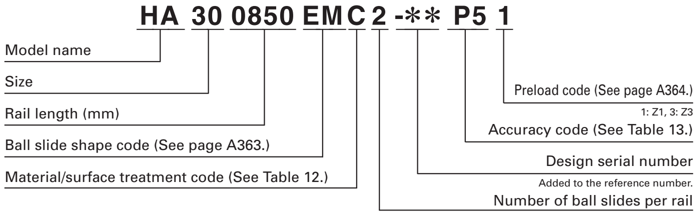
Notes: 1) The HA model does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

Unit: mm

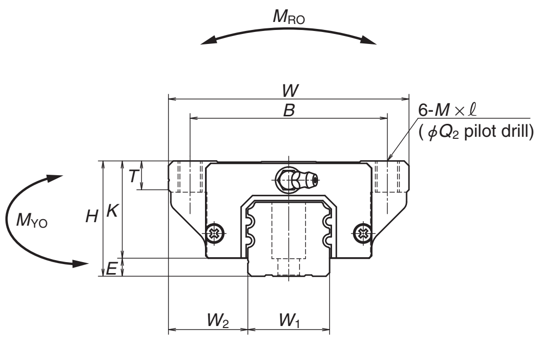
Model No.	Rail				Basic load ratings								Weight	
	Pitch	Mounting bolt hole	G	Maximum length	2)Dynamic		Static	Static moment (N·m)					Ball slide	Rail
					[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}			
	F	d × D × h	(reference)	L_{0max}	C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
HA25AN	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
HA30AN	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
HA35AN	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
HA35AL													2.6	
HA45AN	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
HA45AL													5.0	
HA55AN	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
HA55AL													7.8	

2) Basic load ratings comply with ISO standards (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

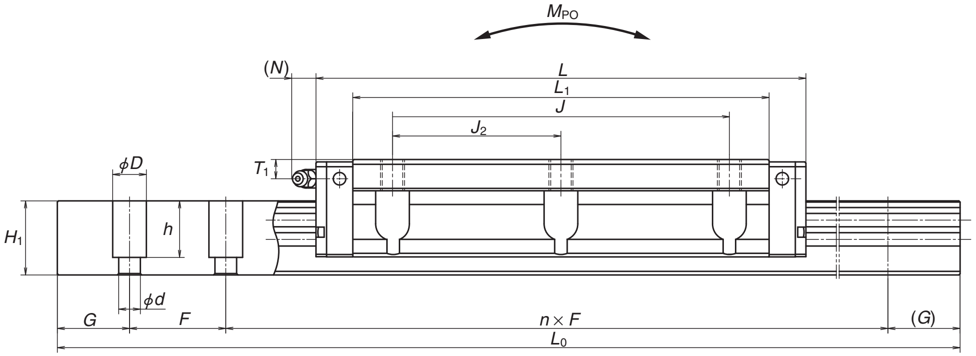
HA-EM



Front view of EM type



Side view of EM type



Unit: mm

Model No.	Assembly			Ball slide													Rail		Rail				Basic load ratings								Weight	
	Height			Width	Length	Mounting hole								Grease fitting			Width	Height	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}			
	H	E	W_2	W	L	B	J	J_2	$M\times$ pitch $\times\ell$	Q_2	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)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
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	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
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	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
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	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
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	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
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	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

Notes: 1) The HA model does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.

2) Basic load ratings comply with ISO standards (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-4-5.2 HS Model

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 units.

(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 vertical load carrying capacity

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

(7) High resistance against impact load

The bottom ball groove forms a Gothic arch and the center of the top and bottom grooves are offset as shown in **Fig. 2**.

Vertical load is generally carried by the top rows at two contact points, but with this design, the bottom rows also carry load when a large impact load is applied vertically as shown in **Fig. 3**. This assures high resistance to 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 for easy and accurate measuring of ball grooves.

(9) Improve rating life dramatically

A new ball groove geometry is introduced utilizing NSK's state-of-the-art tribological and analytical technologies. Rating life is dramatically increased due to the optimized distribution of contact surface pressures.

Load rating capacity is 1.3 times higher than conventional products and life is doubled[*1].

*1: Representative values.

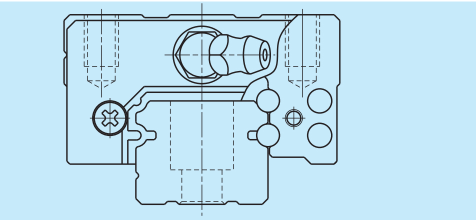


Fig. 1 HS Model

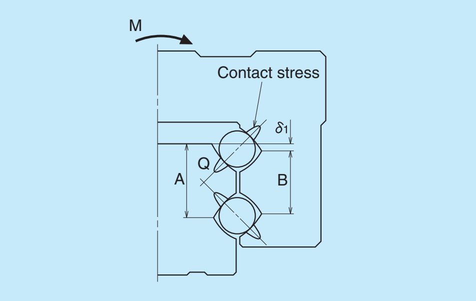


Fig. 2 Enlarged illustration: Offset Gothic arch

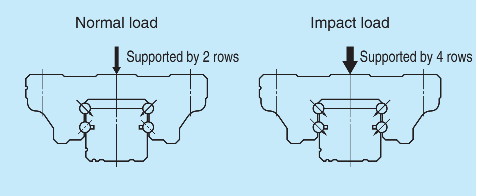


Fig. 3 When load is applied

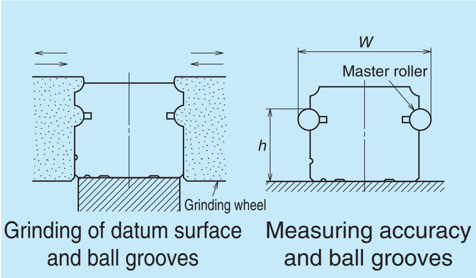


Fig. 4 Rail-grinding and measuring

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 Model, this vibration has been substantially reduced to one-third of conventional models.

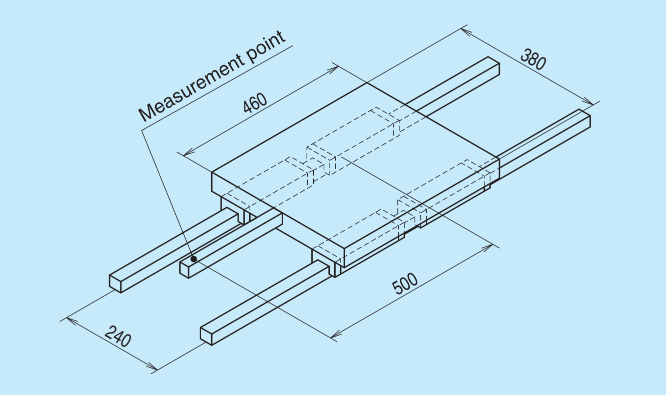


Fig. 5 Schematic view of measurement of ball passage vibration

HS Model

Model No.: HS30
Preload: Z1
Table dimensions: 460 mm × 380 mm

Conventional Model

Model No.: LS30
Preload: Z1
Table dimensions: 460 mm × 380 mm

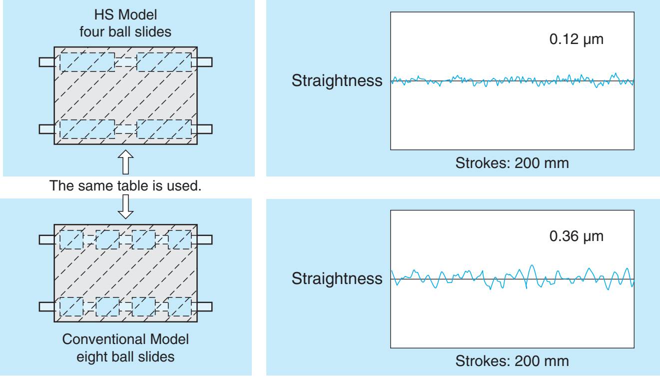
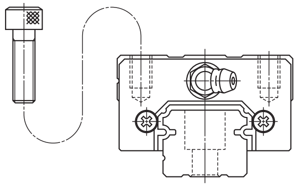
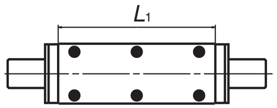
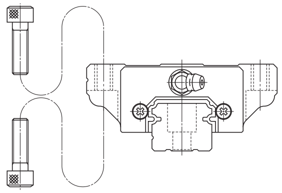
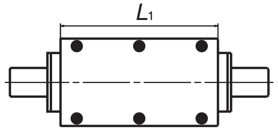


Fig. 6 Measurement results for the HS model vs. conventional model

2. Ball slide shape

Ball slide Shape code	Shape/installation method	Type
AL		AL 
EM		EM 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Accuracy grade / Rail length(mm)		Preloaded assembly		
over	or less	Ultra precision P3	Super precision P4	High precision P5
–	200	2	2	3.5
200 –	250	2	2.5	4.5
250 –	315	2	2.5	5
315 –	400	2	3	5.5
400 –	500	2	3	6
500 –	630	2	3.5	6.5
630 –	800	2	4	7
800 –	1 000	2.5	4.5	7.5
1 000 –	1 250	3	5	8.5
1 250 –	1 600	3.5	5.5	9.5
1 600 –	2 000	4	6.5	11
2 000 –	2 500	4.5	7.5	12
2 500 –	3 150	5.5	8.5	13
3 150 –	4 000	6	9.5	14

---

(2) Accuracy Standard

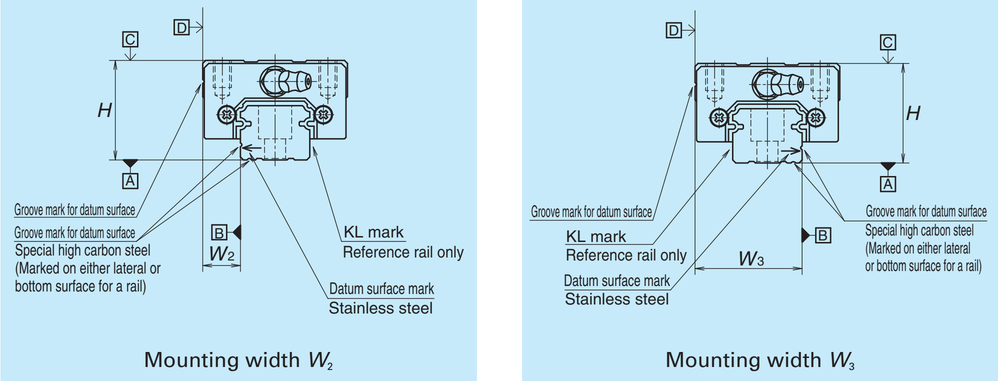
Three accuracy grades are available: Ultra precision P3, Super precision P4 and High precision P5.

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)	±8 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)	±10 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



Mounting width W_2 Mounting width W_3

Fig. 7

(4) Preload and rigidity

Slight preload Z1 and Medium preload Z3 are available, 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

Model / Size	15	20	25	30	35
HS	2 000 (1 300)	3 960 (3 500)	3 960 (3 500)	4 000 (3 500)	4 000 (3 500)

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

5. Installation

(1) Permissible values of mounting error

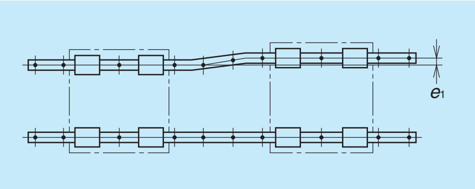


Fig. 8

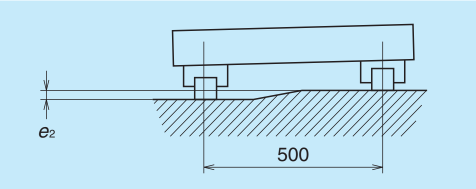


Fig. 9

Table 5

Unit: μm

Value	Preload	Model No.				
		HS15	HS20	HS25	HS30	HS35
Permissible values for parallelism error of two rails e_1	Z1	18	20	26	31	37
	Z3	12	14	18	22	26
Permissible values for height error of two rails e_2	Z1, Z3	330 μm/500 mm				

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

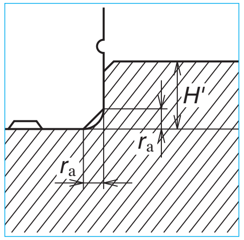


Fig. 10 Shoulder for the rail datum surface

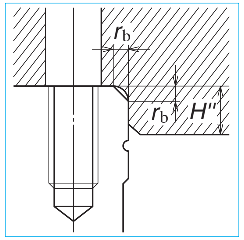


Fig. 11 Shoulder for the ball slide datum surface

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 A58 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 an extended thread body length (L) for the addition of dust-resistant accessories such as NSK K1-L lubrication units, double seals and protectors.

NSK can also provide extended length threads for ease of replenishment.

Please contact NSK if stainless lubrication accessories are required.

(2) Mounting position of lubrication accessories

The standard position for grease fittings is at the end face of the ball slide, but we can mount them on the side of the end cap as an option. (**Fig. 13**)

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

Using a piping unit with thread of M6 × 1 requires a connector to connect to a grease fitting mounting hole with M6 × 0.75. The connector is available from NSK.

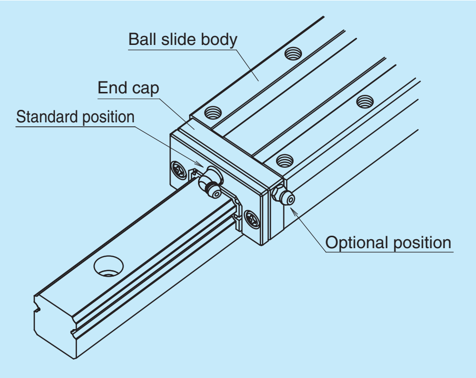


Fig. 13 Mounting position of lubrication accessories

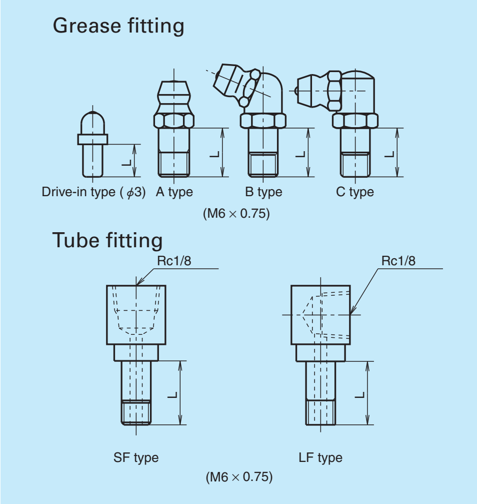


Fig. 12 Grease fitting and tube fitting

Table 7

Unit: mm

Model No.	Dust-resistant specification	Dimension L		
		Grease fitting /Drive-in type	Tube fitting	
			SF type	LF type
HS15	Standard	5	–	–
	With NSK K1-L	10	–	–
	Double seal	*	–	–
	Protector	*	–	–
HS20	Standard	5	–	–
	With NSK K1-L	10	–	–
	Double seal	8	–	–
	Protector	8	–	–
HS25	Standard	5	6	6
	With NSK K1-L	12	11	11
	Double seal	10	9	9
	Protector	10	9	9
HS30	Standard	5	6	6
	With NSK K1-L	14	12	13
	Double seal	12	10	11
	Protector	12	10	11
HS35	Standard	5	6	6
	With NSK K1-L	14	12	13
	Double seal	12	10	11
	Protector	12	10	11

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

7. Dust-resistant components

(1) Standard Specification

Under normal applications, the HS model can be used without modification thanks to its dust resistance. These ball slides come standard with an end seal on both ends.

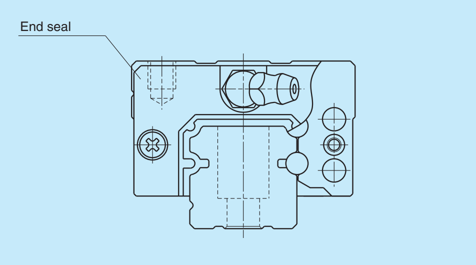


Fig. 14

Table 8 Seal friction per ball slide (maximum): end seal only

Unit: N

Size Model	15	20	25	30	35
HS	3	3	3	3	4

(2) NSK K1-L™ lubrication unit

Refer to **Table 9** for dimensions of linear guides equipped with NSK K1-L lubrication units.

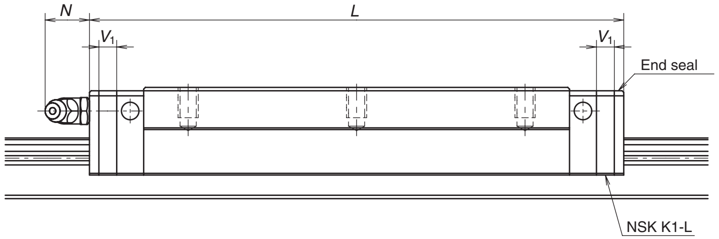


Table 9 Dimensions when equipped with NSK K1-L lubrication units

Unit: mm

Model No.	Ball slide shape code	Standard ball slide length	Ball slide length with two NSK K1-L units *L*	Thickness of single NSK K1-L unit V_1	Protrusion of grease fitting *N*
HS15	AL, EM	106	115.6	4.8	(5)
HS20	AL, EM	119.7	130.3	5.3	(14)
HS25	AL, EM	148	158.6	5.3	(14)
HS30	AL, EM	176.1	188.1	6	(14)
HS35	AL, EM	203.6	216.6	6.5	(14)

Note: Slide length when equipped with NSK K1-L = (standard ball slide length) + (V_1 thickness of single NSK K1-L unit) × (number of K1-L units).

(3) Double seal and protector

For the HS Model, double seals and protectors can be installed only before shipping from the factory. Please consult with NSK when double seals or protectors are required.

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

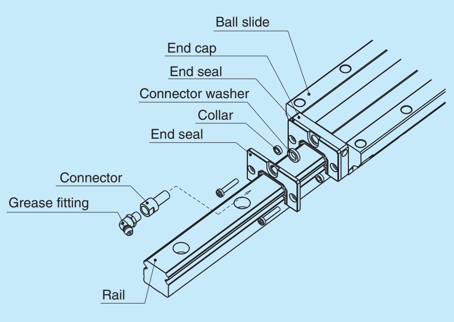


Fig. 15 Double seal

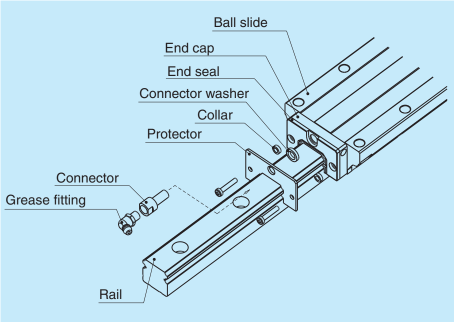


Fig. 16 Protector

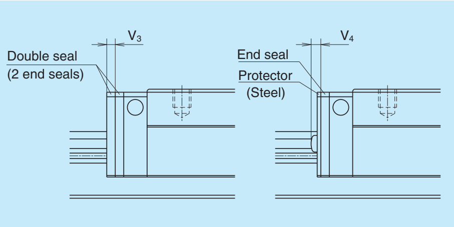


Fig. 17

8. Reference number

A reference number (designation) is set and indicated on the specification drawing for an individual NSK linear guide when its specifications are finalized.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

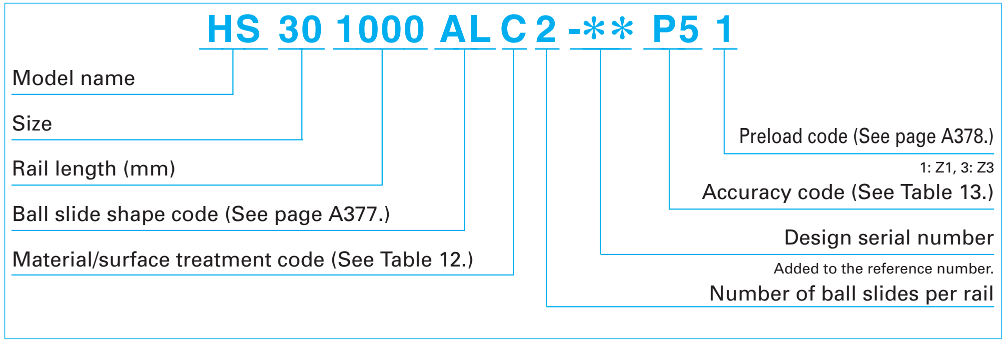


Table 12 Material/surface treatment code

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-L)	With NSK K1-L
Ultra precision grade	P3	L3
Super precision grade	P4	L4
High precision grade	P5	L5

Note: Refer to page A58 for details on NSK K1-L lubrication units.

9. Dimensions
HS-AL

HS 30 1000 AL C 2 -✻✻ P5 1

Model name

Size

Rail length (mm)

Ball slide shape code (See page A377.)

Material/surface treatment code (See Table 12.)

Preload code (See page A378.)

1: Z1, 3: Z3

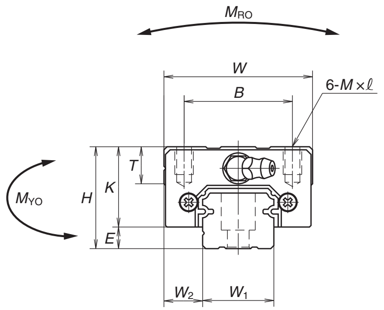
Accuracy code (See Table 13.)

Design serial number

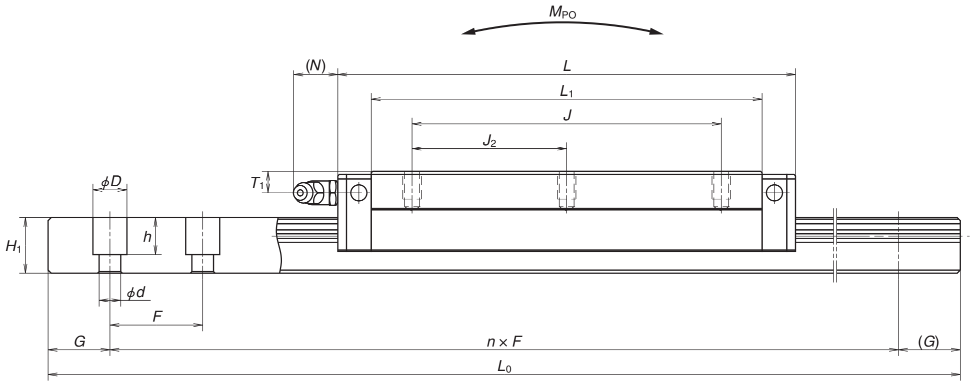
Added to the reference number.

Number of ball slides per rail

Front view of AL types



Side view of AL type



Model No.	Assembly			Ball slide													
	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
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 model does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.
2) The external appearance of stainless steel ball slides differs slightly from that of carbon steel ball slides.

Unit: mm

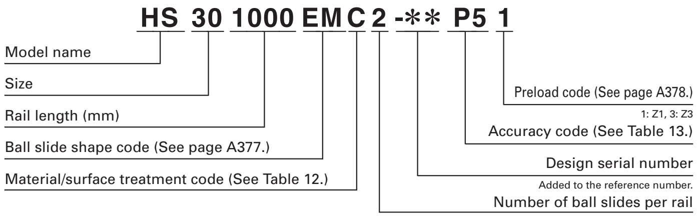
Model No.	Rail				Basic load ratings								Weight	
	Pitch	Mounting bolt hole	G	Max. length L_{0max}. ( ) for stainless	[3]Dynamic		Static	Static moment (N·m)					Ball slide	Rail
					[50km]	[100km]	C_0	M_{RO}	M_{PO}		M_{YO}			
	F	d × D × h	(reference)		C_{50}(N)	C_{100}(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
HS15AL	30	*4.5×7.5×8.5 3.5×6×8.5	20	2 000 (1 300)	20 500	16 300	40 000	199	395	1 990	335	1 670	0.34	1.4
HS20AL	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
HS25AL	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
HS30AL	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
HS35AL	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) Basic load ratings comply with ISO standards (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.

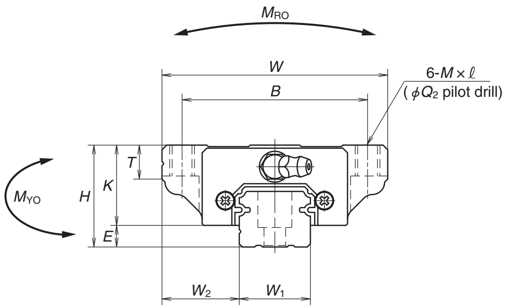
4) Parenthesized dimensions are applicable to stainless steel products.

*) Standard rail mounting bolt hole for HS15 is specified as hole for M4 (4.5 × 7.5 × 8.5). Please contact us to request a different hole for M3 (3.5 × 6 × 8.5).

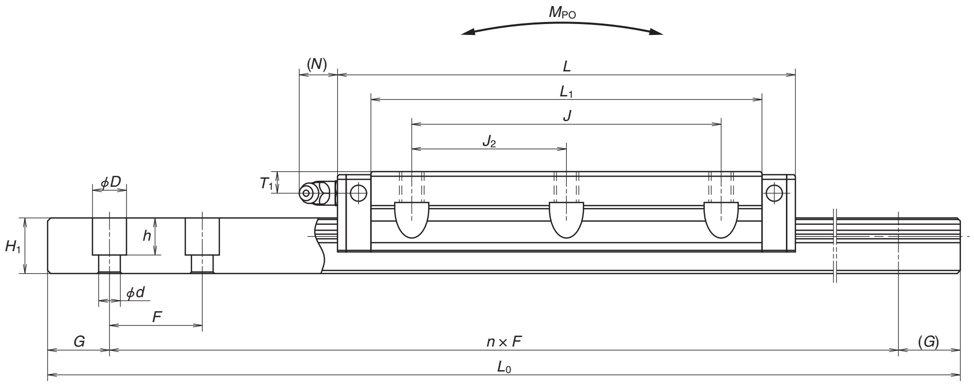
HS-EM



Front view of EM type



Side view of EM type



Unit: mm

Model No.	Assembly			Ball slide														
	Height			Width	Length	Mounting hole								Grease fitting			Width	Height
	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

Model No.	Rail				Basic load ratings								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)
HS15EM	30	*4.5×7.5×8.5 3.5×6×8.5	20	2 000 (1 300)	20 500	16 300	40 000	199	395	1 990	335	1 670	0.45	1.4
HS20EM	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
HS25EM	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
HS30EM	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
HS35EM	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

Notes: 1) The HS model does not have a ball retainer. Note that balls will fall out when the ball slide is removed from the rail.
2) The external appearance of stainless steel ball slides differs slightly from that of carbon steel ball slides.

3) Basic load ratings comply with ISO standards (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 M4 (4.5 × 7.5 × 8.5). Please contact us to request a different hole for M3 (3.5 × 6 × 8.5).

A-5 Other Linear Rolling Guide Products

A-5-1 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 resistance

Models with seals are available. These seals feature low friction and high durability thanks to a highly effective double-lip system.

(5) Superb durability

The material of outer sleeve is vacuum degassed, highly pure, and is heat-treated with good expertise.

2. Models

There are two models

(1) LB model (standard) (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 LB model (standard)

(2) LB-T model (adjustable clearance) (Fig. 2)

LB-T linear rolling bushings feature a cut on the outer sleeve in the axial direction. When used with a housing with an adjustable inner diameter, they allow for the clearance between the linear shaft and inscribed circle (an imaginary circle connecting the tops of the balls) to be adjusted in minute increments.

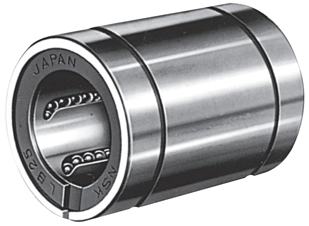


Fig. 2 LB-T model (adjustable clearance)

3. Accuracy

(1) Accuracy grades

- LB model (standard)·····················High precision grade S and super precision grade SP are available.
- LB-T model (adjustable clearance)·····High precision grade S is available.

(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 *B*n		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

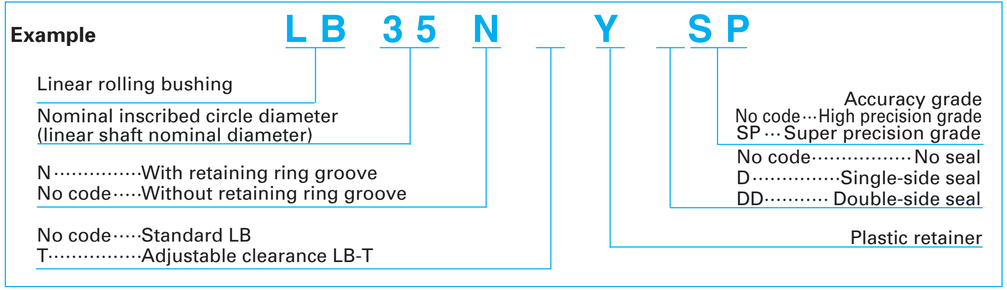
Unit: μm

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 types, 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 _ Y _ SP

Linear rolling bushing

Nominal inscribed circle diameter
(linear shaft nominal diameter)

N···············With retaining ring groove
No code·····Without retaining ring groove

No code·····Standard LB
T················Adjustable clearance LB-T

Accuracy grade
No code···High precision grade
SP···Super precision grade

No code·················No seal
D···············Single-side seal
DD··········· Double-side seal

Plastic retainer

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 grease with consistency levels of 2 are generally used (e.g. NSK Grease LR3, PS2, and AS2).

② Replenishment

- Sealed linear rolling bushings are designed to be disposable. Therefore, replenishing grease is considered to be not required. However, if replenishment becomes necessary due to a 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 seals, wipe off old grease from the linear shaft, and apply new grease.
- Intervals of replenishment 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. 3**, the 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.

$$F = \mu \bullet P \cdots\cdots (1)$$

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 sealed type, a seal resistance of 0.3 to 2.40 N is added to the above.

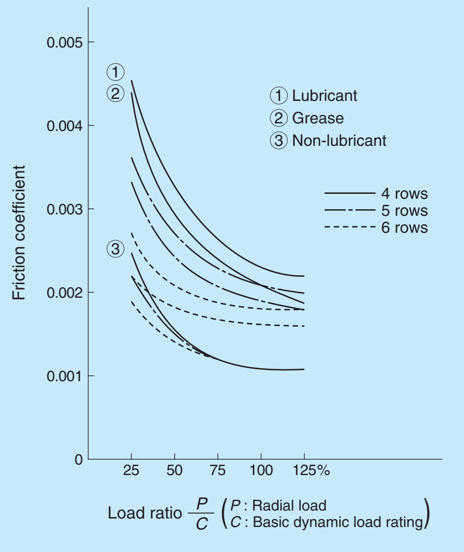


Fig. 3 Dynamic friction coefficient of linear rolling bushing

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.

$$K_N = K\,(P/0.1\mathrm{C})^{1/3} \cdots\cdots (2)$$

In this formula:

K : Rigidity value in the dimension table (N/μm)

P : Radial load (N)

When the load is applied between the ball rows, 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

$$L = 50\, f_L^3 \cdots\cdots (3)$$

$$f_L = C/P \cdots\cdots (4)$$

In this formula:

L : Rated life (km)

P : Radial load (N)

f_L : Life factor (Refer to Fig. 4)

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. 5, and multiply the value.

$$f_L = C \cdot f_H/P \cdots\cdots (5)$$

Or

$$C = P \cdot f_L/f_H \cdots\cdots (6)$$

Life in time can be obtained by the following formula, substituting given stroke length, cycle numbers, and running distance:

$$L_h = (L/1.2 \cdot S \cdot n) \times 10^4 \cdots\cdots (7)$$

In this formula:

L_h : Life hours (h)

L : Rated life (km)

S : Stroke (mm)

n : Cycles per minute (cpm)

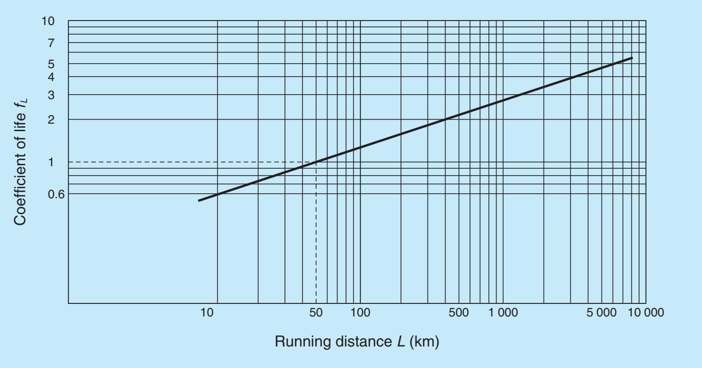


Fig. 4 Relationship between life factor and running distance

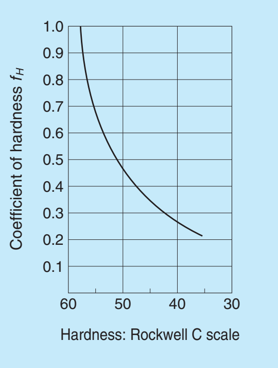


Fig. 5 Hardness factor

(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 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

$$450/3 = 150 \text{ (N)}$$

- 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. 4** and **Fig. 5**,

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.

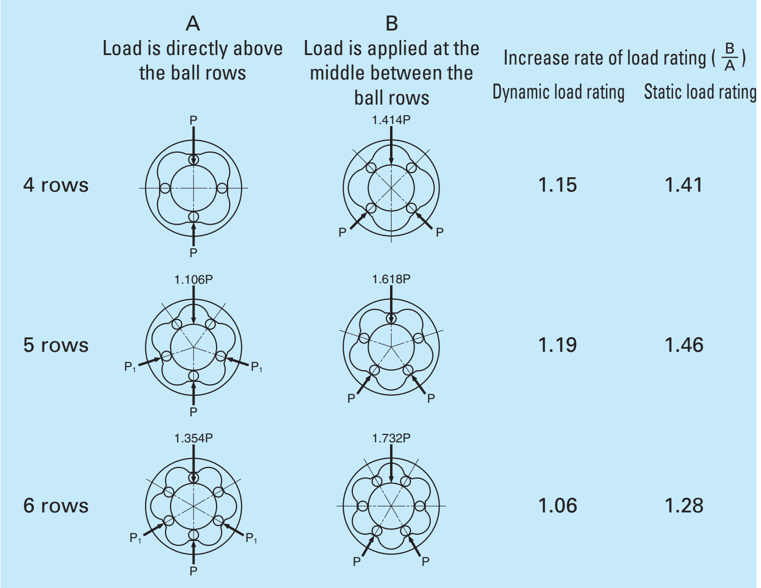
(4) Compensating load rating by ball row position

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. 6**).

(Radial clearance set at zero in this case.)

Load ratings in the dimension tables are in case "A" when applied directly above the ball circuit row. If used as in case "B," the load rating becomes larger (refer to **Fig. 6**).



	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. 6 Increasing rate of load rating by position of ball row (B/A)

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9. Shaft Specifications

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 "clearance for fit" with the ball bushing less than 5 μm -
    Less than 0.8 S
- For SP grade with "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 A390). 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 resistance

Select a linear rolling bushing with seals to prevent moisture or foreign matter 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. 7 is an installation example.

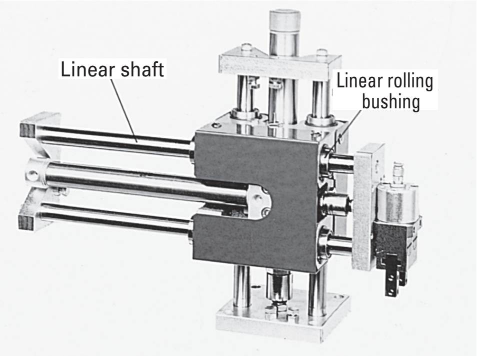
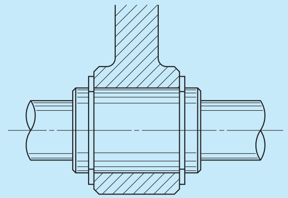


Fig. 7 Installation example

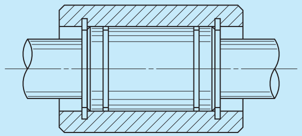
(2) Installation of linear rolling bushing

1) Installation of standard type

Fig. 8 shows a method using a retainer ring. Linear rolling bushings can also be secured to the housing using a stop plate and/or screw.



Retaining ring method (1)



Retaining ring method (2)

Fig. 8 Installation using retaining rings

a) Housing inside diameter should be of a recommended value (**Table 2**, page A390). The entire rolling bushing contracts and gives excessive preload if the inside diameter is small or the roundness or cylindricity is excessive. This may result in an unexpected failure.

b) To install linear rolling bushing, use a tool (**Fig. 9**) and squeeze it in, or use a holder and lightly pound it.

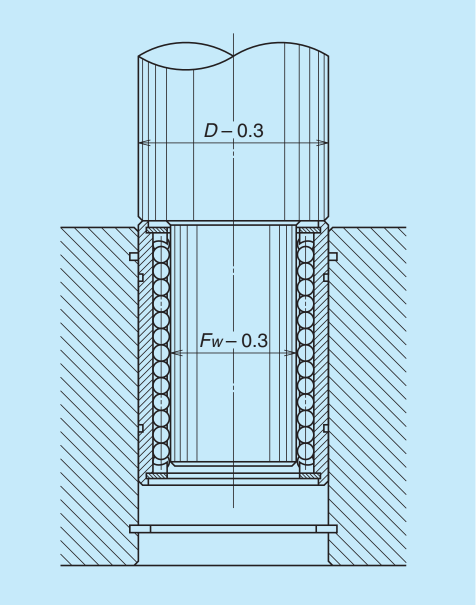


Fig. 9 Tool to install a linear rolling bushing

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 A390). 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 .

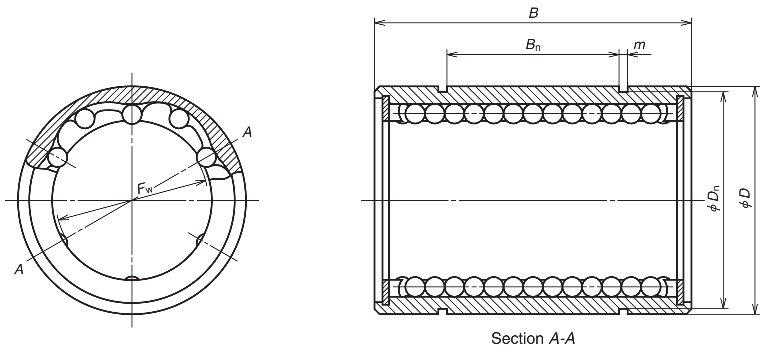
First, loosen the housing until shaft turns freely. Then narrow the clearance gradually. Stop at the point when the shaft rotation becomes heavy. This creates a clearance zero or light preload.

(3) Precautions 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), no seal



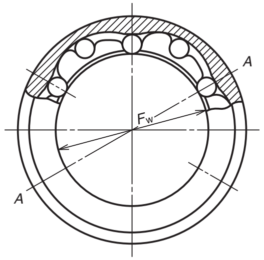
Unit: mm

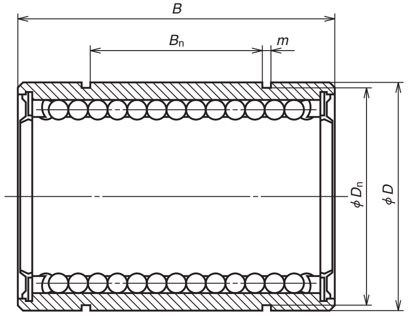
Model No.	Inscribed circle diameter F_w	Outside diameter D	Length B	Retaining ring groove Distance B_n	Retaining ring groove Width m	Retaining ring groove Bottom diameter D_n	Stiffness[*1] (N/μm)	Number of ball circuits	Weight (kg) (Reference only)	Basic dynamic load rating C (N)	Basic static load rating 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), with seal





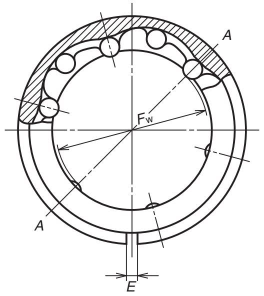
Section *A-A*

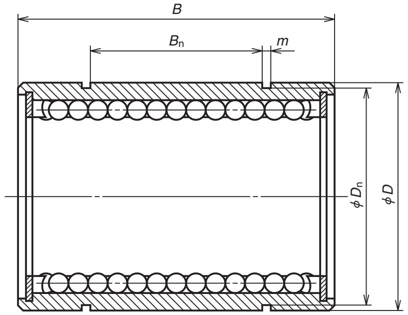
Unit: mm

*Model No.	Inscribed circle diameter F_w	Outside diameter D	Length B	Retaining ring groove			Number of ball circuits	Weight (kg) (Reference only)	Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
				Distance B_n	Width m	Bottom diameter D_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)





Section *A-A*

Unit: mm

Model No.	Inscribed circle diameter F_w	Outside diameter D	Length B	Opening width E	Retaining ring groove			Number of ball circuits	Weight (kg) (Reference only)	Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
					Distance B_n	Width m	Bottom diameter D_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

A-5-2 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, and a side plate which guides the rollers (**Fig. 1**). Roller packs are a type of linear rolling guide, where rollers are allowed to re-circulate infinitely.

There is a plate spring attached to a side of roller pack to prevent the roller pack from falling out when it is turned upside down after assembly.

Another component of the roller pack is the spring pin. A spring pin is on the top surface of the roller pack, and makes installation of the wedge block and fitting plate easier.

A 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. The wedge on the wedge block moves up and down to apply preload by turning the adjustment screw.

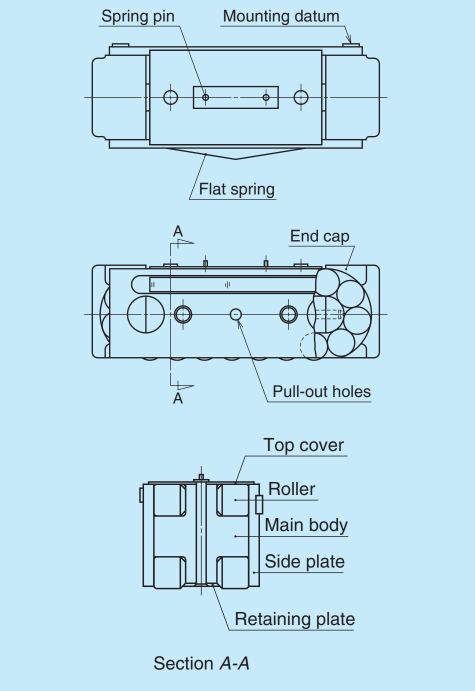


Fig. 1 Roller pack

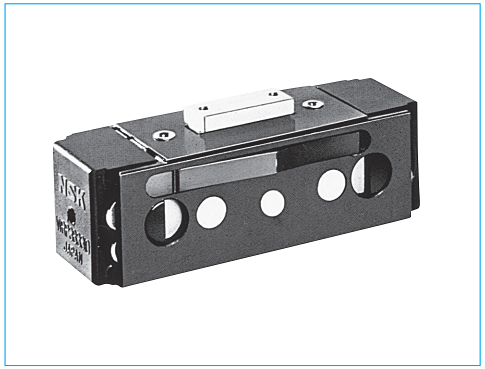


Photo 1 Roller pack

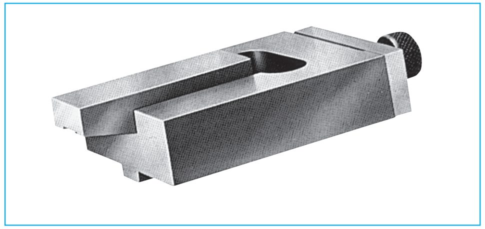


Photo 2 Wedge block

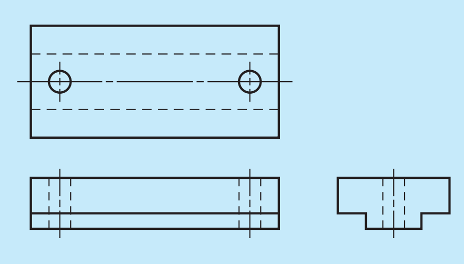


Fig. 2 Fitting plate

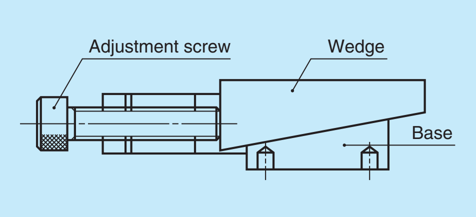


Fig. 3 Wedge block

2. Features

Roller packs have 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 a "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, 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.

Roller packs also allow for easy application of preload by the wedge block, installation to vertical shafts, and reduced noise levels.

3. Accuracy

The height tolerance of roller pack is 10 μm. Roller packs are grouped into by size for every 2 μm (coded 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.

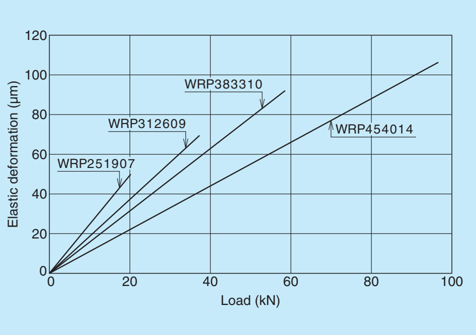


Fig. 4 Elastic deformation of the roller pack

5. Preload

Fig. 5 shows conversions of tightening torque of the wedge block adjustment screw into preload volume. Use a dial gauge for accurate measurement.

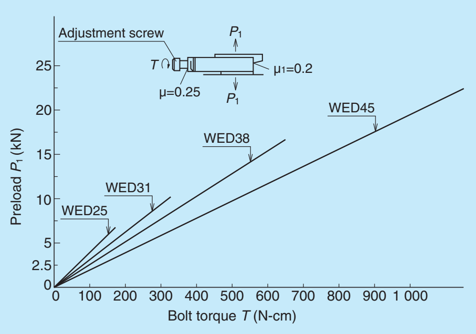


Fig. 5 Tightening torque of the adjustment screw, and preload volume

6. Friction and Lubrication

(1) Lubricants and volume

Mineral oils are commonly used. Since a 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 matter (swarf from cutting, and other dust) from entering the roller pack to enjoy the full benefit of the designed life. The material of the seal should have strong resistance to oil and wear. Felt and synthetic rubber (acrylonitril butadiene rubber) are some suitable materials. **Fig. 6** shows a general method to install seals.

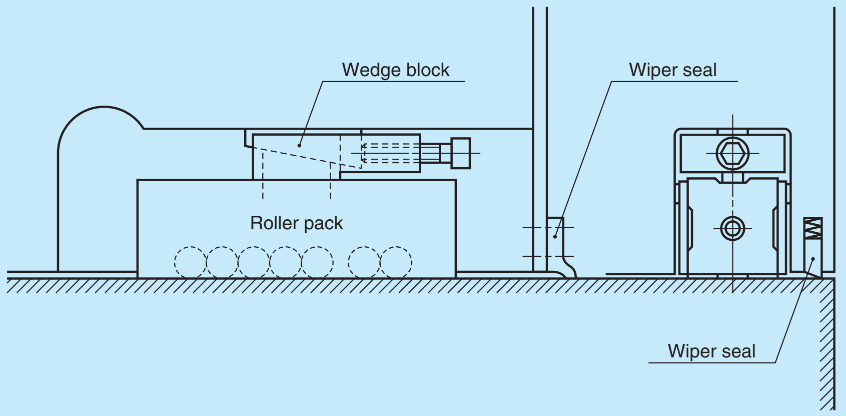


Fig. 6 Installation of seal

7. Installation

(1) Installation and applying preload

As shown in **Fig. 7**, 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 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 faces.

(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.

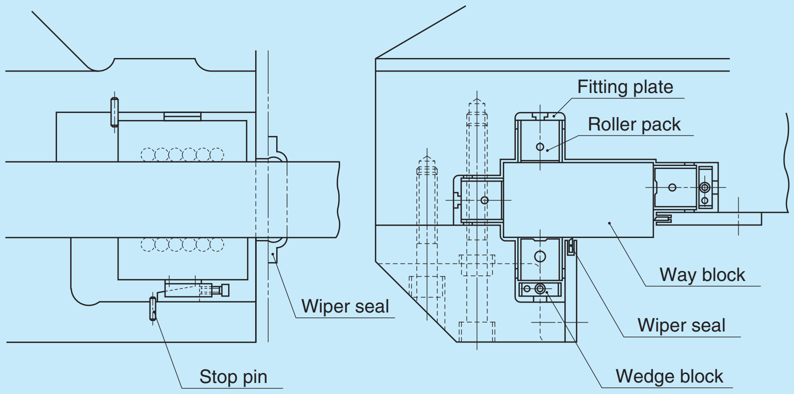


Fig. 7 Design of the roller pack pocket (example)

8. Rated life

Rated life L (km) is shown in the following formula.
In this formula:

$$L = 50\left(\frac{C}{f_w \cdot F_c}\right)^{\frac{10}{3}} \text{.......................................} (2)$$

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

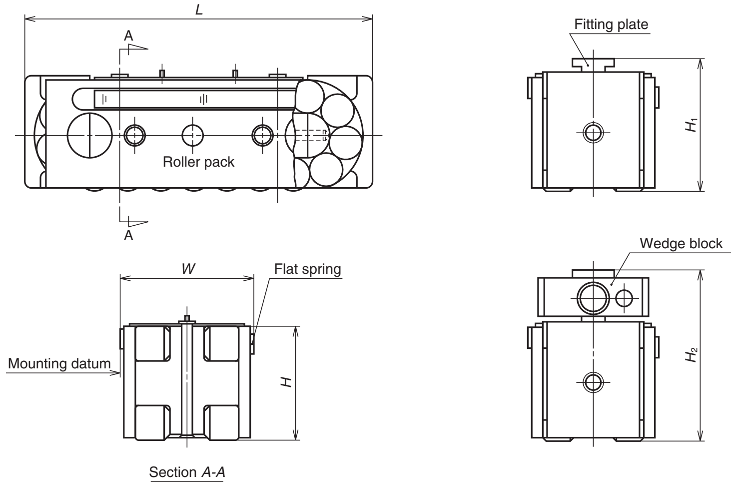
9. Disassembly

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 can 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 Tables

Roller pack: Model WRP

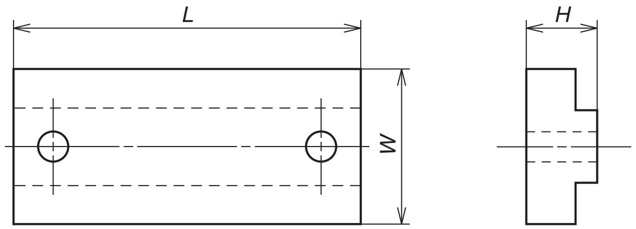


Unit: mm

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 parentheses in column H_2 show the adjustable height range of the wedge block.

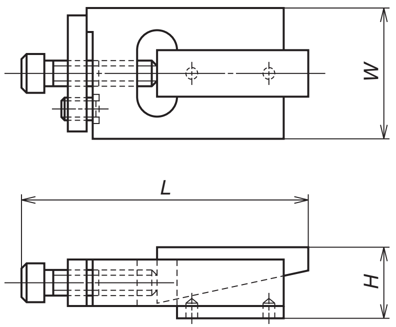
Fitting plate: Model WFT



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 parentheses in column H_2 show the adjustable height range of the wedge block.

B BLOCK

Ball Screws

B-1 Selection Guide for NSK Ball Screw

B-2 Technical Description of Ball Screws

B-3 Ball Screw Dimension Tables

B1 -B36

B37 -B104

B105 -B568

B-1 Selection Guide for NSK Ball Screw

B-1-1 Features of NSK Ball Screws

(1) Quick delivery

Standard ball screws are for short lead times.

- Precision ball screws with finished shaft ends
  Compact FA model, MA model, FA model, SA model, KA model
- Precision ball screws with blank shaft ends
  MS model, FS model, SS model, HSS model
- Ball screws for transfer equipment with finished shaft ends
  VFA model, RMA model
- Ball screws for transfer equipment with blank shaft ends
  RMS model, R model

(2) Competitive prices

NSK reduces cost by well-planned mass production of standardized items. We rank the best in the world production of ordered items. We are able to offer our products at competitive prices by producing similar items in the same production group.

(3) Unparalleled accuracy

NSK utilizes its unique grinding technique and measuring equipment for top-notch precision.

(4) Superb durability

NSK uses thoroughly purified alloy steel for superb durability.

(5) No backlash, and unparalleled rigidity

NSK ball screws use Gothic arch grooves as shown in **Fig. 1.1** to minimize the clearance between the balls and grooves. Further, an application of preload makes no backlash possible. As providing controlled preload is easy, appropriate rigidity is obtained.

As the Gothic arch also minimizes the clearance between the balls and the grooves, the backlash is minimized without applying preload.

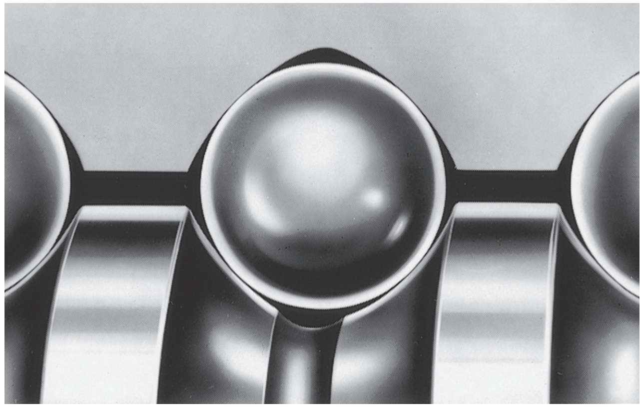


Fig. 1.1 Ball groove profile of NSK ball screw

(6) Smooth movement assures high efficiency

NSK uses a gothic-arch design for the ball grooves. This design prevents the balls from slightly wedging into the grooves of the ball nut and screw shaft and causing small vibrations. This phenomenon is common with the circular-arc design used by other manufacturers. The gothic arch, along with the low friction inherent in a ball screw, results in a smooth and highly efficient conversion of motion as shown in **Fig. 1.2**.

(7) Enhanced support units

Utilizing bearing technology, NSK produces high quality support units (for light load small equipment and heavy load machine tools) exclusively for ball screws. These units are standardized.

NSK also offers quality-assured accessories such as lock nuts to tighten bearings, travel stoppers to prevent overrun, and sealing units to cool hollow shaft ball screws.

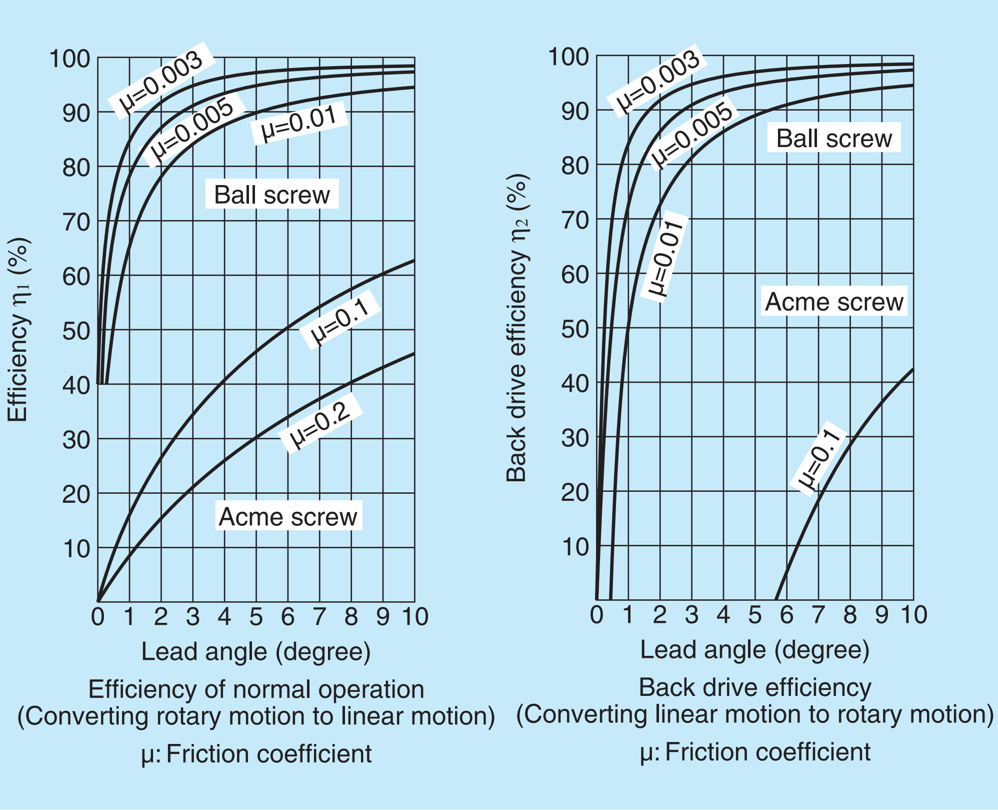


Fig. 1.2 Mechanical efficiency of ball screws

B-1-2 Structure of a Ball Screw

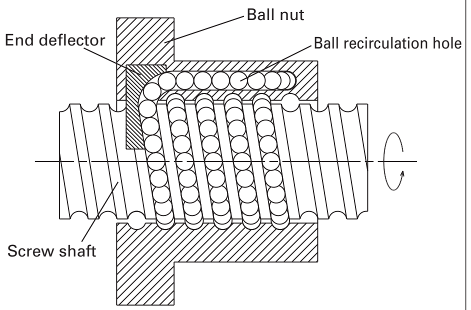
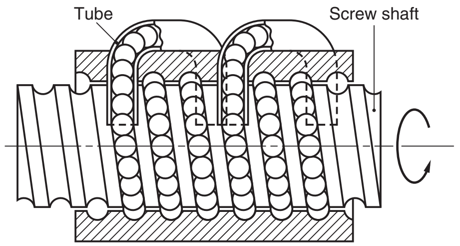
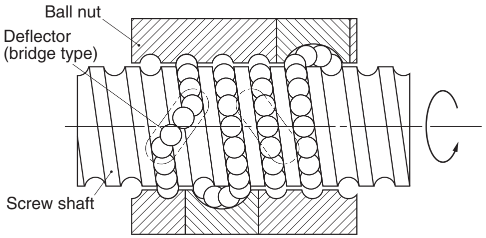
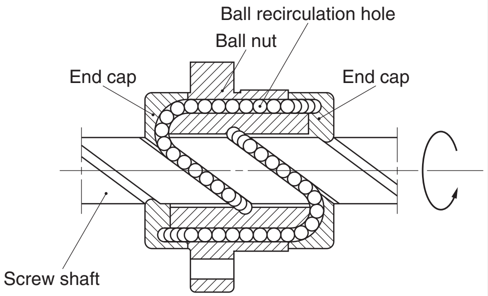
Balls are placed between the screw shaft and nut and roll. This system is called a "ball screw." To keep the balls recirculating continually, this system requires a screw shaft, a nut, balls, and recirculation components as basic items. A ball screw has the following functions.

(1) Converting motion: Changing rotary motion to linear motion (normal operation); Changing linear motion to rotary motion efficiently (back-drive operation).
(2) Increasing power: A small torque is converted to a large thrust force.
(3) Positioning: Sets accurate position in linear motion.

B-1-2.1 Ball Recirculation System

A ball screw's structure is typically classified by its recirculation system and preload.
As shown in **Table 2.1**, four types of ball recirculation system are used for NSK ball screws.

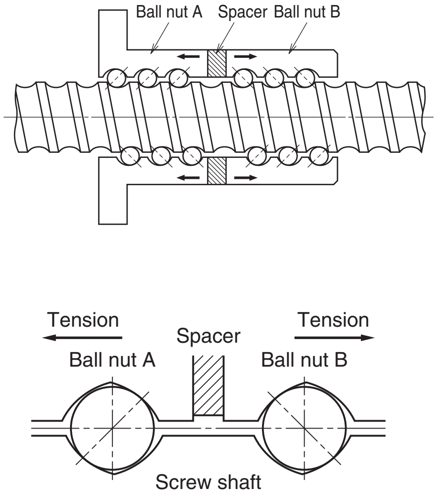
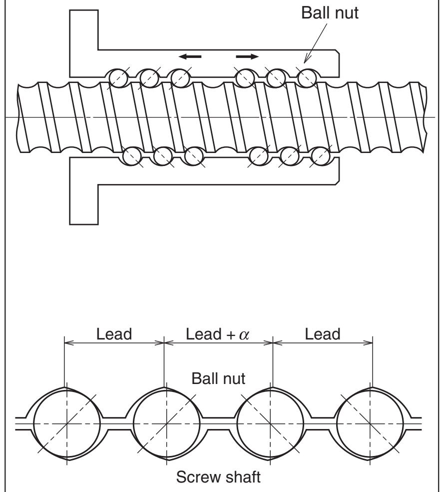
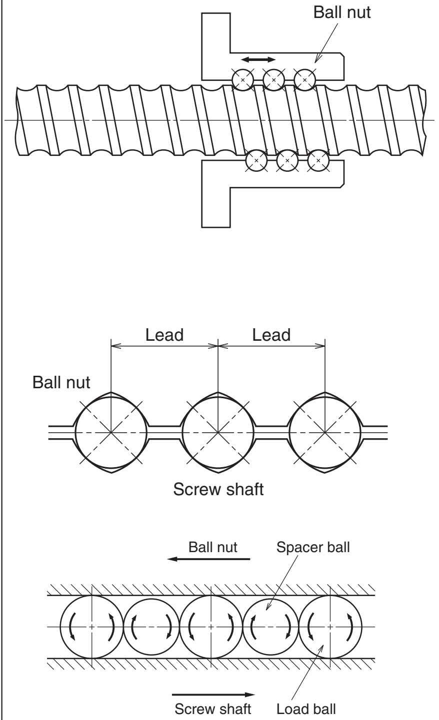
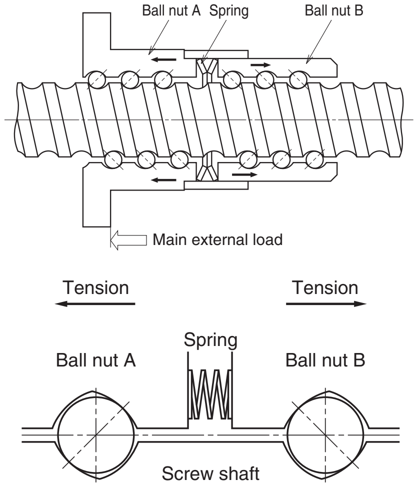
Table 2.1 Ball screw recirculation system

End deflector	Tube	Deflector (bridge)	End cap
			
[Structure] Balls are smoothly picked up in the tangential direction at the end of the nut, and recirculated via a hole in the nut. This type is called a middle deflector when the balls are picked up at the middle of the nut.	[Structure] Balls are recirculated through a pipe (ball return tube) of optimized size, bridging the start and end of recirculation.	[Structure] Balls are recirculated by a horseshoe shaped deflector bridging the adjacent ball thread grooves.	[Structure] Balls are picked up by an end cap placed at both ends of the nut, and recirculated via a hole through the nut.
[Features] · Small nut outside diameter allows compact nut design. · Low noise, high speed.	[Features] · Adapts to various specifications (screw shaft diameter, lead).	[Features] · Suitable for fine lead ball screws. · Small nut outside diameter, allows compact nut design.	[Features] · Suitable for large lead ball screws. · Not universal due to complex recirculation structure.

B-1-2.2 Preload system

There are four systems to apply preload to NSK ball screws, depending on the application.

Table 2.2 Preload system for ball screws

Preload system	Double nut preload (D-Preload)	Offset preload (Z-Preload)	Oversize ball preload (P-Preload)	Spring preloaded double nut (J-Preload)
Structure				
Description	Uses two nuts with a spacer between them to apply the preload. In general, a spacer is thicker (by the deformation equivalent to the preload) than the actual space between two nuts. However, a thin spacer is inserted in some cases.	To apply preload, the lead near the center of the nut is offset by the volume equivalent to preload (α). This method is similar to double nut preload (D-preload) by a single ball nut, thus enabling a compact nut design.	Balls slightly larger than the ball groove space (oversize balls) are inserted to allow them to contact at four points. Provides better torque characteristics in the low torque range.	Similar to D-Preload except with a spring instead of a spacer. Must be used with care as rigidity will vary by load direction.
Nut length	Long	Medium	Short	Long
Torque characteristics	○	○	○	◎
Rigidity	◎	◎	○	△

B-1-3 Ball Screw Model

B-1-3.1 Ball Screw Classification

- Ball screws
  - Standard ball screws
    - Finished shaft end
      - Compact FA model **Page B107**
      - MA model, miniature, fine lead ball screws **Page B159**
      - FA model for small equipment **Page B181**
      - SA model for machine tools **Page B209**
      - Stainless steel KA model **Page B265**
      - VFA, RMA models for transfer equipment **Page B337**
    - Blank shaft end
      - High-speed SS (HSS) model **Page B147**
      - MS model, miniature, fine lead ball screws **Page B291**
      - FS model for small equipment **Page B299**
      - SS model for machine tools **Page B309**
      - RMS, R models for transfer equipment **Page B359**
  - Standard nut ball screws
    - End deflector Recirculation **Page B415**
    - SRC Recirculation **Page B425**
    - Tube Recirculation **Page B429**
    - Deflector(bridge) Recirculation **Page B461**
    - High-speed Low-noise Deflector Recirculation **Page B475**
  - Application-oriented ball screws

    Features and application examples are shown on page B481.
    - For high-speed machine tools
      - HMD model **Page B483**
      - HMS model **Page B487**
    - For high-load drives
      - HTF-SRC model **Page B491**
      - HTF-SRD model **Page B495**
      - HTF model **Page B499**
    - For contaminated environments
      - VSS model **Page B515**
      - Ball screws with X1 seals for contaminated environments and grease retention **Page B519**
    - Twin-drive model **Page B527**
    - For high precision machine tools
      - Hollow shaft ball screws **Page B528**
      - Nut cooling ball screws **Page B533**
      - Ball Screws For High-Accuracy Machine Tools **Page B537**
      - High-Durability Precision Ball Screws **Page B538**
    - Rotary nut model **Page B539**
    - ∑ model for robots **Page B547**
    - Ball screws equipped with NSK K1™ Lubrication Units **Page B559**
    - Ball screws for Rechargeable Battery Manufacturing Equipment **Page B565**

- Ball screw accessories
  - Support units (Support bearing units for ball screws)
    - For small equipment, light load **Page B380**
    - For machine tools, high speed and high load **Page B393**
  - Lock nuts **Page B397**
  - Grease units **Page B401**
  - Travel stoppers (available on request) **Page B402**
  - NSKHPS Angular contact thrust ball bearings for ball screw support
    - NSKTAC C Series (for High-Rigidity Applications) **Page B407**
    - NSKTAC 03 Series (for High-Load Drive Applications) **Page B407**

Lead classification

Classification	Lead ratio K = lead l / shaft diameter d
Fine	$K < 0.5$
Medium	$0.5 \le K < 1$
High helix	$1 \le K < 2$
Ultra high helix	$2 \le K$

B-1-3.2 Product Externals

(1) Ball screws

●Standard ball screws

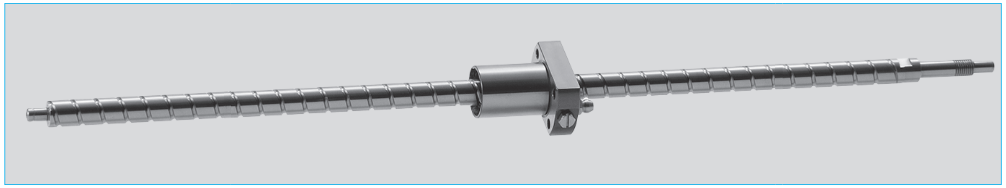


Fig. 3.1 Finished shaft end compact FA model Page B107

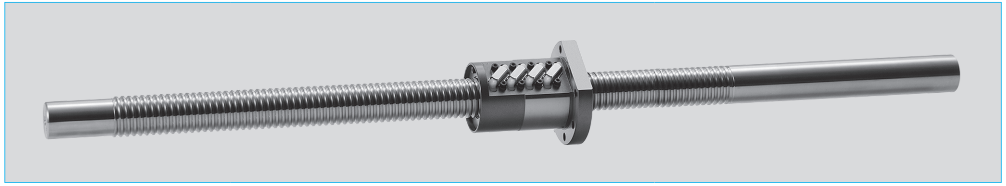


Fig. 3.2 Blank shaft end high-speed SS model Page B147

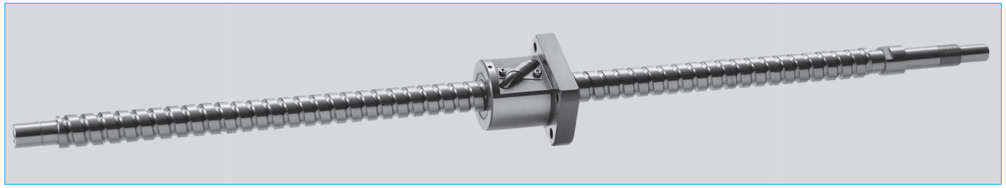


Fig. 3.3 Finished shaft end MA, FA, and SA models Page B157

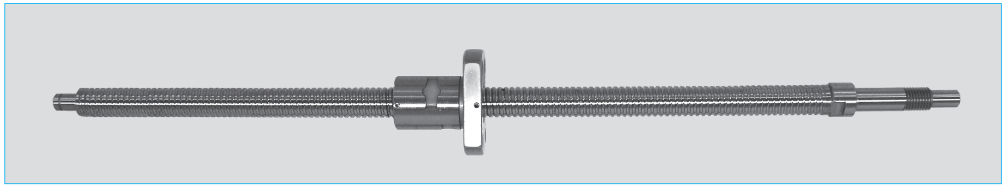


Fig. 3.4 Finished shaft end KA model Page B265

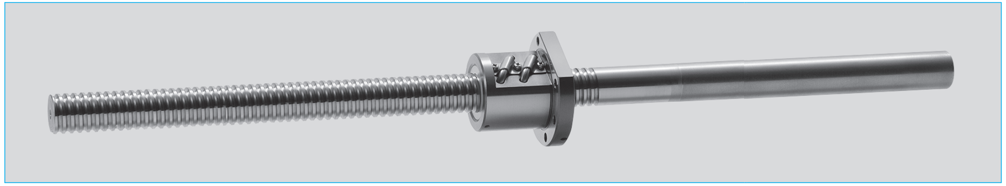


Fig. 3.5 Blank shaft end MS, FS, and SS models Page B289

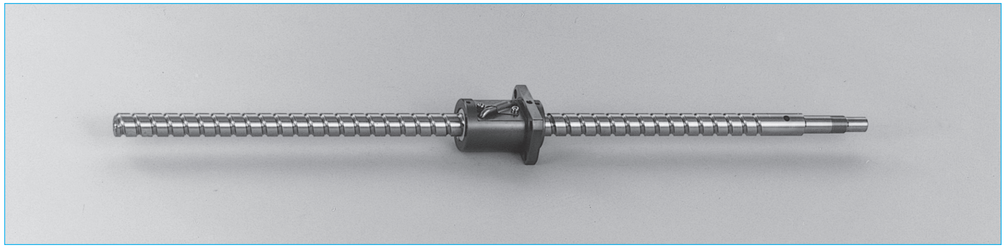


Fig. 3.6 Finished shaft end VFA model for transfer equipment Page B337

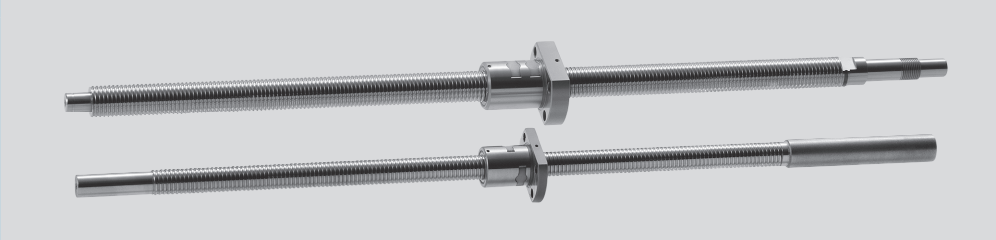


Fig. 3.7 Finished shaft end RMA model and blank shaft end RMS model for transfer equipment Page B337

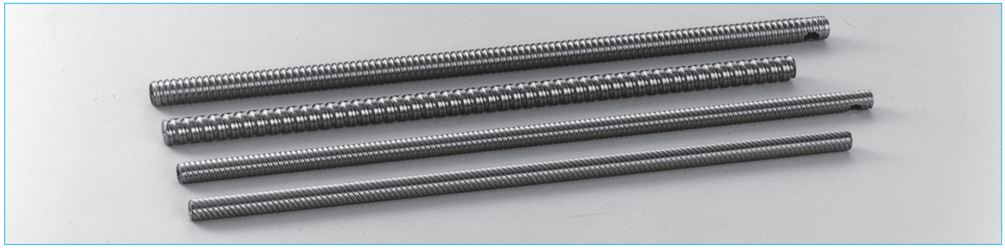


Fig. 3.8 Blank shaft end R model for transfer equipment Page B337

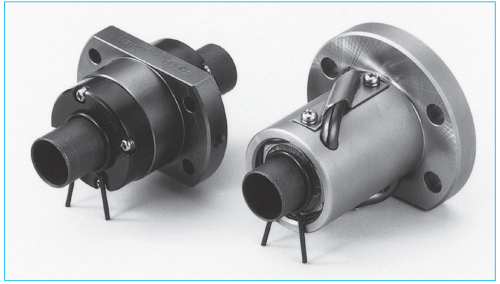


Fig. 3.9 R model nut assembly for transfer equipment Page B337

●Standard nut ball screws

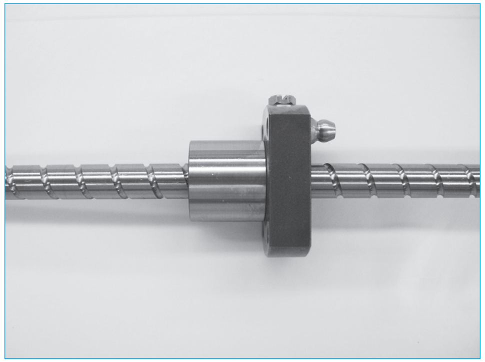


Fig. 3.10 End deflector recirculation Page B415

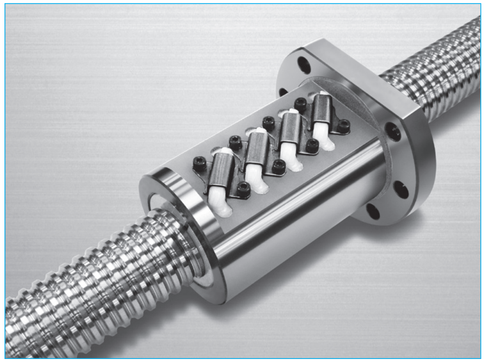


Fig. 3.11 SRC recirculation Page B425

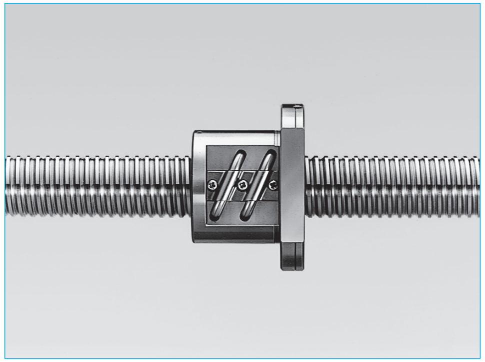


Fig. 3.12 Tube recirculation Page B429

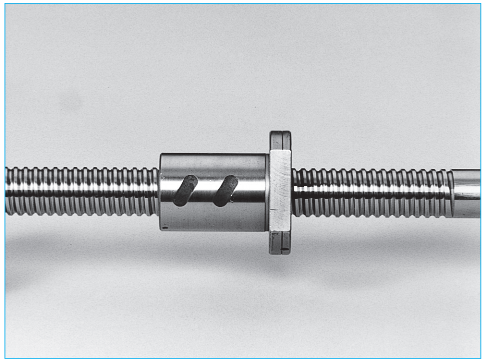


Fig. 3.13 Deflector (bridge) recirculation Page B461

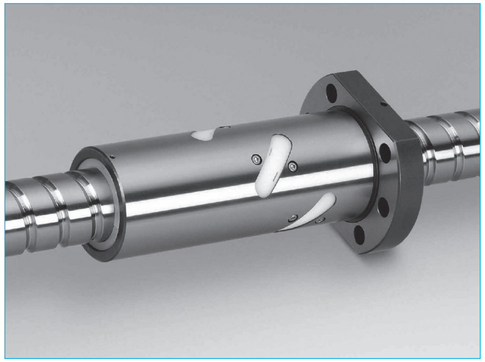


Fig. 3.14 High-speed low-noise deflector recirculation Page B475

●Application-oriented ball screws

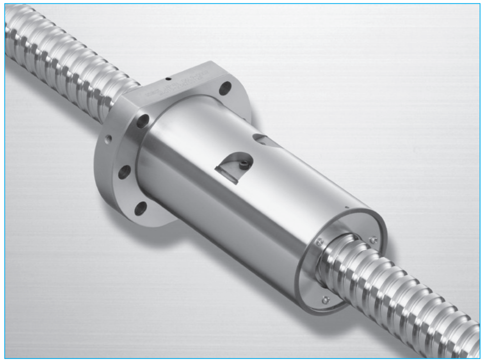


Fig. 3.16 HMD model for high-speed machine tools Page B483

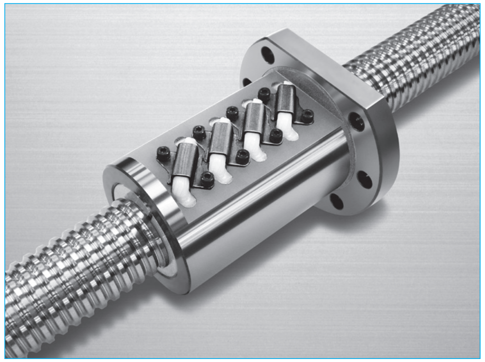


Fig. 3.17 HMS model for high-speed machine tools Page B487

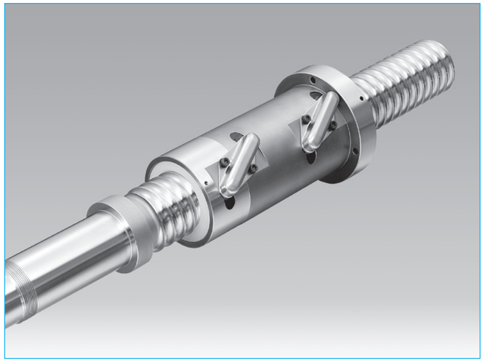


Fig. 3.20 HTF-SRC model for high-load drives Page B491

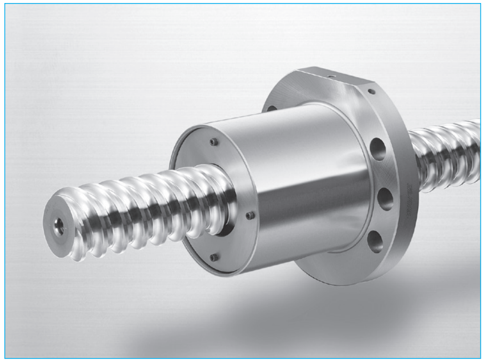


Fig. 3.21 HTF-SRD model for high-load drives Page B495

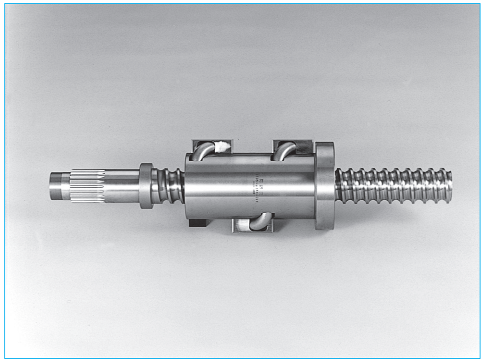


Fig. 3.22 HTF model for high-load drives Page B499

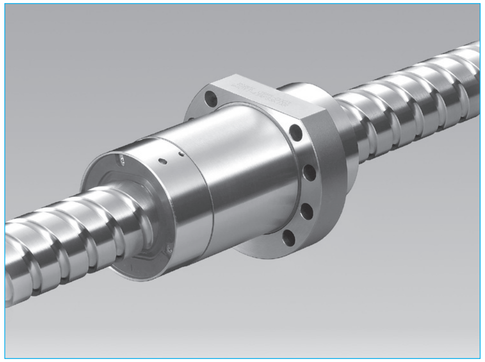


Fig. 3.23 VSS model for contaminated environments Page B515

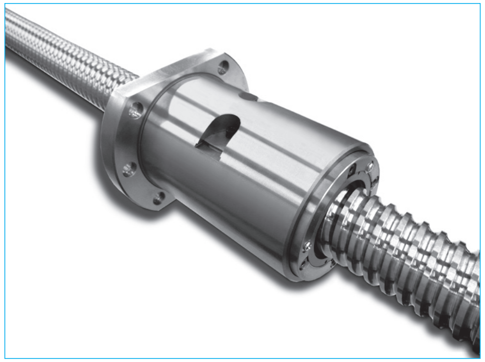


Fig. 3.24 Ball screws with X1 seals for contaminated environments and grease retention Page B519

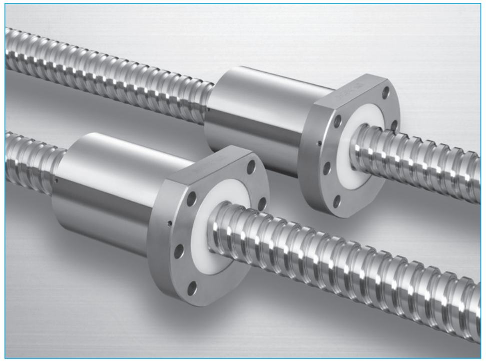


Fig. 3.25 Twin-drive model Page B527

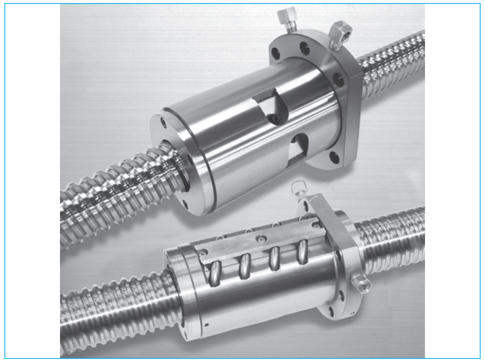


Fig. 3.26 Nut cooling ball screws for high precision machine tools Page B533

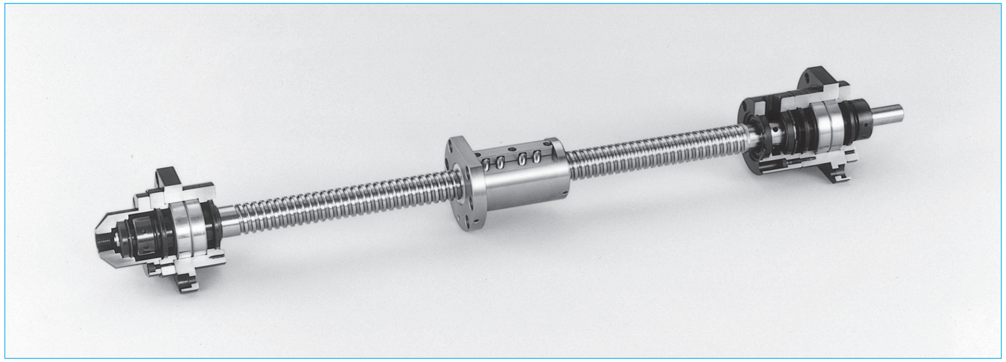


Fig. 3.27 Hollow shaft ball screws for high-precision machine tools Page B528

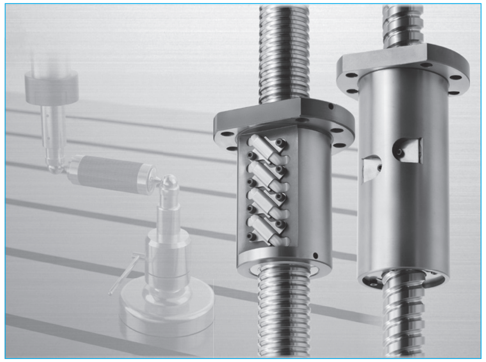


Fig. 3.28 Ball Screws for High-Accuracy Machine Tools Page B537

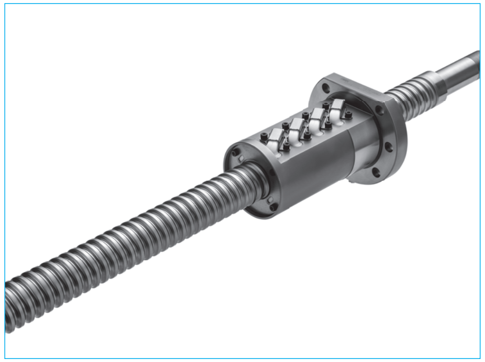


Fig.3.29 High-Durability Precision Ball Screws Page B538

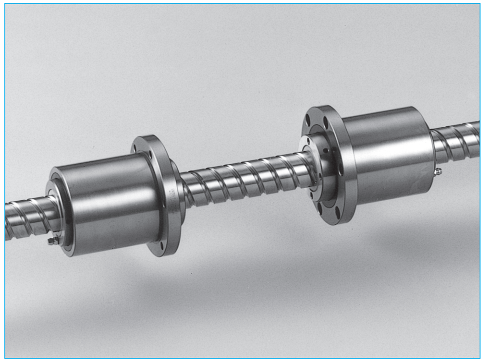


Fig. 3.30 Rotary nut model Page B539

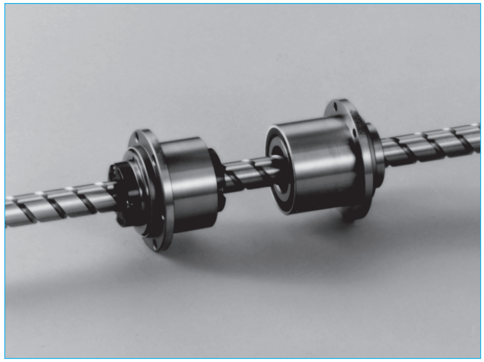


Fig. 3.31 ∑ model for robots Page B547

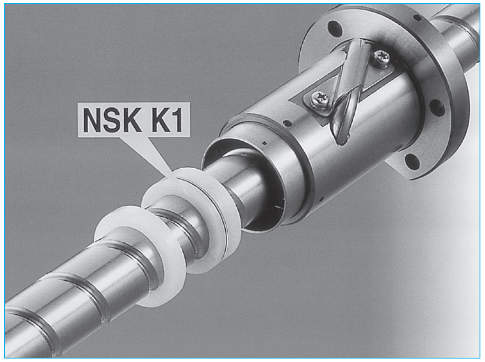


Fig. 3.32 Ball screws equipped with NSK K1™ lubrication units Page B559

(2) Standard accessories

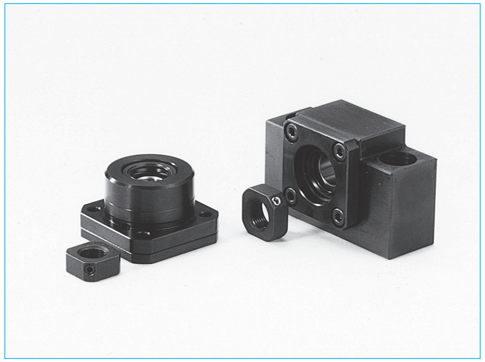


Fig. 3.33 **Support units** **Page B380**
(for small equipment, light load)

Fig. 3.34 **Support units** **Page B380**
(for small equipment, light load, low-profile)

Fig. 3.35 **Support kits for RMA and RMS models** **Page B389**

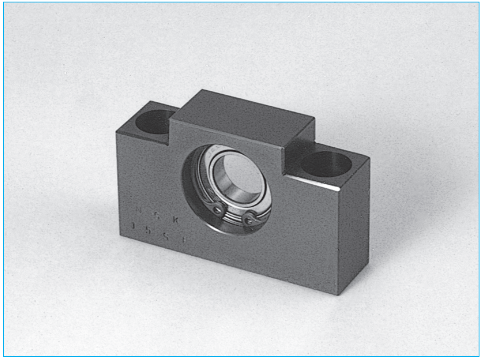


Fig. 3.36 **Support unit for VFA model** **Page B387**
(simple support side)

Fig. 3.37 **Support units** **Page B393**
(for machine tools, high speed, heavy load)

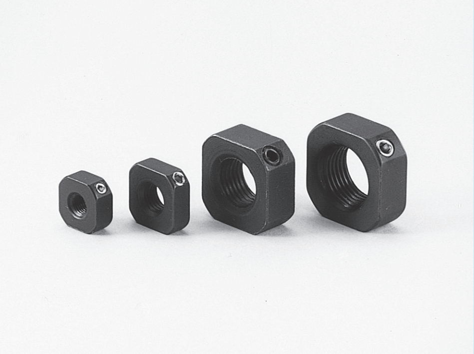


Fig. 3.38 **Lock nuts for light load** **Page B397**

Fig. 3.39 **Lock nuts for high load** **Page B398**

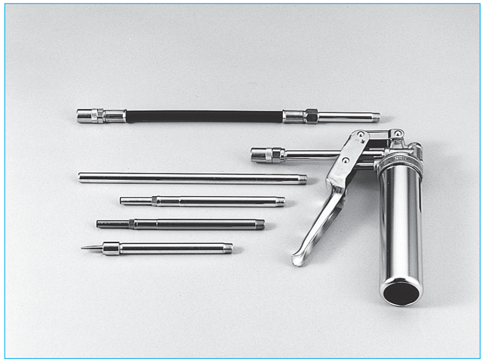


Fig. 3.40 **NSK hand grease pump unit** **Page D19**

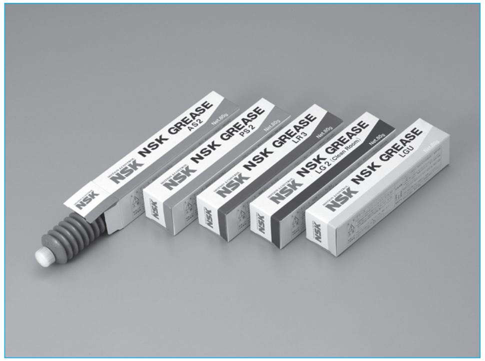


Fig. 3.41 **NSK grease** **Page B401, D19**

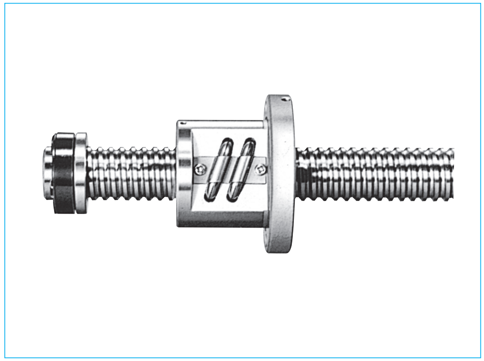


Fig. 3.42 **Travel stoppers** **Page B402**
(by order)

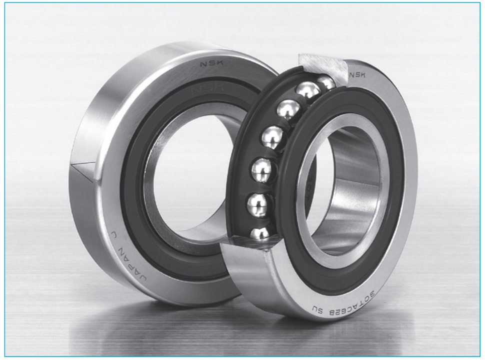


Fig. 3.43 **Ball screw support bearings** **Page B407**
NSKTAC C Series, NSKTAC 03 Series

Ball Screws

B-1-4 Procedures to Select Ball Screw

B-1-4.1 Flow Chart for Selection

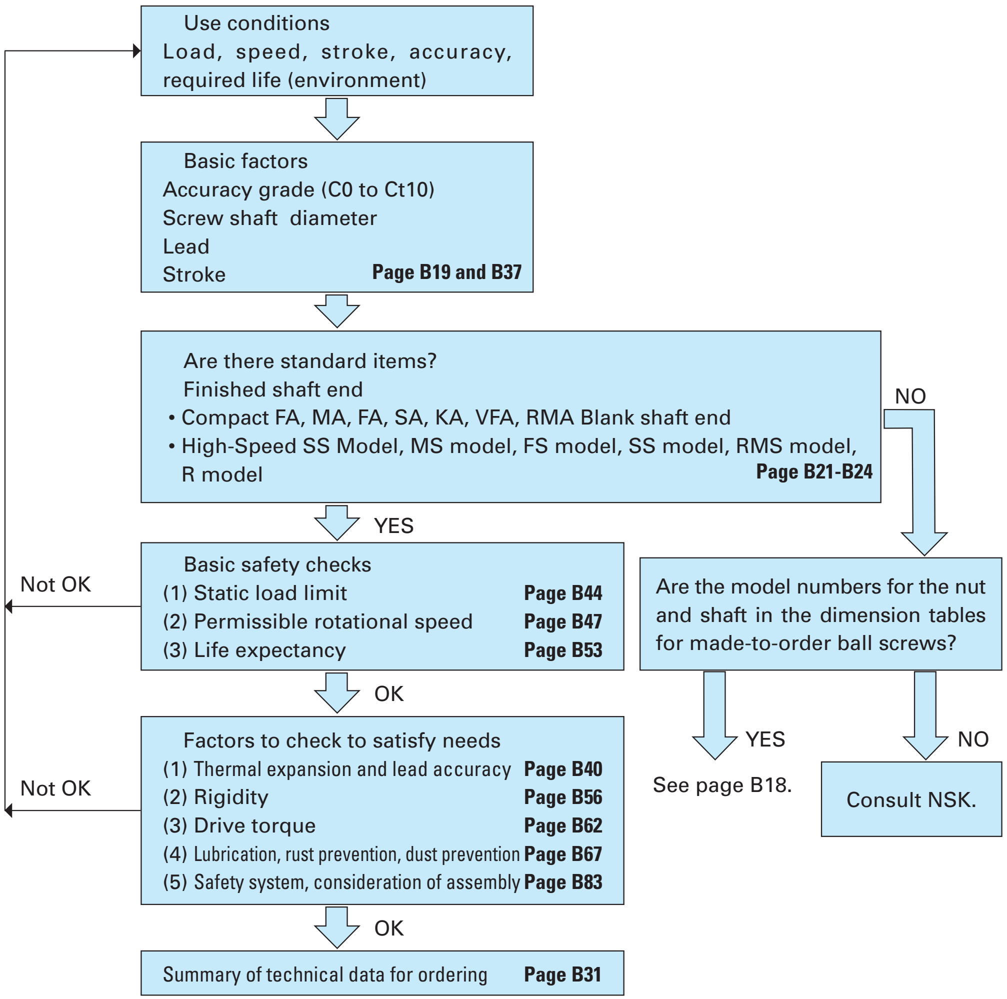
Selecting a ball screw requires a review of use conditions and requirements such as applied load, stroke, positioning accuracy, required life, and the operating environment.

These factors are often at odds, so we recommend a multifaceted approach to selection.

(1) Standard ball screw

The chart below is one selection procedure. To take advantage of prompt delivery and reasonable prices, this procedure focuses on standardized ball screws.

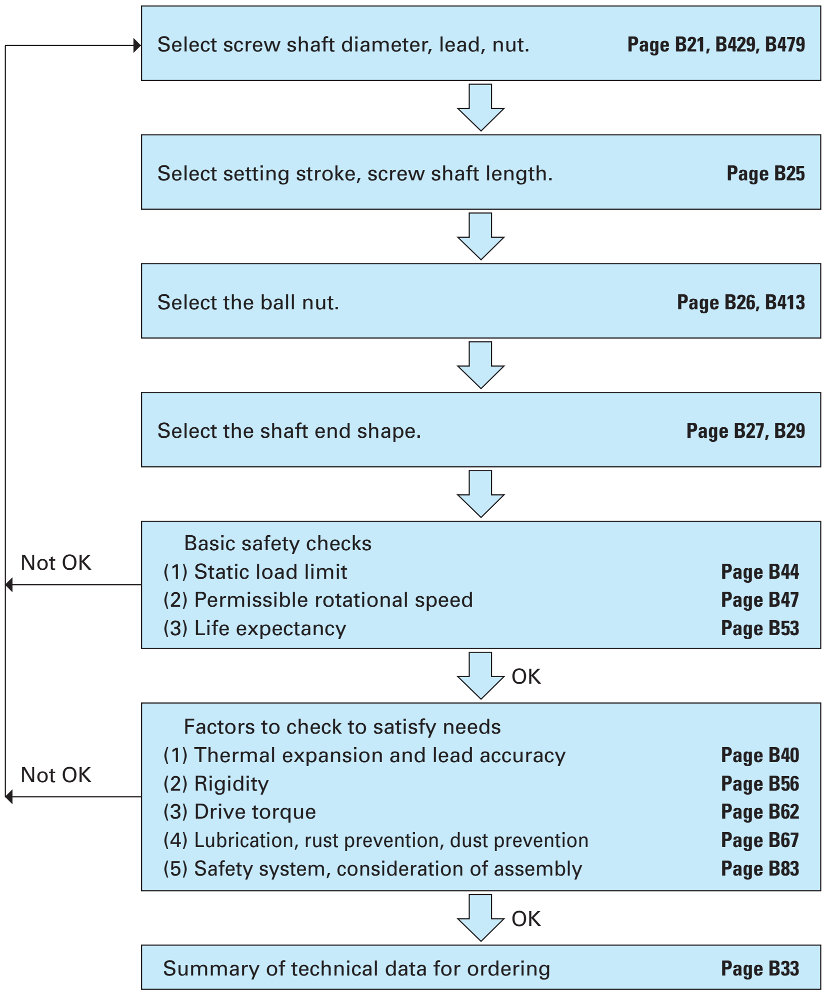
NSK offers a ball screw selection program and a service to select appropriate items using data compiled by our knowledge and experience.



(2) Made-to-order ball screws

Dimensions and specifications can be decided individually for application-oriented ball screws and standard nut ball screws. Procedures are as follows. Refer to the selection exercises on page B87.

Table 4.4 shows combinations of screw shaft diameter and leads for basic ball screws. Please consult NSK if you require types not listed in the table.



B-1-4.2 Accuracy Grades

Table 4.1 shows examples of how to select accuracy grade for a specific use. These practical cases are based on NSK's experience. The circles indicate the range of the accuracy grade in actual use. The double circles indicate accuracy grades most frequently used among the cases marked with the single circle. These symbols help to select the accuracy grade of ball screws temporarily. To confirm whether a specific ball screw accuracy grade satisfies requirements in positioning accuracy in actual use, refer to "Technical Description" and "Mean travel deviation and travel variation." (page B38)

Table 4.1 Applications for ball screws by accuracy grade

Application		NC machine tools																			
		Lathes		Milling machines Boring machines		Machining centers		Drilling machines		Jig boring machines		Grinders		Electric discharge machines		Wire cuttings Electric discharge machines		Punch presss	Laser cutting machines		Woodworking machines
Axis		X	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	XY	Z	
Accuracy grade	C0	○								○	○	○									
	C1	○		○		○				◎	◎	○	○	○		○	○				
	C2	○		○	○	○	○					◎	○	○	○	◎	○				
	C3	◎	○	◎	○	○	○	○					◎	◎	◎	◎	◎	○	○	○	
	C5	◎	◎	◎	◎	◎	◎	◎	◎						◎		○	◎	◎	◎	◎
	Ct7								○												◎
	Ct10																				○

Application		General industrial machines, Machines for specific use	Semiconductor/associated industry						Industrial robots					Steel mills equipment	Plastic injection molding machines	Three-dimensional coordinate measuring machines	Office machines	Image processing equipment	Nuclear power		Aircraft
			Lithographic machines	Chemical processing equipment	Wire bonders	Probers	Electric component mounted devices	Printed circuit board drilling machines	Cartesian		Articulate		SCARA						Fuel rod controls	Mechanical snubbers	
									Assembly	other purposes	Assembly	other purposes									
Accuracy grade	C0		○			○										○		○			
	C1		◎		◎	◎		○								◎		◎			
	C2				○	◎	○	○	○							○					
	C3	○		○			○	◎	○		○		○						○		○
	C5	◎		○			◎	○	◎	○	◎	○	○		○		○		◎		◎
	Ct7	◎		◎					○	◎	○	◎	◎	○	◎		◎		○	◎	
	Ct10	○		○						○				◎	○		○			○	

B-1-4.3 Axial Play

Table 4.2 indicates the combinations of NSK ball screw accuracy grades and axial play. Select an axial play which satisfies the required accuracy in backlash, positioning, and repeatability. Ranges of available ball thread effective lengths in relation to accuracy grade and axial play are shown in **Table 4.3**. Please note that if the effective length exceeds the range, the axial play may become partially negative (preloaded condition).

For the axial play of Ct10 grade (ball screws for transfer equipment), refer to R model dimension tables.

Table 4.2 Combinations of accuracy grades and axial play

Axial play / Accuracy grade	*Z*	*T*	*S*	*N*	*L*
	0 mm (Preload)	0.005 mm or less	0.020 mm or less	0.050 mm or less	0.3 mm or less
C0	C0Z	C0T	—	—	—
C1	C1Z	C1T	—	—	—
C2	C2Z	C2T	—	—	—
C3	C3Z	C3T	C3S	—	—
C5	C5Z	C5T	C5S	C5N	—
Ct7	—	—	C7S	C7N	—

Codes above are used in NSK reference numbers (designations).

Table 4.3 Maximum effective thread length in combination of accuracy grade and axial play

Unit: mm

Screw shaft diameter	Effective length of the screw thread (maximum)				
	Axial play *T* (0.005 mm or under)		Axial play *S* (0.020 mm or under)		
	C0 – C3	**C5**	**C3**	**C5**	**Ct7**
4 – 6	100	80	100	80	—
8 – 10	250	200	300	250	—
12 – 16	500	400	700	600	500
20 – 25	800	700	1 000	1 000	1 000
28 – 40	1 000	800	2 000	1 500	1 500
45 – 63	1 200	1 000	2 500	2 000	2 000
80 – 125	—	—	4 000	3 000	3 000

Note: Refer to **Table 4.8** (page B25) for the available length of screw shaft (maximum length). Also, axial play of code N does not become partially negative if it is within the available range of effective ball thread length.

B-1-4.4 Screw Shaft Diameter, Lead, and Stroke

Choose a screw shaft diameter and stroke based on the allowable space for ball screw installation. A lead should be set based on the required running speed, and should give some allowance to the maximum rotational speed of the motor.

(1) Standard ball screw

Tables 4.4 and **4.5** show the combinations of ball screw shaft diameter, leads, and range of stroke.

From these tables, select the closest values to the shaft diameter, lead, and stroke which had been selected previously. Confirm detailed specifications and sizes in "Dimension Tables for Standard Ball Screws" (page B105).

Table 4.4 Screw shaft diameter, lead and stroke of standard ball screws

Unit: mm

Shaft dia.	Lead	Stroke																										
		– 50	– 100	– 150	– 200	– 250	– 300	– 350	– 400	– 450	– 500	– 550	– 600	– 650	– 700	– 750	– 800	– 850	– 900	– 950	– 1 100	– 1 200	– 1 300	– 1 400	– 1 500	– 1 700	– 2 100	– 3 000
4	1	○	○△																									
6	1	○	○	○△■	○△	■□																						
	8		●																									
	12		●																									
8	1		○△	○■	○△	■□																						
	1.5		○△	○■	○△	■□																						
	2		○△	○■		■□																						
	10		●																									
	15		●																									
10	2		○	○△	○■	○△	■□																					
	2.5		○	○△	○	○△																						
	4		○	○△	○	○△	○	○△																				
	5		●	●		●		●		●																		
	10			●		●		●		●																		
12	2		○	○	○△■	○	○△■□																					
	2.5		○	○	○△	○	○△																					
	5		●○	●○△	○	●○△	○	●	○	●△	○	●																
	10			●○	○△	●	○✓	●	○△	●	○✓	●																
	20				●		●		●		●		●															
	30			●		●		●		●		●																
14	5			○	○		○	△	○		○		△	○														
	8			○	○	○	○	○	○	○	○△	○	○	○		○	△											
15	5			●	●		●		●		●		●		●													
	10			●○	○	●○	○	●○△✓	○	●○	○	●○△✓	○	●○		●○		●○△✓			●○△							
	20			●○	○	●○	○	●○✓	○△	●○	○	●○✓	○△	●○	●○	●○	●○	●○✓	△		●○△							
	30				●		●		●		●		●		●		●		●		●							
16	2		○	○	○	○△		○	△																			
	2.5		○	○	○	○△		○	△																			
	5			○		○		○		○	△			○				○	△									
	16			○	○	○	○	○	○	○	○	○△	○	○		○		○			○△							
20	4				○	○	△	○		○	△	○		○			△											
	5				●○	●○△		●○		●○△		●○		●△		●○		●		△								
	10					●○		●○		●○		●○		●○		●○		●○△		○	●○	○	●○△					
	20					○		○	●	○	●	○	●	○	●	○	●	○	●	○△	●○	○	●		○△	●		
	30					●		●		●		●		●		●		●			●		●					
	40										●○		●		●○		●		●○		●○△		●○			●○△	●	
	60										●		●		●		●				●		●			●	●	
25	4				○	○	△	○		○		○	△			○					△							
	5				●○△	●○△		●○△		●○△		●○△		○		●○△		●△		○	●	○△						
	6							○△				○				○△						○△						
	10						○	△	●		●○	△	●	△	●○	△	●		●○	△	●○△			○	△	●		
	20											●		●	○	●		●	○		●○		●○△		○	●○	●○△	
	25												●		●○		●		●○		●○		●○△		○	●○	●○△	
	30												●		●		●		●		●		●			●	●	
	50												●		●		●○		●		●○		●		△	●○	●○△	
28	5				○	○	○	○△	○	○	○	○△			○	○△			○	○	○	○△						
	6						○	○△			○	○△			○	△			○		○	△						
32	5				○	○	○	○▲△	○	○	○	○▲△	○	○	○	○△		▲△	○	○	○▲	○△		○▲	○△	△		
	6						○	○			○	○△			○	○			○	○△	○	○		○	○△			
	8						○				○	△			○				○	△				○	△			
	10				○		○	▲△	○△		○	▲△	○△		○		○	△	○▲△		○		○▲△	○		○▲△		
	25																				○					○△	○	○△
	32																				○					○△	○	○△
36	10						○		○		○	△	○△				○		○		△	○	○			○△	△	
40	5						○				○	△			○				○	△	○				○	△		
	8					○				○			△	○				○			○△				○	△		
	10						○		○	▲	○	△	○△		○		○	△	○▲△		○	○	○△	○	○▲	○△		○▲△
	12										○		○				○△	▲△	○△			○	○	▲△	△	○		○▲△
	16																		▲						▲			▲
	20																	▲						▲				▲
45	10												○						○▲△				○		▲△	○		○▲△
50	10									○	○		△	○	○			○△	○▲△		○		▲	○△		▲	○△	○▲△
	12																	▲						▲				▲

Note: See Table for stainless steel KA models.

Table 4.5 Screw shaft diameter, lead and stroke of stainless steel KA models

Unit: mm

Shaft dia.	Lead	Stroke								
		– 150	– 200	– 250	– 300	– 350	– 450	– 500	– 650	– 1 050
6	1	●								
8	1		●							
	2		●							
10	2			●						
	4	●				●				
12	2	●			●					
	5			●				●		
	10				●			●		
15	10						●		●	●
	20						●		●	●
16	2	●				●				
20	20						●		●	●

Key:

●: PSS, USS, FSS models; ○: MA, FA, SA models; △: MS, FS, SS models;

▲: HSS model; ✓: VFA model; ■: RMA model; □: RMS model

Table 4.6 Screw shaft diameter, lead and standard screw shaft length of R model Unit: mm

Screw shaft diameter	Lead	Standard screw shaft length									
		400	500	800	1 000	1 500	2 000	2 500	3 000	4 000	5 000
10	3	●		●							
	6	●		●							
12	8	●		●							
	12	●		●							
14	4		●		●						
	5		●		●						
15	20		●		●	●					
16	10		●		●	●					
	16		●		●	●					
	32		●		●	●					
18	8		●		●	●					
20	5		●		●		●				
	10		●		●		●				
	20		●		●		●				
	40		●		●	●	●				
25	5				●		●	●			
	10				●		●	●			
	25				●		●	●			
	50				●		●	●			
28	6				●		●	●			
32	10				●		●		●		
	32				●		●		●		
	64				●		●		●	●	
36	10				●		●		●		
40	10						●		●	●	
	40						●		●	●	
	80						●		●	●	●
45	12						●		●	●	
50	10						●		●	●	
	16						●		●	●	
	50						●		●	●	

B-1-4.5 Manufacturing Capability for Screw Shafts

Table 4.8 shows the manufacturing capability for the screw shaft overall length for each accuracy grade. The capability of large ball screws whose shaft diameter exceeds 100 mm is limited due to weight (indicated by ∗ asterisks in the table). Please consult NSK in such cases.

Also consult NSK if the screw shaft size you desire exceeds the size listed in **Table 4.8**.

Table 4.8 Manufacturing capability for screw shafts

Unit: mm

Accuracy grade / Screw shaft diameter	C0	C1	C2	C3	C5	Ct7	Ct10
4	90	110	120	140	140	140	—
6	150	180	200	250	250	250	—
8	240	280	340	340	340	340	—
10	350	400	500	500	500	550	800
12	450	500	650	700	750	800	800
14	600	650	750	800	1 000	1 000	1 000
15	600	700	800	900	1 250	1 250	1 500
16	600	750	900	1 000	1 500	1 500	1 500
18	—	—	—	—	—	—	1 500
20	850	1 000	1 200	1 400	1 900	1 900	2 000
25	1 100	1 400	1 600	1 900	2 500	2 500	2 500
28	1 100	1 400	1 600	1 900	2 500	2 500	2 500
32	1 500	1 750	2 250	2 500	3 200	3 200	3 000 (4 000)
36	1 500	1 750	2 250	2 500	3 200	3 500	3 000
40	2 000	2 400	3 000	3 400	3 800	4 300	4 000 (5 000)
45	2 000	2 400	3 000	3 400	4 000	4 500	4 000
50	2 000	3 200	4 000	4 500	5 000	5 750	4 000
55	2 000	4 000	5 000	5 800	6 000	6 000	—
63	2 000	4 000	5 000	6 000	6 800	7 700	—
80	—	4 000	6 300	8 200	9 200	10 000	—
100	—	4 000	6 300	10 000	12 500	13 500	—
∗120	—	—	—	—	—	13 500	—
∗125	—	—	—	10 000	13 500	13 500	—
∗140	—	—	—	—	—	10 000	—
∗160	—	—	—	—	—	8 000	—
∗200	—	—	—	—	—	5 000	—

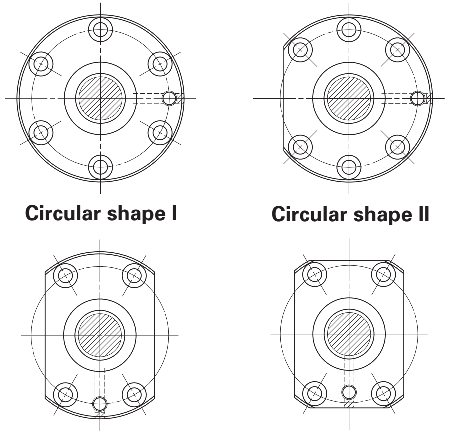
Notes: 1. Values in parentheses of Ct10 are applicable to the ultra high helix lead (l/d≥2). Refer to dimension tables on B373 and following pages for details.

2. Please note that small leads (3 mm or under) are also limited by screw length.

B-1-4.6 Outside Shapes of Ball Nuts

(1) Flange shape

Fig. 4.1 shows the available flange shapes. Select the appropriate shape according to the nut installation conditions. (**Fig. 4.2**)



Circular shape I **Circular shape II**

Circular shape III **Rectangular shape**

Fig. 4.1 Flange shape

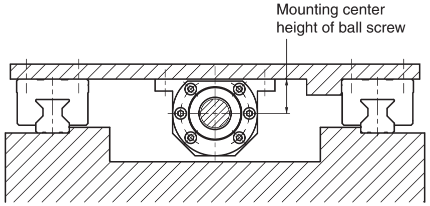


Fig. 4.2 Installation example

(2) Shapes of nut cross section

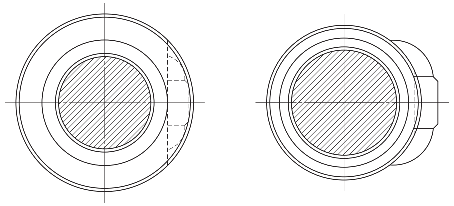
Cross-sections of nuts are shown in **Fig. 4.3**. For detailed dimensions, refer to dimension tables.

① **Circular (round)**

The ball recirculation components are contained inside the circumference of the nut. It can be inserted in a round hole.

② **Tube-projecting type**

This shape is unique to the tube recirculation type. The nut outside diameter is small. However some recess must be given for the housing because the ball recirculation tube protrudes from the circumference of the nut.



Circular (round) **Tube-projecting type**

Fig. 4.3 Shape of the cross section of nut

B-1-4.7 Shaft End Configuration

(1) Standard shaft end dimensions

Tables 4.9 and **4.10** show shaft end types for NSK standard support units.
Refer to the dimension tables below when designing shaft ends of standard ball screws.

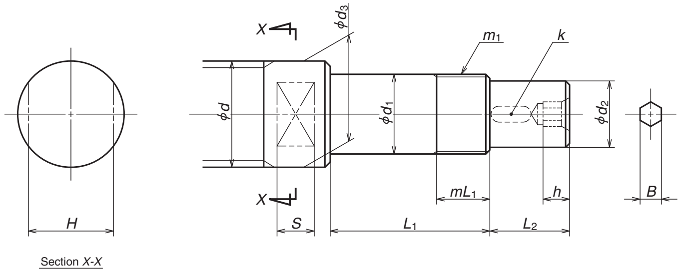


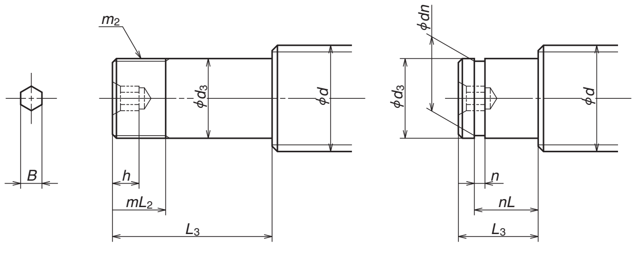
Fig. 4.4 Configuration of standard shaft end (drive side)

Table 4.9 Dimensions of shaft ends (drive side)

Unit: mm

Screw shaft diameter	Bearing journal		Thread		Drive section			Seal section	Hexagon hole		Wrench flats		Support unit	
	Outside diameter	Length	Nominal spec.	Length	Outside diameter	Length	Key width	Outside diameter	Width across flats	Depth	Width across flats	Length		
d	d_1	L_1	m_1	mL_1	d_2	L_2	k	d_3	B	h	H	S	Reference No.	
4	6	22.5	M6×0.75	7	4.5	7.5	—	9.5	—	—	8	4.5	WBK06-01A	WBK06-11
6	6	22.5	M6×0.75	7	4.5	7.5	—	9.5	—	—	8	4.5	WBK06-01A	WBK06-11
8	8	27	M8×1	9	6	10	—	11.5	—	—	10	5.5	WBK08-01A	WBK08-11
10	8	27	M8×1	9	6	10	—	11.5	—	—	10	5.5	WBK08-01A	WBK08-11
12	10	30	M10×1	10	8	15	—	14	—	—	12	6.5	WBK10-01A	WBK10-11
14	12	30	M12×1	10	10	15	3	15	4	6	12	6.5	WBK12-01A	WBK12-11
15	12	30	M12×1	10	10	15	3	15	4	6	12	6.5	WBK12-01A	WBK12-11
16	12	30	M12×1	10	10	15	3	15	4	6	12	6.5	WBK12-01A	WBK12-11
20	15	40	M15×1	15	12	20	4	19.5	5	7	17	8.5	WBK15-01A	WBK15-11
	17	81	M17×1	23	12	29	4	20	5	7	17	10	WBK17DF-31H	
25	20	53	M20×1	16	15	27	5	25	6	8	22	10	WBK20-01	WBK20-11
	20	81	M20×1	23	15	39	5	25	6	8	22	10	WBK20DF-31H	
28	20	53	M20×1	16	15	27	5	25	6	8	22	10	WBK20-01	WBK20-11
	20	81	M20×1	23	15	39	5	28	6	8	24	12	WBK20DF-31H	
32	25	62	M25×1.5	20	20	33	6	32	8	10	27	12	WBK25-01W	WBK25-11
	25	89	M25×1.5	26	20	51	6	32	8	10	27	12	WBK25DF-31H	
	25	104	M25×1.5	26	20	51	6	32	8	10	27	12	WBK25DFD-31H	
36	30	89	M30×1.5	26	25	61	8	36	10	12	30	13	WBK30DF-31H	
	30	104	M30×1.5	26	25	61	8	36	10	12	30	13	WBK30DFD-31H	
40	30	89	M30×1.5	26	25	61	8	40	10	12	—	—	WBK30DF-31H	
	30	104	M30×1.5	26	25	61	8	40	10	12	—	—	WBK30DFD-31H	
45	35	92	M35×1.5	30	30	63	8	45	12	14	—	—	WBK35DF-31H	
	35	107	M35×1.5	30	30	63	8	45	12	14	—	—	WBK35DFD-31H	
50	40	92	M40×1.5	30	35	78	10	50	14	18	—	—	WBK40DF-31H	
	40	107	M40×1.5	30	35	78	10	50	14	18	—	—	WBK40DFD-31H	

Note: Low-profile support units are available for the compact FA model.



Shape Ⅰ **Shape Ⅱ**

Fig. 4.5 Standard shaft end configuration (opposite the drive side)

Table 4.10 Dimensions of shaft ends (opposite the drive side)

Unit: mm

Screw shaft diameter	Shape	Bearing journal		Thread for lock nut		Retainer ring groove			Hexagonal hole		Support unit Reference No. Numbers in parentheses are bearing designations	
		Outside diameter	Length	Nominal spec.	Length	Width	Groove diameter	Groove position	Width across flats	Depth		
d		d_3	L_3	m_2	mL_2	n	dn	nL	B	h		
8	Ⅱ	6	9	—	—	0.8	5.7	6.8	—	—	WBK08S-01	
10	Ⅱ	6	9	—	—	0.8	5.7	6.8	—	—	WBK08S-01	
12	Ⅱ	8	10	—	—	0.9	7.6	7.9	—	—	WBK10S-01	
14	Ⅱ	10	22(12)	—	—	1.15	9.6	9.15	4	6	WBK12S-01	
15	Ⅱ	10	22(12)	—	—	1.15	9.6	9.15	4	6	WBK12S-01	
16	Ⅱ	10	22(12)	—	—	1.15	9.6	9.15	4	6	WBK12S-01	
20	Ⅱ	15	25(13)	—	—	1.15	14.3	10.15	5	7	WBK15S-01	
25	Ⅱ	20	19	—	—	1.35	19	15.35	6	8	WBK20S-01	
	Ⅰ	20	53	M20×1	16	—	—	—	6	8	WBK20-01	WBK20-11
	Ⅰ	20	81	M20×1	23	—	—	—	6	8	WBK20DF-31H	
28	Ⅱ	20	19	—	—	1.35	19	15.35	6	8	WBK20S-01	
	Ⅰ	20	53	M20×1	16	—	—	—	6	8	WBK20-01	WBK20-11
	Ⅰ	20	81	M20×1	23	—	—	—	6	8	WBK20DF-31H	
32	Ⅱ	25	20	—	—	1.35	23.9	16.35	8	10	WBK25S-01W	
	Ⅰ	25	62	M25×1.5	20	—	—	—	8	10	WBK25-01W	WBK25-11
	Ⅰ	25	89	M25×1.5	26	—	—	—	8	10	WBK25DF-31H	
36	Ⅱ	25	20	—	—	1.35	23.9	16.35	10	12	(6205)	
	Ⅰ	25	89	M25×1.5	26	—	—	—	10	12	WBK25DF-31H	
40	Ⅱ	30	22	—	—	1.75	28.6	17.75	10	12	(6206)	
	Ⅰ	30	89	M30×1.5	26	—	—	—	10	12	WBK30DF-31H	
45	Ⅱ	35	25	—	—	1.75	33	18.75	12	14	(6207)	
	Ⅰ	35	92	M35×1.5	30	—	—	—	12	14	WBK35DF-31H	
50	Ⅱ	40	25	—	—	1.95	38	19.95	14	18	(6208)	
	Ⅰ	40	92	M40×1.5	30	—	—	—	14	18	WBK40DF-31H	

(2) Shaft end configuration of R model ball screws for transfer equipment

Tables 4.11 and **4.12** show shaft end types for the R model.

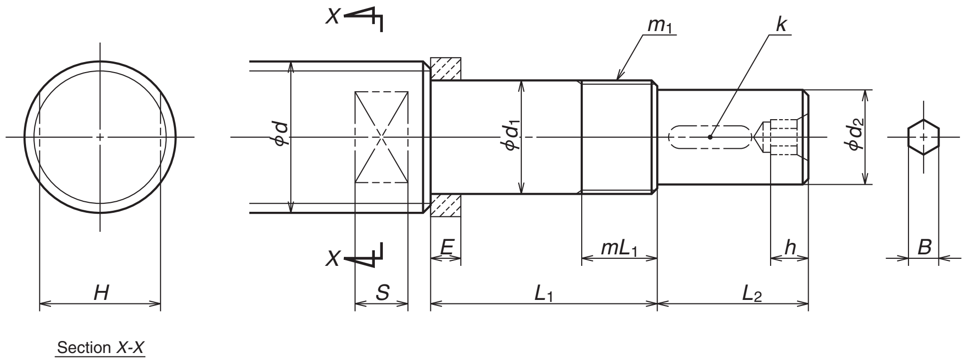


Fig. 4.6 R Model shaft end (drive side)

Table 4.11 Dimensions of R model shaft ends (drive side)

Unit: mm

Screw shaft diameter	Bearing journal		Thread for lock nut		Spacer	Drive section			Hexagonal hole		Wrench flat		Support unit	
	Outside diameter	Length	Nominal spec	Length	Width	Outside diameter	Length	Key width	Width across flats	Depth	Width across flats	Length		
d	d_1	L_1	m_1	mL_1	E	d_2	L_2	k	B	h	H	S	Reference No.	
10	6	27	M6×0.75	7	5.0	4.5	7.5	—	—	—	8	4.5	WBK06-01A	WBK06-11
12	8	32	M8×1	9	5.5	6	10	—	—	—	10	5.5	WBK08-01A	WBK08-11
14	10	35	M10×1	10	5.5	8	15	—	—	—	12	6.5	WBK10-01A	WBK10-11
15	10	35	M10×1	10	5.5	8	15	—	—	—	12	6.5	WBK10-01A	WBK10-11
16	12	35	M12×1	10	5.6	10	15	3	4	6	12	6.5	WBK12-01A	WBK12-11
18	12	35	M12×1	10	5.6	10	15	3	4	6	12	6.5	WBK12-01A	WBK12-11
20	15	50	M15×1	15	10	12	20	4	5	7	17	8.5	WBK15-01A	WBK15-11
25	17	53	M17×1	17	7	15	27	5	6	8	22	10	WBK17-01A	—
	20	64	M20×1	16	11	15	27	5	6	8	22	10	WBK20-01	WBK20-11
28	20	64	M20×1	16	11	15	27	5	6	8	22	10	WBK20-01	WBK20-11
32	25	76	M25×1.5	20	14	20	33	6	8	10	27	12	WBK25-01W	WBK25-11
36	25	76	M25×1.5	20	14	20	33	6	8	10	27	12	WBK25-01W	WBK25-11
40	30	89	M30×1.5	26	—	25	61	8	10	12	—	—	WBK30DF-31H	
45	35	92	M35×1.5	30	—	30	63	8	12	14	—	—	WBK35DF-31H	
50	35	92	M35×1.5	30	—	30	63	8	12	14	—	—	WBK35DF-31H	

Note: The dimension d_1 must be smaller than the minor diameter of the ball screw thread to provide sufficient shoulder surface for the spacer.
Refer to "Precautions for Designing Ball Screws (page B83)".

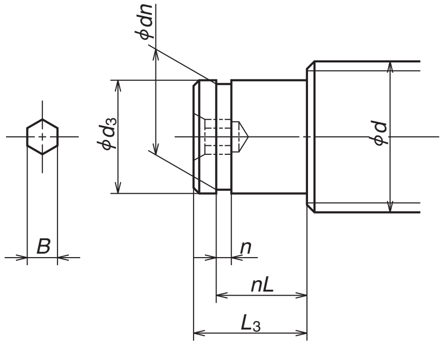


Fig. 4.7 Shaft end configuration of R model (opposite the drive side)

Table 4.12 Dimensions of R model shaft ends (opposite the drive side)

Unit: mm

Screw shaft diameter	Bearing journal		Retaining ring groove			Hexagonal hole		Support unit
	Outside diameter	Length	Width	Groove diameter	Groove position	Width across flats	Depth	Numbers in parentheses are bearing designations.
d	d_3	L_3	n	dn	nL	B	h	
10	6	9	0.8	5.7	6.8	—	—	WBK08S-01(606)
12	8	10	0.9	7.6	7.9	—	—	WBK10S-01(608)
14	10	12	1.15	9.6	9.15	4	6	WBK12S-01(6000)
15	10	12	1.15	9.6	9.15	4	6	WBK12S-01(6000)
16	10	12	1.15	9.6	9.15	4	6	WBK12S-01(6000)
18	10	12	1.15	9.6	9.15	4	6	WBK12S-01(6000)
20	15	13	1.15	14.3	10.15	5	7	WBK15S-01(6002)
25	17	16	1.15	16.2	13.15	6	8	WBK17S-01(6203)
	20	19	1.35	19	15.35	6	8	WBK20S-01(6204)
28	20	19	1.35	19	15.35	6	8	WBK20S-01(6204)
32	25	20	1.35	23.9	16.35	8	10	WBK25S-01W(6205)
36	25	20	1.35	23.9	16.35	8	10	WBK25S-01W(6205)
40	30	22	1.75	28.6	17.75	10	12	(6206)
45	35	23	1.75	33	18.75	12	14	(6207)
50	35	23	1.75	33	18.75	12	14	(6207)

B-1-5 When Placing Orders

To avoid confusion, please use "reference numbers" or provisional reference numbers when inquiring about desired ball screw specifications.

◇ **Reference Number (Ref. No.)**

Alphanumeric codes are assigned to each ball screw. When placing orders, please use this reference number.

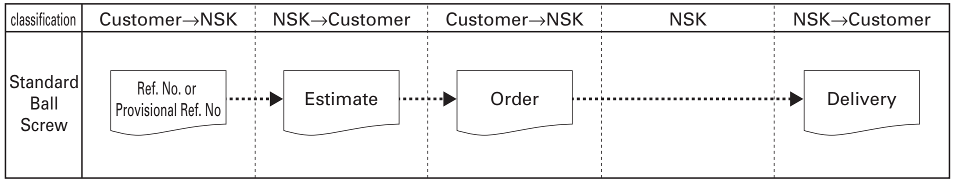
◇ **Provisional Ref. No.:**

Specification factors are identified by alpha-numeric codes. Codes allow for easy explanation of your requirements. (If you do not use these numbers, please itemize your requirements.)

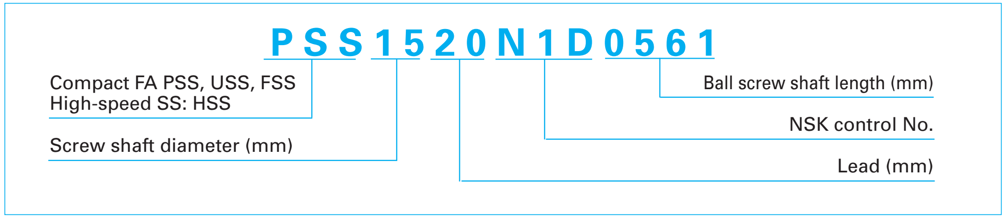
B-1-5.1 When Ordering Standard Ball Screws

Find the reference number from the dimension tables. Enter the reference number in the "Order Form" (page B34). Send this form to your local NSK agency (branch office, sales office, or your local representative.).

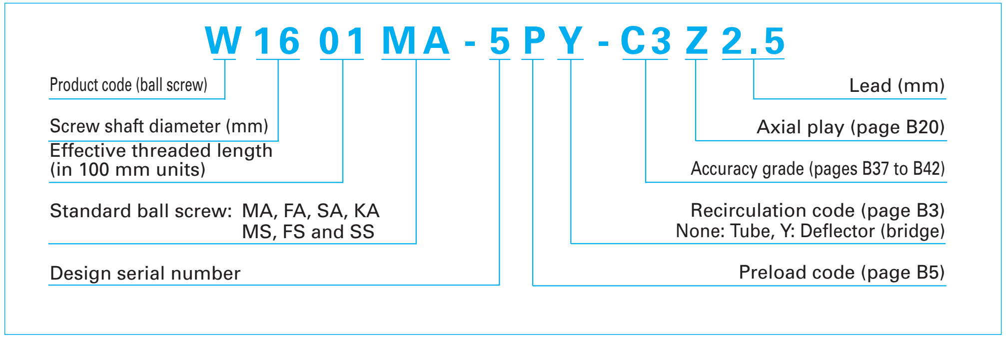
The following shows a flowchart for ordering standard ball screws.



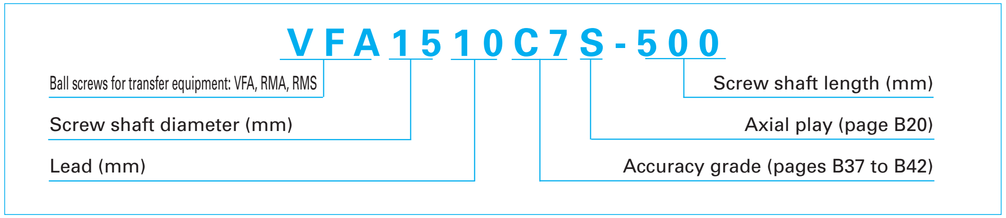
(1) Example reference number standard compact FA model and high-speed SS (HSS) model



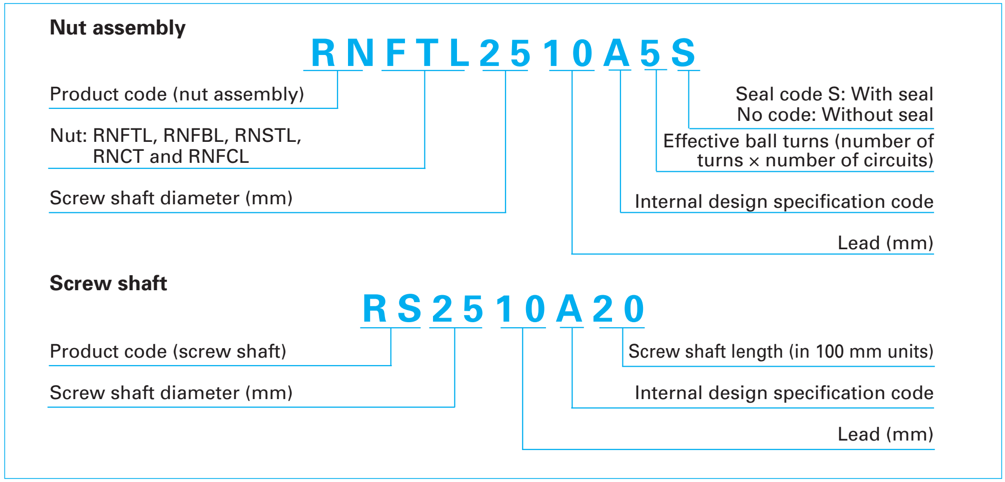
(2) Example reference number for standard ball screws



(3) Example reference number of ball screws for transfer equipment with finished shaft ends or blank shaft ends



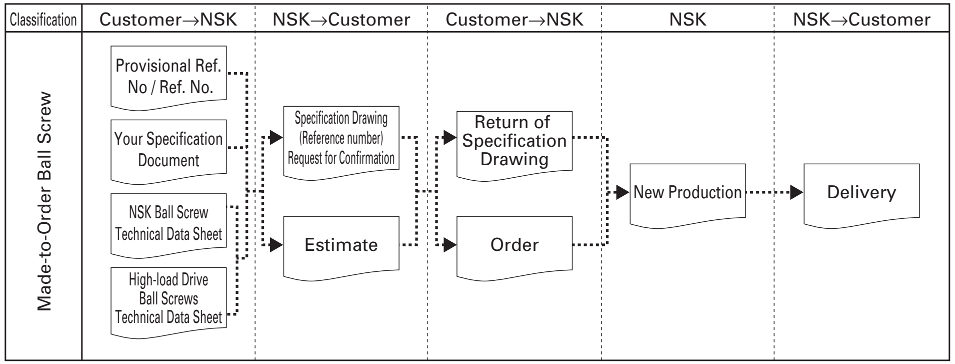
(4) Example reference number of R model ball screws for transfer equipment



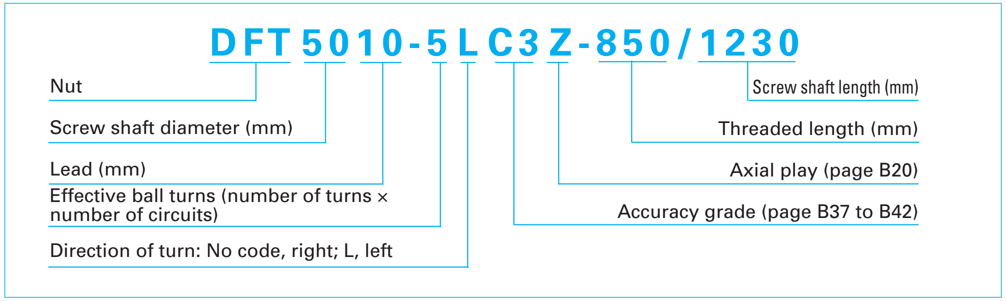
B-1-5.2 When Ordering Made-to-Order Ball Screws

If you would like to discuss technical points regarding specifications, use the NSK ball screw technical data sheet as an aid (page B36). For high-load drive ball screws, use the technical sheet on page B513 for NSK high-load drive ball screws.

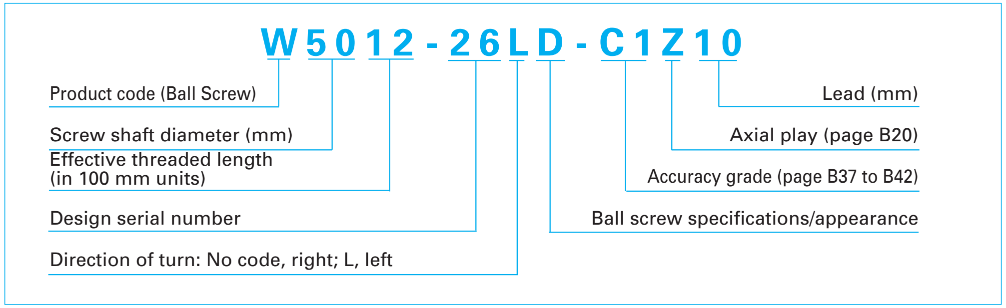
The following shows a flowchart for ordering made-to-order ball screws.



(1) Example of specification number of made-to-order ball screw



(2) Example reference number of made-to-order ball screw



Order Form

(Make copies for future orders)

(1) Standard ball screw

Company name :

Date: Day Month Year

Address :

Telephone :

Name of Contact Person :

Section :

Product name	Provisional Ref. No / Ref. No.	Quantity	Desired delivery date
Precision ball screw			
R model ball screw Nut			
R model ball screw Screw shaft			
Support unit			
Lock nut			
Grease unit			

Describe the shaft end configuration if processing is required (blank shaft end ball screws) and specify which ball screw(s) must be processed.

Refer to pages B27 to B30 for shaft end configurations. These pages also show reference numbers for support units.

Drive side

Opposite drive side

NSK Ball Screw Technical Data Sheet (example)

(2) Made-to-order ball screw

Company name
Date: Day Month Year
Address
Telephone
Contact person
Section
Machine *Machining center Model MC-*
Application *Table left/right movement (X axis)*
Drawing/rough sketch attached? Yes [✓ No]

Use conditions

	Axial load	Rotational speed	Operating hours		
Maximum load	*9 000* N	*20* min^{-1}	*15* %	Operating conditions	[✓ Shaft rotation - Moving nut] [✓ Normal operation] Shaft rotation - Moving shaft Back drive operation Nut rotation - Moving nut Nut rotation - Moving shaft Oscillation
Load in normal use	*4 000* N	*360* min^{-1}	*60* %		
Minimum load	*2 000* N	*1 000* min^{-1}	*25* %	Degree of vibration shock	*Normal*
Maximum rotational speed	*1 000* min^{-1}			Required life	*20 000h*
Lubricant	Grease/oil (Brand name: *NSK GRS AS2* Maker:)			Motor in use	*Company A, Model 1*
Seal	Yes	No		Control system	*Company B, Model 2* (resolution:*1μm*)
Support bearing	Drive side *35TAC62DF*			Opposite drive side	*35TAC62DF*
Guide way	[✓ Rolling] Sliding (*RA451500GM2-P4Z3-Ⅱ*)				
Environment	Temperature (Normal temperature in degrees Celsius) Dust Humidity Gas Liquid (where?) Cleanroom In vacuum				
Schedule for prototype	Day	Month	Year (approx.)	Quantity used	Piece
Production start/ quantity	/Month	/Year	/Lot	per machine	

Specifications

Screw shaft diameter	*50 mm*	Direction of turn	*right*	Accuracy grade	*C2*	Screw shaft length	*880 mm*	Preload	*3000 N*
Lead	*10 mm*	Effective ball turns		Axial play	*0 mm*	Overall shaft length	*1 335 mm*	Required torque	
Nut model	ZFT5010-10		Flange type	*Circular I*		Nut orientation	Same as shown in the dimension table		Opposite

Supplemental explanation/requests

NSK Ball Screw Technical Data Sheet

(2) Made-to-order ball screw

Company name
Date: Day Month Year
Address
Telephone
Contact person
Section
Machine
Application
Drawing/rough sketch attached? Yes No

Use conditions

	Axial load	Rotational speed	Operating hours		
Maximum load	N	min^{-1}	%	Operating conditions	Shaft rotation - Moving nut Normal operation Shaft rotation - Moving shaft Back drive operation Nut rotation - Moving nut Nut rotation - Moving shaft Oscillation
Load in normal use	N	min^{-1}	%		
Minimum load	N	min^{-1}	%	Degree of vibration shock	
Maximum rotational speed	min^{-1}			Required life	
Lubricant	Grease/oil (Brand name: Maker:)			Motor in use	
Seal	Yes	No		Control system	(resolution:)
Support bearing	Drive side			Opposite drive side	
Guide way	Rolling Sliding ( )				
Environment	Temperature (Normal temperature in degrees Celsius) Dust Humidity Gas Liquid (where?) Cleanroom In vacuum				
Schedule for prototype	Day	Month	Year (approx.)	Quantity used	Piece
Production start/ quantity	/Month	/Year	/Lot	per machine	

Specifications

Screw shaft diameter		Direction of turn		Accuracy grade		Screw shaft length		Preload	
Lead		Effective ball turns		Axial play		Overall shaft length		Required torque	
Nut model			Flange type			Nut orientation	Same as shown in the dimension table		Opposite

Supplemental explanation/requests

B-2 Technical Description of Ball Screws

B-2-1 Accuracy

B-2-1.1 Lead Accuracy

The lead accuracy of NSK precision ball screws (C0 to C5 grades) conforms to the four characteristics specified in JIS Standards. These characteristics are expressed by *ep*, υ_u, υ_{300}, and $\upsilon_{2\pi}$.

Fig.1.1 explains the definition of each characteristic and shows allowable values of each. Leads are classified into two categories: the C system for positioning and the Ct system for transportation. **Tables 1.2**, **1.3** and **1.4** show tolerance of each characteristic.

JIS B1192 sets C type and Cp type standards for positioning ball screws. NSK uses the specification of C type only. JIS B1192 specifies Ct1, 3, and 5 grade. NSK standards are integrated by C type only. Refer to **Table 1.2** for C type standard tolerance.

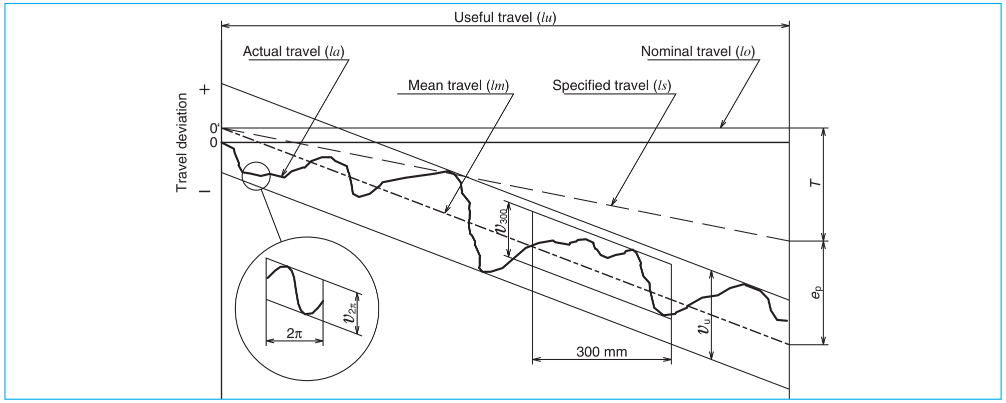


Fig. 1.1 Definition of lead accuracy

Table 1.1 Terminology in lead accuracy

Term	Code	Description	Tolerance
Specified travel	*ls*	The travel compensating the nominal travel for elongation caused by an increase of temperature or load.	
Travel compensation	*T*	Value obtained by subtracting the specified travel from the nominal travel based on the useful travel. The value is to compensate for errors caused by thermal deformation or deformation by load.This value is determined by tests and experience (see page B39).	
Actual travel	*la*	Actually measured travel	
Actual mean travel	*lm*	A straight line that demonstrates the direction of actual travel. This straight line is obtained from the curve that shows actual travel volume by the least-squares method or by approximation.	
Tolerance on specified travel	*ep*	Obtained by subtracting the specified travel from the actual mean travel.	**Table 1.2**
Travel variation	υ_u υ_{300} $\upsilon_{2\pi}$	Maximum range of the actual travel which is between the two straight lines drawn parallel to the actual mean travel. There are three categories as shown below. • Maximum range relative to the effective length of thread. • Maximum range relative to the length of 300 mm anywhere within the effective length of thread. • Maximum range which corresponds to any single rotation (2π *rad.*) within the effective length of thread.	**Table 1.2** **Table 1.3, 1.4** **Table 1.3**

Table 1.2 Tolerance on specified travel (±*ep*) and travel variation (υ_u) of positioning (*C* type) ball screws

Unit: μm

Accuracy grade			C0		C1		C2		C3		C5	
	over	or less	±*ep*	υ_u	±*ep*	υ_u	±*ep*	υ_u	±*ep*	υ_u	±*ep*	υ_u
Effective thread length, mm	–	100	3	3	3.5	5	5	7	8	8	18	18
	100	200	3.5	3	4.5	5	7	7	10	8	20	18
	200	315	4	3.5	6	5	8	7	12	8	23	18
	315	400	5	3.5	7	5	9	7	13	10	25	20
	400	500	6	4	8	5	10	7	15	10	27	20
	500	630	6	4	9	6	11	8	16	12	30	23
	630	800	7	5	10	7	13	9	18	13	35	25
	800	1 000	8	6	11	8	15	10	21	15	40	27
	1 000	1 250	9	6	13	9	18	11	24	16	46	30
	1 250	1 600	11	7	15	10	21	13	29	18	54	35
	1 600	2 000			18	11	25	15	35	21	65	40
	2 000	2 500			22	13	30	18	41	24	77	46
	2 500	3 150			26	15	36	21	50	29	93	54
	3 150	4 000			30	18	44	25	60	35	115	65
	4 000	5 000					52	30	72	41	140	77
	5 000	6 300					65	36	90	50	170	93
	6 300	8 000							110	60	210	115
	8 000	10 000									260	140
	10 000	12 500									320	170

Table 1.3 Tolerance of travel variation relative to 300 mm (υ_{300}) and one revolution ($\upsilon_{2\pi}$) of positioning (*C* type) ball screws

Unit: μm

Accuracy grade	C0	C1	C2	C3	C5
υ_{300}	3.5	5	7	8	18
$\upsilon_{2\pi}$	2.5	4	5	6	8

Note: ▨ = JIS B1192 standards. Values in other areas are NSK standards.

Table 1.4 Travel variation (υ_{300}) relative to 300 mm of transport (*Ct* type) ball screws

Unit: μm

Accuracy grade	Ct7	Ct10
υ_{300}	52	210

Note: Tolerance on specified travel (*ep*) of transport (*Ct* type) ball screws is calculated as follows.

$$ep = \pm \frac{lu}{300} \times \upsilon_{300}$$

lu: Effective length of the screw thread

Example selection of lead accuracy

<Use Conditions>

Model No.: ZFT4010-10

Stroke: 1 000 mm

Positioning accuracy: ±0.035 mm/1 000 mm

<Calculation>

Obtain required lead accuracy of a ball screw under these conditions.

(1) Calculate the length of the thread

Stroke + nut length + margin =1 000 + 193 + 100

=1 293 (mm)···→1 300 mm

(2) Calculate lead accuracy

From **Table 1.2**, obtain the tolerance on specified travel relative to the length of thread (1 300 mm).

C5 ··· ±0.054/1 250 – 1 600

C3 ··· ±0.029/1 250 – 1 600

(3) Determine lead accuracy

Positioning accuracy is: ±ep <±0.035/1 000 mm

Accuracy grade: C3 grade $\pm ep$ = 0.029/length of thread (1 300 mm)

$\upsilon_u = 0.018$

B-2-1.2 Thermal Expansion and Target Value of Specified Travel

(1) Thermal expansion

Thermal expansion of screw shaft induces the degradation of positioning accuracy of ball screws. Thermal expansion of a screw shaft is calculated as follows.

$\Delta L_\theta = \rho \cdot \theta \cdot L$ (mm) ····· 1)

In this formula:

ΔL_θ : Thermal expansion (mm)

ρ : Thermal expansion coefficient(12.0×10^{-6} °C^{-1})

θ : Average temperature rise of screw shaft (Celsius)

L : Length of screw shaft (mm)

The above formula indicates that when the temperature rises one degree Celsius, the screw shaft stretches 12 μm per meter. Ball screws generate more heat when used at high speed. This causes elongation of the screw shaft. Although the ball screw lead is ground high precision, an elongated screw shaft due to high temperature rise may not satisfy required highly accurate positioning.

(2) Countermeasures against temperature rise

Hollow shaft or nut-cooled ball screws are recommended for operation under high-speed and high-precision conditions. Take these countermeasures against temperture rise:

(a) Suppress heat generation.
- Do not apply excessive preload to the ball screw and support bearing.
- Select appropriate lubricant and use it properly.
- Use higher helix ball screw lead to lower rotational speed.

(b) Use forced cooling.
- Feed liquid coolant into the hollow shaft or nut-cooled ball screws. Refer to information on hollow shaft ball screws for high accuracy machine tools in the section for application-oriented ball screws (pages B528 to B536).
- Cool screw shaft surface with lubricant oil or air.

(c) Avoid effects of temperature rise on positioning.
- Warm up the machine at high speed until the temperature rise of ball screw shaft saturates, then maintain it properly.
- Set pre-tension. (**Fig. 1.2**)
- Set the negative (minus) target value of specified travel.
- Employ a closed loop control system.

(3) How to determine specified travel

In general, the specified travel of a ball screw is the same as the nominal travel. However, the specified lead of ball screw is sometimes set to negative (minus) or positive (plus) to adjust expansion by temperature rise during operation, or the elongation/contraction of the screw shaft by external load. For such occasions, specify travel compensation (*T*) when ordering the ball screw.

As an example, **Table 1.5** shows the travel compensation (*T*) for typical NC machine tools.

Table 1.5 Travel compensation (*T*) of specified travel for typical NC machine tools

Unit: mm

Type of machine	Axis	Travel compensation (per 1 m)
NC lathes	X	– 0.02 — – 0.05
	Z	– 0.02 — – 0.03
Machining centers	X, Y	– 0.03 — – 0.04
	Z	Differs by structure

(4) How to determine pre-tension force

In order to absorb thermal expansion, pre-tension can be provided to the screw shaft at the time of installation. In this case, the pre-tension is usually equivalent to the expansion brought about by a temperature rise of 2 to 3°C. **Fig. 1.2** shows the bearing support structure in such occasions.

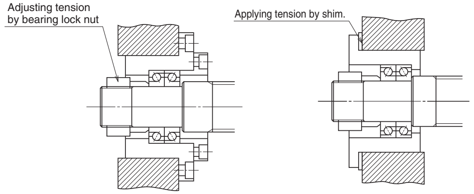


Fig. 1.2 Bearing structure to provide pre-tension

B-2-1.3 Mounting Accuracy and Tolerance of Ball Screws

The accuracy to mount the ball screws is specified by the following seven characteristics (**Fig. 1.3**).

Tolerances are indicated in the specification drawing.

Detailed tolerances are specified by JIS B1192. For reference, **Table 1.6** shows standard values of "(7) Total run-out of the screw shaft axis (straightness of the screw shaft)". NSK sets stricter tolerance standards than JIS standards. For accuracy of ball screw installation, refer to "Installation of Ball Screw (1) Centering of the units" (page B73).

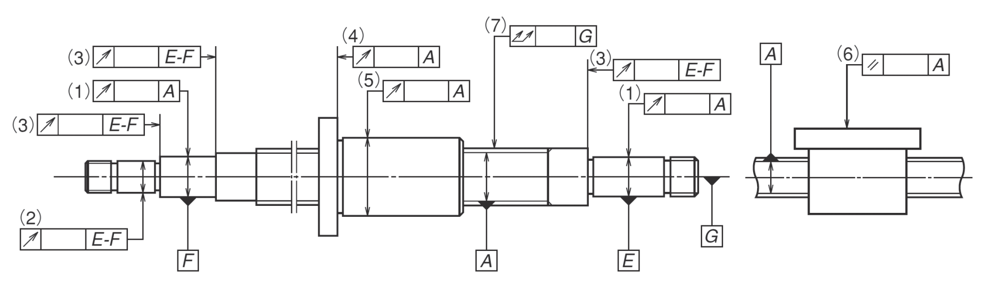


Fig. 1.3 Mounting accuracy of ball screw

(1) Radial run-out of the support bearing seat relative to the axis of the ball thread of screw shaft.
(2) Radial run-out of the other shaft ends section relative to the axis of the support bearing seat.
(3) Radial run-out of the shoulder of support bearing seat relative to the axis of support bearing seat.
(4) Radial run-out of the nut flange surface, or of the nut end datum surface, relative to the axis of screw shaft.
(5) Radial run-out of the nut outside surface (cylindrical shape) to the axis of screw shaft.
(6) Parallelism of the nut mounting surface to the screw shaft axis (in case of flat mounting surface).
(7) Total run-out of the screw shaft axis.

Table 1.6 Total run-out of the screw shaft axis

Unit: μm

Accuracy grade			C0						C1						
Nominal diameter (mm)		over	–	8	12	20	32	50	–	8	12	20	32	50	80
	over	or less	8	12	20	32	50	80	8	12	20	32	50	80	125
Overall length of screw shaft (mm)	–	125	15	15	15				20	20	15				
	125	200	25	20	20	15			30	25	20				
	200	315	35	25	20	20			40	30	25	20			
	315	400		35	25	20	15		45	40	30	25	20		
	400	500		45	35	25	20			50	40	30	25		
	500	630		50	40	30	20	15		60	45	35	25	20	
	630	800			50	35	25	20			60	40	30	25	
	800	1 000			65	45	30	25			75	55	40	30	25
	1 000	1 250			85	55	40	30			95	65	45	35	30
	1 250	1 600			110	70	50	40			130	85	60	45	35
	1 600	2 000				95	65	45				120	80	55	40
	2 000	2 500											100	70	50
	2 500	3 150												130	90
	3 150	4 000													120

Unit: μm

Accuracy grade			C3							C5						
Nominal diameter (mm)		over	–	8	12	20	32	50	80	–	8	12	20	32	50	80
	over	or less	8	12	20	32	50	80	125	8	12	20	32	50	80	125
Overall length of screw shaft (mm)	–	125	25	25	20					35	35	35				
	125	200	35	35	25	20				50	40	40	35			
	200	315	50	40	30	30				65	55	45	40			
	315	400	60	50	40	35	25			75	65	55	45	35		
	400	500		65	50	40	30				80	60	50	45		
	500	630		70	55	45	35	30			90	75	60	50	40	
	630	800			70	55	40	35				90	70	55	45	
	800	1 000			95	65	50	40	30			120	85	65	50	45
	1 000	1 250			120	85	60	45	35			150	100	75	60	50
	1 250	1 600			160	110	75	55	40			190	130	95	70	55
	1 600	2 000				140	95	70	50				170	120	85	65
	2 000	2 500					120	85	60					150	110	80
	2 500	3 150					160	110	75					200	140	95
	3 150	4 000					220	150	100					260	180	120
	4 000	5 000						200	130						240	160
	5 000	6 300													310	210
	6 300	8 000														280
	8 000	10 000														370

B-2-1.4 Automatic Lead Accuracy Measuring System of NSK

In response to the demand for high precision in production technology, NSK was the first to develop and use the "Lead Accuracy Measuring System (LAMS)." Lead accuracy is measured by a system that employs a laser interferometer measuring instrument and a personal computer.

Fig. 1.4 shows the lead accuracy measuring system. Inspection data for the ball screw is shown in **Fig. 1.5.** The laser interferometer measures either ball nut travel accuracy or lead accuracy of the ball thread. The data input into a computer are processed into four characteristic readings regarding lead accuracy. (See page B37.)

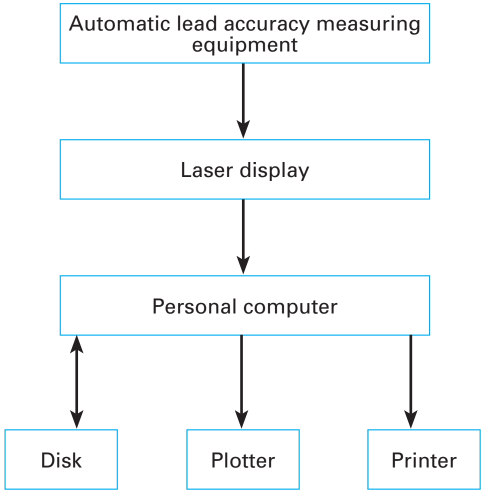
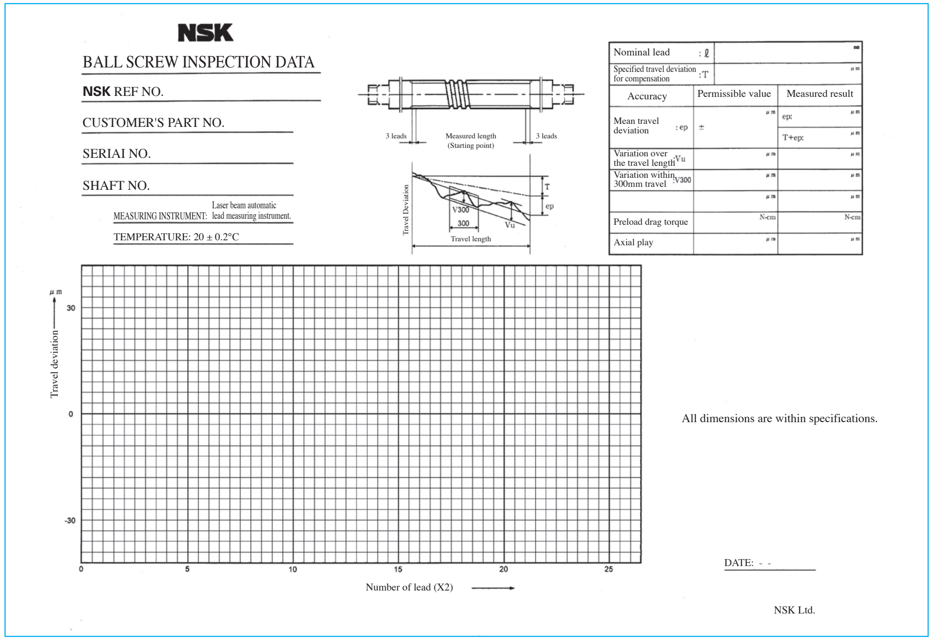


Fig. 1.4 Lead accuracy measuring system



NSK

BALL SCREW INSPECTION DATA

NSK REF NO.

CUSTOMER'S PART NO.

SERIAI NO.

SHAFT NO.

MEASURING INSTRUMENT: Laser beam automatic lead measuring instrument.

TEMPERATURE: 20 ± 0.2°C

3 leads

Measured length (Starting point)

3 leads

Travel Deviation

T

ep

V300

300

Vu

Travel length

Nominal lead : ℓ	mm	
Specified travel deviation for compensation :T	μm	
Accuracy	Permissible value	Measured result
Mean travel deviation : ep	± μm	ep: μm T+ep: μm
Variation over the travel length :Vu	μm	μm
Variation within 300mm travel :V300	μm	μm
	μm	μm
Preload drag torque	N-cm	N-cm
Axial play	μm	μm

μm

Travel deviation

30

0

-30

0 5 10 15 20 25

Number of lead (X2)

All dimensions are within specifications.

DATE: - -

NSK Ltd.

Fig. 1.5 Ball screw inspection data

B-2-2 Static Load Limits

Ball screws, based on their function, will generally receive axial load only. Ball screw shafts in general are long, so it is necessary to consider the 3 items below:

- Buckling load of the screw shaft
- Yielding of the screw shaft by tensional or compressive stress
- Permanent deformation at the ball contact points

B-2-2.1 Buckling Load

It is necessary to calculate whether the ball screw shaft is safe against buckling.

Buckling load, i.e. permissible compressive load P to the axial direction, is calculated as follows.

$$P = \alpha \times \frac{N \cdot \pi^2 \cdot E \cdot I}{L^2} = m \frac{d_r^{\,4}}{L^2} \times 10^4 \ \text{(N)} \cdots\cdots 2)$$

In this formula:

α : Safety factor ($\alpha = 0.5$)

E : Elastic modulus ($E = 2.06 \times 10^5$ MPa)

I : Moment of inertia

$$I = \frac{\pi}{64} d_r^{\,4} \qquad (\text{mm}^4) \cdots\cdots 3)$$

d_r : Screw shaft root diameter (mm) (See the dimension table.)

L : Distance between support positions (mm) (See **Figs. 4.1** and **4.2** 'Support configuration for screw shaft and nut' on page B51.)

m, N : Factors determined by the supporting condition of the ball screw shaft

Table 2.1 Factors of bucking load

Support condition	*m*	*N*
Fixed-Fixed	19.9	4
Fixed-Simple	10.0	2
Fixed-Free	1.2	0.25
Simple-Simple	5.0	1

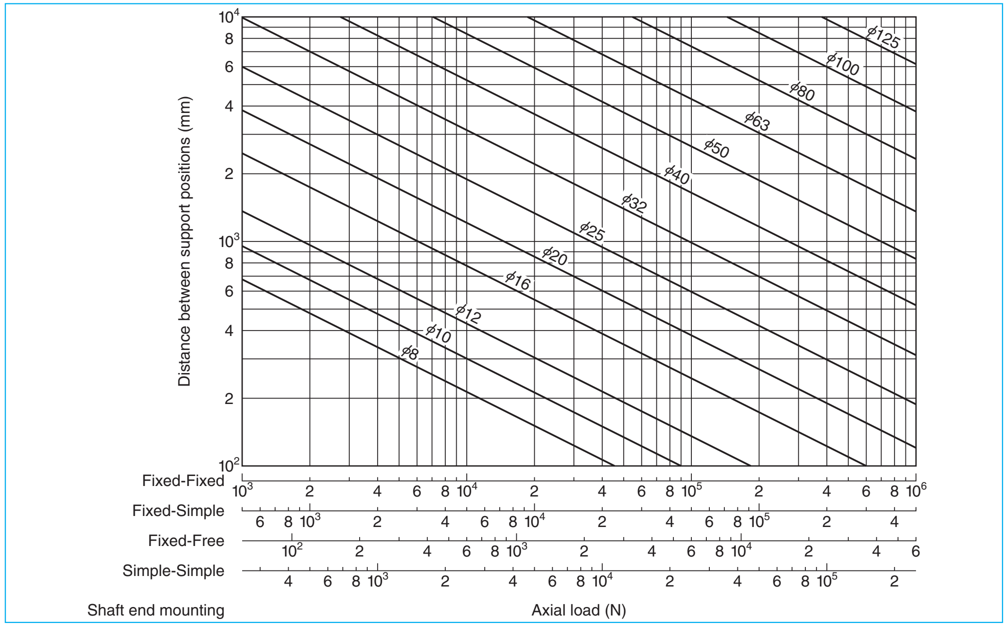


Fig. 2.1 Buckling load

<<Example calculation for buckling load>>

Calculate buckling load under the conditions in **Fig. 2.2**.

<Use conditions>

Model No.: ZFT4010-10

Support configuration is Fixed - Fixed (From (ii) in **Fig. 4.1** "Support configuration of screw shaft and nut' on page B51.)

Distance between support positions $L = 2\,000$ mm

Screw shaft root diameter $d_r = 34.4$ mm (From the dimension table)

<Calculation>

Support configuration is Fixed - Fixed from **Table 2.1** on page B44

$N = 4$

$m = 19.9$

By formula 2) on page B44

$$P = m\frac{d_r^4}{L^2} \cdot 10^4 = 19.9 \times \frac{34.4^4}{2\,000^2} \times 10^4 = 69\,667 \text{ (N)}$$

Therefore,

Permissible buckling load $P = 69\,600$ N

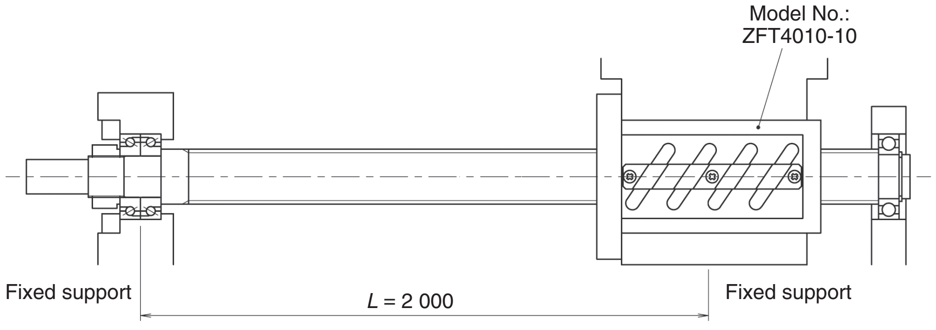


Fig. 2.2 Example calculation for buckling load

B-2-2.2 Yield by Tensional/Compressive Stress

It is necessary to consider permissible load in regards to the yield stress.

Permissible load P by tensional or compressive stress to screw shaft is

$$P = \sigma \cdot A = 1.15d_r^2 \times 10^2 \text{ (N)} \quad \cdots 4)$$

In this formula:

σ : Allowable stress (= 147 MPa)

A : Cross section area of a screw shaft using root diameter (mm^2)

$$A = \frac{\pi}{4} \cdot d_r^2 \text{ (mm}^2\text{)} \quad \cdots 5)$$

d_r : Screw shaft root diameter (mm)

<<Example calculation for yield load>>

Obtain load in respect to the allowable stress under the conditions in **Fig. 2.2**.

<Use conditions>

Model No.: ZFT4010-10

Screw shaft root diameter $d_r = 34.4$ (mm)

(From the dimension table)

<Calculation>

By formula 4)

$P = 1.15d_r^2 \times 10^2 = 1.15 \times 34.4^2 \times 10^2$

$= 136\,086$ (N)

Therefore,

Permissible load $P = 136\,000$ N

B-2-2.3 Permanent Deformation at the Ball Contact Point

Exposed to an excessively heavy load in axial direction, the balls are squashed, and the ball rolling surface is dented. The deformations on these points do not perfectly restore to original shape after the load is removed. They are permanently disfigured. It is necessary to determine the limit of this disfigurement to contain it within a certain range.

(1) Basic static load rating C_{0a}

Basic static load rating C_{0a} is a load in the axial direction that results in combined permanent deformation equal to 0.01% of the ball diameter at the contact points of ball and ball grooves of the screw shaft and nut.

(2) Calculation of permissible load by C_{0a}

P_o (allowable axial load to limit permanent deformation) is calculated using C_{0a}.

$$P_0 = \frac{C_{0a}}{f_s} \text{ (N)} \quad \cdots 6)$$

In this formula, f_s: Static permissible load factor

Table 2.2 Static permissible load factor

At time of normal operation	1 – 2
With vibration impact	1.5 – 3

<<Example calculation for maximum allowable load>>

Obtain the maximum allowable load to the ball groove section under conditions in **Fig. 2.2**.

<Use conditions>

Model No.: ZFT4010-10

Basic static load rating $C_{0a} = 137\,000$ (N)

(From the dimension table)

Static permissible load factor $f_s = 2$

(normal operation, no vibration impact)

<Calculation>

By formula 6), the maximum allowable load of the ball groove section

$$P_0 = \frac{C_{0a}}{f_s} = \frac{137\,000}{2} = 68\,500 \text{ (N)}$$

B-2-3 Permissible Rotational Speed

Permissible rotational speed is determined by the feeding speed and ball screw lead. When selecting a ball screw, it is important to know the permissible rotational speed.

It is necessary to calculate two items below, and take the smaller as the permissible rotational speed.

The lower of the following two factors, *d·n* and critical speed, will determine the overall permissible rotational speed of the ball screw.

- Critical speed, which is the resonance vibration of the shaft.
- *d·n* value, which is involved in damaging the ball recirculation components.

* Please consult NSK if the maximum rotational speed exceeds the criteria of maximum rotational speed on page B50, even if both the critical speed of screw shaft rotation and the *d·n* value are in range of the allowable limits.

B-2-3.1 Critical Speed of the Screw Shaft

Calculate the critical speed matching the ball screw rotational speed and the natural frequency of the screw shaft. 80% of the critical speed is defined as the permissible rotational speed.

Calculate the critical speed of the screw shaft whether you use shaft rotation or nut rotation. Critical speed varies by the nut traveling position. Please consult NSK for detailed calculations.

If using a ball screw exceeding the critical speed, it is necessary to increase the natural frequency by using an intermediate support, etc. If using nut rotation, it is possible to operate exceeding critical speed by installing a vibration energy absorbing system (optional, vibration control damper: patented by NSK) to the screw shaft. (Refer to "Rotary nut ball screws" on page B539.)

Calculate the permissible rotational speed based on critical speed n_c as follows, taking in account "B-2-4 Support Configuration for Calculation of Buckling Load and Critical Speed" on page B51.

Fig. 3.1 shows the permissible rotational speeds against critical speed for each shaft diameter.

$$n_c = \alpha \times \frac{60\lambda^2}{2\pi L^2}\sqrt{\frac{E\cdot I\cdot 10^9}{\rho\cdot A}}$$

$$= f\frac{d_r}{L^2}\times 10^7\ (\text{min}^{-1}) \qquad \cdots 7)$$

In this formula:

α : Safety factor ($\alpha = 0.8$)

E : Elastic modulus ($E = 2.06 \times 10^5$ MPa)

I : Moment of inertia of area of screw shaft

$$I = \frac{\pi}{64}d_r^4\ (\text{mm}^4) \qquad \cdots 3)$$

d_r : Screw shaft root diameter (mm) (See the dimension table.)

ρ : Material density (ρ=7.86 g/cm^3)

A : Cross section area of the screw shaft root diameter (mm^2)

$$A = \frac{\pi}{4}\times d_r^2\ (\text{mm}^2) \qquad \cdots 5)$$

L : Distance between support positions (mm) (See **Figs. 4.1**, and **4.2** "Support configuration of screw shaft and ball nut" on page B51)

f, λ : Factors determined by support conditions

Table 3.1 Coefficients of critical speed

Support condition	*f*	λ
Fixed-Fixed	15.1	3.927
Fixed-Simple	21.9	4.730
Fixed-Free	3.4	1.875
Simple-Simple	9.7	π

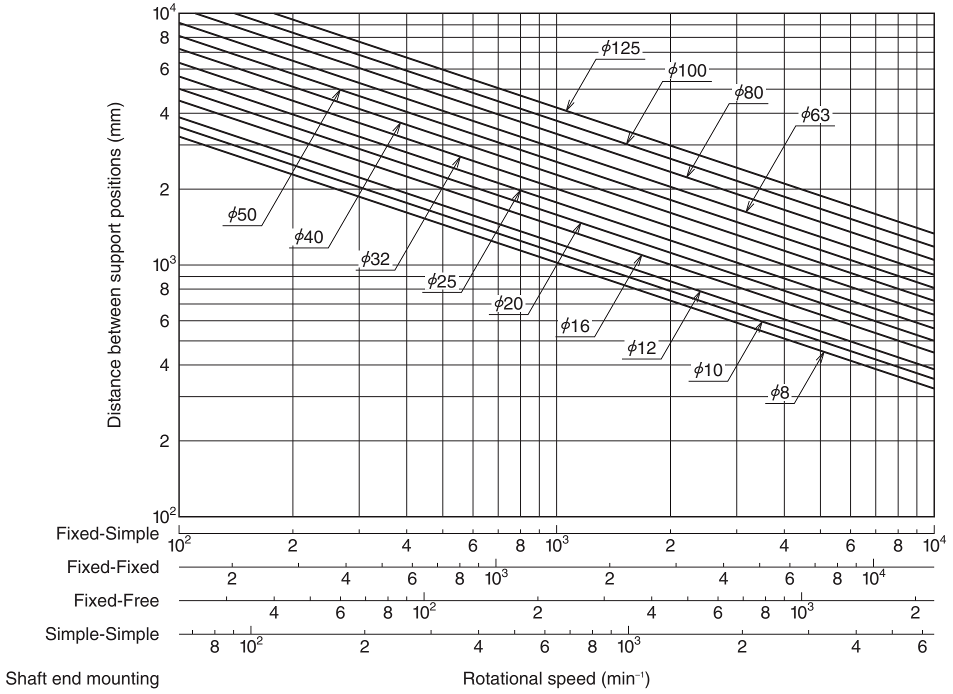


Fig. 3.1 Permissible rotational speeds vs. critical speeds

<<Example calculation of permissible rotational speed to critical speed>>
Calculate the permissible rotational speed to the critical speed under conditions in **Fig. 3.2**.

<Use conditions>

Model No.: ZFT4010-10

The support configuration is Fixed-Simple (condition (ii) in **Fig 4.1** Support configuration of screw shaft and ball nut on page B51.)

Distance between support positions L = 2 000 mm

Screw shaft root diameter d_r = 34.4 mm (from the dimension table)

<Calculation>

The support configuration is Fixed-Simple, from **Table 3.1** on page B47

$\lambda = 3.927$

$f = 15.1$

By formula 7) on page B47, permissible rotational speed to critical speed is

$$n_c = f\frac{d_r}{L^2} \times 10^7 = 15.1 \times \frac{34.4}{2\ 000^2} \times 10^7 = 1\ 298.6\ (\mathrm{min}^{-1})$$

$$n_c = 1\ 290\ \mathrm{min}^{-1} \text{ or under}$$

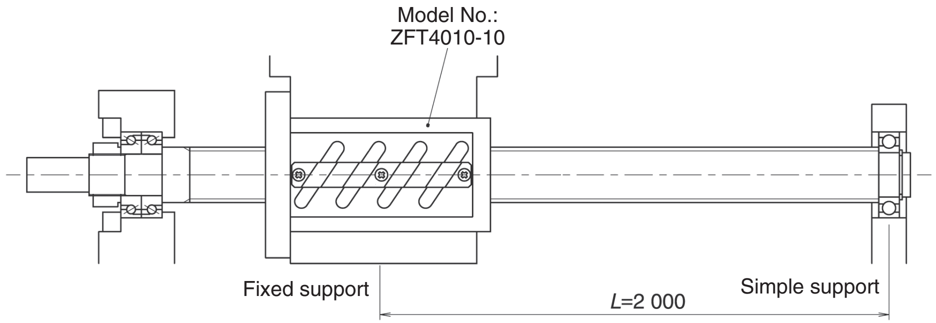


Fig.3.2 Example calculation of permissible rotational speed to critical speed

B-2-3.2 *d·n* Value

An increase of ball revolution speed increases the collision impacts of balls to ball recirculation parts, thus resulting in damage. For this reason, the permissible rotational speed is also limited by the *d·n* value (d, shaft diameter in millimeters; n, rotational speed per minutes). **Table 3.2** shows the allowable *d·n* value and the maximum rotational speed of ball screws.

Notes: 1. Special measures must be taken for high-speed specification products. Please consult NSK.

2. Please consult NSK if the maximum rotational speed or the *d·n* value exceed the values below, even if both the critical speed of screw shaft and the *d·n* value are in range of allowable limits.

Table 3.2 Criteria of allowable *d·n* value and maximum rotational speed

Ball screw recirculation system, model		Allowable *d·n* value		Criterion of permissible rotational speed [min^{-1}]
		Standard	High-speed	
Standard ball screw	R model ball screws for transfer equipment	50 000 or less	–	3 000
Standard nut ball screws	End-deflector recirculation	180 000 or less	–	5 000
	SRC recirculation	160 000 or less	–	5 000
	Tube recirculation	70 000 or less	100 000 or less	3 000
	Deflector (bridge) recirculation	84 000 or less	100 000 or less	3 000
	High-speed Low-noise Deflector Recirculation	160 000 or less, 150 000 or less*1	–	5 000
Application-oriented ball screws	HMD model for high-speed machine tools	160 000 or less	–	4 000
	HMS model for high-speed machine tools	160 000 or less	–	5 000
	HTF-SRC model for high-load drives	140 000 or less, 160 000 or less*1	–	3 225
	HTF-SRD model for high-load drives	120 000 or less	–	2 400
	HTF model for high-load drives	50 000 or less, 70 000 or less*1	100 000 or less	3 125
	VSS model for contaminated environments	150 000 or less	–	3 000
	Rotary nut ball screws	70 000 or less	100 000 or less	3 000
	∑ model for robots	70 000 or less	–	3 000

∗1) Please refer to the relevant page when two allowable *d·n* values are listed:
· High-speed Low-noise Deflector Recirculation: page B475
· HTF-SRC model for high-load drives: page B491
· HTF model for high-load drives: page B499

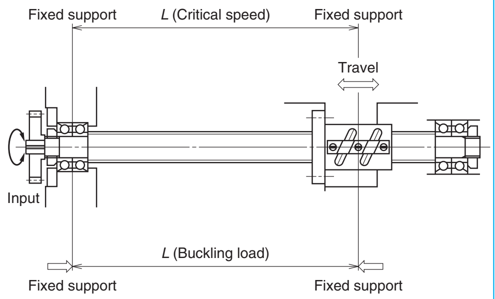
B-2-4 Support Configuration for Calculation of Buckling Load and Critical Speed

Figs. 4.1 and **4.2** are typical conditions in supporting ball screws. Use them to calculate buckling load and critical speed.
Please consult NSK to scrutinize calculations due to use conditions, or if boundary conditions are not clear due to a special installation.

[How to read the tables]
Example ii: A buckling load is generated between the nut and the left bearings, indicating that the critical speed appears between the nut and the right bearing. Therefore, set *L* at the maximum stroke for each side. Calculate by applying support bearing conditions.

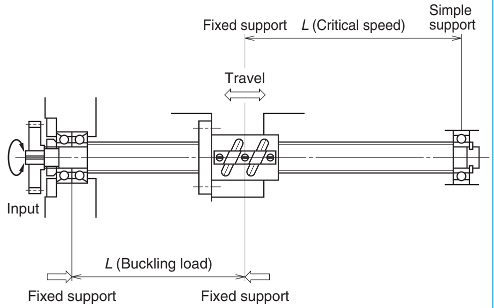
i

Buckling load: Fixed - Fixed
Critical speed: Fixed - Fixed



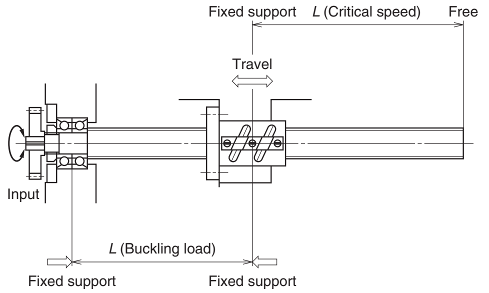
ii

Buckling load: Fixed - Fixed
Critical speed: Fixed - Simple



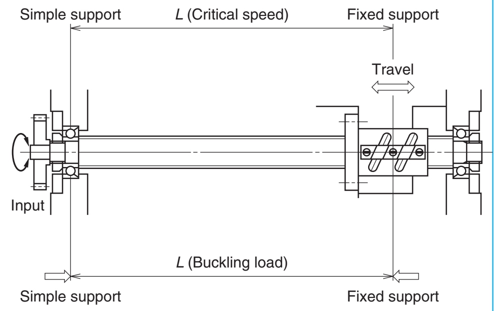
iii

Buckling load: Fixed - Fixed
Critical speed: Fixed - Free



iv

Buckling load: Fixed - Simple
Critical speed: Fixed - Simple



v

Buckling load: Fixed - Fixed
Critical speed: Fixed - Fixed

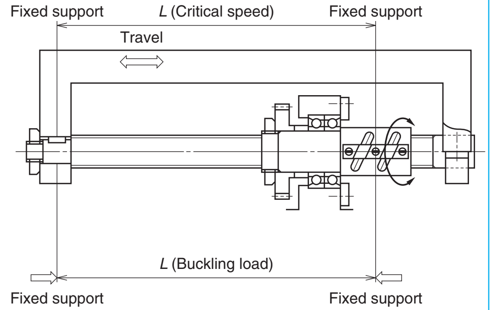
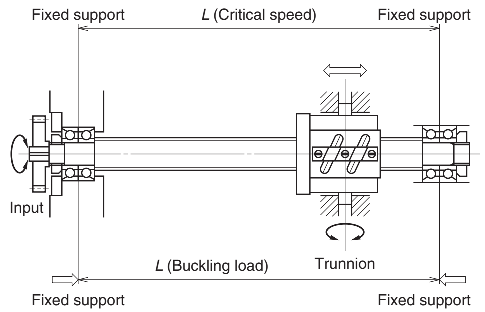


Fig. 4.1 Support configuration for screw shaft and ball nut

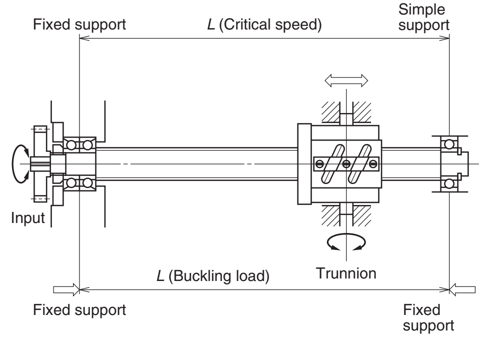
vi

Buckling load: Fixed - Fixed } Minimum value (estimate) is obtained in the state as shown in the figure.
Critical speed: Fixed - Fixed



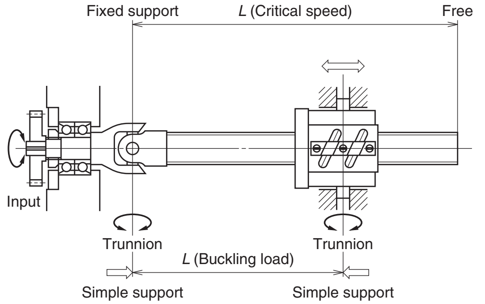
vii

Buckling load: Fixed - Fixed } Minimum value (estimate) is obtained in the state as shown in the figure.
Critical speed: Fixed - Simple



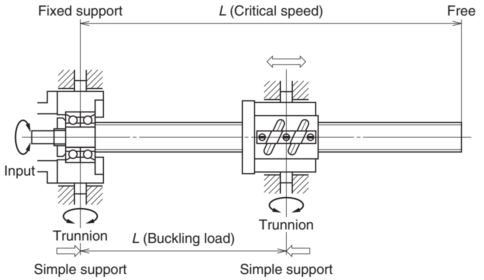
viii

Buckling load: Simple support - Simple
Critical speed: Fixed - Free→ Minimum value (estimate) is obtained in the state as shown in the figure.



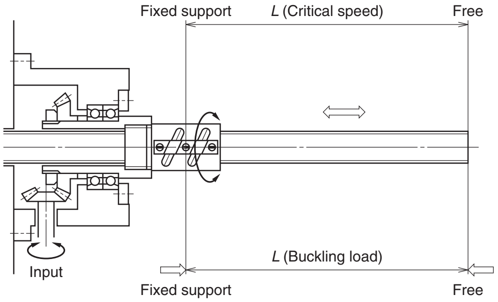
ix

Buckling load: Simple support - Simple
Critical speed: Fixed - Free→ Minimum value (estimate) is obtained in the state as shown in the figure.



x

Buckling load: Fixed - Free
Critical speed: Fixed - Free



xi

Buckling load: Fixed - Fixed
Critical speed: Fixed - Free

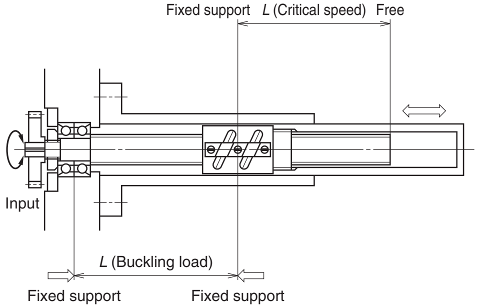


Fig. 4.2 Support configuration for screw shaft and ball nut

B-2-5 Life (Dynamic Load Limits)

B-2-5.1 Life of Ball Screws

Although used in appropriate conditions and ideally designed, the ball screw deteriorates after a certain operation period, and eventually becomes unusable. The period in this situation is the life of the ball screw. There are two life categories, "fatigue life" caused by flaking, and "accuracy life" caused by deterioration in precision because of wear.

B-2-5.2 Fatigue Life

Fatigue life of a ball screw can be estimated by the basic dynamic load rating (C_a) as for rolling bearings.

(1) Basic dynamic load rating C_a

The basic dynamic load rating is the axial load that allows 90% of the group of the same ball screws to rotate 1 million times (10^6 rev) under the same conditions without causing flaking by rolling contact fatigue.

(2) Fatigue life calculation

Fatigue life is defined in general as the total number of rotations. It is sometimes indicated by total rolling hours or total running distance. Fatigue life is obtained by the following formula.

$$L = \left(\frac{C_a}{F_a \cdot f_w}\right)^3 \cdot 10^6 \qquad \cdots 8)$$

$$L_t = \frac{L}{60n} \qquad \cdots 9)$$

$$L_s = \frac{L \cdot l}{10^6} \qquad \cdots 10)$$

In this formula:

L : Rating fatigue life (rev)

L_t : Life in hours (h)

L_s : Life by running distance (km)

C_a : Basic dynamic load rating (N)

F_a : Axial load (N)

n : Rotational speed (min^{-1})

l : Lead (mm)

f_w : Load factor (Coefficient by operating condition)

Load factor f_w for operating conditions is shown in **Table 5.1**.

Table 5.1 Load coefficient f_w

Smooth operation without impacts	1.0 – 1.2
Normal operation	1.2 – 1.5
Operation associated with impacts or vibrations	1.5 – 3.0

Setting fatigue life too long requires larger, more costly ball screws. Below are the general target values of operating life for machines.

Table 5.2 General target values of fatigue life

Machine tools	20 000 hours
Industrial machines	10 000 hours
Automatic control system	15 000 hours
Measuring equipment	15 000 hours

(3) Mean load

If the axial load often varies, calculate life by obtaining the mean load, which gives the equivalent fatigue life under varying load conditions.

(a) When the load and the rotational speed shift stepwise

Obtain the mean load F_m by the formula below.

Obtain mean rotational speed N_m by the formula below as **Table 5.3** and **Fig. 5.1**.

$$F_m = \left(\frac{F_1^{\,3} \cdot n_1 \cdot t_1 + F_2^{\,3} \cdot n_2 \cdot t_2 + \cdots F_n^{\,3} \cdot n_n \cdot t_n}{n_1 \cdot t_1 + n_2 \cdot t_2 + \cdots + n_n \cdot t_n}\right)^{\frac{1}{3}} \qquad \cdots 11)$$

$$N_m = \frac{n_1 \cdot t_1 + n_2 \cdot t_2 + \cdots + n_n \cdot t_n}{t_1 + t_2 + \cdots + t_n} \qquad \cdots 12)$$

Table 5.3 Stepwise operation conditions

Axial load (N)	Rotational speed (min^{-1})	Hours of use, or ratio of hours of use
F_1	n_1	t_1
F_2	n_2	t_2
:	:	:
F_n	n_n	t_n

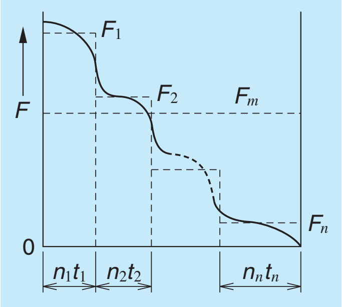


Fig. 5.1 Stepwise load variation

(b) When the rotational speed is constant, and the load changes linearly, obtain the approximate value of the mean load F_m by the formula below.

$$F_m = \frac{1}{3}\left(F_{min} + 2F_{max}\right) \qquad \cdots 13)$$

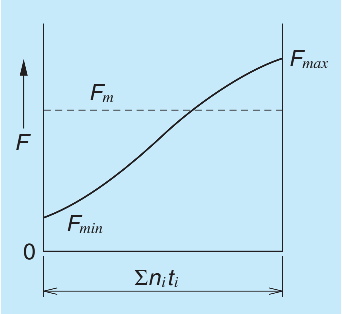


Fig. 5.2 Linear load change

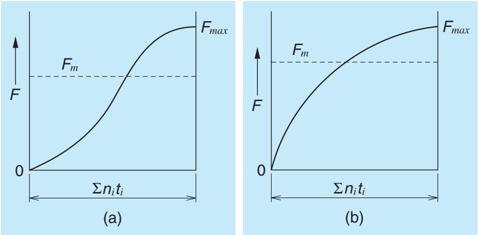
(c) When the rotational speed is constant, and the load changes in a sinusoidal pattern, obtain the approximate value of the mean load F_m by the formula below.

When the sine curve is Fig. (a)

$$F_m \fallingdotseq 0.65\ F_{max} \qquad \cdots 14)$$

When the sine curve is Fig. (b)

$$F_m \fallingdotseq 0.75\ F_{max} \qquad \cdots 15)$$



(a)

(b)

Fig. 5.3 Load changes in sinusoidal pattern

(4) Efffects of mounting misalignment

Moment load or radial load applied to the ball screw adversely affects ball screw function and shortens life. Watch for eccentric load that induces moment or radial load.

Fig. 5.4 shows a calculation example of fatigue life when moment load is applied to the ball screw. In this figure, the value of the rigidity of mounting ball screw sections (screw shaft, support bearing, guide, etc.) is set at infinity. In actual use, deformation absorbs the moment load in various areas, and the moment load between the screw shaft and nut is abated.

In general, the following values are recommended as control values for precision grade.

Misalignment in inclination : 1/2 000 or less

(Target value : 1/5 000 or less)

Eccentricity : 0.020mm or less

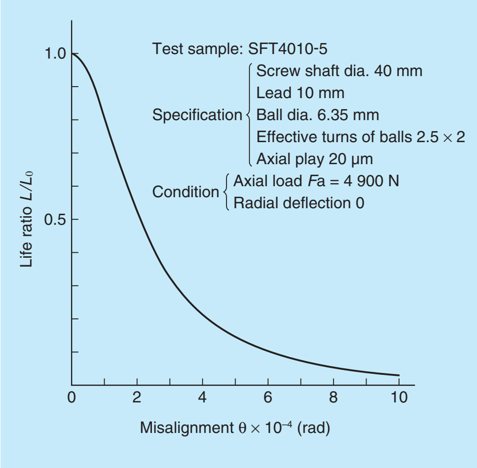


Fig. 5.4 Effects of misalignment

(5) Effects of heavy load and short stroke

If the ball screw is used under heavy load and short strokes, such as for the drive of plastic injection molding machines and press machines, the fatigue life may become significantly shorter than the rated fatigue life calculated in B-2-5.2.

This decreased life occurs because the heavy load generates large stress (surface pressure) in the contact points of balls and ball grooves of the screw shaft and the nut, adversely affecting life.

The axial load F_{amax}[*1] during operation and the size of strokes, which affect fatigue life, can be obtained by the following formula.

In such cases, the life calculation should take into account the surface pressure as well as the size of the stroke. Please consult with NSK.

$$F_{\text{amax}} \geq 0.10C_{0\text{a}} \qquad \cdots 16)$$

$$S \leq 4$$

In this formula:

F_{amax} : Maximum load in axial direction during drive (N)
$C_{0\text{a}}$: Basic static load rating (N)
S : Stroke (rev)

$$S = \frac{L_{\text{s}}}{l}$$

L_{s} : Stroke distance (mm)
l : Lead (mm)

---

*1) Axial load: The load applied in the axial direction when the screw shaft and the nut of ball screw are rotating relative to each other. The rotational speed is irrelevant.

B-2-5.3 Ball Screw Hardness

Table 5.4 indicates the hardness of NSK standard ball screws.

Table 5.4 Ball screw materials and their hardness

Component	Heat treatment method	Hardness (HRC)
Screw shaft	Carburizing	58 or over
	Induction hardening	58 or over
Nut	Carburizing	58 or over

Note: NSK manufactures special material ball screws for special environments (stainless steel: SUS440C, SUS630). NSK also furnishes protective surface treatments (refer to page D5). Please consult NSK for such requests.

B-2-5.4 Wear Life

Wear of materials, as is the case for other mechanical components, is significantly affected by use conditions, lubrication conditions, and other factors. It is difficult to estimate its volume, and measuring requires various tests and field data.

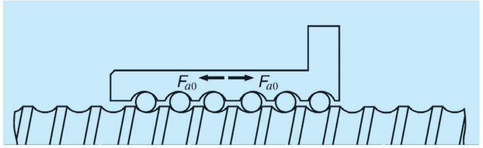
NSK has wear data accumulated through abundant experience. Please contact NSK for inquiries pertaining to wear.

B-2-6 Preload and Rigidity

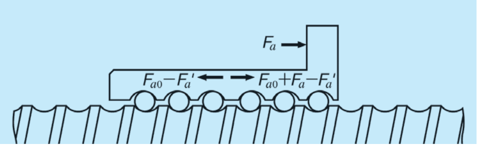
B-2-6.1 Elastic Deformation of Preloaded Ball Screw

(1) Position preload (D, Z, and P preload)

The concept of offset preload ball screw is shown in **Fig. 6.1**.



(a) External load : 0



(b) External load : F_{a}

Fig. 6.1 Position preload

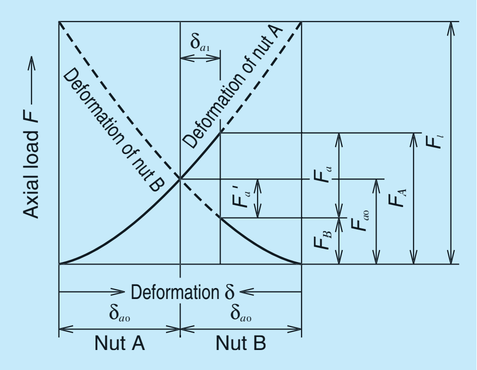


Fig. 6.2 Deformation of nuts A and B (position preload)

Elastic deformation of Nut A and B is already given at the time of assembly by the amount of δao by preload $F_{a\text{o}}$. When the external load F_a is added to Nut A, the elastic deformation δ_a and δ_{b} of Nut A and B change as shown in **Fig. 6.2**,

$$\delta_a = \delta_{a\text{o}} + \delta_{a1} \qquad \delta_{\text{b}} = \delta_{a\text{o}} - \delta_{a1}$$

At this time, the loads to Nut A and B are:

$$F_{\text{A}} = F_{a\text{o}} + F_a - F_a'$$

$$F_{\text{B}} = F_{a\text{o}} - F_a'$$

This shows that the load applied to Nut A is affected by Nut B and reduced by the amount of F_a'. Thereby, the elastic deformation of Nut A becomes smaller. This effect continues until the elastic deformation from external load becomes $\delta_{a\text{o}}$, and the preload of Nut B disappears.

Assuming that the load when preload is absorbed is F_l, the relationship between the axial load and elastic deformation is as follows (refer to **Fig. 6.2**).

$$\delta_{a\text{o}} = K \bullet F_{a\text{o}}^{2/3} \qquad 2\delta_{a\text{o}} = K \bullet F_l^{2/3}$$

(K: Constant)

$$\left[\frac{F_l}{F_{a\text{o}}}\right]^{2/3} = \frac{2\delta_{a\text{o}}}{\delta_{a\text{o}}} = 2$$

$$F_l = 2^{3/2} \times F_{a\text{o}} \fallingdotseq 3F_{a\text{o}}$$

For this reason, the preload should be about 1/3 the maximum axial load. However, please note that if preload of about 1/3 the maximum axial load exceeds 8% of C_{a}, which is the criterion of the maximum preload, the ball screw may adversely generate more heat and/or have shortened life.

Fig. 6.3 shows two types of elastic deformation curves: one is by a ball screw with preload, the other without preload. When an axial load which is about three times as large as the preload is applied, the deformation of the preloaded ball screw is 1/2 the deformation of the ball screw without preload.

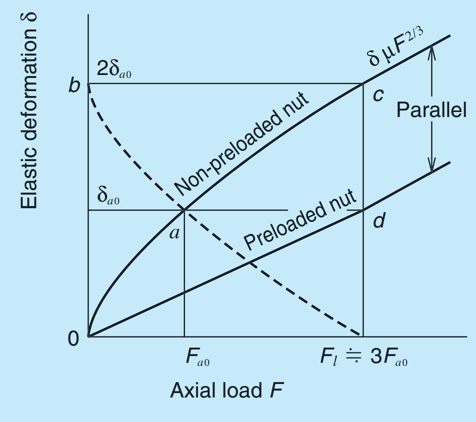


Fig. 6.3 Deformation of preloaded ball nut (position preload)

(2) Constant pressure preload (J preload: preloaded by spring)

Fig. 6.5 shows elastic deformation of a ball screw which is preloaded with "constant pressure." The rigidity of the preload spring is sufficiently smaller than the nut rigidity. Therefore, the deformation of the spring becomes nearly parallel to the abscissa axis. For this reason, elastic deformation by preload with constant pressure changes along the deformation curve by Nut A.

In order to take advantage of the characteristics of preload with constant pressure, the major external load should be applied in the directions shown by arrows in **Fig. 6.4**.

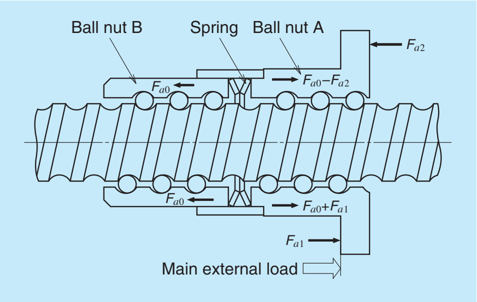


Fig. 6.4 Constant pressure preload (double nut)

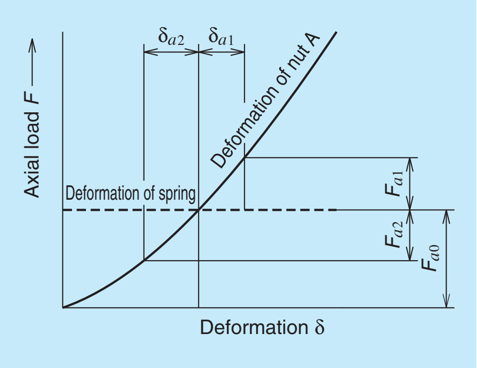


Fig. 6.5 Deformation curve of constant pressure preloaded nut

B-2-6.2 Rigidity of the Feed Screw System

A low rigidity around the feed screw mounting area causes lost motion. To improve the positioning accuracy of precision machines such as NC machine tools requires a good balance in axial rigidities of the parts composing the feed screw system.

One should also examine the torsional rigidities of the feed screw system.

(1) Axial rigidity of the feed screw system K_T

Elastic deformation and rigidity of the feed screw system can be obtained by the following formula.

$$\delta = \frac{F_a}{K_T} \quad \cdots\cdots 17)$$

$$\frac{1}{K_T} = \frac{1}{K_S} + \frac{1}{K_N} + \frac{1}{K_B} + \frac{1}{K_H} \quad \cdots\cdots 18)$$

In this formula:

δ : Volume of axial elastic deformation of the feed screw system (μm)
F_a : Axial load on the feed screw system (N)
K_T : Axial rigidity of the feed system (N/μm)
K_S : Axial rigidity of the screw shaft (N/μm)
K_N : Axial rigidity of the nut (N/μm)
K_B : Axial rigidity of the support bearing (N/μm)
K_H : Axial rigidity of the nut and bearing mounting section (N/μm)

(2) Axial rigidity of the screw shaft: K_S

(a) In case of: Fixed - Free (axial direction)

$$K_S = \frac{A \cdot E}{x} \times 10^{-3} \quad \cdots\cdots 19)$$

In this formula:

K_S : Axial rigidity of the screw shaft (N/μm)
A : Cross section area of the screw shaft (mm²)

$$A = \frac{\pi}{4}\, dr^2$$

dr : Screw shaft root diameter (mm)
E : Elastic modulus ($E = 2.06 \times 10^5$ MPa)
x : Distance between points of load application (mm)

(b) In case of: Fixed – Fixed support (axial direction)

$$K_S = \frac{A \cdot E \cdot L}{x\,(L - x)} \times 10^{-3} \quad \cdots\cdots 20)$$

In this formula:

K_S : Axial rigidity of the screw shaft (N/μm)
L : Distance between support positions (mm)
x : Axial deformation is maximum at position $x = L/2$.

Axial rigidity of the screw shaft can be obtained by the following formula.

$$K_S = \frac{4A \cdot E}{L} \times 10^{-3} \quad \cdots\cdots 21)$$

<<Example calculation for axial rigidty (1)>>

Obtain axial rigidity of the screw shaft under the conditions in **Fig. 6.6**.

<Use conditions>

Model No.: ZFT 4010-10
From **Fig. 6.6**: Support configuration
Fixed-Free (axial direction)
Distance between points of load application
x = 1 200 mm
Screw shaft root diameter (from the dimension table)
d_r = 34.4 mm

<Calculation>

By formula 19), axial rigidity K_S is :

$$A = \frac{\pi}{4}\, d_r^2 = \frac{3.14}{4} \times 34.4^2 = 929.4 \ (\text{mm}^2)$$

$$K_S = \frac{A \cdot E}{x} \times 10^{-3} = \frac{929.4 \times 2.06 \times 10^5}{1\,200} \times 10^{-3} = 159 \ (\text{N/μm})$$

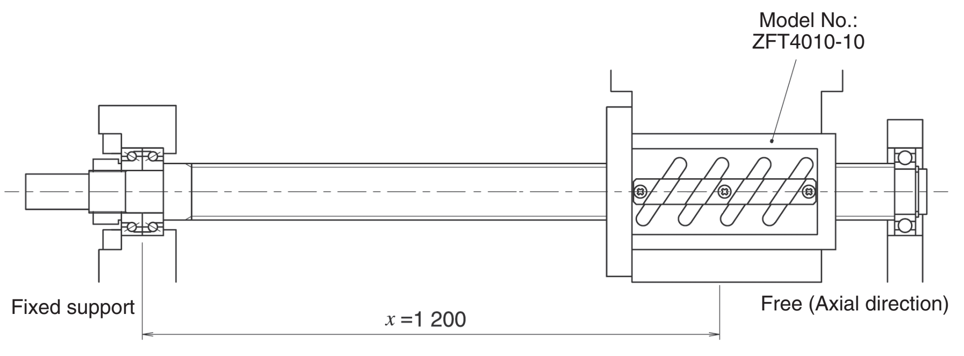


Fig. 6.6 Example calculation for axial rigidity of screw shaft (1)

<<Example calculation for axial rigidty (2)>>

Obtain axial rigidity of the screw shaft under the conditions in **Fig. 6.7**.

<Use conditions>

Model No.: ZFT 4010-10
From **Fig. 6.7**: Support configuration:
Fixed - Fixed support (axial direction)
$L = 1\,200$ mm
Distance between points of load application:
Screw shaft root diameter (from the dimension table)
$dr = 34.4$ mm

<Calculation>

By formula 21), axial rigidity K_S is :

$$A = \frac{\pi}{4}\,dr^2 = \frac{3.14}{4} \times 34.4^2 = 929.4\ (\text{mm}^2)$$

$$K_S = \frac{4A \bullet E}{L} \times 10^{-3} = \frac{4 \times 929.4 \times 2.06 \times 10^5}{1\,200} \times 10^{-3} = 638\ (\text{N/μm})$$

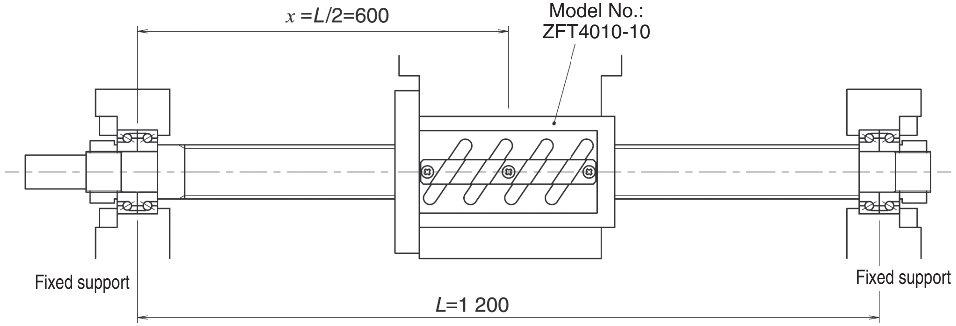


Fig. 6.7 Example calculation for axial rigidity of screw shaft (2)

(3) Axial rigidity of the ball nut : K_N

(a) Rigidity of the nut with axial play

Theoretical rigidity *K* is shown in the dimension tables. The value of *K* is obtained from the elastic deformation between screw grooves and balls when an axial load equivalent to 30% of the basic dynamic load rating C_a is applied. The criterion for the ball nut rigidity is 80% of the value listed in the table taking into consideration deformation of the ball nut, etc.

The rigidity K_N is obtained by the following formula when the axial load F_a is not 30% of "C_a."

$$K_N = 0.8 \times K \left(\frac{F_a}{0.3\,C_a} \right)^{1/3}\ (\text{N/μm}) \qquad \cdots 22)$$

In this formula:

K : Rigidity in dimension tables (N/μm)
F_a : Axial load (N)
C_a : Basic dynamic load rating (N)

<<Example calculation for axial rigidity (3)>>

Obtain axial rigidity of the nut under the following conditions.

<Use conditions>

Model No.: SFT 4010-5
Axial load: $F_a = 6\,000$ N
F_a = Rigidity at 0.3 C_a $K = 741$ N/μm
(from the dimension table)

<Calculation>

By formula 22), axial rigidity K_N is :

$$K_N = 0.8 \times K \left(\frac{F_a}{0.3 \bullet C_a} \right)^{1/3}$$

$$= 0.8 \times 741 \times \left(\frac{6\,000}{0.3 \times 61\,200} \right)^{1/3}$$

$$= 408\ (\text{N/μm})$$

(b) Rigidity of preloaded ball nut

Theoretical rigidity *K* of a preloaded ball nut under an axial load is shown in each dimension table. *K* is obtained from the elastic deformation of the ball rolling surface and the balls when a preload equivalent to 10% of the basic dynamic load rating C_a (5% in case of the P-preload [single-nut oversize ball preload system]) is applied. The criterion for calculation of nut rigidity is 80% of the value listed in the table taking into consideration deformation of the ball nut, etc.

Rigidity K_N is obtained by the following formula when preload F_{a0} is not 10% (or 5%) of C_a.

$$K_N = 0.8 \times K \left(\frac{F_{a0}}{\varepsilon \bullet C_a} \right)^{1/3}\ (\text{N/μm}) \qquad \cdots 23)$$

In this formula:

K : Rigidity in dimension tables (N/μm)
F_{a0} : Preload (N)
ε : Basic factor to calculate rigidity ($\varepsilon = 0.1$. For P-preload, use the percentage of the preload to the basic dynamic load rating e.g. 0.03 for BSS and 0.015 for VSS.)

<<Example calculation for axial rigidity of screw shaft (4)>>

Obtain axial rigidity of the nut under the following conditions.

<Use conditions>

Model No.: ZFT 4010-10
Preload : $F_{a0} = 4\,000$ N
Rigidity *K* when $F_{a0} = \varepsilon\, C_a$: $K = 1\,454$ N/μm
(from the dimension table on page B461)
Basic factor to calculate rigidity for D-Preload $\varepsilon = 0.1$

<Calculation>

By formula 23)

$$K_N = 0.8 \times K \left(\frac{F_{a0}}{\varepsilon \bullet C_a} \right)^{1/3}$$

$$= 0.8 \times 1\,454 \times \left(\frac{4\,000}{0.1 \times 61\,200} \right)^{1/3}$$

$$= 1\,009\ (\text{N/μm})$$

Ball screw preload criteria

Nut rigidity increases with larger preload volume. But excessive preload shortens life and generates heat. Set the maximum preload to about 0.08 C_a (0.03 for *P*-Preload). **Table 6.1** shows the criteria for preload for different applications.

Table 6.1 Criteria of preload

Ball screw application	Preload (relative to dynamic load rating C_a)
Robots, material handling systems, etc.	Axial play or under 0.01 C_a
Semiconductor manufacturing systems, etc. That require highly accurate positioning	0.01 C_a – 0.03 C_a
Medium- high-speed machine tools for cutting	0.03 C_a – 0.05 C_a
Low to medium-speed systems that require especially high rigidity	0.05 C_a – 0.07 C_a

(4) Axial rigidity of support bearing: K_B

The rigidity (K_B) of a bearing used for ball screw support is shown in the dimension tables. See Page B403 for NSKTAC C Series bearings.

(5) Axial rigidity of the ball nut and bearing mounting section: K_H

As the rigidity of the mounting section has a profound effect on positioning accuracy, we recommend incorporating high rigidity mounting sections for the ball nut and support bearings into the design the machine.

(a) Torsional rigidity of the feed screw system

Major torsion factors in the rotating system that bring about error in positioning accuracy are:

- Torsional deformation of the screw shaft
- Torsional deformation of the joint section
- Torsional deformation of the motor

The value of the effect of torsional strain to positioning accuracy is smaller than axial deformation. However, check the effect when designing equipment that requires high positioning accuracy.

(b) Suppress thermal error

To minimize the thermal error for positioning accuracy:

- Suppress heat
- Use forced cooling
- Avoid temperature rise

Refer to "Measures against thermal expansion" on page B40.

B-2-7 Friction Torque and Drive Torque

Operations that use ball screw drives require a motor torque equivalent to the total of the following:

- Friction torque, i.e. the friction of the ball screw itself
- Drive torque which is required for operation

B-2-7.1 Friction Torque

(1) Starting friction torque (breakaway torque)

High torque is necessary to start a ball screw. This is called "starting friction torque" or "breakaway torque." This torque is 2 to 2.5 times larger than the dynamic (friction) torque due to preload, which is described below. The starting friction torque quickly diminishes once the ball screw begins to move.

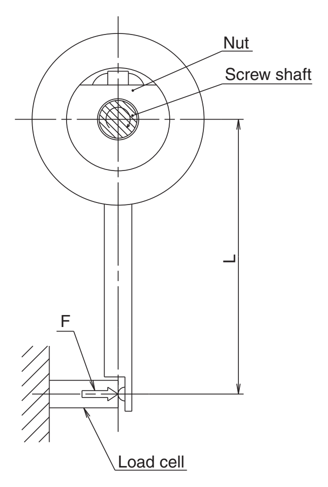


Fig. 7.1 Preload dynamic torque measuring method

(2) Dynamic friction torque (dynamic friction torque due to preload)

When a ball screw is moving, two types of torque are generated: dynamic friction torque due to preload and friction torque associated with ball recirculation. JIS B1192 sets the standard of dynamic friction torque due to preload, which is the total of these two torque types. They are defined in **Fig. 7.2**.

Dynamic friction torque due to preload is calculated by the following formula. When the screw shaft is rotated as in **Fig. 7.1** in the following measuring conditions, measure the nut holding power *F* and then multiple the distance of action line *L* perpendicular to the direction of the power *F*.

$$T_p = F \cdot L \qquad \cdots 24)$$

- Measure at a rotational speed of 100 min^{-1}.
- Viscosity of lubrication is ISO VG 68 as prescribed in JIS K 2009.
- Remove Seals.

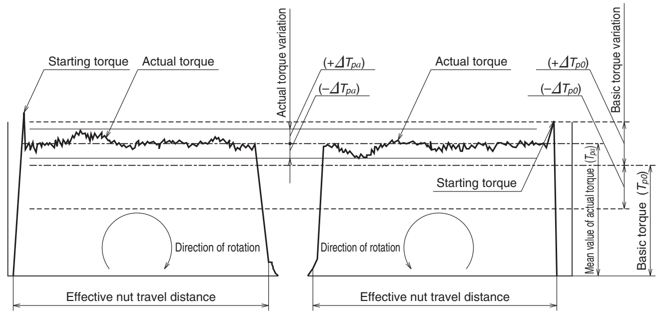


Fig. 7.2 Definitions of dynamic preloaded drag torque

(3) Calculation of basic torque

The basic torque of a preloaded ball screw T_{p0} can be obtained by the following formula.

$$T_{p0} = K\frac{F_{a0} \bullet l}{2\pi} \fallingdotseq 0.014F_{a0}\sqrt{d_m \bullet l} \quad (\mathrm{N \cdot cm}) \qquad \cdots 25)$$

In this formula:

F_{a0} : Preload (N)

l : Lead (cm)

K : Torque coefficient of ball screw

$$K = \frac{0.05}{\sqrt{tan\beta}}$$

β : Lead angle (deg.)

d_m : Ball pitch circle diameter (cm)

Allowable values of torque variation relative to basic torque are specified as shown in **Table 7.1**.

B-2-7.2 Drive Torque

(1) Operating torque of a ball screw

(a) Normal drive

The torque when converting rotational motion to linear motion (normal operation) is obtained by the following formula.

$$T_a = \frac{F_a \bullet l}{2\pi \bullet \eta_1} \quad (\mathrm{N \cdot cm}) \qquad \cdots 26)$$

In this formula:

T_a : Normal operation torque (N · cm)

F_a : Axial load (N)

l : Lead (cm)

η_1 : Normal efficiency ($\eta_1 = 0.9$ to 0.95)

(b) Back-drive operation

The torque when converting linear motion to rotational motion (back-drive operation) is obtained by the following formula.

$$T_b = \frac{F_a \bullet l \bullet \eta_2}{2\pi} \quad (\mathrm{N \cdot cm}) \qquad \cdots 27)$$

In this formula:

T_b : Reverse operation torque (N · cm)

η_2 : Reverse efficiency ($\eta_2 = 0.9$ to 0.95)

(c) Dynamic drag torque of preloaded ball screws

The operation torque of preloaded ball screws can be obtained by Formula 25).

Table 7.1 Range of allowable values of torque variation rates (Source: JIS B 1192)

Basic torque (N · cm)		Effective length of the screw thread (mm)										
		4 000 or under								Over 4 000 and 10 000 or under		
		Slenderness ratio(1): 40 or less				Slenderness ratio(1): More than 40 and 60 or less				—		
		Accuracy grade				Accuracy grade				Accuracy grade		
Over	Incl.	C0	C1	C2, 3	C5	C0	C1	C2, 3	C5	C1	C2, 3	C5
20	40	±30%	±35%	±40%	±50%	±40%	±40%	±50%	±60%	—	—	—
40	60	±25%	±30%	±35%	±40%	±35%	±35%	±40%	±45%	—	—	—
60	100	±20%	±25%	±30%	±35%	±30%	±30%	±35%	±40%	—	±40%	±45%
100	250	±15%	±20%	±25%	±30%	±25%	±25%	±30%	±35%	—	±35%	±40%
250	630	±10%	±15%	±20%	±25%	±20%	±20%	±25%	±30%	—	±30%	±35%
630	1 000	—	±15%	±15%	±20%	—	—	±20%	±25%	—	±25%	±30%

Notes: 1. Slenderness ratio: The value obtained by dividing the length of the screw thread section of screw shaft (mm) by diameter of the screw shaft (mm).
2. NSK independently sets torque standards under 20 N•cm.

(2) Drive torque of the motor

(a) Drive torque at constant speed

The torque necessary to drive a ball screw at a constant speed resisting external loads can be obtained by the following formula.

$$T_1 = (T_a + T_{pmax} + T_u) \times \frac{N_1}{N_2} \qquad \cdots 28)$$

In this formula:

T_a : Drive torque at constant speed

$$T_a = \frac{F_a \bullet l}{2\pi \bullet \eta_1} \qquad \cdots 26)$$

F_a : Axial load (N)

The value of F_a in **Fig. 7.3** is:

$F_a = F + \mu \bullet m \bullet g$

F : Axial forces on screw shaft such as cutting force, etc. (N)

μ : Friction coefficient of the guide way

m : Volume of the traveling section (table mass plus work mass (kg)

g : Gravitational acceleration (9.80665 m/s^2)

T_{pmax} : Upper limit of the dynamic friction torque of ball screw (N · cm)

T_u : Friction torque of the support bearing (N · cm)

N_1 : Number of teeth in Gear 1

N_2 : Number of teeth in Gear 2

Generally, though it depends on the type of motor, T_1 is normally under 30% of the motor rating torque.

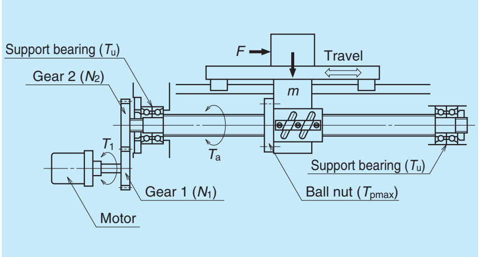


Fig. 7.3 Driving mechanism of ball screw

(b) Drive torque at acceleration

Accelerating a ball screw resisting axial load requires the maximum torque in an operation. Drive torque necessary for this occasion can be obtained by the following formula.

$$T_2 = T_1 + J \bullet \dot{\omega} \qquad \cdots 29)$$

$$J = J_M + J_{G1}\left(\frac{N_1}{N_2}\right)^2\left[J_{G2} + J_S + m\left(\frac{l}{2\pi}\right)^2\right] \quad (\mathrm{kg \cdot m^2}) \qquad \cdots 30)$$

In this formula:

T_2 : Maximum drive torque at time of acceleration (N · m)

$\dot{\omega}$: Motor's angular acceleration (rad/s^2)

J : Moment of inertia applied to the motor (kg · m^2)

J_M : Moment of inertia of the motor (kg · m^2)

J_{G1} : Moment of inertia of Gear 1 (kg · m^2)

J_{G2} : Moment of inertia of Gear 2 (kg · m^2)

J_S : Moment of inertia of the screw shaft (kg · m^2)

When selecting a motor, it is necessary to examine the maximum torque of the motor relative to the drive torque T_2 at the time of acceleration.

For the calculation of the moment of inertia of a cylindrical object (ball screw, gear, etc.), please refer to the formula below.

Formula for the moment of inertia of a cylindrical object

$$J = \frac{\pi \bullet \gamma}{32} D^4 \bullet L \ (\mathrm{kg \cdot cm^2}) \qquad \cdots 31)$$

In this formula:

γ : Material density (kg/cm^3)

D : Diameter of the cylindrical object (cm)

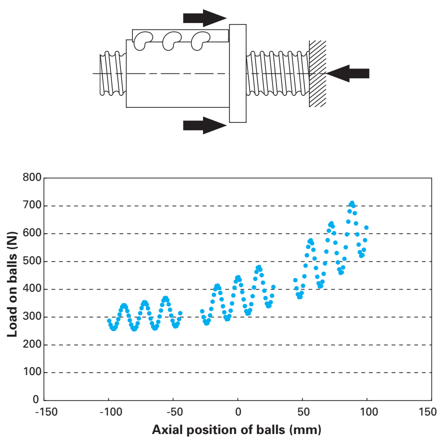
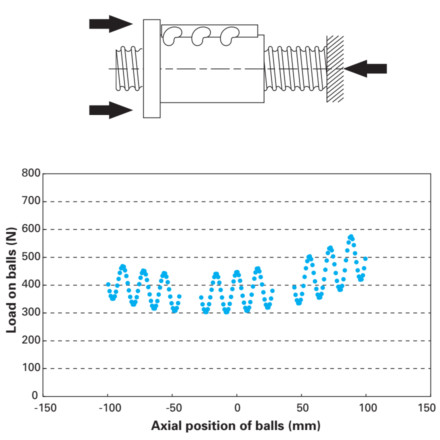
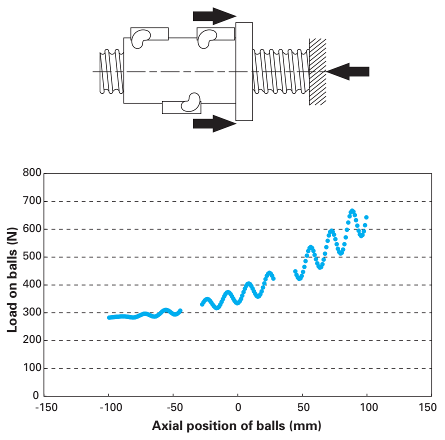
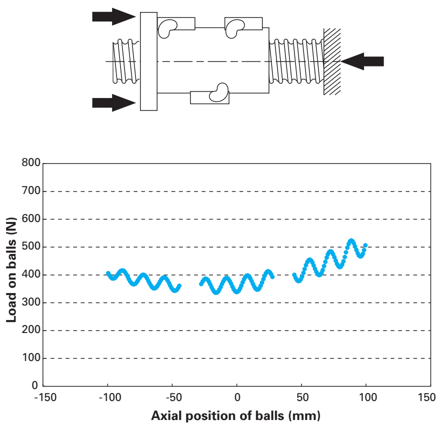
L : Length of the cylindrical object (cm)

B-2-8 Even Load Distribution in Ball Nuts (Ball Screws for High-Load Drives)

Generally, the distribution of loaded balls in a ball nut is three-dimensionally asymmetric, thus resulting in uneven load distribution to the balls and ball nut. NSK has taken measures for even load distribution on the balls by an optimal arrangement of the position of ball recirculation circuits.

Additionally, a heavier load results in measurable axial deformation of the screw shaft and the ball nut, thus further increasing the unevenness of load distribution. We have lessened the unevenness of load distribution to the balls by arranging the load acting point of the ball nut and the screw shaft opposite to each other. The relation between loading points and load distribution is shown in **Fig. 8.1**, while **Table. 8.1** shows the results of load distribution analysis.

Table. 8.1 Results of equalization of load distribution

	Conventional mounting direction	NSK recommended mounting direction
Conventional design	 	
HTF design	 	

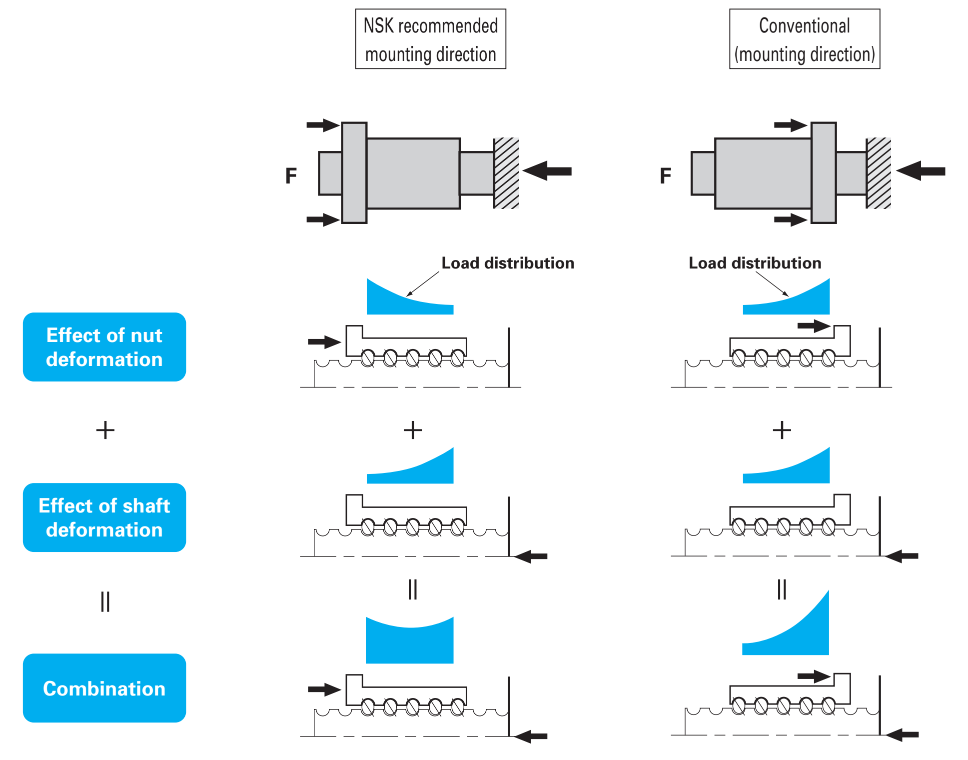


Fig. 8.1 Relationship between acting point of load and load distribution

B-2-9 Lubrication of Ball Screws

Lithium soap-based grease with base oil viscosity of 30 to 140 mm^2/s (40°C) is recommended for grease lubrication and oil of ISO VG 32 to 100 for oil lubrication.

In general, a lubricant with low base oil viscosity is recommended where a ball screw is used for high-speed operation and thus requires reducing thermal elongation of the screw shaft. On the other hand, a lubricant with high base oil viscosity is recommended for low-speed, high-temperature operation or high-load, oscillating operation.

Please consult NSK about greases for high-load drives and high-temperature applications.

NSK offers "NSK Grease Units" as standard products for a variety of applications. NSK Grease Units for ball screw lubrication include:

1) Various types of grease in bellows tubes which can be easily attached to a grease pump

2) Hand grease pumps which are compact and easy to use

3) Nozzles

Table 9.1 shows NSK grease and names of other ball screw grease.

Table 9.2 explains check points in lubrication and standard intervals between replenishments. It is important to wipe off old grease from the screw shaft prior to applying new grease. Page D16 also explains in detail the replenishing methods.

Table 9.1 Grease for ball screw

Product name	Thickener	Base oil	Base oil viscosity mm^2/s (40°C)	Range of temperature for use (°C)	Application
NSK Grease AS2	Lithium	Mineral oil	130	–10 – 110	For general use at high load
NSK Grease PS2	Lithium	Synthetic oil combined with Synthetic hydrocarbon oil	15.9	–50 – 110	For light load
NSK Grease LR3	Lithium	Synthetic oil	30	–30 – 130	For high-speed medium load
NSK Grease LG2	Lithium	Mineral oil combined with Synthetic hydrocarbon oil	32	–20 – 70	For cleanroom environments
NSK Grease NF2	Urea composite	Synthetic hydrocarbon oil	26	–40 – 100	For fretting resistance

∗Refer to page D13 for characteristics of NSK greases.

Table 9.2 Checking lubricant and intervals of replenishment

Lubricating method	Checking intervals	Check points	Replenishment/replacement interval
Intermittent automatic oil supply	Once a week	Remaining volume, contamination	Supply oil when checking (depending on the tank volume)
Grease	2 – 3 months after start of use	Clean, foreign matters	Generally once a year (replenish when necessary)
Oil bath	Every day, when starting work	Oil level	Specify according to oil consumption

B-2-10 Dust Prevention for Ball Screws

If foreign matter enters inside the ball nut, all screw grooves and balls wear rapidly, and the ball screw may malfunction due to damage of groove and/or ball recirculation system. Use bellows or telescopic pipes (**Fig. 10.1**) to keep foreign matter from entering into the feed screw system. Install these items so as to exclude foreign matter completely from the ball screw.

It is even more effective to add seals on the ball nut as shown in **Figs. 10.2** to **10.7**. We provide the seals listed in **Table 10.1**.

Table 10.1 Seal

	Sealing capability	Torque	Heat	Grease retention	Application
Thin plastic seal	○	○	○	○	End defector recirculation, HMS model, BSL model
Plastic seal	×	◎	◎	×	Tube recirculation, deflector (bridge) recirculation (seals are not used with leads 1 mm or smaller)
Wiper seal	○	×	×	○	
X1 seal	◎	○	○	◎	HMS model, HMD model
High performance seal	◎	○	○	○	VSS model
Brush-seal	△	○	○	△	R model (plastic seals are used for shaft diameters of 14 mm of less)

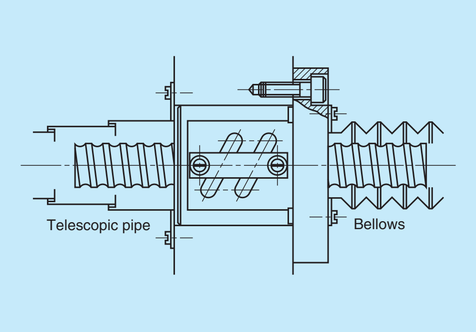


Fig. 10.1 Dust prevention by telescopic pipe and bellows

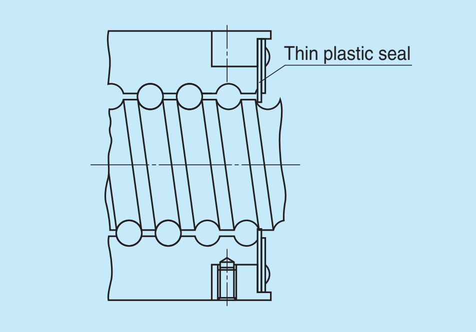


Fig. 10.2 Thin plastic seal

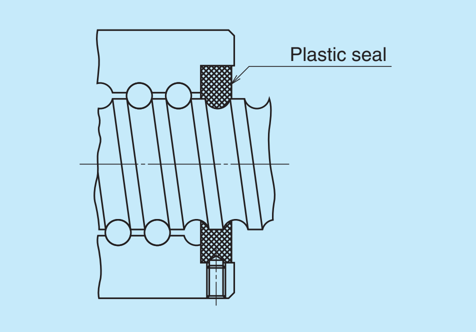


Fig. 10.3 Plastic seal

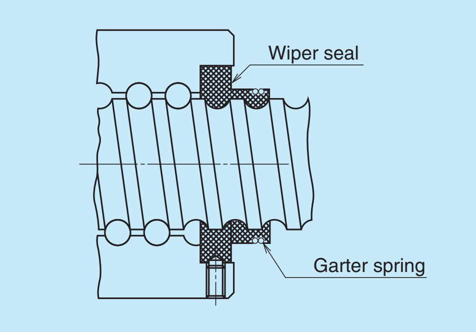


Fig. 10.4 Wiper seal

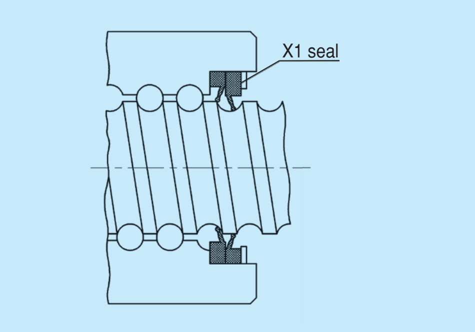


Fig. 10.5 X1 seal

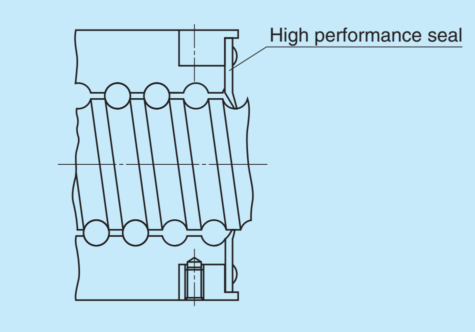


Fig. 10.6 High performance seal

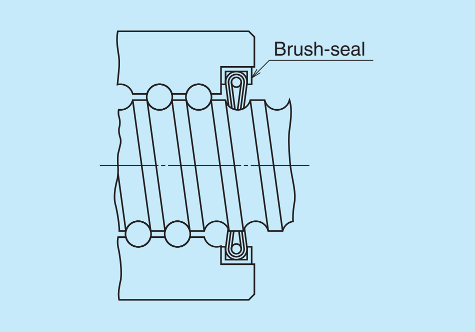


Fig. 10.7 Brush-seal for R Model

B-2-11 Rust Prevention and Surface Treatment of Ball Screws

(1) Stainless steel ball screw

KA model ball screws made of stainless steel are available. Please consult NSK for a custom made stainless steel ball screw.

(2) Types of surface treatment

The following are common types of treatment.

○Low temperature chrome plating
- Used to prevent corrosion and light reflection, and for cosmetic purposes.

○Fluoride low temperature chrome plating
- Fluoroplastic coating is provided following the low temperature chrome plating.
- Resistance to corrosion is higher than the low temperature chrome plating.

○Hard chrome plating
- Very hard coating provides high resistance to both wear and corrosion.

○Electroless nickel plating
- Creates a film of consistent thickness on complex shaped items.
- For corrosion prevention.

(3) Recommended surface treatment

Among the surface treatments mentioned above, we recommend "Low temperature chrome plating" and "fluoride low temperature chrome plating" for rust prevention because of humidity chamber test results.

However, never apply any organic solvent for degreasing because it will have an adverse effect on antirust characteristics.

Table 11.1 Surface treatment length

	Applicable length
Low temperature chrome plating	5 m or less
Fluoride low temperature chrome plating	4 m or less

Refer to "1.3 Rust Prevention and Surface Treatment" (page D5) for the results of humidity chamber tests.

B-2-12 Ball Screw Specifications for Special Environments

B-2-12.1 Cleanroom Environments

NSK manufactures NSK Clean Grease "LG2" and "LGU" for NSK linear guides, ball screws, and Monocarriers used under normal temperature and pressure in cleanrooms.

LG2 and LGU grease have stable torque characteristics far superior to that of vacuum grease which has been used as a countermeasure against dust generation. LG2 and LGU also have sufficient durability and dust prevention capability.

Features of "LG2" and "LGU"

(a) Generates less dust than prevailing vacuum grease and general greases. Cleanliness is enhanced by simply switching the grease to LG2 or LGU.

(b) Extremely low and stable torque characteristics. LG2 and LGU are ideal for high-speed operation.

(c) Unlike prevailing vacuum greases, LG2 and LGU have a nature similar to general grease. Their effect is long-lasting and sufficiently durable. They greatly contribute to minimize the frequency of maintenance.

(d) They have an equal capability in rust prevention as general grease and are reliable.

When using NSK linear guides, ball screws, or Monocarriers in a cleanroom environment, request LG2 or LGU as a packed lubricant prior to delivery. NSK also makes bellows tubes which contain 80 grams of LG2 or LGU. The tube is easy to use and is ideal for maintenance (refer to pages B401 and D19). Wash to remove grease or oil substances prior to use.

Refer to page D8 for the functions and characteristics of LG2 and LGU.

B-2-12.2 Measures for Use Under Vacuum

NSK developed MoS_2 / WS_2 spattering and dry-filmed ball screws for equipment to be used in space. NSK also makes soft-metal film (gold and silver) ball screws to be used in a vacuum environment for semiconductor and flat panel display processing equipment.

Lubricants widely used for ball screws in a high vacuum are:
- Vacuum grease which uses a base oil of low vapor pressure.
- Solid lubricants such as MoS_2 and WS_2 used mainly for equipment in space.
- Solid lubricants with soft-metal such as gold, silver, or lead film.

When used for semiconductor and flat panel display manufacturing equipment, the oil of vacuum grease evaporates and causes environmental contamination. Also, it hinders creation of a super high vacuum. MoS_2 in the state of solid lubricant generates a large volume of dust, and Mo is unsuitable for semiconductors and reformed surfaces. Therefore, it is not suitable for processing machines for semiconductors and flat panel displays.

NSK recommends solid lubricant ball screws with a long life. These ball screws are treated with special silver film by NSK's unique processing technology and can be used in a super-high vacuum. However, solid lubricant may cause the film to peel off and stick to surface of ball grooves repeatedly, causing torque to rise momentarily on some occasions. The drive motor should be of large capacity to handle this drastic variation of torque.

Refer to page D7 for the test data of ball screws in vacuum.

For ball screw specifications for special environments, refer to page D2.

B-2-13 Noise and Vibration

B-2-13.1 Consideration of Noise

As the machine operates at higher speeds, noise levels tend to increase. Covering the nut section is insufficient to lower noise. NSK has abundant data (NSK Motion & Control Technical Journal No.4, etc.), and offers advice to users regarding selecting ball screws.

To lower noise level in general, the following points should be taken into consideration.

(a) Use as a large lead as possible to reduce rotational speed.

(b) Use a ball screw with the smallest outer diameter possible.

(Designs near limits often require special specifications. Please consult NSK.)

For reference, noise levels by ball screws alone are plotted below. The formula for calculation is also shown below.

(a) Average value at measuring distance of 400 mm

$$\text{dB (A)} = 25.2\ \{\log_{10}(D_w \cdot d_m \cdot n \times 10^{-5})\} + 63.9 \qquad \cdots 32)$$

(b) Upper limit at measuring distance of 400 mm

Average value + 6 dB (A)

D_w : Ball diameter (mm)

d_m : Ball pitch circle dia. (mm)

n : Rotational speed (min^{-1})

If measuring distance is 1 m, 8 dB (A) is subtracted from the 400 m average value to obtain the average noise level.

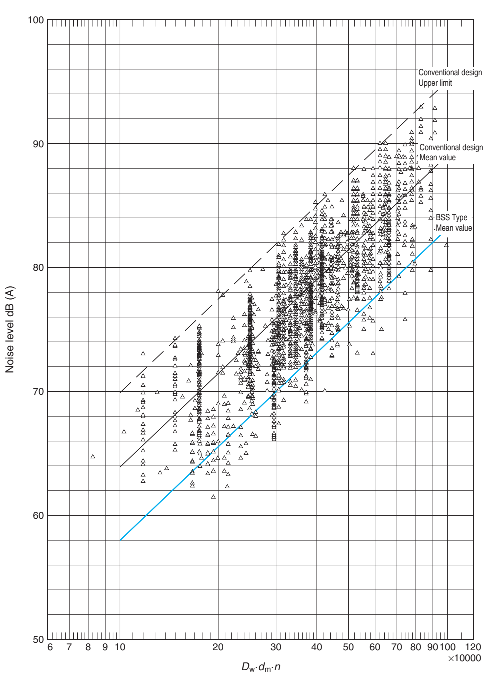


Fig. 13.1 Noise levels of ball screws

<<Calculation example for noise levels>>

<Use conditions>

Model No.: ZFT4010-10

From the dimension table: $D_w = 6.350$

$d_m = 41$

Maximum rotational speed: 2 000 min^{-1}

<Calculation>

By formula 34):

$$\begin{aligned}\text{dB (A)} &= 25.2\ \{\log_{10}(D_w \cdot d_m \cdot n \times 10^{-5})\} + 63.9\\ &= 25.2\ \{\log_{10}(6.350 \times 41 \times 2\,000 \times 10^{-5})\} + 63.9\\ &= 82\ \text{dB (A)}\end{aligned}$$

The average value of noise level by ball screws alone at maximum rotational speed (measuring distance 400 mm) is 82 dB (A). Upper limit is: 82 dB (A) + 6 dB (A) = 88 dB (A)

If the measuring distance is 1 m, the average value of noise level is 74 dB (A), and upper limit is 80 dB (A).

When installed, the noise of ball screw becomes higher from the noise of the machine and the characteristics of machine vibration.

B-2-13.2 Consideration of Ball Screw Support System

A ball screw has low radial rigidity because its support span is long compared to its shaft diameter. It has only small damping capacity, requiring as much support rigidity as possible through design.

A simplified support bearing system to cut costs invites noise and vibration problems. Therefore, consideration to the ball screw support system of both shaft ends is increasingly becoming important as the speed of machines is ever-increasing.

If one shaft end must be left unfixed without a support bearing due to structural reasons, noise and vibration problems may occur. These problems are related to the natural vibration frequency of the screw shaft on the unsecured end. This problem can be averted by installing an impact damper to the shaft end (**Fig. 13.2**). Please consult NSK for details.

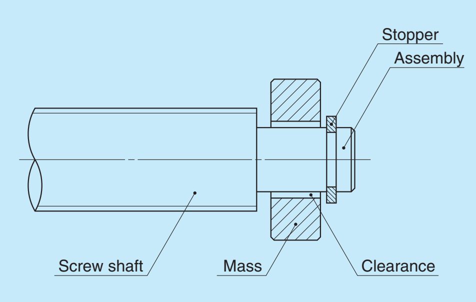
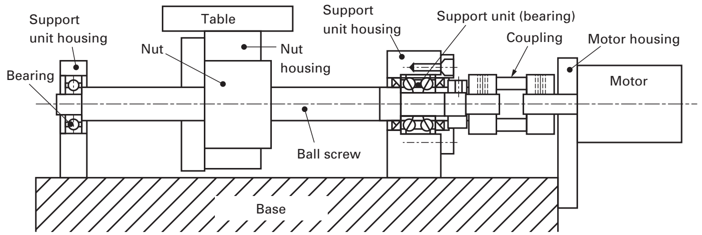


Fig. 13.2 Impact damper (Applied for patent)

B-2-14 Installation of Ball Screw

The following simplified component drawing shows a representative example of a single-axis table.



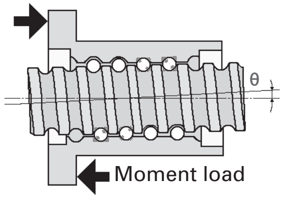
The screw shaft of the ball screw is supported by a nut and bearings, and it is driven by a motor.
It is critically important to complete centering work to ensure the predetermined operation life, functionality, and accuracy of the ball screw. In general, the following accuracy is recommended for precision-class applications.

Inclination of center line: 1/2000 or less (Target: 1/5000 or less)
Eccentricity: 0.020 mm or less

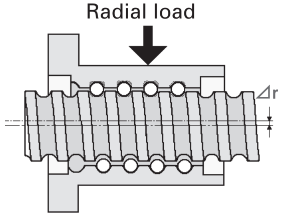
The following problems could occur if installation error negatively affected the ball screw:

(1) Effects on durability:
→ Lowered flaking life or wearing life.
(2) Effects on torque characteristics:
→ Increased friction torque or torque variations.
(3) Effects on feed rate:
→ Decreased accuracy in motion.

<Inclination of center line>

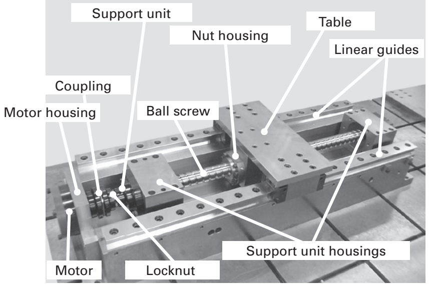


<Eccentricity>



Overall View of Assembled Body

Explanations of the assembly procedure are given below, using a single-axis table as an example:
In this explanation, two different installation procedures are provided: one for machine tools, where high installation accuracy is required, and another for general industrial machinery.



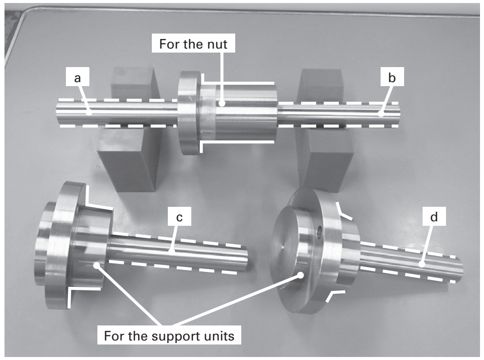
B-2-14.1 Installation Procedure for High Accuracy Applications (Machine Tools, etc.)

A single-axis table must be installed according to the following procedure:

1. Centering of nut housing →
2. Centering of support unit housing →
3. Installation of ball screw →
4. Installation of support units →
5. Adjusting axial runout of screw shaft end and fastening lock nut of support unit →
6. Replenishing lubrication grease →
7. Verification of functionality →
8. Centering of motor housing →
9. Installation of coupling and motor →
10. Trial operation

I. Jigs required for installation

Test bars:
(For the nut: one piece; for the support units: two pieces)
⇒ For centering and measurement of axial runout. The portions onto which the housing is installed (marked with the solid line) and the portions subject to measurement (a, b, c and d, marked with the broken line) must be finished to high precision.

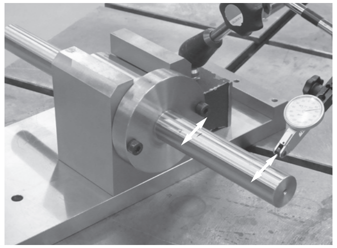


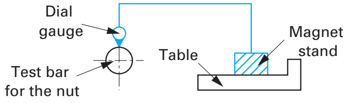
II. Installation of assembled body

1. Centering of nut housing

1-1

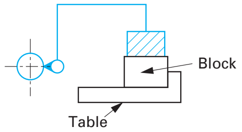
Turn the table over and mount the nut housing and test bar for the nut onto it.
Set up a magnet stand with a dial gauge attached, taking the rear side of the table as reference. Measure two spots at the top of the test bar for the nut by moving the magnetic stand around to check the inclination in the vertical direction.
If inclination of center line is observed, adjust the surfaces on which the nut housing is installed.

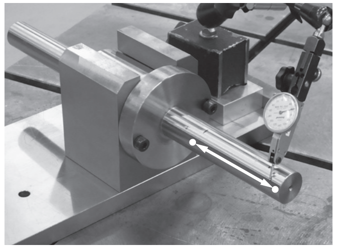




1-2

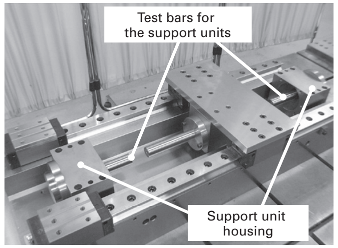
Fix the magnetic stand with the dial gauge attached onto a block. While pressing the block toward the reference surface of the table, move the magnet stand around. Measure the side surface of the test bar for the nut and check the inclination in the horizontal direction. If inclination of center line is observed, adjust the portion where the nut housing is installed onto the table.





2. Centering of support unit housing

Install the linear guides onto the machine base, and then install the table, which has already been centered. (For installation of linear guides, please refer to A77 in CAT. No. 9008.)



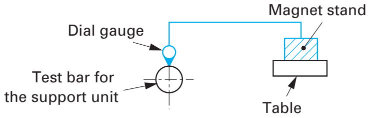
2-1

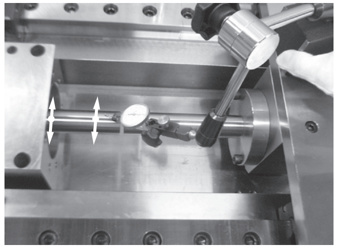
Install the test bar for the support unit onto the support unit housing.

2-2

Install the magnet stand with the dial gauge attached using the table as reference. While moving the table, measure the two spots at the top of the test bar for the motor-side support unit to check the inclination in the vertical direction. If inclination of center line is observed, adjust the mounting surfaces of the support unit housing.

Follow the same procedure for the opposite side of the motor.



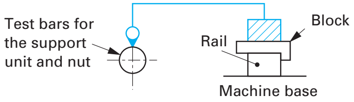


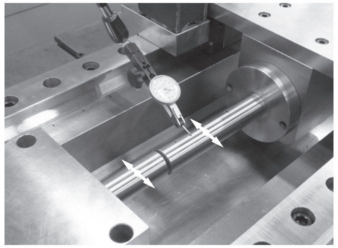
2-3

Fix the magnet stand with the dial gauge attached onto a block, and install the block onto the top surface of the linear guide rail. Measure the top points of the test bar for the nut and the support unit to check for eccentricity in the vertical direction.

If eccentricity is observed, adjust the mounting surface of the support unit housing.

Follow the same procedure for the opposite side of the motor.

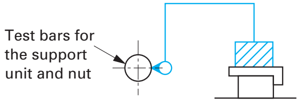


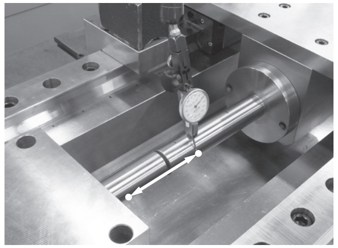


2-4

Fix the magnet stand with the dial gauge attached onto a block. While pressing the block toward the top surface of the linear guide rail as reference and moving it, take measurements of the side surfaces of the test bars for the nut and support unit to check for eccentricity in the horizontal direction. If eccentricity is observed, adjust the mounting surface of the support unit housing.

Follow the same procedure for the opposite side of the motor.



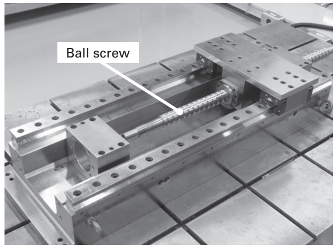


3. Installation of ball screw

Remove all test bars from the housing.

Clean the outside diameter surface of the nut and the inside diameter surface of the housing using a cloth, and install the ball screw.

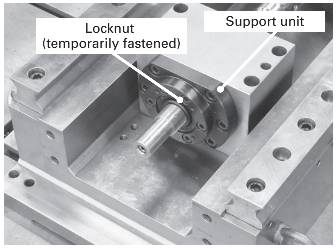
Apply grease to spots with metal-to-metal contact to avoid any scratches or dents. While doing this, be careful not to drop the ball screw or hit it with anything which might cause malfunctions. If the housing must be removed in order to mount the ball screw, use a positioning pin so that the housing can be mounted back in its original position.



4. Installation of support units

Insert the screw shaft into the support unit housing and mount the support units on both shaft ends. Fix the motor-side support unit to the housing. Fasten the locknut temporarily.

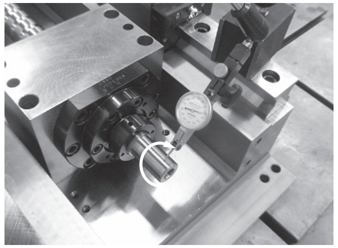
Follow the same procedure for the opposite side of the motor.



5. Adjusting axial runout of screw shaft end and fastening lock nut of support unit

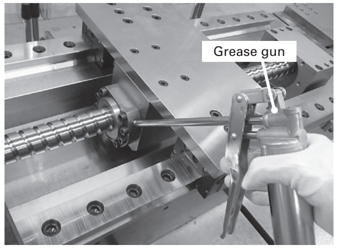
Bring the dial gauge into contact with the top of the shaft end. Then, while rotating the screw shaft, measure the runout of the shaft end. While adjusting the shaft end runout, fasten the locknut to attain the required fastening torque.

Follow the same procedure for the opposite side of the motor.



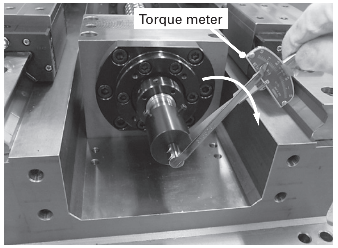
6. Replenishing lubrication grease

Wipe away the antirust oil from the empty ball screw to which grease has not been applied, and supply grease through the grease hole to fill the inside. (Supply the grease while rotating the ball screw in the direction that moves grease toward the inside of the nut. This will lubricate the ball screw evenly.)
If you use a ball screw already filled with grease, it is not necessary to add more.



7. Verification of functionality

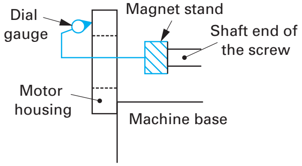
To check whether the ball screw has been installed accurately, verify its functionality. Measure the driving torque with a torque meter over the entire movable range of the screw.
Confirm (including by touch) that there are no abnormalities.

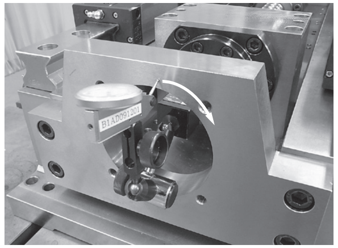


8. Centering of motor housing

8-1

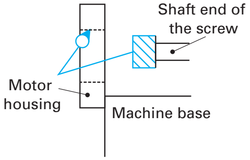
Install the motor housing, and mount the dial gauge onto the shaft end of the ball screw. Rotate the screw shaft to check the inclination of the motor housing with the stylus of the dial gauge in contact with the end face of the motor housing. If inclination of the end surface of the motor housing is observed, adjust the mounting surface of the motor housing.

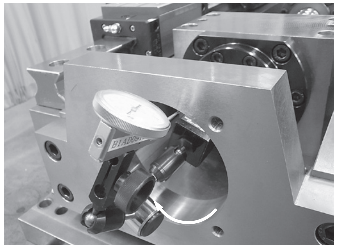




8-2

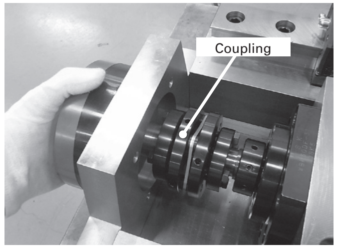
Set up the dial gauge onto the end face of the ball screw. Rotate the screw shaft to check eccentricity with the stylus touching the inside diameter surface of the motor housing. If eccentricity is observed, adjust it by installing the motor housing appropriately.





9. Installation of coupling and motor

Mount the coupling onto the shaft end of screw, and install the motor.
Fasten the bolts of the coupling to connect the shaft end with the motor shaft.



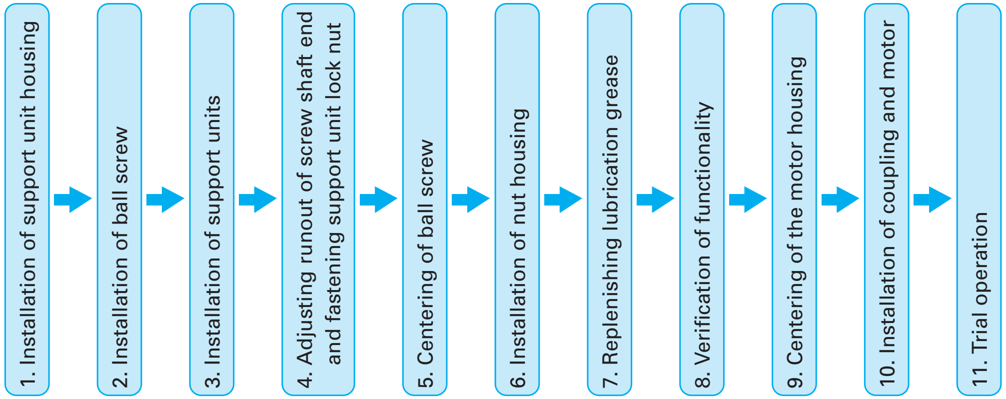
10. Trial operation

At the beginning, run the assembly at low speed to check for vibrations and noise. Then, run it at moderate speed, and finally at high speed and check for abnormalities. Then run it continuously for approximately two hours and carry out a running-in operation while checking for any abnormalities. During this running-in operation, the excess grease inside of the nut is pushed out of the nut. Wipe it away.

B-2-14.2 Installation Procedure for General Industrial Machinery

In this procedure, the ball screw is installed with the accuracy required for the linear guide. The centering of the nut and table are adjusted by installing the nut housing appropriately. Since no test bars are required and the inside diameter of the nut housing does not need to be fit with the nut, the ball screw can be installed relatively easily and cheaply.

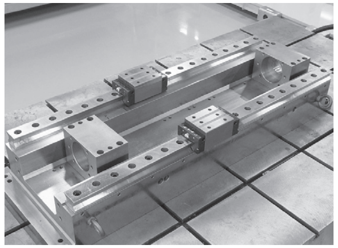
The installation procedure used for a single-axis table is shown below:



I. Installation of assembled body

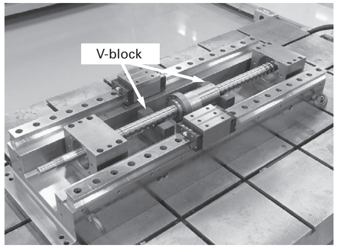
1. Installation of support unit housing

Install the linear guide onto the machine base.
(For installation procedurez for linear guidez, please refer to A77, CAT. No. 9908.)
Place the support unit housing at the predetermined position and fasten it temporarily.



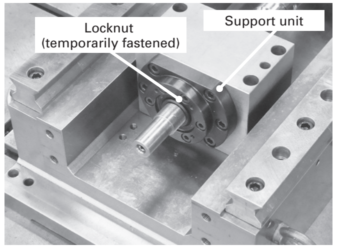
2. Installation of ball screw

Clean the outside diameter surface of the nut and the inside diameter surface of the housing using a cloth, and install the ball screw.
Apply grease to spots with metal-to-metal contact to avoid scratches and dents. While doing this, be careful not to drop the ball screw or hit it with anything which might cause malfunctionx.
Conduct this task using a V-block to prevent scratches and dents.



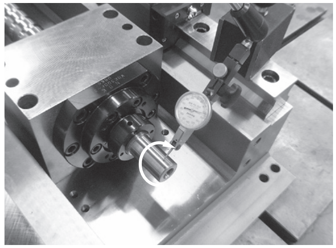
3. Installation of support units

Insert the screw shaft into the support unit housing and mount support units on both shaft ends. Fix the motor-side support unit to the housing. Fasten the locknut temporarily.
Follow the same procedure for the opposite side of the motor.



4. Adjusting runout of screw shaft end and fastening support unit locknut

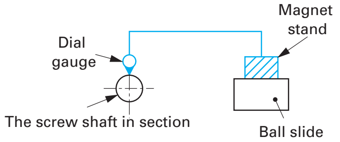
Bring the dial gauge into contact with the top of the shaft end. Then, while rotating the screw shaft, measure the runout of the shaft end. While adjusting the shaft end runout, fasten the locknut to attain the required fastening torque.
Follow the same procedure for the opposite side of the motor.

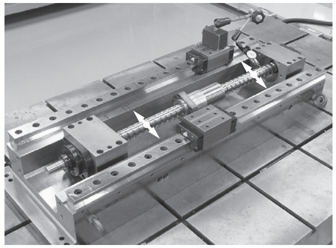


5. Centering of ball screw

5-1

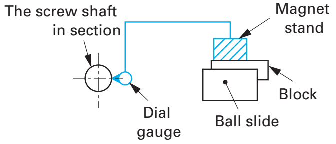
Set up a magnet stand with a dial gauge attached, using the ball slide of the linear guide as a reference. Measure the top of the screw shaft in the vicinity of the support unit housing both on the motor and opposite side to check the inclination in the vertical direction. If inclination of center line is observed, adjust the mounting surface of the support unit housing.

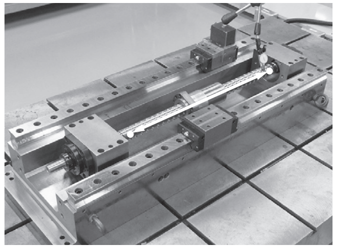




5-2

Fix the magnet stand with the dial gauge attached onto a block. While pressing the block toward the ball slide of the linear guide, move the block. Measure the side surface of the screw shaft in the vicinity of the support unit housing both on the motor and opposite side to check the inclination in the horizontal direction. If inclination of center line is observed, adjust by installing the support unit housing appropriately.
After the adjustment, fix the support unit housings of the motor side and the opposite side.



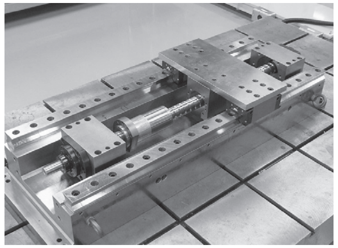


6. Installation of nut housing

6-1

Temporarily fasten the nut housing onto the table, and fasten the table, using the ball slide of the linear guide as reference surface.

To minimize bending of the screw shaft caused by the weight of the nut, move the nut toward the support unit housing at the shaft end.

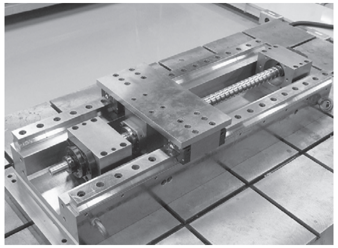


6-2

Move the table toward the nut, and fasten the nut to the nut housing.

Loosen the bolts that fasten the table to the nut housing, and re-fasten them.

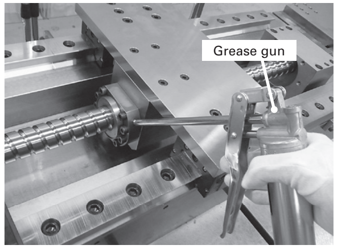
Loosen the bolts that fasten the nut housing and the nut, and re-fasten them.



7. Replenishing lubrication grease

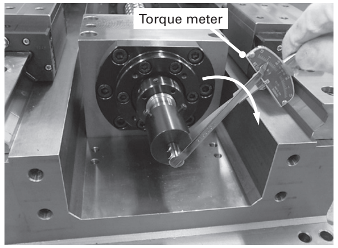
Wipe away the antirust oil from the empty ball screw to which grease has not been applied and supply grease through the grease hole to fill the inside. (Supply grease while rotating the ball screw in the direction that moves grease toward the inside of the nut. This will lubricate the ball screw evenly.)

If you use a ball screw already filled with grease, it is not necessary to add more.



8. Verification of functionality

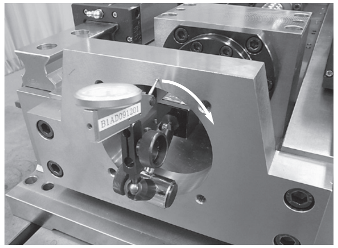
To check whether the ball screw has been installed accurately, verify its functionality. Measure the driving torque with a torque meter over the entire movable range of the screw. Confirm (including by touch) that there are no abnormalities.

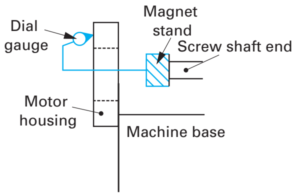


9. Centering of motor housing

9-1

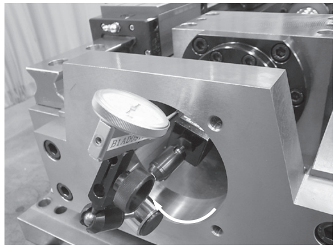
Install the motor housing, and mount the dial gauge onto the end face of the ball screw. Rotate the screw shaft to check the inclination of the motor housing with the stylus of the dial gauge in contact with the end face of the motor housing. If inclination of center line is observed, adjust the mounting surface of the motor housing.

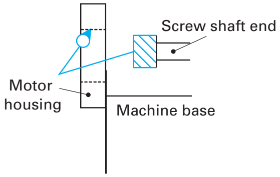




9-2

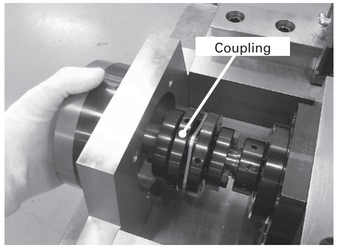
Set up the dial gauge onto the end face of the screw shaft. Rotate the screw shaft to check eccentricity with the stylus touching the inside-diameter surface of the motor housing. If eccentricity is observed, adjust it by installing the motor housing appropriately.





10. Installation of coupling and motor

Mount the coupling onto the shaft end, and install the motor. Fasten the bolts of the coupling to connect the shaft end with the motor shaft.



11. Trial operation

At the beginning, run the assembly at low speed to check for vibrations and noise. Then, run it at moderate speed, and finally at high speed and check for abnormalities. Then run it continuously for approximately two hours and carry out a running-in operation while checking for any abnormalities. During this running-in operation, the excessive grease inside of the nut is pushed out of the nut. Wipe it away.

B-2-15 Precautions for Designing Ball Screws

B-2-15.1 Safety System

As shown in the illustration on page B352, a stopper is installed in some cases to prevent the nut from overrunning due to malfunction of the safety system of the machine itself, or human error during operation.

The travel stopper should be installed at a place where it will not come into contact with the nut when the nut reaches the designed stroke end.

An impact absorbing travel stopper (NSK patent, refer to page B402) is available.

B-2-15.2 Design Considerations for Assembly

(1) Cutting through the thread screw to the end

Some recirculation systems, including deflector (bridge), end-cap, S1 (high-load drive), and some end-deflector specifications, require one end of the thread screw to be cut. This is necessary to assemble the ball nut to the screw shaft (**Fig. 15.1**). In this case, the shaft end diameter to where this "cut-through thread" is made should be 0.2 mm or smaller than the ball groove root diameter "d_r". (See the dimension tables.) A similar precaution is required when it is absolutely necessary to remove the nut from the screw shaft in order to install the ball screw to the machine. Also, if using the cut-through end as the shoulder of the support bearing, make certain that a sufficient amount of the effective flat surface is left from the root diameter. If it is insufficient, the bearing cannot be installed perpendicularly to the bearing seat. (**Fig. 15.2**)

(2) Designing the screw shaft end and the nut mounting area

When installing a ball screw to the machine, avoid a design which makes it necessary to separate the nut from the screw shaft as shown in **Fig. 15.3**. If separated, the balls may fall out. The separation may also deteriorate the ball screw accuracy or damage the ball screw. If separating them is unavoidable, please furnish NSK with the component which is to be installed between the nut and screw shaft. NSK will install the component prior to delivery.

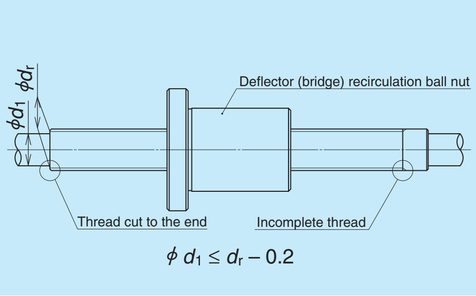


Fig. 15.1 Shaft end of a deflector (bridge) recirculation system ball screw

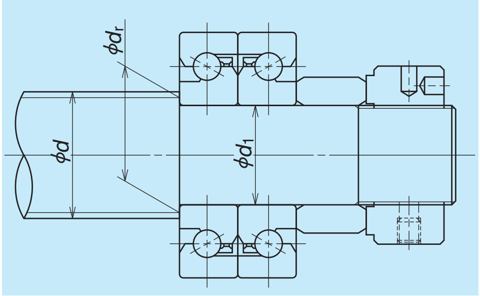


Fig. 15.2 Support bearing and end face (shoulder) for installation

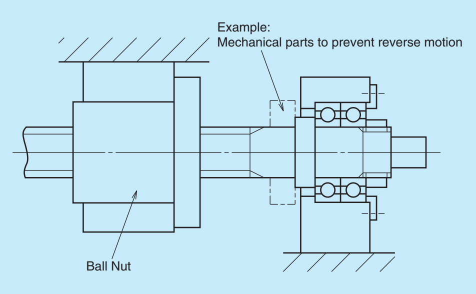


Fig. 15.3 Nut and ball screw are required to be separated when installing in this structure.

(3) Removing the nut from the screw shaft at the time of assembly

If it is unavoidable, use an arbor (**Fig. 15.4**) to keep the balls in the nut. In this case, the outside diameter of the arbor should be approximately 0.2 mm to 0.4 mm smaller than the ball groove root diameter "d_r." However, Miniatures are excluded.

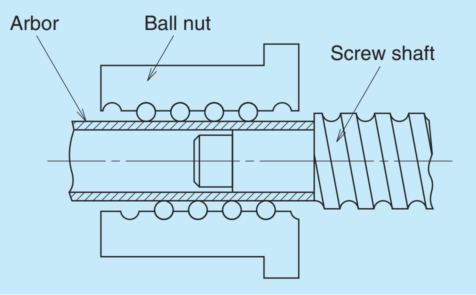


Fig. 15.4 Arbor to install and remove nut

(4) Centering of the ball nut when installing

When installing the nut as shown in **Fig. 15.5**, provide a space between the housing and the nut body diameter, allowing centering to be performed.

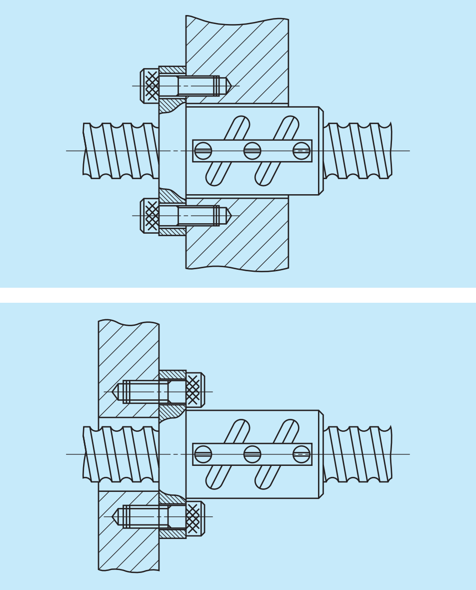


Fig. 15.5 Fixing a ball nut by flange

(5) Preventing the thread screw of nut from loosening

When installing and securing the nut to the housing at the thread screw section, as in the case for RNCT ball screws, apply an agent which prevents the nut from loosening.

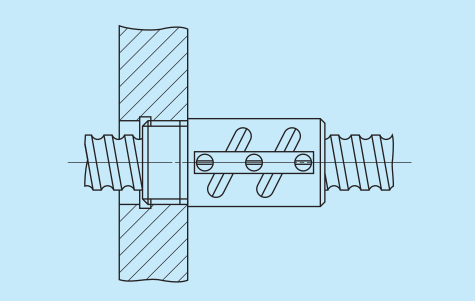


Fig. 15.6 Fixing a ball nut with thread screw

(6) Installation of brush-seal to the nut

If a brush-seal is installed at the thread screw side of the nut similar to the RNCT model which comes with a thread screw, the brush-seal should be secured as shown in **Fig. 15.7**.

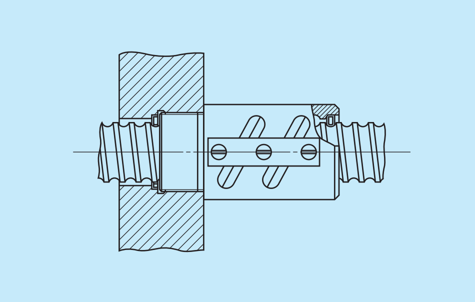


Fig. 15.7 Installation of brush-seal to a ball nut with thread screw

B-2-15.3 Effective Stroke of Ball Screws

When hardened by induction hardening, the hardness of a ball screw may be slightly low at both ends of the screw section. Consider this low hardness prior to determining the length of the effective stroke. Please consult NSK for details.

B-2-15.4 Machining after Delivery

When, after the delivery of a ball screw, you require a drill knock pin hole on the screw shaft end or at the nut mounting area please inform NSK on the position and size of the hole.
NSK will take measures and protect designated spots from heat treatment prior to delivery to make subsequent machining easy.

B-2-15.5 "NSK K1" Lubrication Unit

When using the NSK K1 lubrication unit, be aware of the operating temperature and chemicals that contact the unit to maintain the K1's best performance.

Temperature range for use:

Maximum temperature; 50°C

Momentary maximum temperature; 80°C

Chemicals to avoid contact with:

Do not leave the K1 unit in organic solvents, white kerosene such as hexane, thinners which remove oil, and rust preventive oil which contains white kerosene.

Water-based cutting oil, oil-based cutting oil, AS2 mineral grease, and PS2 ester grease can be used without damaging the K1 unit.

B-2-15.6 Intermediate support

The deflection of a long screw shaft due to its own weight may cause a radial load on the nut. There is also a risk that excessively large repeated load (rotational bending stress) will be applied to the shaft end during rotation. We therefore recommend intermediate support of the screw shaft at multiple points to minimize deflection.

B-2-15.7 Shaft End Strength

Take extra care to consider the strength of the shaft end shape and provide a design with a safety factor in mind when:

*A pulley is mounted to the ball screw drive with a folded motor

*Radial loads are applied due to the mounting structure

*The ball screw is used under tension.

B-2-16 Shaft End Machining

You must machine the shaft ends of:

*Precision ball screws with blank shaft ends

*R model ball screws with blank shaft ends, and

*Completed ball screws that require additional machining

The following summarizes the machining of these shaft ends. For details, please contact NSK.

(1) Machining of blank shaft ends of precision ball screws

(a) Cutting screw shaft

Use a cutting whetstone or the like to cut the shaft, leaving stock for turning. Keep the nut assembled to the screw shaft, and open only one side of the plastic wrapping bag exposing only the shaft end section to be machined, and then cut the screw shaft. This prevents foreign matter from entering the ball screw section. Do the same for other machining.

(b) Precautions in cutting shaft end

Outside of the screw shaft is ground with precision (excluding the R model). There are center holes in the ends. Use them for centering. Do not rotate the shaft quickly or stop it suddenly, or the nut might move along the shaft. We recommend securing the nut with tape. To machine a very long shaft, apply work rests to the screw shaft surface to suppress vibration (especially caused by critical speed).

(c) Turning by lathe

Cut to the length, turn shaft end steps, turn the thread screw, and provide the center hole. Refer to JIS B1192 for shaft end accuracy.

(d) Processing by grinding

Apply the same precautions used for cutting when centering and securing the nut and work rest. Grind sections where the bearings and "Spann ring" are installed.

e) Milling processing

Process keyways and tooth seats for lock washers.

(f) Deburring, washing, and rust prevention

Wash with clean white kerosene after processing. Apply lubricant for immediate use. For later use, apply a rust preventive agent.

Note: Contact NSK if the nut is accidentally removed.

B-2-17 Ball Screw Selection Exercise

Drill 1: High-speed transporting system

1. Design conditions

Table mass : $m_1 = 40$ kg
Mass of the work : $m_2 = 20$ kg
Maximum stroke : $S_{\max} = 700$ mm
Rapid traverse speed : $V_{\max} = 1\,000$ mm/sec (60 m/min)
Positioning accuracy : ±0.05/700 mm (0.005 mm/pulse)
Repeatability : ±0.005 mm
Required life : $L_t = 25\,000$ h (5 years)
Guide way (rolling) : $\mu = 0.01$ (friction coefficient)
Drive motor : AC servo motor
($N_{\max} = 3\,000$ min^{-1})

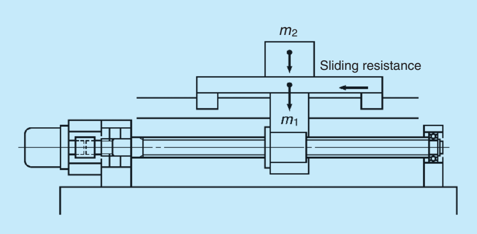


Fig. 17.1 System appearance

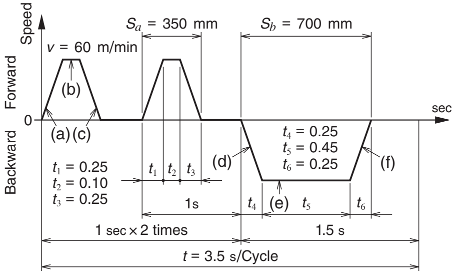


Fig. 17.2 Operating conditions

2. Selection of basic factors

(1) Selection of accuracy grade and axial play

According to **Table 4.1** "Applications for ball screws by accuracy grade" on page B19, the accuracy grade of ball screws for Cartesian industrial robots is C5 to Ct10.

From the following conditions in design, the axial play should be 0.005 mm or less.

Repeatability : ±0.005 (mm)
Resolution : 0.005 mm/pulse

According to **Table 4.2** "Combinations of accuracy grades and axial play" on page B20, you will require the accuracy grade C5 to satisfy the axial play of 0.005 mm or less. Therefore select accuracy grade C5 and the axial play of 0 mm (Z-preload).

(2) Selection of lead

Calculate the lead l based on the maximum speed of the AC servo motor and the rapid traverse speed $V_{\max}$.

$$l \geq \frac{V_{\max}}{N_{\max}} = \frac{1\,000 \times 60}{3\,000} = 20 \text{ (mm)}$$

Select a lead l of 20 mm or larger.

(3) Selection of screw shaft diameter

According to **Table 4.4** "Shaft diameter, lead and stroke of standard ball screws" on page B21, the screw shaft diameter d which has a lead l larger than 20 mm should be in the range of 15 mm to 32 mm. Select the smallest: 15 mm.

(4) Selection of stroke

From **Table 4.4** "Screw shaft diameter, lead, and stroke of standard ball screws" on page B21, a ball screw with shaft diameter d of 15 mm and lead l of 20 mm meets maximum stroke of 700 mm, therefore it is possible to select from standard ball screws. The primary selection is as follows:

Primary selection:
Shaft diameter : 15 (mm)
Lead : 20 (mm)
Stroke : 700 (mm)
Accuracy grade : C5
Axial play : Z

3. Confirmation of standard ball screw

In consideration of delivery time and price, select from standard ball screws with finished shaft ends.

Primary candidate: PSS1520N1D0879

4. Basic safety check

Let's examine the primary candidate.

(1) Allowable axial load

[1] Calculation of allowable axial load

From **Fig. 17.2**: Acceleration α_1 at accelerating / decelerating is:

$$\alpha_1 = \frac{V_{\max}}{t_1} = \frac{1\,000}{0.25} = 4\,000 \text{ (mm/s}^2\text{)} = 4 \text{ (m/s}^2\text{)}$$

Axial load F_i is:

(At the time of acceleration (a)(d))

$$F_1 = \mu\,(m_1 + m_2) \times g + (m_1 + m_2) \times \alpha_1$$
$$= 0.01 \times (40 + 20) \times 9.80665 + (40 + 20) \times 4$$
$$= 246 \text{ (N)}$$

(At the time of constant speed (b)(e))

$$F_2 = \mu\,(m_1 + m_2) \times g = 0.01 \times (40 + 20) \times 9.80665$$
$$= 6 \text{ (N)}$$

(At the time of deceleration (c)(f))

$$F_3 = -\mu\,(m_1 + m_2) \times g + (m_1 + m_2) \times \alpha_1$$
$$= -0.01 \times (40 + 20) \times 9.80665 + (40 + 20) \times 4$$
$$= 234 \text{ (N)}$$

Thus, the maximum axial load P is 246 N.

[2] Buckling load

PSS1520N1D0879 has a support length of 804 mm (L_a as per the dimension table on page B193), and must support maximum axial load P of 246 (N). The support configuration of screw shaft is "Fixed – Simple", and the support configuration of ball nut is "Fixed". Due to the direction of the load, the whole ball screw support configuration is "Fixed – Fixed" (Factor m = 19.9).

From fomula 2) on page B44:

$$d_r \geq \left(\frac{P \bullet L_a^{\,2}}{m} \times 10^{-4}\right)^{1/4} = \left(\frac{246 \times 804^2}{19.9} \times 10^{-4}\right)^{1/4}$$
$$= 5.3 \text{ (mm)}$$

PSS1520N1D0879 has the dimension d_r of 12.2 mm as per the dimension chart (page B193) and therefore meets the conditions.

Result: Acceptable

(2) Allowable rotational speed

The permissible rotational speed listed in the dimension table is 3 150 min^{-1}. Since the motor maximum rotational speed is 3 000 min^{-1}, the operation is in the range of permissible rotational speed.

Result: Acceptable

(3) Checking life expectation

[1] Mean load F_m and mean rotational speed N_m

From the calculation of axial load, rotational speed N_i and the operating time t_i are:

(At the time of acceleration (a)(d))

$$F_1 = 246 \text{ (N)}$$
$$N_1 = \frac{n}{2} = \frac{3\,000}{2} = 1\,500 \text{ (min}^{-1}\text{)}$$
$$t_a = 2 \times t_1 + t_4 = 0.75 \text{ (s)}$$

(At the time of constant speed (b)(e))

$$F_2 = 6 \text{ (N)}$$
$$N_2 = 3\,000 \text{ (min}^{-1}\text{)}$$
$$t_b = 2 \times t_2 + t_5 = 0.65 \text{ (s)}$$

(At the time of deceleration (c)(f))

$$F_3 = 234 \text{ (N)}$$
$$N_3 = 1\,500 \text{ (min}^{-1}\text{)}$$
$$t_c = 2 \times t_3 + t_6 = 0.75 \text{ (s)}$$

Calculation results are shown in **Table 17.1**

Table 17.1 Axial load and rotational speed

Operating conditions	Axial load (N)	Rotational speed (mean) (min^{-1})	Operating time (s)
(a) (d)	$F_1 = 246$	$N_1 = 1\,500$	$t_a = 0.75$
(b) (e)	$F_2 = 6$	$N_2 = 3\,000$	$t_b = 0.65$
(c) (f)	$F_3 = 234$	$N_3 = 1\,500$	$t_c = 0.75$

From formulas 11) and 12) on page B53:

$$F_m = \left(\frac{F_1^{\,3} \bullet N_1 \bullet t_a + F_2^{\,3} \bullet N_2 \bullet t_b + F_3^{\,3} \bullet N_3 \bullet t_c}{N_1 \bullet t_a + N_2 \bullet t_b + N_3 \bullet t_c}\right)^{1/3}$$
$$= 195 \text{ (N)}$$

$$N_m = \frac{N_1 \bullet t_a + N_2 \bullet t_b + N_3 \bullet t_c}{t}$$
$$= 1\,200 \text{ (min}^{-1}\text{)}$$

[2] Calculation of life expectancy

As the basic dynamic load rating C_a of PSS1520N1D0879 (Clearance Z) is 5 660N (as per the dimension table on page B193), from formulas 8) and 9) on page B53:

$$L_t = \left(\frac{C_a}{F_m \bullet f_w}\right)^3 \times \frac{1}{60N_m} \times 10^6$$

$$= \left(\frac{5\,660}{195 \times 1.2}\right)^3 \times \frac{1}{60 \times 1\,200} \times 10^6$$

$$\fallingdotseq 196{,}500$$

The ball screw satisfies the required life.

<u>Result: Acceptable</u>

5. Check other requirements

(1) Accuracy and axial play

As per the dimension table on page B180 and **Table 1.2** for the permissible value of lead accuracy on page B38:

According to **Table 1.2**:

Accuracy grade: C5

$e_p = \pm 0.035/800$ (mm)

$\upsilon_u = 0.025$ (mm)

This grade satisfies the required positioning accuracy of ±0.05/700 mm.

The checking of axial play is omitted here since it is explained in "2. Selection of basic factors."

(2) Drive torque

Required specifications are as follows.

Motor rotational speed: 3 000 min^{-1}

Time to reach maximum speed: Less than 0.25 sec

[1] Load (converted to the motor axis)

Using formulas 30) and 31) on page B64, calculate the moment of inertia where γ is the material density of the ball screw.

(Screw shaft)

$$J_B = \frac{\pi \bullet \gamma}{32} D^4 \bullet L = \frac{\pi \times 7.8 \times 10^{-3}}{32} \times 1.5^4 \times 88$$

$$= 0.34\ (\text{kg} \cdot \text{cm}^2)$$

(Moving part)

$$J_w = m \times \left(\frac{l}{2\pi}\right)^2 = 60 \times \left(\frac{2}{2\pi}\right)^2$$

$$= 6.1\ (\text{kg} \cdot \text{cm}^2)$$

(Coupling)

$J_c = 0.25\ (\text{kg} \cdot \text{cm}^2)$···Temporary

(As a whole)

Moment of inertia of the ball screw J_L is:

$$J_L = J_B + J_W + J_C$$

$$= 0.34 + 6.1 + 0.25$$

$$= 6.7 \times 10^{-4}\ (\text{kg} \cdot \text{m}^2)$$

[2] Driving torque

We assume that the WBK12-01B compact light load model is used as recommended for PSS1520N1D0879, and the moment of inertia of motor J_M is 3.1 $(\text{kg} \cdot \text{cm}^2)$ $(3.1 \times 10^{-4}\ \text{kg} \cdot \text{m}^2)$.

(At the time of constant speed)

The torque which is necessary to drive the ball screw at a constant speed resisting external loads is per formula 28) on page B64:

$$T_1 = T_a + T_{pmax} + T_u$$

In this formula, T_a is the drive torque at constant speed, T_{pmax} is the upper limit of the dynamic friction torque of the ball screw, and T_u is the friction torque of the support bearings.

From the chart on pages B193 and B400, T_{pmax} is 13.8 (N · cm) and T_u is 2.1 (N · cm) respectively.

$$T_a = \frac{F_a \bullet l}{2\pi\eta_1}$$

Using formula 26) on page B63, the drive torque at a constant speed T_1 is:

$$T_1 = \frac{F_a \bullet l}{2\pi \bullet \eta_1} + T_{pmax} + T_u$$

$$= \frac{6 \times 2}{2\pi \times 0.9} + 13.8 + 2.1$$

$$= 18\ (\text{N} \cdot \text{cm}) = 0.18\ (\text{N} \cdot \text{m})$$

(At the time of acceleration)

The drive torque necessary for accelerating the ball screw resisting axial load can be calculated by the formula 29) on page 64.

$$T_2 = T_1 + J \bullet \frac{2\pi \bullet n}{60t_1}$$

$$= T_1 + (J_L + J_M) \bullet \frac{2\pi \bullet n}{60t_1}$$

$$= 0.18 + (6.7 \times 10^{-4} + 3.1 \times 10^{-4})\ \frac{2\pi \times 3\,000}{60 \times 0.25}$$

$$= 1.41\ (\text{N} \cdot \text{m})$$

(At the time of deceleration)

Similarly, at the time of acceleration:

$$T_3 = T_1 - J \bullet \frac{2\pi \bullet n}{60t_3}$$

$$= T_1 - (J_L + J_M) \bullet \frac{2\pi \bullet n}{60t_3}$$

$$= 0.18 - (6.7 \times 10^{-4} + 3.1 \times 10^{-4})\ \frac{2\pi \times 3\,000}{60 \times 0.25}$$

$$= -1.05\ (\text{N} \cdot \text{m})$$

[3] Selection of motor

Selection conditions are as follows.

Maximum rotational speed: $N_M \geq 3\,000\ (\text{min}^{-1})$

Motor rating torque: $T_M \geq T_{rms}$ (N · m)

(T_{rms}: Effective torque)

Moment of inertia of the motor: $J_M > J_L/3$ or more

From above: select an AC servo motor with the following specifications.

Motor specifications:

Rating power output: $W_M = 300$ (W)

Maximum rotational speed:

$N_M = 3\,000\ (\text{min}^{-1})$

Rating torque: $T_M = 1\ (\text{N} \cdot \text{m}) = 1 \times 10^2\ (\text{N} \cdot \text{cm})$

Moment of inertia: $J_M = 3.1 \times 10^{-4}\ (\text{kg} \cdot \text{m}^2)$

$= 3.1\ (\text{kg} \cdot \text{cm}^2)$

[4] Check effective torque

Effective torque T_{rms} can be calculated as follows:

$$T_{rms} = \sqrt{\frac{T_2{}^2 \times t_a + T_1{}^2 \times t_b + T_3{}^2 \times t_c}{t}}$$

$$= \sqrt{\frac{1.41^2 \times 0.75 + 0.18^2 \times 0.65 + 1.05^2 \times 0.75}{3.5}}$$

$$= 0.82$$

Thus the condition of "$T_M \geq T_{rms}$" is cleared.

[5] Check time to reach maximum speed

The time required to reach the rapid traverse speed can be calculated as follows. Where $T_M{}' = 2 \times T_M$:

$$t_a = \frac{(J_L + J_M) \times 2\pi \times n}{(T_M{}' - T_1)} \times 1.4$$

$$= \frac{(6.7 \times 10^{-4} + 3.1 \times 10^{-4}) \times 2\pi \times 3\,000}{(2 \times 1 - 0.18) \times 60} \times 1.4$$

$$= 0.24$$

Thus, the ball screw meets the requirement of "0.25 sec or less".

<u>From the above, use PSS1520N1D0879</u>

Drill 2: Processing table for special machines

1. Design conditions

Table mass: m_1 = 1 000 kg

Mass of the work: m_2 = 600 kg

Maximum stroke: $S_{\max}$ = 1 000 mm

Maximum speed: $V_{\max}$ = 15 000 mm/min

Positioning accuracy: ±0.035/1 000 mm (no load)

∗ Attitude accuracy of the table and thermal displacement are not included in the accuracy requirements of the ball screw.

Repeatability: ±0.005 mm (no load)

Lost motion: 0.020 mm (no load)

Required life expectancy: L_t = 20 000 h ($16^{\text{h}} \times 250^{\text{days}} \times 10^{\text{years}} \times 0.5^{\text{rate of operation}}$)

Guide way (sliding): μ = 0.15 (friction coefficient)

Processing: Milling and drilling

Drive motor: AC servo motor ($N_{\max}$ = 2 000 min^{-1})

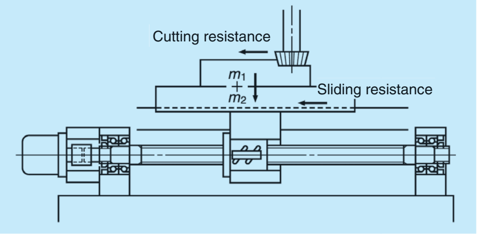


Fig. 17.3 System appearance

Table 17.2 Operating conditions

Operation	Axial load (N)		Feed speed (mm/min)	Use time ratio (%)
	Cutting resistance	Sliding resistance		
Rapid traverse	0	2 354	15 000	30
Light/medium cutting	4 000	2 354	500	50
Heavy cutting	8 000	2 354	100	20

∗ Sliding resistance: $F_r = \mu\,(m_1 + m_2)\,g = 0.15 \times (1\,000 + 600) \times 9.80665 = 2\,354$ (N)

∗ Ignore the inertia force at the time of acceleration/deceleration because their time rate is negligibly short.

2. Selection of basic factors

(1) Selection of accuracy grade and axial play

The proper accuracy grade for machining centers should be in the range from C1 to C5 according to "**Table 4.1** Applications for ball screws by accuracy grade" on page B19. Assuming the nut length is 200 mm and margin stroke is 100 mm, shaft length L_0 is obtained as follows:

L_0 = Maximum stroke + nut length + margin

= 1 000 = (200) + (100) = 1 300

From "**Table 1.2** Tolerance on specified travel and travel variation of positioning ball screws" on page B38, the accuracy factors which satisfy the required functions are:

Accuracy C3 grade

e_p = ±0.029/1 600 (mm)

υ_u = 0.018 (mm)

Considering the importance of lost motion, select Z code (axial play 0 mm and less) for the axial play.

(2) Selection of lead

From the maximum rotational speed of AC servo motor $N_{\max}$ and rapid traverse speed of table $V_{\max}$, lead l is :

$$l \geq \frac{V_{\max}}{N_{\max}} = \frac{15\,000}{2\,000} = 7.5 \text{ (mm)}$$

A larger lead l would be beneficial for higher feed speed. But from the view of the control system (resolution), lead l is limited to 8 mm or 10 mm.

(3) Selection of screw shaft diameter

According to **Table 4.4** "Screw shaft diameter, lead and stroke of standard ball screws" on page B21, screw shaft diameters with leads of 8 mm or 10 mm are in the range of 10 mm to 50 mm. Placing more importance on rigidity than volume of lost motion, select a relatively large size in the range of 32 mm to 50 mm.

(4) Selection of stroke

Select 1 000 mm, the maximum stroke as specified in the design conditions.

Primary selection:

Standard ball screw

Shaft diameter: 32, 36, 40, 45, 50 mm

Lead: 8, 10 mm

Stroke: 1 000 mm

Grade: C3

Axial play code: Z

3. Confirmation of standard ball screw

Giving consideration to delivery time and price, select a standard ball screw.

C3 grade is not found in standard ball screws. Let us check application-oriented ball screws for a C3 grade.

4. Confirmation of made-to-order ball screw

Because standard ball screws do not meet the accuracy grade requirement, we will consider made-to-order ball screws which are based on standard ball screws but with accuracy grade of C3.

Second selection:

Made-to-order ball screw

Shaft diameter : 32, 36, 40, 45, 50 mm

Lead : 8, 10 mm

Stroke : 1 000 mm

Accuracy grade : C3

Axial play : Z

5. Selection of screw shaft diameter, lead, and nut

(1) Dynamic load rating

Obtain required load carrying capacity for each lead through load conditions. From **Table 17.2** "Operating conditions" on page B91, calculate the rotation speed N_i as shown in **Table 17.3**.

$$N_i \geq \frac{V_i}{l}$$

Table 17.3 Load conditions

Operating condition	Axial load (N)	Rotations per minute (min^{-1})		Use time ratio (%)
		$l = 8$	$l = 10$	
Rapid traverse	$F_1 = 2\,354$	$N_1 = 1\,875$	$N_1 = 1\,500$	$t_1 = 30$
Light/medium cutting	$F_2 = 6\,354$	$N_2 = 62.5$	$N_2 = 50$	$t_2 = 50$
Heavy cutting	$F_3 = 10\,354$	$N_3 = 12.5$	$N_3 = 10$	$t_3 = 20$

By using formulas 11) and 12) on page B53, calculate the mean load F_m and the mean rotational speed N_m as shown below.

$$F_m = \left(\frac{F_1^3 \bullet N_1 \bullet t_1 + F_2^3 \bullet N_2 \bullet t_2 + F_3^3 \bullet N_3 \bullet t_3}{N_1 \bullet t_1 + N_2 \bullet t_2 + N_3 \bullet t_3} \right)^{1/3}$$

$$N_m = \frac{N_1 \bullet t_a + N_2 \bullet t_b + N_3 \bullet t_c}{t}$$

Table 17.4 Mean load and mean rotational speed

Lead (mm)	8	10
Mean load F_m (N)	3 122	3 122
Mean rotational speed N_m (min^{-1})	596	477

Required dynamic load rating C_a is:
Using formulas 8) and 9) on page B53, calculate the required dynamic load rating.

$$C_a \geq (60 N_m \cdot L_t)^{1/3} \cdot F_m \cdot f_w \times 10^{-2}\ (N)$$

Whereas required life expectancy L_t = 20 000 (h), load coefficient f_w = 1.2 (refer to page B53),

l = 8 (mm)············$C_a \geq$ 33 500 (N)
l = 10 (mm)··········$C_a \geq$ 31 100 (N)

(2) Selection of the nut

Due to the requirement on lost motion, the nut will be selected as follows emphasizing the importance of system rigidity.

Table 17.5 shows the dynamic load rating of each specification.

- Standard nut ball screw, tube recirculation
- Model No.: ZFT (pages B431 to B460)
- Number of ball turns: Select from 2.5 turns 2 circuits or 2.5 turns 3 circuits

From **Table 17.5**, select an item that meets the required dynamic load rating C_a as follows:

Third selection: the range surrounded by dotted lines ⬚ in **Table 17.5**

Table 17.5 Dynamic load rating of each specification

Screw shaft diameter (mm)	Dynamic load rating *Ca*: (N)			
	Lead 8 mm		Lead 10 mm	
	2.5 turns 2 circuits	2.5 turns 3 circuits	2.5 turns 2 circuits	2.5 turns 3 circuits
32	37 300	–	54 500	–
36	–	–	58 000	–
40	41 100	–	61 200	–
45	–	–	65 800	
50	45 700	64 800	68 100	96 500

(3) Permissible rotational speed

[1] Critical speed

Check if the rapid traverse speed of 15 000 mm/min (V_{max}) clears the critical speed. Ball screw rotational speed at each lead N is:

l = 8 (mm)·······N = 1 875 (min^{-1})
l = 10 (mm)·····N = 1 500 (min^{-1})

From formula 7) on page B47, screw shaft root diameter to meet critical speed requirements is:

$$d_r \geqq \frac{N \cdot L_a^2}{f} \times 10^{-7}\ \text{(mm)}$$

In this formula, distance between support positions L_a is:

L_a = Maximum stroke + nut length/2 + shaft end extra length
= 1 000 + 100 + 200 = 1 300 (mm)

The support configuration of the screw shaft is Fixed - Fixed, and that of the ball nut is Fixed. Therefore, support configuration is Fixed - Fixed (Factor f = 21.9)

l = 8 (mm)······$d_r \geq$ 14.5 (mm)
l = 10 (mm)····$d_r \geq$ 11.6 (mm)

[2] $d \cdot n$ value

From **Table 3.2** on page B50, as the $d{\cdot}n$ is 70 000 or less, screw shaft diameters to meet $d{\cdot}n$ are:

$$d \leq \frac{70\ 000}{N}\ \text{(mm)}$$

l = 8 (mm)············$d \leq$ 37.3 (mm)
l = 10 (mm)··········$d \leq$ 46.7 (mm)

Based on nut specifications (pages B431 to B460) select an item that meets screw shaft root diameter d_r and screw shaft diameter d.

＊Please consult NSK if the $d \cdot n$ value exceeds 70 000.

Fourth selection: the range surrounded by solid lines in **Table 17.5**

(4) Rigidity of the ball screw system

Set the lost motion of the ball screw system (screw shaft, nut and support bearings) at 80% of the specified value. Then calculate the system rigidity. The criterion for lost motion is:

20 (μm) × 0.8 = 16 (μm)

At this time, the one-way elastic deformation ΔL of the major factors of the ball screw system will be less than half the above criterion.

$\Delta L \leq 8$ (μm)

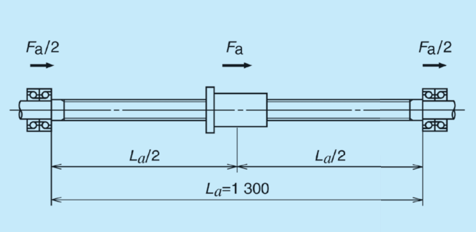


Fig. 17.4 Distance between support positions

[1] Rigidity of the screw shaft K_S
Calculate the rigidity at the center of screw shaft where the axial deformation becomes the largest. Because the support configuration of the screw shaft is Fixed - Fixed, the rigidity is per formula 21) on page B58:

$$K_s = \frac{\pi \cdot d_r^2 \cdot E}{L_a} \times 10^{-3}\ \text{(N/mm)}$$

E is the elastic modulus. From formula 17) on page B57, the elastic deformation of the screw shaft ΔL_S is:

$$\Delta L_s = \frac{F_a}{K_s} = \frac{rF_a \cdot L_a}{\pi \cdot d_r^2 \cdot E} \times 10^3\ \text{(μm)}$$

The sliding resistance F_a is:

$F_a = \mu\ (m_1 + m_2)$ = 0.15 × (1 000 + 600)
= 2 354 (N)

Table 17.7 shows the rigidity of screw shaft K_S and the elastic deformation ΔL_S.

[2] Rigidity of the ball nut K_N
Set about 1/3 the maximum axial load as preload value F_{a0}.

$$F_{a0} = \frac{F_{max}}{3} = \frac{10\ 354}{3} = 3\ 452 \rightarrow 3\ 500\ \text{(N)}$$

From formula 23) on page B60, the rigidity of the ball nut K_N is:

$$K_N = 0.8 \times K \left(\frac{F_{a0}}{\varepsilon \cdot C_a} \right)^{1/3} = 0.8 \times K \left(\frac{3\ 500}{0.1 \cdot C_a} \right)^{1/3}\ \text{(N/μm)}$$

K : Theoretical rigidity

From formula 17) on page B57, elastic deformation of the ball nut ΔL_N is:

$$\Delta L_N = \frac{F_a}{K_N} = \frac{2\ 354}{K_N}$$

Table 17.7 shows the rigidity of ball nut K_N and the elastic deformation ΔL_N.

[3] Rigidity of the support bearing K_B
NSKTAC C Series ball screw support bearings will be used. We specify designations for support units by shaft diameter as shown in Table 17.6 (refer to page B403).

Table 17.6 Bearing No. (designation)

Screw shaft diameter (mm)	Bearing No. (designation)
32	25TAC62CDF
36	25TAC62CDF
40	30TAC62CDF
45	35TAC72CDF

Refer to page B410 for the rigidity K_B of each bearing unit (axial spring modulus). Elastic deformation of bearing ΔL_B is:

$$\Delta L_B = \frac{F_a}{2K_B}$$

Table 17.7 shows the rigidity of support bearing K_B and elastic deformation ΔL_B.

Table 17.7 Rigidity and elestic deformation

Model No.:	Screw shaft		Nut		Support bearing		Total
	K_S	ΔL_S	K_N	ΔL_N	K_B	ΔL_B	ΔL
ZFT3208-10	376	6.3	912	2.6	850	1.4	10.3
ZFT3210-10	347	6.8	843	2.8			11.0
ZFT3610-10	460	5.1	898	2.6			9.1
ZFT4010-10	589	4.0	966	2.4	890	1.3	7.7
ZFT4510-10	773	3.0	1 055	2.2	1 030	1.1	6.3

Choose the most economical ball screw system which meets the requirement of one-way deformation (ΔL) of 8 μm or less.

The selected ball screw:

Model No.:	ZFT4010-10
Shaft diameter:	40 (mm)
Lead:	10 (mm)
Dynamic load rating:	61 200 (N)

6. Decision of screw shaft length

ZFT4010-10 ball nut has a length of 163 mm, and thus the distance between support positions of screw shaft L_a should be:

L_a = Maximum stroke + nut length + margin
= 1 000 + 163 + 100 = 1 263 → 1 300 mm

7. Checking basic safety

(1) Permissible axial load

Calculate the buckling load for conditions shown in **Fig. 17.5** with P of 10 354 (N) and L_1 of 1 200 (mm).

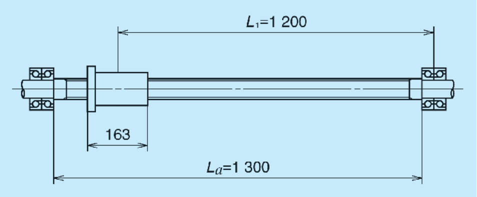


Fig. 17.5 Examination of bucking load

Support configuration is Fixed - Fixed, and from calculation formula 2) on page B44, the screw shaft diameter d_r to prevent buckling is

$$d_r \geq \left(\frac{P \bullet L_1^2}{m} \times 10^{-4} \right)^{1/4}$$

$$= \left(\frac{10\ 354 \times 1200^2}{19.9} \times 10^{-4} \right)^{1/4} = 16.5 \text{ (mm)}$$

From the specification of ZFT4010-10 ball nut (page B449), the root diameter of screw shaft d_r is 34.4 mm and thus meets the above conditions.

Result: Acceptable

(2) Permissible rotational speed

[1] Critical speed n

From the critical speed calculation formula 7) on page B47:

$$n = f \bullet \frac{d_r}{L_1^2} \times 10^7 = 21.9 \times \frac{34.4}{1\ 200^2} \times 10^7$$

$$\fallingdotseq 5\ 230$$

The maximum rotational speed (N_{max}) of 1 500 min^{-1} is less than the critical speed and thus meets requirements.

Result: Acceptable

[2] $d \bullet n$ value

The $d \bullet n$ value is:

$$d \bullet n = 40 \times 1\ 500 = 60\ 000$$

From **Table 3.2** on page B50, the $d{\cdot}n$ of the tube recirculation ball nut is 70 000 or less and meets requirements.

Result: Acceptable

(3) Life L_t

The dynamic load rating C_a is 61 200 N (see dimension table on page B449), and from formulas 8) and 9) on page B53 the life expectancy is:

$$L_t = \left(\frac{C_a}{f_w \bullet F_m} \right)^3 \times 10^6 \times \frac{1}{60 \bullet N_m}$$

$$\fallingdotseq 152\ 000$$

The above result satisfies the required life of 20 000 (h).

Result: Acceptable

8. Check whether factors satisfy requirements

(1) Checking accuracy

[1] Positioning accuracy

The positioning accuracy of ±0.035/1 000 mm, from **Table 1.2** "Tolerance of specified travel and travel variation" on page B38 meets the required positioning accuracy as follows:

Accuracy grade : C3

$e_p = \pm 0.029/1\ 600$ (mm)

$\upsilon_u = 0.018$ (mm)

[2] Measures against thermal expansion

Provide pre-tension force equivalent to the elongation from 3°C temperature rise, taking in consideration the load carrying capacity of bearings. Also, adjust the travel compensation for the specified travel equivalent to 3°C temperature rise (refer to page B40).

(a) Thermal elongation : ΔL_θ

From formula 1) on page B40:

$$\Delta L_\theta = \rho \bullet \theta \bullet L_a = 12.0 \times 10^{-6} \times 3 \times 1\ 300$$
$$= 0.047 \text{ (mm)}$$

(b) Pre-tension force : F_θ

$$F_\theta = \Delta L_\theta \bullet Ks = \frac{\Delta L_\theta \bullet E \bullet \pi \bullet d_r^2}{4L_a}$$

$$= \frac{0.047 \times 2.06 \times 10^5 \times \pi \times 34.4^2}{4 \times 1\ 300}$$

$$\fallingdotseq 6\ 922 \rightarrow 6\ 900 \text{ (N)}$$

Travel compensation :	–0.047/1 300 (mm)
Pre-tension force :	6 900 (N)
Tension (elongation) volume :	0.047 (mm)

[3] Selection of support bearing

Assuming that the ratio of basic dynamic load rating of support bearing (C_a) and pre-tension force (F_θ) is ε, select a bearing which generally satisfies the following:

$$\varepsilon = F_\theta / C_a < 0.20$$

Design the bearing support configuration to which pre-tension force is applied in such way that the axial load is supported by a paired mounting or other multi-bearing arrangement. Please consult NSK when one bearing must sustain the pre-tension load.

Table 17.8 Comparison of dynamic load rating and pre-tension force

Bearing No. (designation)	C_a (N)	ε
30TAC62CDF	29 200	0.23
30TAC62CDFD	47 500	0.14

Selected support bearing: 30TAC62CDFD

(2) Checking drive torque of motor

❬Required specifications❭

- Motor rotational speed: 1 500 min^{-1}
- Time to reach maximum speed: 0.16 sec or less (At the time of rapid traverse)

[1] Load (converted to the motor load)

Calculate the moment of inertia of the ball screw. From formulas 30) and 31) on page B64, moment of inertia of ball screw parts J is calculated as follows, where γ is material density and ball screw shaft length L_o is 1 550 mm.

(Screw shaft)

$$J_B = \frac{\pi \bullet \gamma}{32} D^4 \bullet L_o = \frac{\pi \times 7.8 \times 10^{-3}}{32} \times 4^4 \times 155$$

$$= 30 \text{ (kg} \cdot \text{cm}^2\text{)}$$

(Moving part)

$$J_w = m \times \left(\frac{l}{2\pi} \right)^2 = 1\ 600 \times \left(\frac{1}{2\pi} \right)^2$$

$$= 40 \text{ (kg} \cdot \text{cm}^2\text{)}$$

(Coupling)

$$J_c = 10 \text{ (kg} \cdot \text{cm}^2\text{)} \cdots \text{assumed}$$

(Total)

$$J_L = J_B + J_w + J_c = 30 + 40 + 10$$
$$= 80 \text{ (kg} \cdot \text{cm}^2\text{)} \rightarrow 80 \times 10^{-4} \text{ (kg} \cdot \text{m}^2\text{)}$$

[2] Driving torque

The required torque to drive a ball screw resisting external loads T_1 can be obtained by formula 28) on page B64:

$$T_1 = T_A + T_P + T_U$$

In this formula, T_A is drive torque at constant speed, T_P is dynamic friction torque, and, T_U is friction torque of the support bearings. From formula 26) and 25) on page B63, T_A and T_P are:

$$T_A = \frac{Fa \bullet l}{2\pi \eta_1}$$

$$T_P = 0.014 F_{a0} \sqrt{d_m \bullet l}$$

$$\eta_1 = 0.9$$

Refer to the starting torque value in **Table** on page B410:

T_U is:

$$T_U = (16 \times 1.35) + (16 \times 1.35) = 43.2 \text{ (N} \cdot \text{cm)}$$

So, the required drive torques during rapid traverse T_{11} and heavy cutting T_{13} are:

(At the time of rapid traverse)

$$T_{11} = T_{A1} + T_{P1} + T_{U1}$$

$$= \frac{2\ 354 \times 1}{2\pi \times 0.9} + 0.014 \times 3\ 500 \sqrt{4.1 \times 1} + 43.2$$

$$= 559 \text{ (N} \cdot \text{cm)} \rightarrow 559 \times 10^{-2} \text{ (N} \cdot \text{m)}$$

(At the time of heavy cutting)

$$T_{12} = T_{A2} + T_{P2} + T_{U2}$$

$$= \frac{10\ 354 \times 1}{2\pi \times 0.9} + 0.014 \times 3\ 500 \sqrt{4.1 \times 1} + 43.2$$

$$= 1\ 973 \text{ (N} \cdot \text{cm)} \rightarrow 1\ 973 \times 10^{-2} \text{ (N} \cdot \text{m)}$$

[3] Selection of the motor

❬Selection conditions❭

Maximum rotational speed: $N_M \geq 1\ 500$ (min^{-1})

Motor rating torque: $T_M > T_1$ (N · m)

Moment of inertia of the motor: $J_M > J_L / 3$ (kg · m^2)

Based on the above, select an AC servo motor as follows.

Motor specifications

Rating power output: W_M = 1.8 (kW)

Maximum rotational speed:

N_M = 1 500 (min^{-1})

Rating torque: T_M = 22.5 (N · m)

= 22.5 × 10^2 (N · cm)

Moment of inertia: J_M = 190 × 10^{-4} (kg · m^2)

= 190 (kg · cm^2)

[4] Checking the time to reach maximum speed:
Required time to reach rapid traverse speed can be calculated as follows (where $T_M' = 2 \times T_M$):

$$t_a = \frac{(J_L + J_M) \times 2\pi \times N}{(T_M' - T_1) \times 60} \times 1.4$$

$$= \frac{(80 \times 10^{-4} + 190 \times 10^{-4}) \times 2\pi \times 1\,500}{(2 \times 22.5 - 559 \times 10^{-2}) \times 60} \times 1.4$$

$$= 0.15 \text{ (sec)}$$

Thus, the time meets the requirement of 0.16 sec or less.

Drill 3: Cartesian robot Z axis (vertical axis)

1. Design conditions

Mass of the work : m = 300 kg

Maximum travel : $S_{\max}$ = 1 500 mm

Rapid traverse speed : $V_{\max}$ = 10 000 mm/min

Repeatability : 0.3 mm

Required life : L_t = 24 000 h
(16 $^{\text{hours}}$ × 300 $^{\text{days}}$ × 5 $^{\text{years}}$)

Screw shaft support configuration :
Fixed -- Simple

Nut: Flanged single nut

Guide way (rolling) : μ = 0.01 (friction coefficient)

Drive motor : AC servo motor ($N_{\max}$ = 1 000 min^{-1})

Environment : Slightly dusty

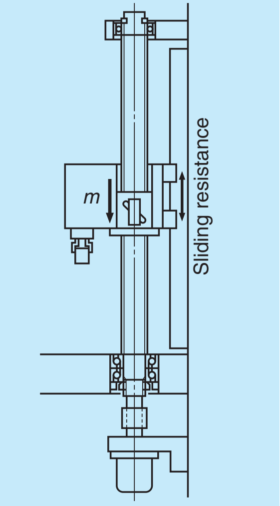


Fig. 17.6 System appearance

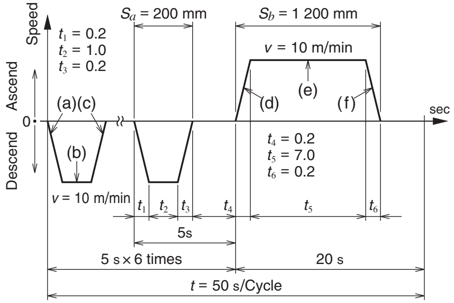


Fig. 17.7 Operating conditions

2. Selection of basic factors

(1) Selection of accuracy grade

Although this application is not listed in **Table 4.1** "Accuracy grades of ball screws and their applications" on page B19, it is possible to use an R model ball screw for transfer equipnment because the required repeatability of 0.3 mm is not very high.

(2) Selection of lead

From the maximum rotational speed of the AC motor:

$$l \geq \frac{V_{\max}}{N_{\max}} = \frac{10\,000}{1\,000} = 10 \text{ (mm)}$$

Select a lead 10 mm or over.

(3) Selection of screw shaft diameter

According to **Table 4.6** "Shaft diameter, lead and standard screw length of R models" on page B23, the shaft diameters whose lead is 10 mm or over are in the range of 12 mm to 50 mm.

(4) Selection of stroke

From **Table 4.6** "Screw shaft diameter, lead and standard screw shaft length of R models" on page B23, it is possible to select from R models because the diameter d of 15 mm to 50 mm and lead l of 10 mm will meet the required maximum stroke of 1500 mm.

Primary selection : R model ball screw for transfer equipment
Screw shaft diameter : 15 – 50 (mm)
Lead : 10 (mm)
Stroke : 1 500 (mm)

3. Confirmation of standard ball screw

Select from flanged single nuts of R model ball screws for transfer equipment.

Second selection : R model ball screw for transfer equipment
Screw shaft diameter : 16, 20, 25, 32, 36
40, 50 (mm)
Lead : 10 (mm)
Stroke : 1 500 (mm)

4. Decision of screw length

Screw length L_o is:

L_o = Stroke + nut length + margin + shaft end length

= 1 500 + 100 + 100 + 200 = 1 900 (mm)

Normally, the overall screw shaft length L_o less than or equal to 70 times the screw shaft diameter d is recommended.

Therefore, screw shaft diameter d is:

$$d \geq \frac{L_s}{70} = \frac{1\,900}{70} = 27.1 \text{ (mm)}$$

Third selection : R model ball screw for transfer equipment
Shaft diameter: 32, 36, 40, 45, 50 (mm)
Lead: 10 (mm)
Stroke: 1 500 (mm)

5. Checking basic safety

(1) Allowable axial load

[1] Calculation of allowable axial load

Accelerating/decelerating time is:

$$\alpha = \frac{V}{60\,t} = \frac{10 \times 10^3}{60 \times 0.2} = 833 \text{ (mm/s}^2\text{)}$$

$$= 0.833 \text{ (m/s}^2\text{)}$$

$$t = t_1 = t_3 = t_4 = t_6$$

(a), (f) $\cdots\cdots F_1 = mg - m\alpha$

$= 300 \times 9.80665 - 300 \times 0.833$

$= 2\,690$ (N)

(b), (e) $\cdots\cdots F_2 = mg = 2\,940$ (N)

(c), (d) $\cdots\cdots F_3 = mg + m\alpha = 3\,190$ (N)

[2] Buckling load

For conditions in **Fig. 17.8**, use values below.

$P = 3\,190$ N, $L_1 = 1\,600$ mm

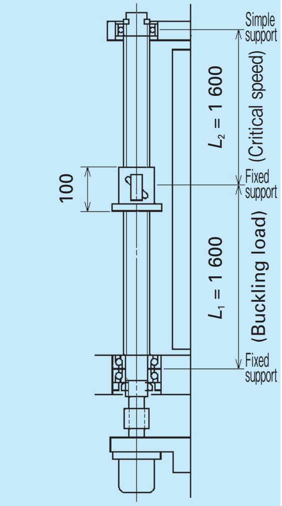


Fig. 17.8 Inspecting for buckling load and critical speed

From formula 2) on page B44:

$$d_r \geq \left(\frac{P \bullet L_1^2}{m} \times 10^{-4}\right)^{1/4}$$

$$= \left(\frac{3\,190 \times 1\,600^2}{19.9} \times 10^{-4}\right)^{1/4} = 14.2 \text{ (mm)}$$

(2) Checking permissible rotational speed

[1] Critical speed

Use values below.

$n = 1\,000$ (min^{-1}), $L_2 = 1\,600$ (mm)

From formula 7) on page B47:

$$d_r \geq \frac{n \bullet L_2^2}{f} \times 10^{-7} = \frac{1\,000 \times 1\,600^2}{15.1} \times 10^{-7}$$

$$= 17 \text{ (mm)}$$

[2] $d \bullet n$ value

From **Table 3.2** on page B50:

$$d \leq \frac{50\,000}{n} = \frac{50\,000}{1\,000}$$

$$= 50 \text{ (mm)}$$

＊Please consult NSK when the $d \bullet n$ value exceeds 50 000.

(3) Checking life (dynamic load rating)

Determine the required load carrying capacity from the load conditions in **Table 17.9**.

Table 17.9 Load conditions

Operating condition	Axial load (N)	Rotational speed (mean) (min^{-1})	Use time (s)
(a)$_{\times 6}$(f)	F_1 = 2 690	N_1 = 500	t_a = 1.4
(b)$_{\times 6}$(e)	F_2 = 2 940	N_2 = 1 000	t_b = 13.0
(c)$_{\times 6}$(d)	F_3 = 3 190	N_3 = 500	t_c = 1.4

Calculate mean load F_m and mean rotational speed N_m from the formulas 11) and 12) on page B53:

Required load carrying capacity is:

$$F_m = \left(\frac{F_1^3 \bullet N_1 \bullet t_a + F_2^3 \bullet N_2 \bullet t_b + F_3^3 \bullet N_3 \bullet t_c}{N_1 \bullet t_a + N_2 \bullet t_b + N_3 \bullet t_c}\right)^{1/3}$$

$$= 2\,940 \text{ (N)}$$

$$N_m = \frac{N_1 \bullet t_a + N_2 \bullet t_b + N_3 \bullet t_c}{t}$$

$$= 288 \text{ (min}^{-1}\text{)}$$

From formulas 8) and 9) on page B53:

$$C_a \geq (60 N_m \bullet L_t)^{1/3} \bullet F_m \bullet f_w \times 10^{-2} \; (N)$$

$$= (60 \times 288 \times 24\,000)^{1/3} \times 2\,940 \times 1.2 \times 10^{-2}$$

$$= 26\,300 \text{ (N)}$$

(4) Checking static load rating

$$C_{0a} = F_{max} \times f_s = 3\,190 \times 2$$

$$= 6\,380 \text{ (N)}$$

In consideration of expense, select a ball screw shaft as follows.

Fourth selection : R model ball screw for transfer equipment
Shaft diameter : 32 (mm)
Lead : 10 (mm)
Stroke :
Ball turns and numbers of circuits : 2.5 × 2
Screw length : 2 000 (mm)
Basic dynamic load rating : 42 000 (N)

6. Selection of nut

Select a "standard nut with a flange and a built-in brush seals" based on the environment conditions.

Selected ball screw:
Nut assembly RNFTL3210A5S
Screw shaft RS3210A20

B-2-18 References

"NSK Motion & Control (technical journal)" was compiled to introduce NSK products and technologies. You will find data summaries for selecting ball screws in this catalog. If you need detailed technical data, please refer to "NSK Motion & Control" technical journals.

For inquiries and orders, please contact NSK branch offices, sales offices, or representatives.

Table 18.1 NSK Motion & Control (technical journal) : Issues relating to ball screws (2002-)

Issue No.	Date of Publication	Articles Related to Ball Screws[*1]
No.13	October 2002	Development of HTF Series Ball Screws for High Load Drive Applications
No.13	October 2002	High Lead Precision Rolled Ball Screws
No.14	May 2003	High Speed and Low Noise Ball Screws HMC-B02 Series
No.15	December 2003	Clean Support Units for Ball Screws
No.16	August 2004	Development of High Speed and Low Noise Ball Screws
No.18	August 2005	S3 Ball Screws: Super Low Noise Ball Screws for Automation Equipment
No.19	September 2006	High-Speed and Low-Noise Ball Screw for Standard Stock - Compact FA Series
No.21	December 2007	V1 Series Ball Screws for Contaminated Environments HTF-SRC Series Ball Screws for High-Speed and High-Load Applications
No.22	March 2011	Technological Trends of Ball Screws for Industrial Machinery BSL Series Ball Screws for Small Lathes HTF-SRD Series Long-Lead Ball Screws for High-Speed and Heavy-Load Applications
No.23	June 2013	TW Series Ball Screws for Twin-Drive Systems HMD Series Ball Screws for High-Speed Machine Tools
No.24	December 2014	Ball Screw for Motorcycle Brake Systems
No.25	September 2015	HMS Series Ball Screws for High-Speed Machine Tools Miniature Large-Lead Series of High-Speed, Low-Noise Ball Screws
No.26	April 2016	Development of a Nut Cooling Ball Screw Ball Screws with X1 Seals for Machine-Tool Applications HTF-SRE Large, High-Speed, High-Load Capacity Ball Screws
No.27	November 2016	Strategy for Frictional Behavior Control in Ball Screws Ball Screws with Minimal Grease-Splatter L1 Seals
No.28	June 2017	Ultra-Large Ball Screws
No.30	June 2019	The Technical Trend of Machine Tool Components
No.31	June 2020	Development of Long Life Ball Screw using Material with High Retained Austenite Amount γ R for High-Load Drive
No.32	June 2021	High Load Endurance Test Unit for Electric Injection Molding Machine Ball Screws Ball Screw Units for Electric Hydraulic Brake Systems High Durability Precision Ball Screw
No.33	June 2022	Ball Screw Technologies to Control Machine Tool Quadrant Glitches
No.34	June 2023	Evaluation of Lubrication Performance in Ball Screws and Linear Guides by the Electrical Impedance Method
No.35	June 2024	NSK Ball Screw for High-Load Drives:Long-Life Specification

1. Titles reflect the original publication. Note that product names, expressions, etc. may have been changed/corrected since publication.

B-2-19 Guide to Technical Services

(1) CAD data

■Web page

http://www.jp.nsk.com/app01/en/ctrg/

(2) Telephone consultation with NSK engineers

This catalog contains technical explanations for each section. However, some descriptions and explanations may be insufficient due to page limitations, 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. Please do not hesitate to contact a NSK office or representative in your area.

(3) Additional machining (processing) of standard ball screws in stock

NSK processes standard ball screw blank shaft ends. NSK also cuts linear guide rails to required lengths. Service is available at NSK processing factories throughout the world. Requests are taken by branch offices and agencies.

B-2-20 Precautions When Handling Ball Screws

Ball screws are precision products. They require careful handling as described below.

Confirm lubrication

Lubrication

(1) Confirm the state of lubrication before use. Insufficient lubrication causes loss of ball screw functions in a short period.

(2) Do not apply any lubrication if grease is already applied to the ball screws. Remove dust or swarf if stuck to the greased surface during handling. Wipe the surface with clean white kerosene, and then apply the same type of new lubricant before use. Avoid using different types of grease at the same time.

Consult NSK for special oil lubricant if it is required for your application.

(3) Check the grease after two to three months of operation. Wipe off the old grease if it is excessively contaminated, and apply a sufficient volume of fresh grease. After the initial check, check and replenish the grease approximately every year. Check more often if the environment requires.

Note: Refer to pages B67 and D13 for lubrication.

Do not disassemble

Do not reassemble

Watch out for falling objects

Handle with care

Do not apply shock

Handling

(1) Never disassemble the ball screw. It invites dust to enter and lowers precision and may cause an accident.

(2) Once the ball screw is disassembled for some reason, the user should never reassemble the ball screw. Loss of ball screw function is apt to occur if a mistake is made. Please send the ball screw to NSK for repair or re-assembly. It will be reworked at a nominal fee.

(3) The ball screw shaft or nut may fall off due to its own weight. Watch out for such falling objects. If it falls, the ball groove or ball recirculation component may be damaged and their function might be lost. Make certain to return such items to NSK for checks. There will be a nominal fee for this service.

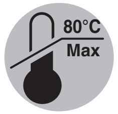
(4) If the recirculation component, the shaft outside, or the ball groove is scratched or damaged by impact, recirculation operation becomes deficient and may cause a loss of function.

Note: Refer to page B73 for assembling components.

Prevent dust

Follow speed limits

Do not overrun



Do not exceed temperature limits

Precautions in use

(1) Ball screws should be used in a clean environment. Use a dust cover to keep dust and swarf from entering into the system. Insufficient dust protection causes not only the ball screw function to deteriorate, but also brings about damage to the recirculation components if dust plugs the system. This may result in more serious accidents such as a fall of the table.

(2) For rotational speed in operation, refer to the applicable section in this catalog which describes permissible rotational speeds or to specification drawings furnished by NSK. Exceeding permissible rotational speed damages recirculation components and may cause the table to fall. A system such as a safety nut is recommended for vertical use of ball screws. Please consult NSK for safety systems.

(3) Overrunning ball nuts (removed from the ball thread) causes the balls to fall out, damages recirculation components, and dents ball grooves, resulting in insufficient operation. Continued use under such conditions may cause premature wear and damages recirculation components. For these reasons, avoid overrun by all means. If overrun occurs, please request NSK to check. There will be a nominal fee for this service.

(4) Ball screws are designed to be used at a temperature of less than 80°C. Do not operate at temperatures higher than this limit. Use at a higher temperature may damage recirculation and seal components. Please consult NSK if it is necessary to use at a temperature higher than the limit.

When using NSK K1 lubrication units, the operating temperature should be 50°C or less. (Momentary maximum temperature in use: 80°C)

Note: Please read page B83 before designing.

Store in the correct position

Storage

(1) Store in the original NSK packaging. Do not unpack or tear the inner wrapping unnecessarily. This allows dust and moisture to enter, potentially causing rusting and/or deterioration of product performance.

(2) Store indoors in a cool, dry environment with little temperature variation. High temperature and high humidity environments significantly decrease the effectiveness of rust-inhibiting compounds.

(3) The following position is recommended when storing ball screws.

① Keep in the NSK original package, and place it flat.

② Place flat on supports in a clean area.

③ Hang vertically in a clean place.

B-3 Ball Screw Dimension Tables

B-3-1 Dimension Tables and Reference Numbers for Standard Ball Screws

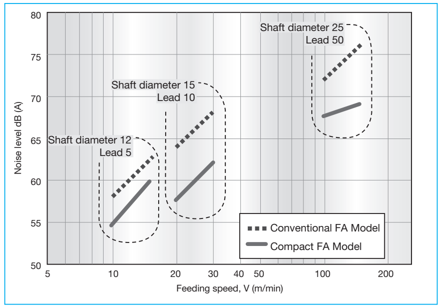
B-3-1.1 Compact FA-PSS, FA-USS, and FA-FSS Models

1. Features

NSK offers the compact FA model featuring end-deflector recirculation systems for high-speed and low-nose operation in a compact design. These exceptionally high performance ball screws are ready for use in a variety of fields such as semiconductor manufacturing equipment, flat panel display manufacturing equipment, chip mounting equipment, measuring apparatus, food and medical equipment, and automotive manufacturing equipment.

●Quieter sound

The operating noise level of ball screws has been reduced by 6 dB(A), about half of what is sensed by the ear.



(Microphone was positioned at a distance of 400 mm for all noise levels)

Fig. 1 Comparison of noise level

●Compact

The outside diameter of the ball nut is as much as 30% smaller than existing NSK products. This contributes to more compact designs of all sorts of equipment and devices such as low-profile positioning stages.

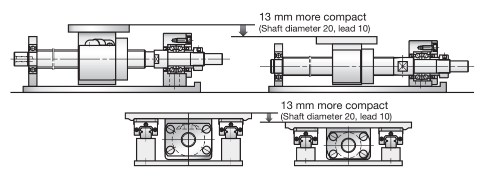


Fig. 2 Comparison of FA and compact FA-PSS models

●High speed

The permissible rotational speed up to 5 000 min^{-1}.
This capability dramatically expands the range of service conditions.
Please refer to the dimension tables for details of the permissible rotational speed.

●A grease fitting is provided as a standard equipment

The new ball screw is equipped with a grease fitting (M5 × 0.8) as standard equipment. Two lubrication ports are provided to facilitate easy maintenance.

●Storage seal

Compact, thin plastic seals are available. Nut outside diameter is compact compared with the tube recirculation system.

●Low-profile design

Low-profile support units especially compatible with the compact FA model are available for a superb space-saving design.

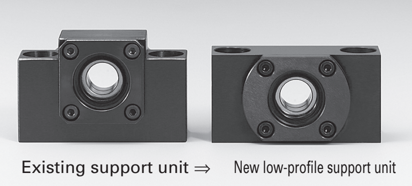


Fig. 3 Comparison of support units

●Low dust generation LG2 grease FA-USS model

The dust count is approximately 1/100 that of the existing FA model. It is suitable for applications in clean environments.

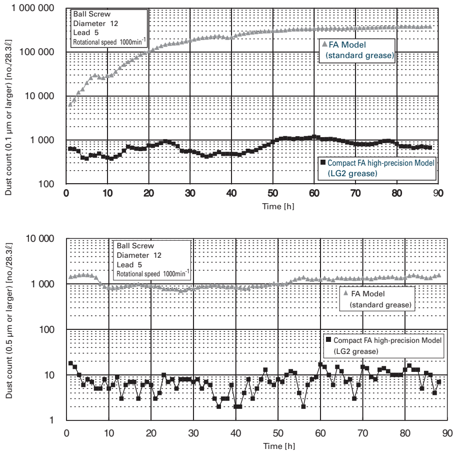


Fig.4 Comparison of dust count

●Easy stroke setting FA-FSS model

Flexible stroke setting with fixed-simple support by mounting a support unit (simple support side) directly onto ball screw thread outside diameter. Proprietary support units (simple support side) are available from NSK.

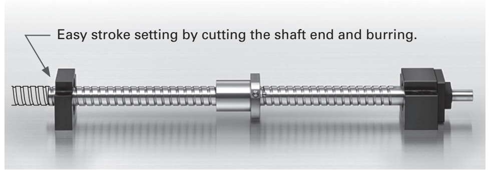


Fig.5 Flexible stroke setting

2. Order of the dimension tables

Dimension tables are arranged by model in order of increasing shaft diameter.

3. Dimension tables

Dimension tables show shapes/sizes as well as specification factors for each shaft diameter/lead combination. Tables also contain data as follows:

●Stroke

Nominal stroke:	A reference for your use.
Maximum stroke:	The limit stroke that the nut can move. The value is obtained by subtracting the nut length from the effective threaded length (L_1).

●Lead accuracy

FA-PSS model: C5 grade; FA-USS model: C3 grade; FA-FSS model: Ct7 grade

T : Travel compensation
e_p : Tolerance on specified travel
υ_u : Travel variation

See "Technical Description: Lead Accuracy" (page B37) for the details of the codes.

●Permissible rotational speed

$d \bullet n$:	Limited by the relative peripheral speed between the screw shaft and the nut.
Critical speed:	Limited by the natural frequency of the ball screw shaft. Critical speed depends on the support condition of the screw shaft.

The lower of the two criteria, the $d{\cdot}n$ and critical speed, will determine the overall permissible rotational speed of the ball screw. For details, see "Technical Description: Permissible Rotational Speed" (page B47).

4. Other

The seal of the ball screw and end deflector are made of synthetic resin. Consult NSK when using our ball screws under extreme environments, in special environments, or if using special lubricant or oil.
The NSK K1 cannot be mounted to the compact FA model.
For special environments, see pages B70 and D2. For lubrication, see pages B67 and D13.
Note: For details on standard stock products, contact NSK.

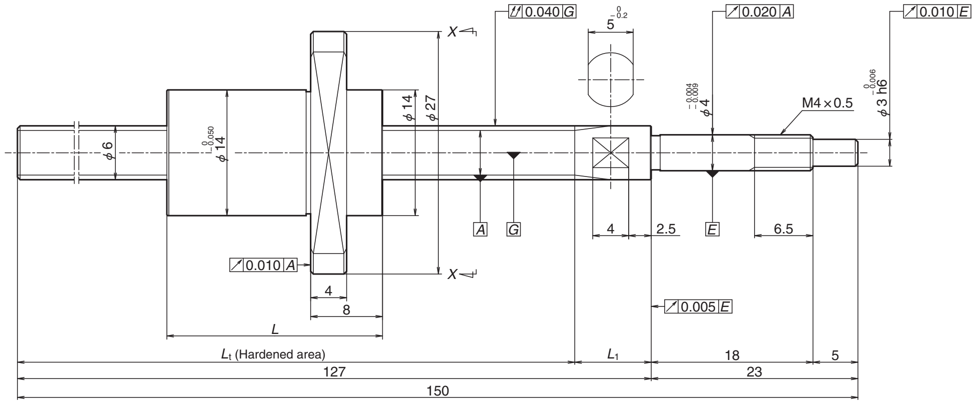
Table 1 Combinations of screw shaft diameter and lead

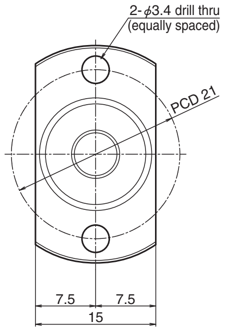
Lead Screw shaft diameter	5	8	10	12	15	20	25	30	40	50	60
6		B109		B109							
8			B111		B111						
10	B113 B133		B113								
12	B115 B135		B115 B139			B115		B115			
15	B117 B137		B117 B141			B119 B141		B119			
20	B121		B121 B143			B123 B143		B123	B125		B125
25	B127		B127 B145			B129 B145	B129 B145	B131		B131	

Screw shaft ø6

Lead 8, 12

Unit: mm





Cross-section *X-X*

Ball screw specifications	
Ball diameter/screw shaft root diameter	1.2 / 4.9
Ball circle dia.	6.2
Accuracy grade/axial play	C5 / 0.005 or less
Factory-packed grease	NSK grease PS2

Recommended support unit

For drive side (Fixed)
WBK04-01M (square)
WBK04-11M (round)

Unit: mm

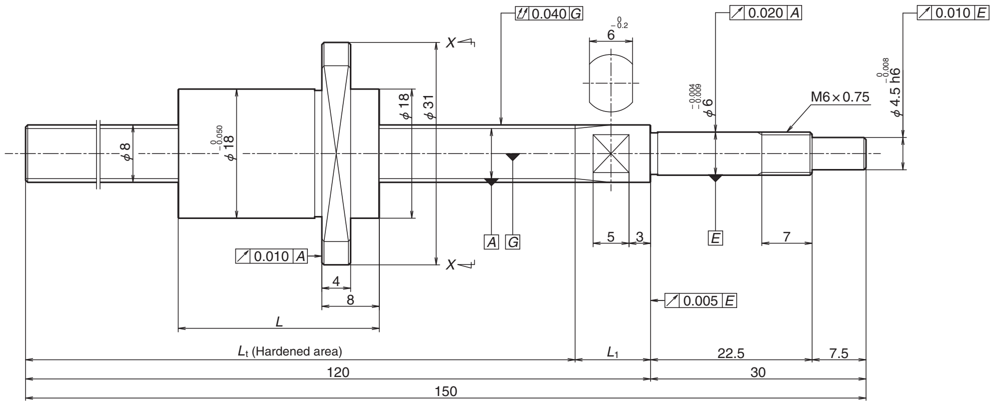
Reference No.	Screw shaft diameter	Lead	Effective ball turns	Basic load ratings (N)		Maximum stroke	Nut length	Screw shaft dimensions		Lead accuracy			Dynamic preload torque	Mass	Permissible rotational speed	Nut internal space	Standard grease replenishment
				Dynamic	Static					Target value	Error	Variation					
	d	l		C_a	C_{0a}		L	L_t	L_1	T	e_p	υ_u	(N·cm)	(kg)	(min^{-1}) *1	(cm^3)	(cm^3)
PSS0608NAD0150	6	8	2	690	805	102.5	16	118.5	8.5	0	0.020	0.018	~0.5	0.06	5 000	0.2	0.1
PSS0608NBD0150			4	1 480	1 940	94.5	24	118.5	8.5					0.06		0.3	0.2
PSS0612NAD0150		12	2	665	800	97.0	20	117	10					0.06		0.2	0.1
PSS0612NBD0150			4	1 430	1 970	85.0	32	117	10					0.07		0.3	0.2

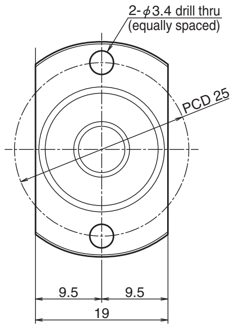
Notes: *1. Contact NSK if permissible rotational speed will be exceeded.

2. These ball screws are suitable for operating temperatures from 0 to 80 °C.
3. We recommend using NSK support units. Refer to Page B377 for details.

Screw shaft ø8
Lead 10, 15

Unit: mm





Cross-section *X-X*

Ball screw specifications	
Ball diameter/screw shaft root diameter	1.588 / 6.6
Ball circle dia.	8.3
Accuracy grade/axial play	C5 / 0.005 or less
Factory-packed grease	NSK grease PS2

Recommended support unit

For drive side (Fixed)
WBK06-01M (square)
WBK06-11M (round)

Unit: mm

Reference No.	Screw shaft diameter	Lead	Effective ball turns	Basic load ratings (N)		Maximum stroke	Nut length	Screw shaft dimensions		Lead accuracy			Dynamic preload torque	Mass	Permissible rotational speed	Nut internal space	Standard grease replenishment
				Dynamic	Static					Target value	Error	Variation					
	d	l		C_a	C_{0a}		L	L_t	L_1	T	e_p	υ_u	(N·cm)	(kg)	(min^{-1}) *1	(cm^3)	(cm^3)
PSS0810NAD0150	8	10	2	1 150	1 420	91.5	18	109.5	10.5	0	0.020	0.018	~0.5	0.09	5 000	0.4	0.2
PSS0810NBD0150			4	2 470	3 430	81.5	28	109.5	10.5					0.11		0.5	0.3
PSS0815NAD0150		15	2	1 130	1 430	85.0	22	107	13					0.1		0.4	0.2
PSS0815NBD0150			4	2 410	3 520	70.0	37	107	13					0.12		0.6	0.3

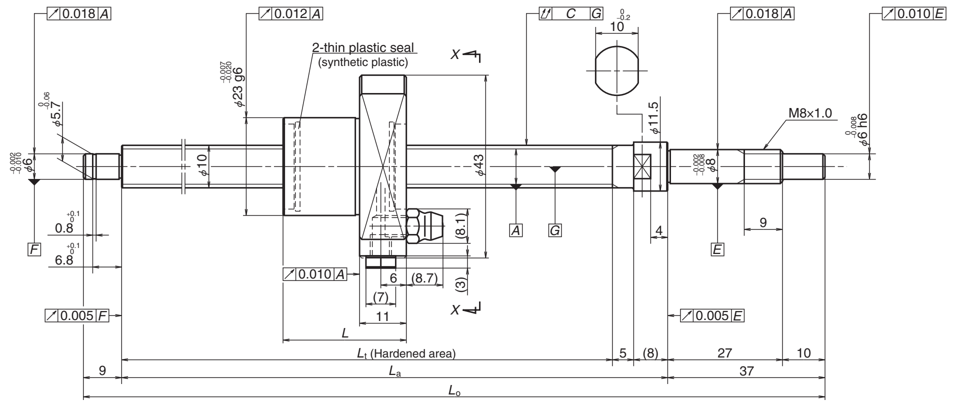
Notes: ***1.** Contact NSK if permissible rotational speed will be exceeded.

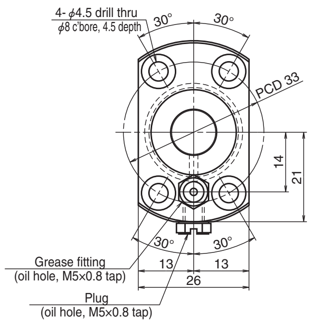
2. These ball screws are suitable for operating temperatures from 0 to 80 °C.
3. We recommend using NSK support units. Refer to Page B377 for details.

Screw shaft ø10

Lead 5, 10

Unit: mm





Cross-section X-X

Ball screw specifications	
Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	2.000 / 8.2
Ball circle dia.	10.3
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease PS2

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK08-01B (low-profile, square)	WBK08S-01B (low-profile, square)
WBK08-11 (round)	
WBK08-11B (round, high load)	

Unit: mm

Reference No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions			Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min⁻¹) *2	Nut internal space	Standard grease replenishment
			Dynamic	Static	Nominal	Max.					Target value	Error	Variation				Fixed-Simple		
	d	l	C_a	C_{0a}			L	L_t	L_a	L_o	T	e_p	υ_u	C	(N·cm) *1	(kg)		(cm³)	(cm³)
PSS1005N1D0171	10	5	3 420	4 840	50	78	29	112	125	171	0	0.020	0.018	0.030	0.7 – 3.3	0.3	5 000	0.8	0.4
PSS1005N1D0221					100	128		162	175	221		0.020	0.018	0.045	0.7 – 3.3	0.3			
PSS1005N1D0321					200	228		262	275	321		0.023	0.018	0.060	0.6 – 4.3	0.3			
PSS1005N1D0421					300	328		362	375	421		0.025	0.020	0.070	0.6 – 4.3	0.4			
PSS1005N1D0521					400	428		462	475	521		0.027	0.020	0.085	0.4 – 4.9	0.5			
PSS1010N1D0221		10	2 290	2 980	100	125	32	162	175	221		0.020	0.018	0.045	0.7 – 3.3	0.3	5 000	0.7	0.4
PSS1010N1D0321					200	225		262	275	321		0.023	0.018	0.060	0.6 – 4.3	0.4			
PSS1010N1D0421					300	325		362	375	421		0.025	0.020	0.070	0.6 – 4.3	0.4			
PSS1010N1D0521					400	425		462	475	521		0.027	0.020	0.085	0.4 – 4.9	0.5			

Notes: ***1.** Ball screw preload control values are shown. Approximately 2.0 N·cm of torque will be added due to thin plastic seals.
***2.** Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.
4. We recommend using NSK support units. Refer to Page B377 for details.
5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

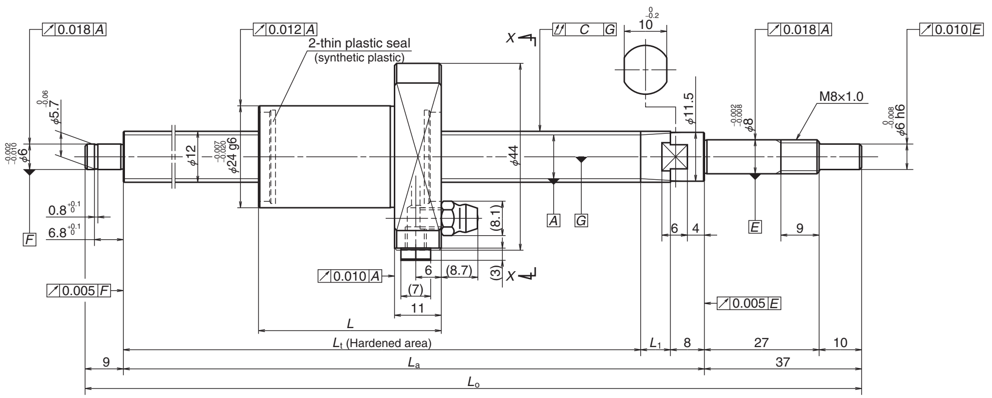
Compact FA-PSS Model (Fine, Medium, High helix lead)

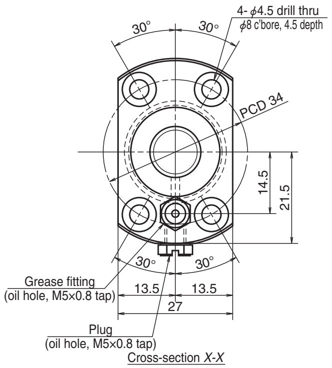
Nut: BSS

Screw shaft ø12

Lead 5, 10, 20, 30

Unit: mm





Ball screw specifications

Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	2.000 / 10.2
Ball circle dia.	12.3
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease PS2

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK08-01B (low-profile, square)	WBK08S-01B (low-profile, square)
WBK08-11 (round)	
WBK08-11B (round, high load)	

Unit: mm

Reference No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions				Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *2	Nut internal space	Standard grease replenishment
			Dynamic	Static	Nominal	Max.						Target value	Error	Variation				Fixed-Simple		
	d	l	C_a	C_{0a}			L	L_t	L_a	L_o	L_1	T	e_p	υ_u	C	(N·cm) *1	(kg)		(cm^3)	(cm^3)
PSS1205N1D0171	12	5	3 750	5 810	50	75	30	110	125	171	7	0	0.020	0.018	0.030	0.7 – 3.3	0.3	5 000	1.0	0.5
PSS1205N1D0221					100	125		160	175	221			0.020	0.018	0.045	0.7 – 3.3	0.3			
PSS1205N1D0321					200	225		260	275	321			0.023	0.018	0.060	0.6 – 4.3	0.4			
PSS1205N1D0421					300	325		360	375	421			0.025	0.020	0.070	0.6 – 4.3	0.5			
PSS1205N1D0521					400	425		460	475	521			0.027	0.020	0.085	0.6 – 4.3	0.6			
PSS1205N1D0621					500	525		560	575	621			0.030	0.023	0.085	0.4 – 4.9	0.7			
PSS1210N1D0221		10	3 760	5 780	100	112	43	160	175	221	7		0.020	0.018	0.045	0.7 – 3.3	0.4	5 000	1.0	0.5
PSS1210N1D0321					200	212		260	275	321			0.023	0.018	0.060	0.6 – 4.3	0.5			
PSS1210N1D0421					300	312		360	375	421			0.025	0.020	0.070	0.6 – 4.3	0.5			
PSS1210N1D0521					400	412		460	475	521			0.027	0.020	0.085	0.6 – 4.3	0.6			
PSS1210N1D0621					500	512		560	575	621			0.030	0.023	0.085	0.4 – 4.9	0.7			
PSS1220N1D0271		20	2 330	3 600	100	153	50	208	225	271	9		0.023	0.018	0.045	1.4 – 4.5	0.4	5 000	1.2	0.6
PSS1220N1D0371					200	253		308	325	371			0.023	0.018	0.060	0.9 – 4.9	0.5	5 000		
PSS1220N1D0471					300	353		408	425	471			0.027	0.020	0.070	0.9 – 4.9	0.6	5 000		
PSS1220N1D0571					400	453		508	525	571			0.030	0.023	0.085	0.6 – 5.9	0.7	5 000		
PSS1220N1D0671					500	553		608	625	671			0.030	0.023	0.110	0.6 – 5.9	0.8	4 480		
PSS1230N1D0271		30	2 190	3 650	100	128	70	203	225	271	14		0.023	0.018	0.045	1.4 – 4.5	0.5	5 000	1.5	0.8
PSS1230N1D0371					200	228		303	325	371			0.023	0.018	0.060	0.9 – 4.9	0.6	5 000		
PSS1230N1D0471					300	328		403	425	471			0.027	0.020	0.070	0.9 – 4.9	0.7	5 000		
PSS1230N1D0571					400	428		503	525	571			0.030	0.023	0.085	0.6 – 5.9	0.7	5 000		
PSS1230N1D0671					500	528		603	625	671			0.030	0.023	0.110	0.6 – 5.9	0.8	4 720		

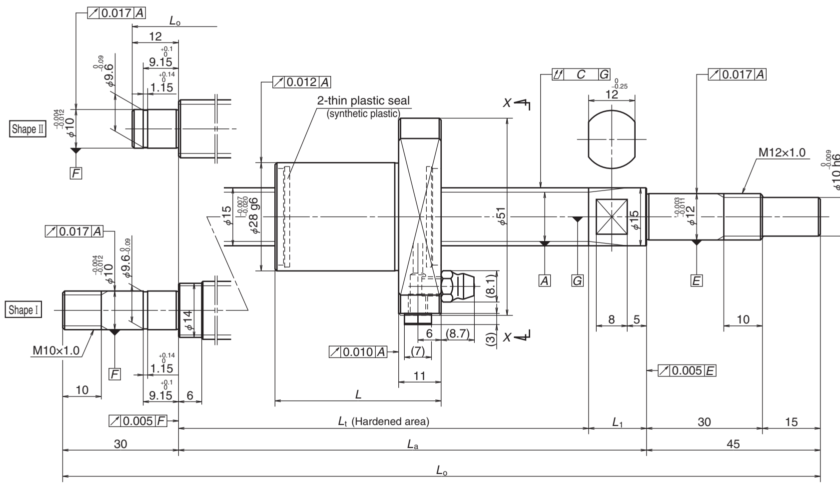
Notes: ***1.** Ball screw preload control values are shown. Approximately 2.0 N·cm of torque will be added due to thin plastic seals.

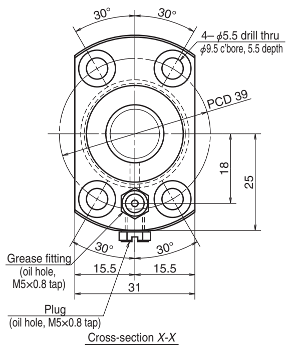
***2.** Contact NSK if permissible rotational speed will be exceeded.

3. These ball screws are suitable for operating temperatures from 0 to 80 °C.
4. We recommend using NSK support units. Refer to Page B377 for details.
5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

Screw shaft ø15
Lead 5, 10

Unit: mm





Cross-section *X-X*

Ball screw specifications	
Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	2.778 / 12.6
Ball circle dia.	15.5
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side	For non-drive side	
(Fixed)	(Fixed)	(Simple)
WBK12-01B (low-profile, square)	WBK10-01B (low-profile, square)	WBK12S-01B (low-profile, square)
WBK12-11 (round)	WBK10-11 (round)	

Unit: mm

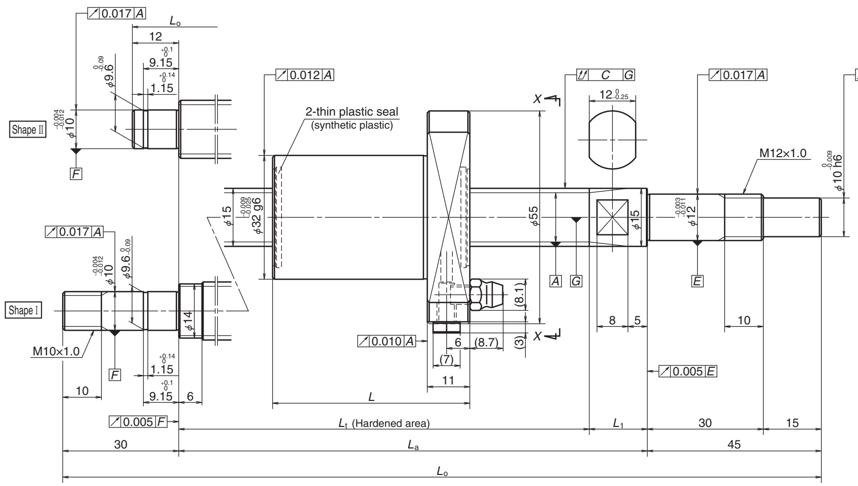
Reference No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions				Left shaft end shape (non-drive side)	Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min⁻¹) *2		Nut internal space	Standard grease replenishment
	d	l	Dynamic C_a	Static C_{0a}	Nominal	Max.	L	L_t	L_a	L_o	L_1		Target value T	Error e_p	Variation υ_u	C	(N·cm) *1	(kg)	Fixed-Simple	Fixed-Fixed	(cm³)	(cm³)
PSS1505N1D0211	15	5	6 410	10 100	50	103	30	139	154	211	15	Ⅱ	0	0.020	0.018	0.035	0.2 – 6.9	0.5	5 000	—	2.0	1.0
PSS1505N1D0261					100	153		189	204	261				0.020	0.018	0.035	0.2 – 6.9	0.5	5 000			
PSS1505N1D0361					200	253		289	304	361				0.023	0.018	0.045	0.2 – 6.9	0.6	5 000			
PSS1505N1D0461					300	353		389	404	461				0.025	0.020	0.050	0.4 – 9.8	0.8	5 000			
PSS1505N1D0561					400	453		489	504	561				0.027	0.020	0.060	0.4 – 9.8	0.9	5 000			
PSS1505N1D0661					500	553		589	604	661				0.030	0.023	0.075	0.4 – 9.8	1.0	5 000			
PSS1505N1D0761					600	653		689	704	761				0.035	0.025	0.075	0.4 – 11.8	1.1	4 130			
PSS1510N1D0261		10	6 530	10 200	100	140	43	189	204	261	15	Ⅱ		0.020	0.018	0.035	0.6 – 7.4	0.6	5 000	—	2.0	1.0
PSS1510N1D0361					200	240		289	304	361		Ⅱ		0.023	0.018	0.045	0.6 – 7.4	0.7	5 000	—		
PSS1510N1D0461					300	340		389	404	461		Ⅱ		0.025	0.020	0.050	0.4 – 9.8	0.8	5 000	—		
PSS1510N1D0561					400	440		489	504	561		Ⅱ		0.027	0.020	0.060	0.4 – 9.8	1.0	5 000	—		
PSS1510N1D0661					500	540		589	604	661		Ⅱ		0.030	0.023	0.075	0.4 – 9.8	1.1	5 000	—		
PSS1510N1D0761					600	640		689	704	761		Ⅱ		0.035	0.025	0.075	0.4 – 11.8	1.2	4 210	—		
PSS1510N1D0879					700	740		789	804	879		Ⅰ		0.035	0.025	0.095	0.4 – 11.8	1.4	3 190	4 410		
PSS1510N1D0979					800	840		889	904	979		Ⅰ		0.040	0.027	0.095	0.4 – 11.8	1.5	2 500	3 470		
PSS1510N1D1179					1 000	1 040		1 089	1 104	1 179		Ⅰ		0.046	0.030	0.120	0.4 – 11.8	1.7	1 650	2 320		

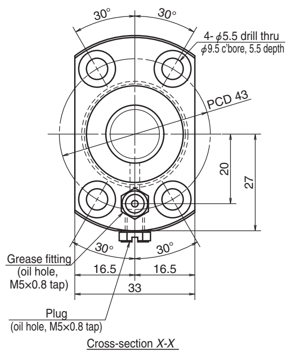
Notes: ***1.** Ball screw preload control values are shown. Approximately 2.0 N·cm of torque will be added due to thin plastic seals.
***2.** Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.
4. We recommend using NSK support units. Refer to Page B377 for details.
5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

Screw shaft ø15

Lead 20, 30

Unit: mm





Cross-section X-X

Ball screw specifications	
Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	3.175 / 12.2
Ball circle dia.	15.5
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side	For non-drive side	
(Fixed)	(Fixed)	(Simple)
WBK12-01B (low-profile, square)	WBK10-01B (low-profile, square)	WBK12S-01B (low-profile, square)
WBK12-11 (round)	WBK10-11 (round)	

Unit: mm

Reference No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions				Left shaft end shape (non-drive side)	Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min⁻¹) *2		Nut internal space	Standard grease replenishment
			Dynamic	Static	Nominal	Max.							Target value	Error	Variation				Fixed-Simple	Fixed-Fixed		
	d	l	C_a	C_{0a}			L	L_t	L_a	L_o	L_1		T	e_p	υ_u	C	(N·cm) *1	(kg)			(cm³)	(cm³)
PSS1520N1D0261	15	20	5 660	8 700	100	129	51	186	204	261	18	II	0	0.020	0.018	0.035	0.8 – 8.8	0.7	5 000	—	2.8	1.4
PSS1520N1D0361					200	229		286	304	361		II		0.023	0.018	0.045	0.8 – 8.8	0.8	5 000	—		
PSS1520N1D0461					300	329		386	404	461		II		0.025	0.020	0.050	0.8 – 10.8	0.9	5 000	—		
PSS1520N1D0561					400	429		486	504	561		II		0.027	0.020	0.060	0.8 – 10.8	1.1	5 000	—		
PSS1520N1D0661					500	529		586	604	661		II		0.030	0.023	0.075	0.8 – 10.8	1.2	5 000	—		
PSS1520N1D0761					600	629		686	704	761		II		0.035	0.025	0.075	0.8 – 13.8	1.3	4 170	—		
PSS1520N1D0879					700	729		786	804	879		I		0.035	0.025	0.095	0.8 – 13.8	1.5	3 150	4 310		
PSS1520N1D0979					800	829		886	904	979		I		0.040	0.027	0.095	0.8 – 13.8	1.6	2 460	3 390		
PSS1520N1D1179					1 000	1 029		1 086	1 104	1 179		I		0.046	0.030	0.120	0.8 – 13.8	1.9	1 620	2 260		
PSS1530N1D0311		30	5 500	8 580	100	153	71	230	254	311	24	II		0.023	0.018	0.035	1.2 – 9.3	0.8	5 000	—	3.4	1.7
PSS1530N1D0411					200	253		330	354	411		II		0.025	0.020	0.050	0.8 – 10.8	1.0	5 000	—		
PSS1530N1D0511					300	353		430	454	511		II		0.027	0.020	0.060	0.8 – 10.8	1.1	5 000	—		
PSS1530N1D0611					400	453		530	554	611		II		0.030	0.023	0.060	0.8 – 10.8	1.2	5 000	—		
PSS1530N1D0711					500	553		630	654	711		II		0.030	0.023	0.075	0.8 – 13.8	1.4	5 000	—		
PSS1530N1D0811					600	653		730	754	811		II		0.035	0.025	0.095	0.8 – 13.8	1.5	3 770	—		
PSS1530N1D0929					700	753		830	854	929		I		0.040	0.027	0.095	0.8 – 13.8	1.6	2 880	3 910		
PSS1530N1D1029					800	853		930	954	1 029		I		0.040	0.027	0.120	0.8 – 13.8	1.8	2 310	3 110		
PSS1530N1D1229					1 000	1 053		1 130	1 154	1 229		I		0.046	0.030	0.120	0.8 – 13.8	2.0	1 540	2 100		

Notes: ***1.** Ball screw preload control values are shown. Approximately 2.0 N·cm of torque will be added due to thin plastic seals.
***2.** Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.
4. We recommend using NSK support units. Refer to Page B377 for details.
5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

Compact FA-PSS Model (Fine, Medium lead)

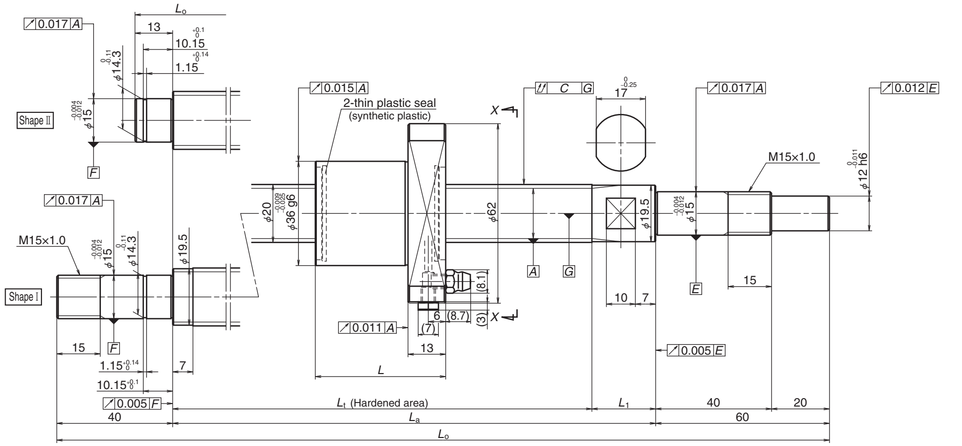
Nut: BSS

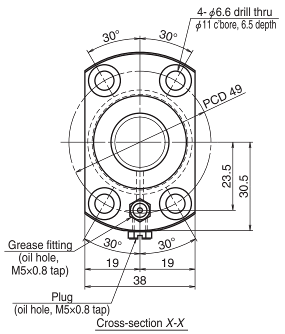
NSK

Screw shaft ø20

Lead 5, 10

Unit: mm





Cross-section X-X

Ball screw specifications	
Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	3.175 / 17.2
Ball circle dia.	20.5
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For non-drive side (Fixed)	(Simple)
WBK15-01B (low-profile, square)	WBK15-01B (low-profile, square)	WBK15S-01B (low-profile, square)
WBK15-11 (round)	WBK15-11 (round)	

Unit: mm

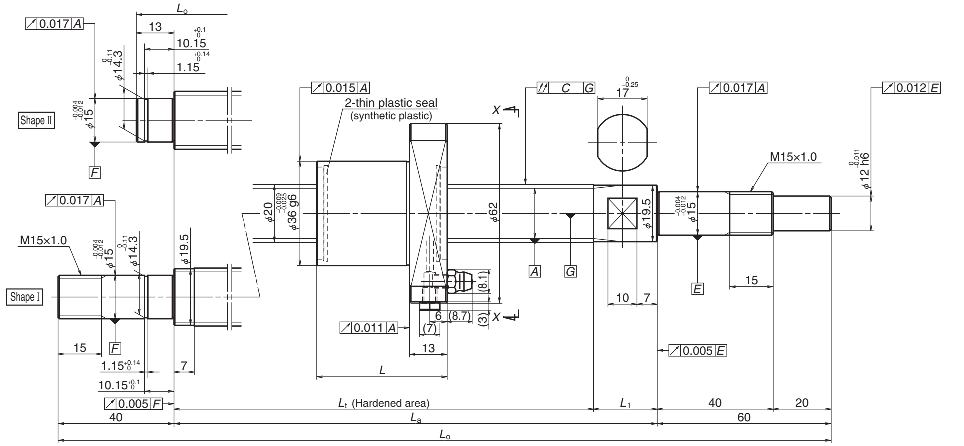
Reference No.	Screw shaft diameter d	Lead l	Basic load ratings (N) Dynamic C_a	Static C_{0a}	Stroke Nominal	Max.	Nut length L	Screw shaft dimensions L_t	L_a	L_o	L_1	Left shaft end shape (non-drive side)	Lead accuracy Target value T	Error e_p	Variation υ_u	Shaft run-out C	Dynamic preload torque (N·cm) *1	Mass (kg)	Permissible rotational speed (min⁻¹) *2 Fixed-Simple	Fixed-Fixed	Nut internal space (cm^3)	Standard grease replenishment (cm^3)
PSS2005N1D0323	20	5	10 400	18 500	150	191	31	228	250	323	22	Ⅱ	0	0.023	0.018	0.045	0.6 – 7.4	1.0	5 000	—	3.4	1.7
PSS2005N1D0373					200	241		278	300	373		Ⅱ		0.023	0.018	0.045	0.6 – 7.4	1.1	5 000	—		
PSS2005N1D0473					300	341		378	400	473		Ⅱ		0.025	0.020	0.050	0.6 – 7.4	1.3	5 000	—		
PSS2005N1D0573					400	441		478	500	573		Ⅱ		0.027	0.020	0.060	0.4 – 9.8	1.5	5 000	—		
PSS2005N1D0673					500	541		578	600	673		Ⅱ		0.030	0.023	0.075	0.4 – 9.8	1.7	5 000	—		
PSS2005N1D0773					600	641		678	700	773		Ⅱ		0.035	0.025	0.075	0.4 – 9.8	1.9	5 000	—		
PSS2005N1D0873					700	741		778	800	873		Ⅱ		0.035	0.025	0.095	0.4 – 9.8	2.2	4 410	—		
PSS2005N1D1000					800	839		878	900	1 000		Ⅰ		0.040	0.027	0.095	0.4 – 11.8	2.4	3 450	4 710		
PSS2010N1D0387		10	10 200	18 600	200	241	45	292	314	387	22	Ⅱ		0.023	0.018	0.045	1.2 – 9.3	1.2	5 000	—	3.2	1.6
PSS2010N1D0487					300	341		392	414	487		Ⅱ		0.025	0.020	0.050	1.2 – 9.3	1.4	5 000	—		
PSS2010N1D0587					400	441		492	514	587		Ⅱ		0.027	0.020	0.060	0.8 – 10.8	1.7	5 000	—		
PSS2010N1D0687					500	541		592	614	687		Ⅱ		0.030	0.023	0.075	0.8 – 10.8	1.9	5 000	—		
PSS2010N1D0787					600	641		692	714	787		Ⅱ		0.035	0.025	0.075	0.8 – 10.8	2.1	5 000	—		
PSS2010N1D0887					700	741		792	814	887		Ⅱ		0.035	0.025	0.095	0.8 – 10.8	2.4	4 330	—		
PSS2010N1D1014					800	839		892	914	1 014		Ⅰ		0.040	0.027	0.120	0.8 – 13.8	2.6	3 400	4 640		
PSS2010N1D1214					1 000	1 039		1 092	1 114	1 214		Ⅰ		0.046	0.030	0.120	0.8 – 13.8	3.1	2 250	3 110		
PSS2010N1D1414					1 200	1 239		1 292	1 314	1 414		Ⅰ		0.054	0.035	0.160	0.8 – 13.8	3.6	1 600	2 220		

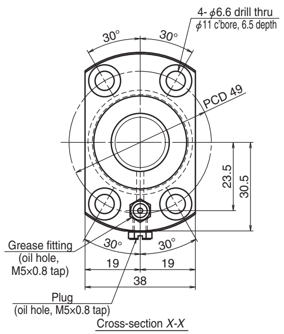
Notes: ***1.** Ball screw preload control values are shown. Approximately 2.0 N·cm of torque will be added due to thin plastic seals.
***2.** Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.
4. We recommend using NSK support units. Refer to Page B377 for details.
5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

Screw shaft ø20

Lead 20, 30

Unit: mm





Ball screw specifications

Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	3.175 / 17.2
Ball circle dia.	20.5
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For non-drive side (Fixed)	For non-drive side (Simple)
WBK15-01B (low-profile, square)	WBK15-01B (low-profile, square)	WBK15S-01B (low-profile, square)
WBK15-11 (round)	WBK15-11 (round)	

Unit: mm

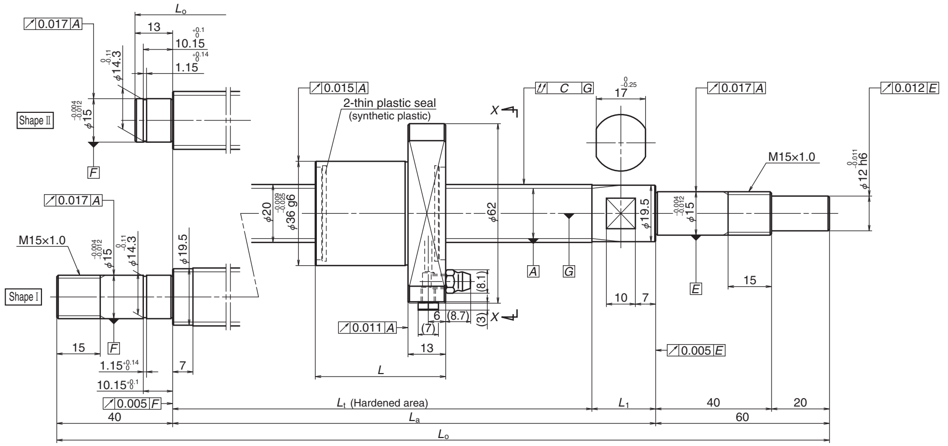
Reference No.	Screw shaft diameter	Lead	Basic load ratings (N) Dynamic	Basic load ratings (N) Static	Stroke Nominal	Stroke Max.	Nut length	Screw shaft dimensions				Left shaft end shape (non-drive side)	Lead accuracy Target value	Lead accuracy Error	Lead accuracy Variation	Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min⁻¹) *2 Fixed-Simple	Permissible rotational speed (min⁻¹) *2 Fixed-Fixed	Nut internal space	Standard grease replenishment
	d	l	C_a	C_{0a}			L	L_t	L_a	L_o	L_1		T	e_p	υ_u	C	(N·cm) *1	(kg)			(cm^3)	(cm^3)
PSS2020N1D0508	20	20	6 790	11 800	300	353	54	413	435	508	22	Ⅱ	0	0.027	0.020	0.060	1.4 – 11.8	1.6	5 000	—	3.2	1.6
PSS2020N1D0608					400	453		513	535	608		Ⅱ		0.030	0.023	0.060	1.4 – 11.8	1.8	5 000	—		
PSS2020N1D0708					500	553		613	635	708		Ⅱ		0.030	0.023	0.075	1.4 – 11.8	2.0	5 000	—		
PSS2020N1D0808					600	653		713	735	808		Ⅱ		0.035	0.025	0.095	1.4 – 11.8	2.3	5 000	—		
PSS2020N1D0908					700	753		813	835	908		Ⅱ		0.040	0.027	0.095	0.8 – 13.8	2.5	4 150	—		
PSS2020N1D1035					800	851		913	935	1 035		Ⅰ		0.040	0.027	0.120	0.8 – 13.8	2.8	3 270	4 470		
PSS2020N1D1235					1 000	1 051		1 113	1 135	1 235		Ⅰ		0.046	0.030	0.120	0.8 – 13.8	3.3	2 180	3 010		
PSS2020N1D1435					1 200	1 251		1 313	1 335	1 435		Ⅰ		0.054	0.035	0.160	0.8 – 13.8	3.8	1 550	2 170		
PSS2020N1D1835					1 600	1 651		1 713	1 735	1 835		Ⅰ		0.065	0.040	0.200	0.8 – 13.8	4.7	900	1 270		
PSS2030N1D0408		30	6 550	11 800	200	228	74	308	335	408	27	Ⅱ		0.023	0.018	0.050	1.6 – 9.8	1.4	5 000	—	4.6	2.3
PSS2030N1D0508					300	328		408	435	508		Ⅱ		0.027	0.020	0.060	1.4 – 11.8	1.7	5 000	—		
PSS2030N1D0608					400	428		508	535	608		Ⅱ		0.030	0.023	0.060	1.4 – 11.8	1.9	5 000	—		
PSS2030N1D0708					500	528		608	635	708		Ⅱ		0.030	0.023	0.075	1.4 – 11.8	2.1	5 000	—		
PSS2030N1D0808					600	628		708	735	808		Ⅱ		0.035	0.025	0.095	1.4 – 11.8	2.4	5 000	—		
PSS2030N1D0908					700	728		808	835	908		Ⅱ		0.040	0.027	0.095	0.8 – 13.8	2.6	4 310	—		
PSS2030N1D1035					800	826		908	935	1 035		Ⅰ		0.040	0.027	0.120	0.8 – 13.8	2.9	3 380	4 570		
PSS2030N1D1235					1 000	1 026		1 108	1 135	1 235		Ⅰ		0.046	0.030	0.120	0.8 – 13.8	3.4	2 240	3 070		
PSS2030N1D1435					1 200	1 226		1 308	1 335	1 435		Ⅰ		0.054	0.035	0.160	0.8 – 13.8	3.9	1 590	2 200		

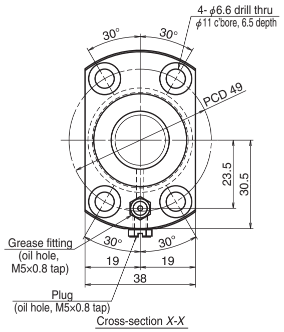
Notes: ***1.** Ball screw preload control values are shown. Approximately 2.0 N·cm of torque will be added due to thin plastic seals.
***2.** Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.
4. We recommend using NSK support units. Refer to Page B377 for details.
5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

Screw shaft ø20

Lead 40, 60

Unit: mm





Ball screw specifications	
Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	3.175 / 17.2
Ball circle dia.	20.5
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side	For non-drive side	
(Fixed)	(Fixed)	(Simple)
WBK15-01B (low-profile, square)	WBK15-01B (low-profile, square)	WBK15S-01B (low-profile, square)
WBK15-11 (round)	WBK15-11 (round)	

Unit: mm

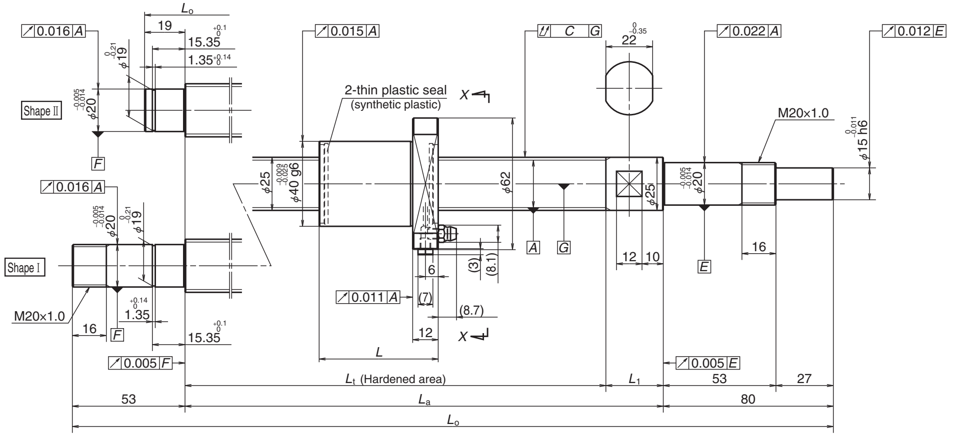
Reference No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions				Left shaft end shape (non-drive side)	Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min⁻¹) *2		Nut internal space	Standard grease replenishment
			Dynamic	Static	Nominal	Max.							Target value	Error	Variation				Fixed-Simple	Fixed-Fixed		
	d	*l*	C_a	C_{0a}			*L*	L_t	L_a	L_o	L_1		*T*	e_p	υ_u	*C*	(N·cm) *1	(kg)			(cm³)	(cm³)
PSS2040N1D0658	20	40	6 380	11 600	400	455	92	553	585	658	32	II	0	0.030	0.023	0.075	2.2 – 12.8	2.1	5 000	—	5.3	2.7
PSS2040N1D0758					500	555		653	685	758		II		0.035	0.025	0.075	2.2 – 12.8	2.4	5 000	—		
PSS2040N1D0858					600	655		753	785	858		II		0.035	0.025	0.095	2.2 – 12.8	2.6	5 000	—		
PSS2040N1D0958					700	755		853	885	958		II		0.040	0.027	0.095	1.8 – 14.8	2.8	3 940	—		
PSS2040N1D1085					800	853		953	985	1 085		I		0.040	0.027	0.120	1.8 – 14.8	3.1	3 120	4 190		
PSS2040N1D1285					1 000	1 053		1 153	1 185	1 285		I		0.046	0.030	0.160	1.8 – 14.8	3.6	2 100	2 850		
PSS2040N1D1485					1 200	1 253		1 353	1 385	1 485		I		0.054	0.035	0.160	1.8 – 14.8	4.1	1 500	2 070		
PSS2040N1D1885					1 600	1 653		1 753	1 785	1 885		I		0.065	0.040	0.200	1.8 – 14.8	5.1	880	1 230		
PSS2040N1D2285					2 000	2 053		2 153	2 185	2 285		I		0.077	0.046	0.240	1.8 – 14.8	6.0	580	810		
PSS2060N1D0708		60	5 680	11 800	400	458	129	593	635	708	42	II		0.030	0.023	0.075	2.7 – 13.8	2.4	5 000	—	7.0	3.5
PSS2060N1D0808					500	558		693	735	808		II		0.035	0.025	0.095	2.7 – 13.8	2.6	5 000	—		
PSS2060N1D0908					600	658		793	835	908		II		0.035	0.025	0.095	2.7 – 13.8	2.9	4 830	—		
PSS2060N1D1008					700	758		893	935	1 008		II		0.040	0.027	0.120	1.8 – 14.8	3.1	3 740	—		
PSS2060N1D1135					800	856		993	1 035	1 135		I		0.040	0.027	0.120	1.8 – 14.8	3.4	2 980	3 920		
PSS2060N1D1335					1 000	1 056		1 193	1 235	1 335		I		0.046	0.030	0.160	1.8 – 14.8	3.9	2 020	2 700		
PSS2060N1D1535					1 200	1 256		1 393	1 435	1 535		I		0.054	0.035	0.160	1.8 – 14.8	4.4	1 460	1 970		
PSS2060N1D1935					1 600	1 656		1 793	1 835	1 935		I		0.065	0.040	0.200	1.8 – 14.8	5.4	860	1 180		
PSS2060N1D2335					2 000	2 056		2 193	2 235	2 335		I		0.077	0.046	0.240	1.8 – 14.8	6.3	570	790		

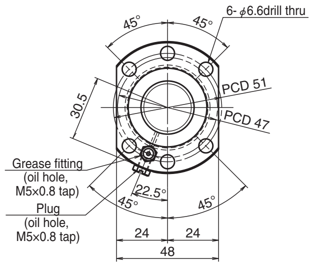
Notes: ***1.** Ball screw preload control values are shown. Approximately 2.0 N·cm of torque will be added due to thin plastic seals.
***2.** Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.
4. We recommend using NSK support units. Refer to Page B377 for details.
5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

Screw shaft ø25

Lead 5, 10

Unit: mm





Cross-section X-X

Ball screw specifications	
Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	3.175 / 22.2
Ball circle dia.	25.5
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side	For non-drive side	
(Fixed)	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

Reference No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions			
			Dynamic	Static	Nominal	Max.					
	d	l	C_a	C_{0a}			L	L_t	L_a	L_o	L_1
PSS2505N1D0349	25	5	11 500	23 500	150	185	32	223	250	349	27
PSS2505N1D0399					200	235		273	300	399	
PSS2505N1D0499					300	335		373	400	499	
PSS2505N1D0599					400	435		473	500	599	
PSS2505N1D0699					500	535		573	600	699	
PSS2505N1D0899					700	735		773	800	899	
PSS2505N1D0999					800	835		873	900	999	
PSS2505N1D1233					1 000	1 027		1 073	1 100	1 233	
PSS2510N1D0549		10	15 000	32 400	300	361	56	423	450	549	27
PSS2510N1D0649					400	461		523	550	649	
PSS2510N1D0749					500	561		623	650	749	
PSS2510N1D0849					600	661		723	750	849	
PSS2510N1D0949					700	761		823	850	949	
PSS2510N1D1049					800	861		923	950	1 049	
PSS2510N1D1283					1 000	1 053		1 123	1 150	1 283	
PSS2510N1D1883					1 600	1 653		1 723	1 750	1 883	

Reference No.	Left shaft end shape (non-drive side)	Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min⁻¹) *2		Nut internal space	Standard grease replenishment
		Target value	Error	Variation				Fixed-Simple	Fixed-Fixed		
		T	e_p	υ_u	C	(N·cm) *1	(kg)			(cm³)	(cm³)
PSS2505N1D0349	II	0	0.023	0.018	0.035	1.2 – 9.3	1.5	5 000	—	4.4	2.2
PSS2505N1D0399	II		0.023	0.018	0.035	1.2 – 9.3	1.6	5 000	—		
PSS2505N1D0499	II		0.025	0.020	0.040	1.2 – 9.3	2.0	5 000	—		
PSS2505N1D0599	II		0.027	0.020	0.045	1.2 – 9.3	2.3	5 000	—		
PSS2505N1D0699	II		0.030	0.023	0.055	0.8 – 10.8	2.7	5 000	—		
PSS2505N1D0899	II		0.035	0.025	0.065	0.8 – 10.8	3.4	5 000	—		
PSS2505N1D0999	II		0.040	0.027	0.065	0.8 – 10.8	3.7	4 490	—		
PSS2505N1D1233	I		0.046	0.030	0.080	0.8 – 13.8	4.5	2 960	4 060		
PSS2510N1D0549	II		0.027	0.020	0.045	3.1 – 11.8	2.4	5 000	—	4.7	2.4
PSS2510N1D0649	II		0.030	0.023	0.055	2.2 – 12.8	2.7	5 000	—		
PSS2510N1D0749	II		0.030	0.023	0.055	2.2 – 12.8	3.1	5 000	—		
PSS2510N1D0849	II		0.035	0.025	0.065	2.2 – 12.8	3.5	5 000	—		
PSS2510N1D0949	II		0.040	0.027	0.065	2.2 – 12.8	3.8	5 000	—		
PSS2510N1D1049	II		0.040	0.027	0.080	2.2 – 12.8	4.2	4 120	—		
PSS2510N1D1283	I		0.046	0.030	0.100	1.8 – 14.8	5.0	2 760	3 790		
PSS2510N1D1883	I		0.065	0.040	0.130	1.8 – 14.8	7.2	1 150	1 620		

Notes: ***1.** Ball screw preload control values are shown. Approximately 2.0 N·cm of torque will be added due to thin plastic seals.
***2.** Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.
4. We recommend using NSK support units. Refer to Page B377 for details.
5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

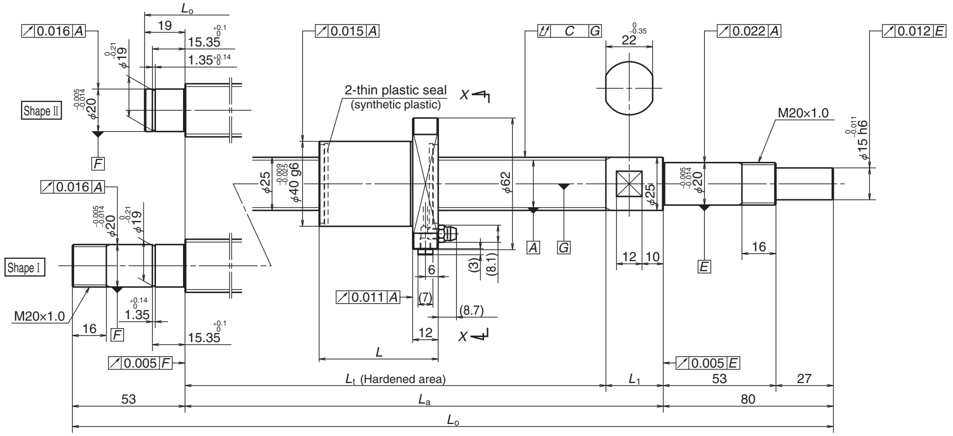
Compact FA-PSS Model (Medium, High helix lead)

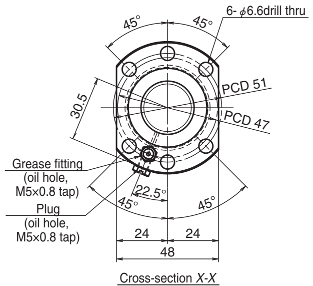
Nut: BSS

Screw shaft ø25

Lead 20, 25

Unit: mm





Cross-section X-X

Ball screw specifications	
Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	3.175 / 22.2
Ball circle dia.	25.5
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side	For non-drive side	
(Fixed)	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

Reference No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions			
	d	l	Dynamic C_a	Static C_{0a}	Nominal	Max.	L	L_t	L_a	L_o	L_1
PSS2520N1D0729	25	20	7 650	14 800	500	544	54	604	630	729	26
PSS2520N1D0829					600	644		704	730	829	
PSS2520N1D0929					700	744		804	830	929	
PSS2520N1D1029					800	844		904	930	1 029	
PSS2520N1D1263					1 000	1 036		1 104	1 130	1 263	
PSS2520N1D1463					1 200	1 236		1 304	1 330	1 463	
PSS2520N1D1863					1 600	1 636		1 704	1 730	1 863	
PSS2520N1D2263					2 000	2 036		2 104	2 130	2 263	
PSS2525N1D0779		25	7 490	14 600	500	581	63	650	680	779	30
PSS2525N1D0879					600	681		750	780	879	
PSS2525N1D0979					700	781		850	880	979	
PSS2525N1D1079					800	881		950	980	1 079	
PSS2525N1D1313					1 000	1 073		1 150	1 180	1 313	
PSS2525N1D1513					1 200	1 273		1 350	1 380	1 513	
PSS2525N1D1913					1 600	1 673		1 750	1 780	1 913	
PSS2525N1D2313					2 000	2 073		2 150	2 180	2 313	

Reference No.	Left shaft end shape (non-drive side)	Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *2		Nut internal space	Standard grease replenishment
		Target value T	Error e_p	Variation υ_u	C	(N·cm) *1	(kg)	Fixed-Simple	Fixed-Fixed	(cm^3)	(cm^3)
PSS2520N1D0729	Ⅱ	0	0.030	0.023	0.055	2.2 – 12.8	3.1	5 000	—	3.9	2.0
PSS2520N1D0829	Ⅱ		0.035	0.025	0.065	2.2 – 12.8	3.4	5 000	—		
PSS2520N1D0929	Ⅱ		0.040	0.027	0.065	2.2 – 12.8	3.8	5 000	—		
PSS2520N1D1029	Ⅱ		0.040	0.027	0.080	2.2 – 12.8	4.2	4 280	—		
PSS2520N1D1263	Ⅰ		0.046	0.030	0.100	1.8 – 14.8	5.0	2 850	3 920		
PSS2520N1D1463	Ⅰ		0.054	0.035	0.100	1.8 – 14.8	5.8	2 030	2 820		
PSS2520N1D1863	Ⅰ		0.065	0.040	0.130	1.8 – 14.8	7.3	1 180	1 650		
PSS2520N1D2263	Ⅰ		0.077	0.046	0.170	1.8 – 14.8	8.8	770	1 080		
PSS2525N1D0779	Ⅱ		0.035	0.025	0.055	2.7 – 13.8	3.3	5 000	—	4.3	2.2
PSS2525N1D0879	Ⅱ		0.035	0.025	0.065	2.7 – 13.8	3.7	5 000	—		
PSS2525N1D0979	Ⅱ		0.040	0.027	0.065	2.7 – 13.8	4.1	4 910	—		
PSS2525N1D1079	Ⅱ		0.040	0.027	0.080	2.7 – 13.8	4.4	3 910	—		
PSS2525N1D1313	Ⅰ		0.046	0.030	0.100	1.8 – 14.8	5.3	2 640	3 620		
PSS2525N1D1513	Ⅰ		0.054	0.035	0.100	1.8 – 14.8	6.0	1 900	2 630		
PSS2525N1D1913	Ⅰ		0.065	0.040	0.130	1.8 – 14.8	7.5	1 120	1 570		
PSS2525N1D2313	Ⅰ		0.077	0.046	0.170	1.8 – 14.8	9.1	740	1 040		

Notes: ***1.** Ball screw preload control values are shown. Approximately 2.0 N·cm of torque will be added due to thin plastic seals.

***2.** Contact NSK if permissible rotational speed will be exceeded.

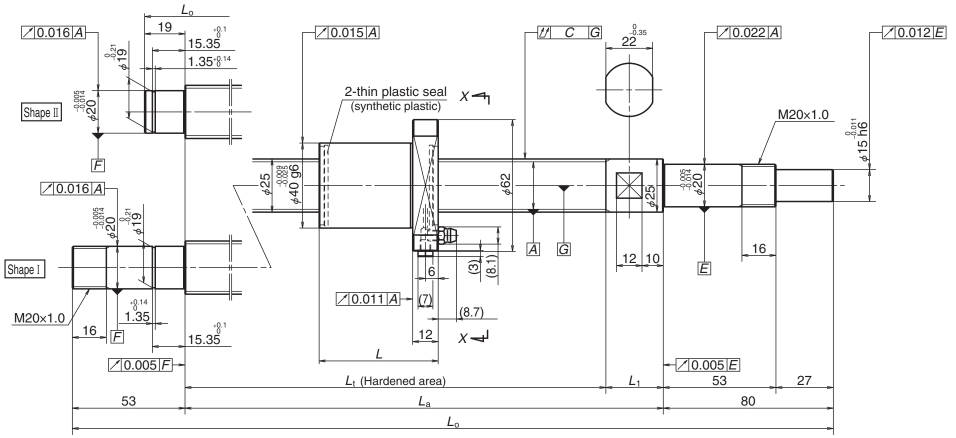
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.

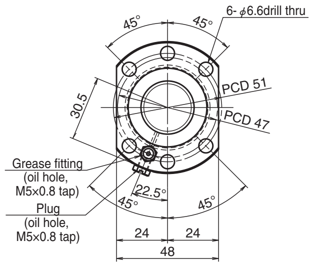
4. We recommend using NSK support units. Refer to Page B377 for details.

5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

Screw shaft ø25
Lead 30, 50

Unit: mm





Cross-section X-X

Ball screw specifications

Ball screw specifications	
Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	3.175 / 22.2
Ball circle dia.	25.5
Accuracy grade/axial play	C5 / 0
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For non-drive side (Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

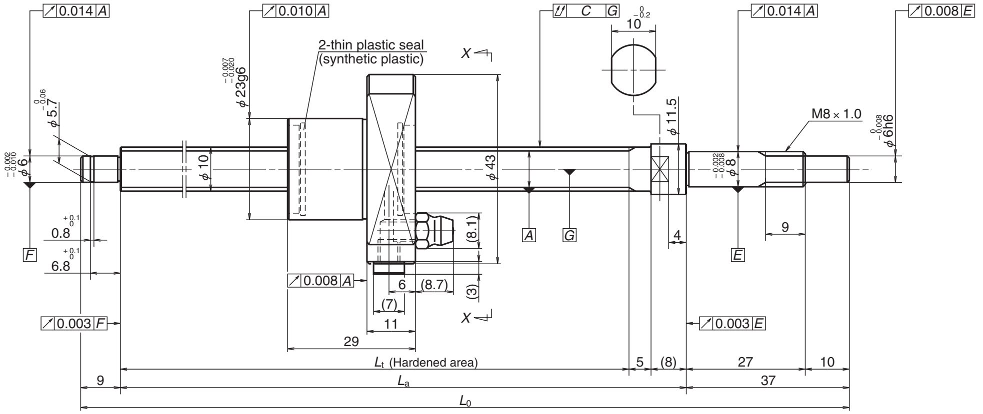
Reference No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions				Left shaft end shape (non-drive side)	Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *2		Nut internal space	Standard grease replenishment
	d	l	Dynamic C_a	Static C_{0a}	Nominal	Max.	L	L_t	L_a	L_o	L_1		Target value T	Error e_p	Variation υ_u	C	(N·cm) *1	(kg)	Fixed-Simple	Fixed-Fixed	(cm^3)	(cm^3)
PSS2530N1D0779	25	30	7 490	14 600	500	570	74	650	680	779	30	Ⅱ	0	0.035	0.025	0.055	2.7 – 13.8	3.4	5 000	—	5.5	2.8
PSS2530N1D0879					600	670		750	780	879		Ⅱ		0.035	0.025	0.065	2.7 – 13.8	3.7	5 000	—		
PSS2530N1D0979					700	770		850	880	979		Ⅱ		0.040	0.027	0.065	2.7 – 13.8	4.1	4 980	—		
PSS2530N1D1079					800	870		950	980	1 079		Ⅱ		0.040	0.027	0.080	2.7 – 13.8	4.5	3 960	—		
PSS2530N1D1313					1 000	1 062		1 150	1 180	1 313		Ⅰ		0.046	0.030	0.100	1.8 – 14.8	5.3	2 670	3 650		
PSS2530N1D1513					1 200	1 262		1 350	1 380	1 513		Ⅰ		0.054	0.035	0.100	1.8 – 14.8	6.1	1 920	2 650		
PSS2530N1D1913					1 600	1 662		1 750	1 780	1 913		Ⅰ		0.065	0.040	0.130	1.8 – 14.8	7.6	1 130	1 580		
PSS2530N1D2313					2 000	2 062		2 150	2 180	2 313		Ⅰ		0.077	0.046	0.170	1.8 – 14.8	9.1	740	1 040		
PSS2550N1D0829		50	6 910	14 700	500	570	114	690	730	829	40	Ⅱ		0.035	0.025	0.065	5.4 – 17.6	3.8	5 000	—	7.7	3.9
PSS2550N1D0929					600	670		790	830	929		Ⅱ		0.035	0.025	0.065	5.4 – 17.6	4.1	5 000	—		
PSS2550N1D1029					700	770		890	930	1 029		Ⅱ		0.040	0.027	0.080	5.4 – 17.6	4.5	4 750	—		
PSS2550N1D1129					800	870		990	1 030	1 129		Ⅱ		0.040	0.027	0.080	5.4 – 17.6	4.9	3 790	—		
PSS2550N1D1363					1 000	1 062		1 190	1 230	1 363		Ⅰ		0.046	0.030	0.100	4.1 – 19.6	5.8	2 570	3 470		
PSS2550N1D1563					1 200	1 262		1 390	1 430	1 563		Ⅰ		0.054	0.035	0.100	4.1 – 19.6	6.5	1 860	2 540		
PSS2550N1D1963					1 600	1 662		1 790	1 830	1 963		Ⅰ		0.065	0.040	0.130	4.1 – 19.6	8.0	1 100	1 520		
PSS2550N1D2363					2 000	2 062		2 190	2 230	2 363		Ⅰ		0.077	0.046	0.170	4.1 – 19.6	9.6	730	1 020		

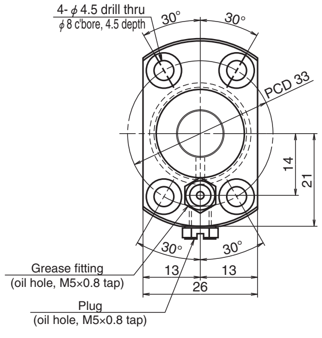
Notes: ***1.** Ball screw preload control values are shown. Approximately 2.0 N·cm of torque will be added due to thin plastic seals.
***2.** Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.
4. We recommend using NSK support units. Refer to Page B377 for details.
5. We recommend filling about 50% of the nut's internal space with grease. See Page D16 for details.

Screw shaft ø10

Lead 5

Unit: mm





Cross-section X-X

Ball screw specifications	
Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	2.000 / 8.2
Ball circle dia.	10.3
Accuracy grade/axial play	C3 / 0
Factory-packed grease	NSK grease LG2

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK08-01C (square, clean)	WBK08S-01C (square, clean)
WBK08-11C (round, clean)	WBK08S-01B (low-profile, square)
WBK08-01B (low-profile, square)	
WBK08-11 (round)	

Unit: mm

Reference No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Screw shaft dimensions			Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *2	Nut internal space	Standard grease replenishment
			Dynamic	Static	Nominal	Max.				Target value	Error	Variation						
	d	l	C_a	C_{0a}			L_t	L_a	L_o	T	e_p	V_u	C	(N·cm) *1	(kg)	Fixed-Simple	(cm^3)	(cm^3)
USS1005N1D0221	10	5	3 420	4 840	100	133	162	175	221	0	0.010	0.008	0.035	0.2–1.8	0.3	5 000	0.8	0.4
USS1005N1D0321					200	233	262	275	321		0.012	0.008	0.045	0.2–2.0	0.3			
USS1005N1D0521					400	433	462	475	521		0.015	0.010	0.070	0.2–3.0	0.5			

Notes: ***1.** Ball screw preload control values are shown. Approximately 0.5 N·cm of torque will be added due to thin plastic seals.
***2.** Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.
4. We recommend using NSK support units. Refer to Page B377 for details.

Compact FA-USS Model (Fine lead)

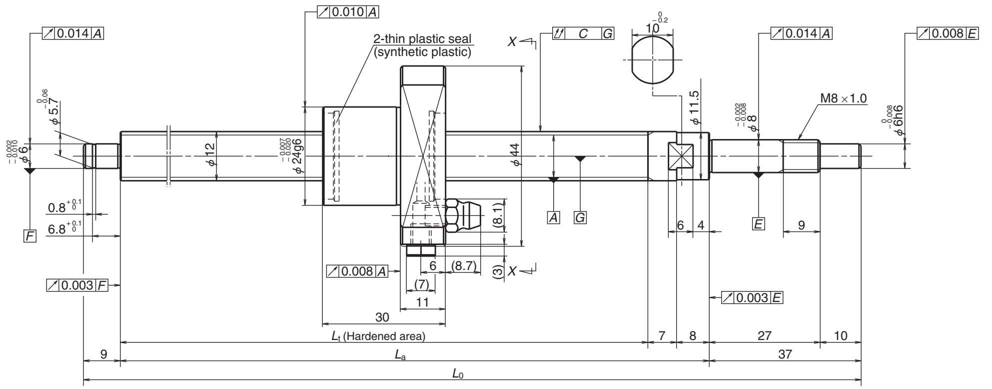
Nut: BSS

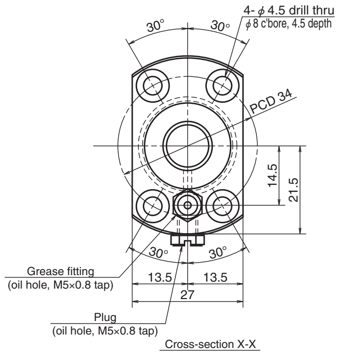
NSK

Screw shaft ø12

Lead 5

Unit: mm





Ball screw specifications

Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	2.000 / 10.2
Ball circle dia.	12.3
Accuracy grade/axial play	C3 / 0
Factory-packed grease	NSK grease LG2

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK08-01C (square, clean)	WBK08S-01C (square, clean)
WBK08-11C (round, clean)	WBK08S-01B (low-profile, square)
WBK08-01B (low-profile, square)	
WBK08-11 (round)	

Unit: mm

Reference No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Screw shaft dimensions			Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *2	Nut internal space	Standard grease replenishment
			Dynamic	Static	Nominal	Max.				Target value	Error	Variation						
	d	l	C_a	C_{0a}			L_t	L_a	L_o	T	e_p	V_u	C	(N·cm) *1	(kg)	Fixed-Simple	(cm^3)	(cm^3)
USS1205N1D0221	12	5	3 750	5 810	100	130	160	175	221	0	0.010	0.008	0.035	0.2–1.8	0.3	5 000	1.0	0.5
USS1205N1D0321					200	230	260	275	321		0.012	0.008	0.045	0.2–2.0	0.3			
USS1205N1D0621					500	530	560	575	621		0.016	0.012	0.070	0.2–3.0	0.7			

Notes: ***1.** Ball screw preload control values are shown. Approximately 0.5 N·cm of torque will be added due to thin plastic seals.
***2.** Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.
4. We recommend using NSK support units. Refer to Page B377 for details.

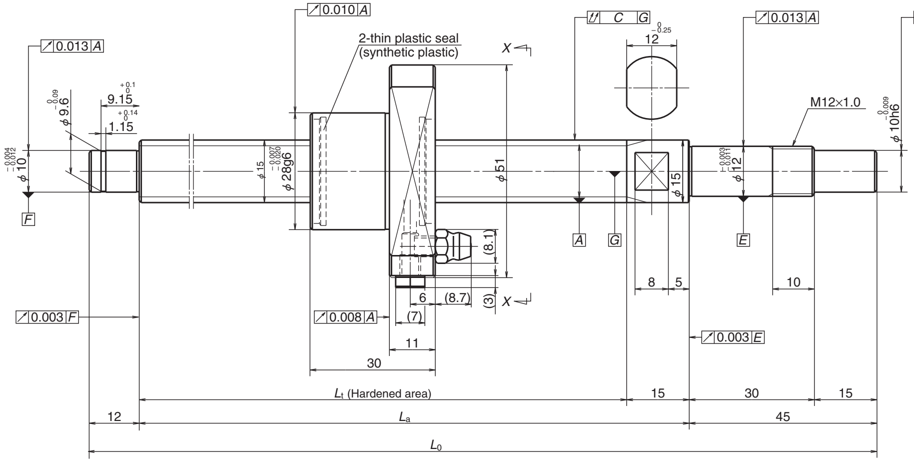
Compact FA-USS Model (Fine lead)

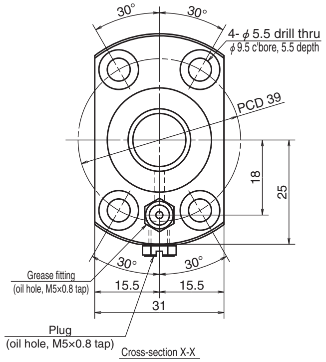
Nut: BSS

Screw shaft ø15

Lead 5

Unit: mm





Ball screw specifications	
Preload	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	2.778 / 12.6
Ball circle dia.	15.5
Accuracy grade/axial play	C3 / 0
Factory-packed grease	NSK grease LG2

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK12-01C (square, clean)	WBK12S-01C (square, clean)
WBK12-11C (round, clean)	WBK12-01B (low-profile, square)
WBK12S-01B (low-profile, square)	
WBK12-11 (round)	

Unit: mm

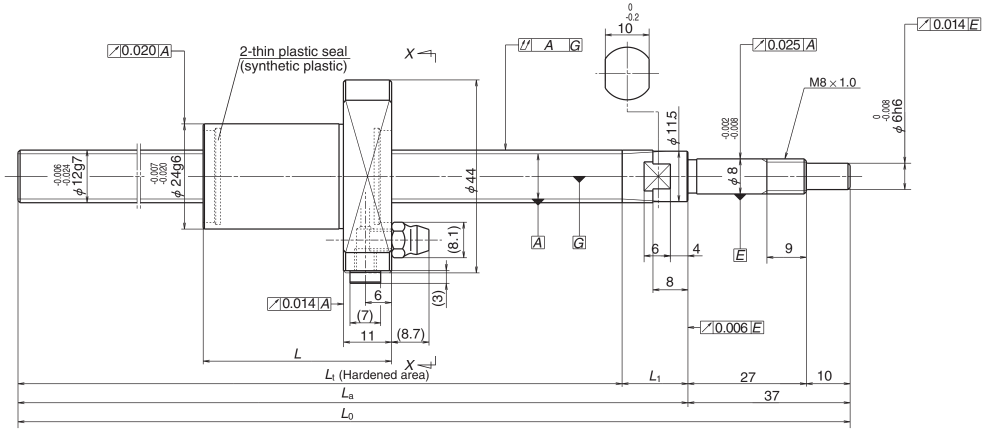
Reference No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Screw shaft dimensions			Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *2	Nut internal space	Standard grease replenishment
			Dynamic	Static	Nominal	Max.				Target value	Error	Variation						
	d	l	C_a	C_{0a}			L_t	L_a	L_o	T	e_p	V_u	C	(N·cm) *1	(kg)	Fixed-Simple	(cm^3)	(cm^3)
USS1505N1D0261	15	5	6 410	10 100	100	159	189	204	261	0	0.010	0.008	0.025	0.2–5.0	0.5	5 000	2.0	1.0
USS1505N1D0361					200	259	289	304	361		0.012	0.008	0.035	0.2–5.0	0.6	5 000		
USS1505N1D0561					400	459	489	504	561		0.015	0.010	0.045	0.2–6.0	0.9	5 000		
USS1505N1D0761					600	653	689	704	761		0.018	0.013	0.060	0.2–8.0	1.1	4 130		

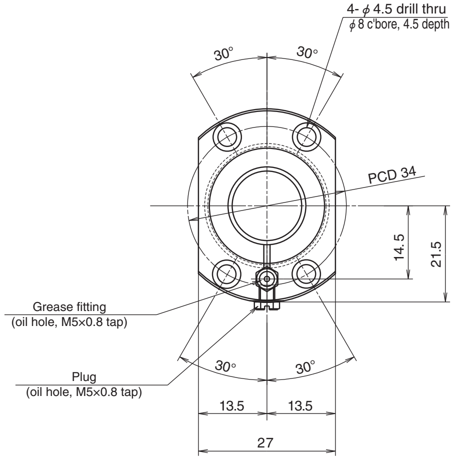
Notes: ***1.** Ball screw preload control values are shown. Approximately 0.5 N·cm of torque will be added due to thin plastic seals.
***2.** Contact NSK if permissible rotational speed will be exceeded.
3. These ball screws are suitable for operating temperatures from 0 to 80 °C.
4. We recommend using NSK support units. Refer to Page B377 for details.

Screw shaft ø12

Lead 10

Unit: mm





Ball screw specifications	
Ball diameter/screw shaft root diameter	2.000 / 10.2
Accuracy grade/axial play	Ct7 / 0.010 or less
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK08-01B (low-profile, square)	WBK12SF-01B (low-profile, square)

Unit: mm

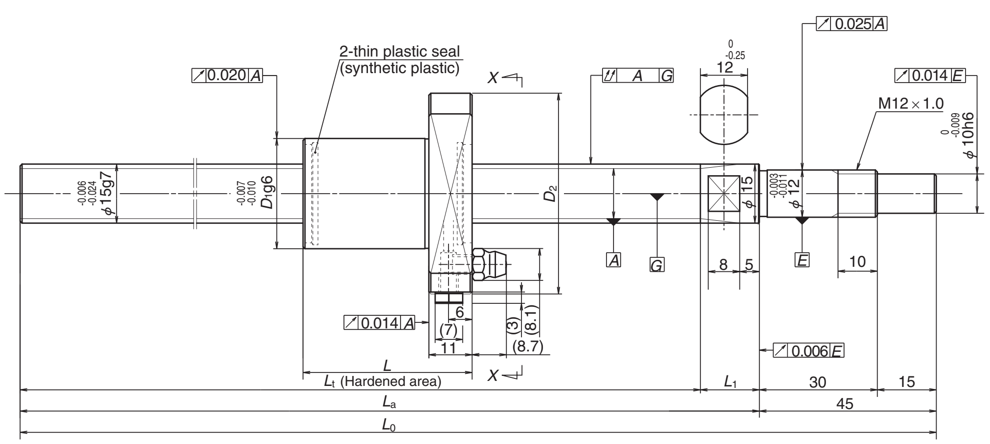
Reference No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions				Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *5	Nut internal space	Standard grease replenishment
			Dynamic	Static	Nominal	Max.						Target value	Error	Variation				Fixed-Simple		
	d	l	C_a	C_{0a}			L	L_t	L_a	L_o	L_1	T	e_p	V_{300}	C	(N·cm)	(kg)		(cm^3)	(cm^3)
FSS1210N1D0400	12	10	3 760	5 780	250	287	43	348	363	400	15	0	0.120	0.052	0.080	–	0.5	5 000	1.0	0.5
FSS1210N1D0600					450	487		548	563	600			0.195		0.120		0.7	5 000		
FSS1210N1D0900					750	787		848	863	900			0.310		0.180		1.0	2 300		

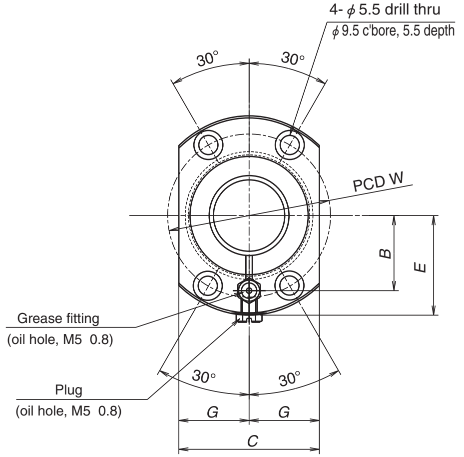
Notes:
1. Ball screw preload control values are shown. Approximately 2.0 N·cm of torque will be added due to thin plastic seals.
2. These ball screws are suitable for operating temperatures from 0 to 80 °C.
3. We recommend using NSK support units. Refer to Page B377 for details.
4. Stroke and permissible rotational speeds shown apply when using support units recommended by NSK in a Fixed-Simple configuration.

***5.** Permissible rotational speed changes when using cut screw shafts. In these cases, use the smaller of the following two values as the permissible rotational speed:
-Critical speed where shaft resonance is generated (see Page B47)
-5 000 min^{-1} (maximum rotational speed)

Screw shaft ø15
Lead 10, 20

Unit: mm





Ball screw specifications		
Lead	10	20
Ball diameter/screw shaft root diameter	2.778 / 12.6	3.175 / 12.2
Accuracy grade/axial play	Ct7 / 0.010 or less	
Factory-packed grease	NSK grease LR3	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK12-01B (low-profile, square)	WBK15SF-01B (low-profile, square)

Unit: mm

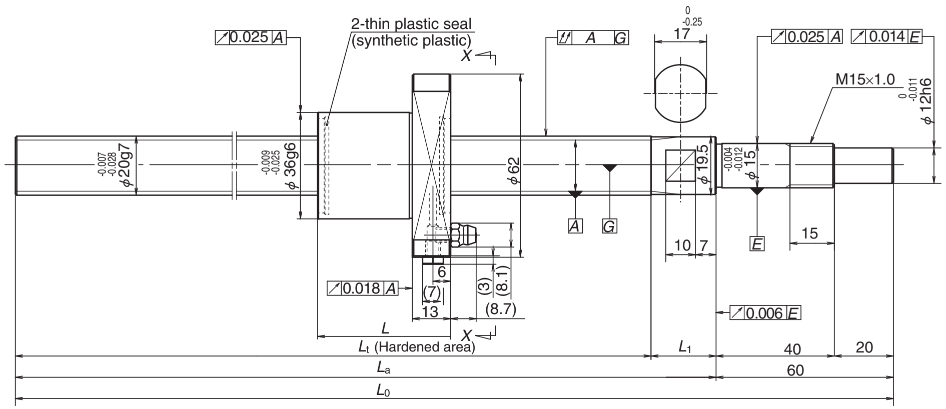
Reference No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Screw shaft dimensions				Lead accuracy			Nut dimensions								Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *5	Nut internal space	Standard grease replenishment
			Dynamic	Static	Nominal	Max.					Target value	Error	Variation												Fixed-Simple		
	d	l	C_a	C_{0a}			L_t	L_a	L_o	L_1	T	e_p	V_{300}	L	D_1	D_2	W	B	C	E	G	C	(N·cm)	(kg)		(cm^3)	(cm^3)
FSS1510N1D0500	15	10	6 530	10 200	350	379	440	455	500	15	0	0.155	0.052	43	28	51	39	18	31	25	15.5	0.070	–	0.9	5 000	2.0	1.0
FSS1510N1D1000					850	879	940	955	1 000			0.310										0.125		1.7	2 300		
FSS1510N1D1450					1 300	1 329	1 390	1 405	1 450			0.490										0.200		2.3	1 020		
FSS1520N1D0500		20	5 660	8 700	350	368	437	455	500	18		0.155		51	32	55	43	20	33	27	16.5	0.070		1.0	5 000	2.8	1.4
FSS1520N1D1000					850	868	937	955	1 000			0.310										0.125		1.7	2 260		
FSS1520N1D1450					1 300	1 318	1 387	1 405	1 450			0.490										0.200		2.3	1 000		

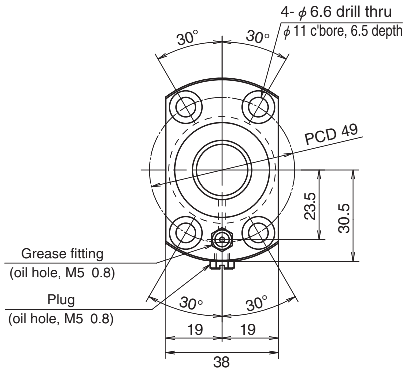
Notes: 1. Ball screw preload control values are shown. Approximately 2.0 N·cm of torque will be added due to thin plastic seals.
2. These ball screws are suitable for operating temperatures from 0 to 80 °C.
3. We recommend using NSK support units. Refer to Page B377 for details.
4. Stroke and permissible rotational speeds shown apply when using support units recommended by NSK in a Fixed-Simple configuration.
***5.** Permissible rotational speed changes when using cut screw shafts. In these cases, use the smaller of the following two values as the permissible rotational speed:
-Critical speed where shaft resonance is generated (see Page B47)
-5 000 min^{-1} (maximum rotational speed)

Screw shaft ø20

Lead 10, 20

Unit: mm





Ball screw specifications	
Ball diameter/screw shaft root diameter	3.175 / 17.2
Accuracy grade/axial play	Ct7 / 0.010 or less
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK15-01B (low-profile, square)	WBK20SF-01B (low-profile, square)

Unit: mm

Reference No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions				Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *5	Nut internal space	Standard grease replenishment
			Dynamic	Static	Nominal	Max.						Target value	Error	Variation				Fixed-Simple		
	d	l	C_a	C_{0a}			L	L_t	L_a	L_o	L_1	T	e_p	V_{300}	C	(N·cm)	(kg)		(cm^3)	(cm^3)
FSS2010N1D0600	20	10	10 200	18 600	400	451	45	518	540	600	22	0	0.195	0.052	0.085	–	1.7	5 000	3.2	1.6
FSS2010N1D1000					800	851		918	940	1 000			0.310		0.125		2.6	3 310		
FSS2010N1D1450					1 250	1 301		1 368	1 390	1 450			0.490		0.200		3.6	1 450		
FSS2020N1D0600		20	6 790	11 800	400	442	54	518	540	600			0.195		0.085		1.8	5 000		
FSS2020N1D1000					800	842		918	940	1 000			0.310		0.125		2.7	3 350		
FSS2020N1D1450					1 250	1 292		1 368	1 390	1 450			0.490		0.200		3.8	1 460		

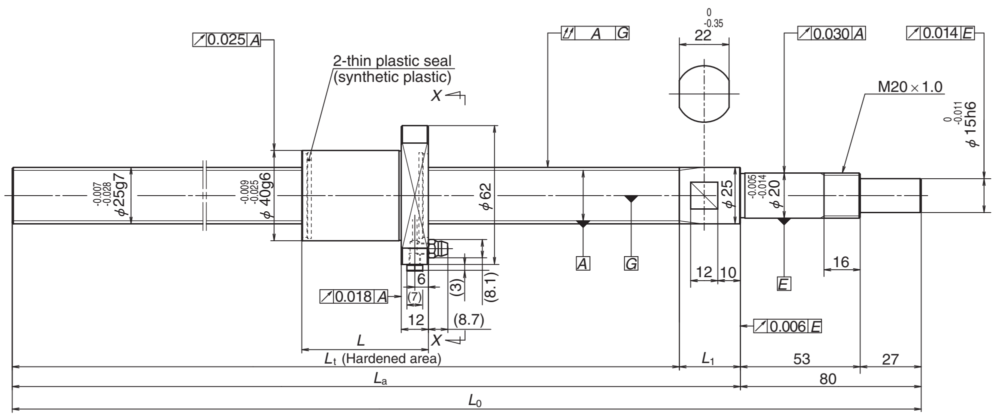
Notes:
1. Ball screw preload control values are shown. Approximately 2.0 N·cm of torque will be added due to thin plastic seals.
2. These ball screws are suitable for operating temperatures from 0 to 80 °C.
3. We recommend using NSK support units. Refer to Page B377 for details.
4. Stroke and permissible rotational speeds shown apply when using support units recommended by NSK in a Fixed-Simple configuration.

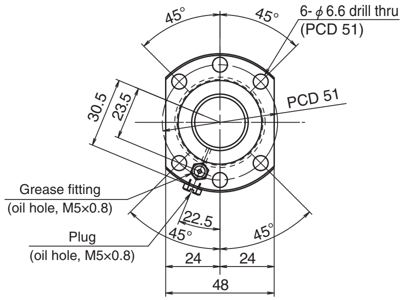
***5.** Permissible rotational speed changes when using cut screw shafts. In these cases, use the smaller of the following two values as the permissible rotational speed:
-Critical speed where shaft resonance is generated (see Page B47)
-5 000 min^{-1} (maximum rotational speed)

Screw shaft ø25

Lead 10, 20, 25

Unit: mm





Ball screw specifications	
Ball diameter/screw shaft root diameter	3.175 / 22.2
Accuracy grade/axial play	Ct7 / 0.010 or less
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK20-01 (square)	WBK25SF-01 (square)

Unit: mm

Reference No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions				Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *5	Nut internal space	Standard grease replenishment
			Dynamic	Static	Nominal	Max.						Target value	Error	Variation				Fixed-Simple		
	d	l	C_a	C_{0a}			L	L_t	L_a	L_o	L_1	T	e_p	V_{300}	C	(N·cm)	(kg)		(cm^3)	(cm^3)
FSS2510N1D0600	25	10	15 000	32 400	400	415	56	493	520	600	27	0	0.155	0.052	0.065	–	2.6	5 000	4.7	2.4
FSS2510N1D1000					800	815		893	920	1 000			0.310		0.090		4.0	4 590		
FSS2510N1D1450					1 250	1 265		1 343	1 370	1 450			0.490		0.130		5.8	1 970		
FSS2520N1D0600		20	7 650	14 800	400	418	54	494	520	600	26		0.155		0.065		2.6	5 000	3.9	2.0
FSS2520N1D1000					800	818		894	920	1 000			0.310		0.090		4.0	4 570		
FSS2520N1D1450					1 250	1 268		1 344	1 370	1 450			0.490		0.130		5.8	1 960		
FSS2525N1D0600		25	7 490	14 600	400	405	63	490	520	600	30		0.155		0.065		2.6	5 000	4.3	2.2
FSS2525N1D1000					800	805		890	920	1 000			0.310		0.090		4.1	4 660		
FSS2525N1D1450					1 250	1 255		1 340	1 370	1 450			0.490		0.130		5.8	1 990		

Notes: 1. Ball screw preload control values are shown. Approximately 2.0 N·cm of torque will be added due to thin plastic seals.
2. These ball screws are suitable for operating temperatures from 0 to 80 °C.
3. We recommend using NSK support units. Refer to Page B377 for details.
4. Stroke and permissible rotational speeds shown apply when using support units recommended by NSK in a Fixed-Simple configuration.
***5.** Permissible rotational speed changes when using cut screw shafts. In these cases, use the smaller of the following two values as the permissible rotational speed:
-Critical speed where shaft resonance is generated (see Page B47)
-5 000 min^{-1} (maximum rotational speed)

B-3-1.2 High-Speed SS (HSS) Model

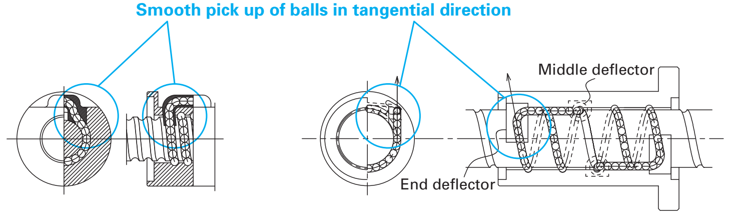
◇ Features

The HMS and HMD models, originally developed for machine tools, are an addition to NSK's lineup of standard ball screws. They have a wide range of applications, from general machines to high performance machines such as those requiring high speed and precision.

● High speed

A new recirculation system that utilizes NSK's high speed and low noise technology more than doubles the *d • n* value from 70 000 to 160 000.

To extend the range of the lead to 20 mm, high speed operation of over 60m/min. is possible.



SRC recirculation system
Lead 5 to 12

End deflector and middle deflector recirculation system
Lead 16 and 20

Fig 1 Ball recirculation system

Table 1 Allowable feed speed of combinations of shaft diameter and lead

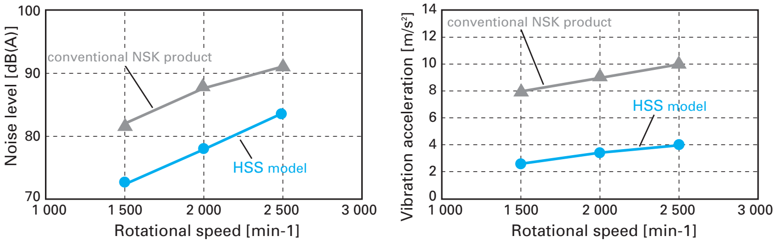
shaft diameter [mm] \ Lead [mm]	5	10	12	16	20
32	25m/min	50m/min			
40		40m/min	48m/min	64m/min	80m/min
45		35m/min			
50		32m/min	38m/min		

* Allowable speed needs to be calculated. See the permissible rotational speed in the dimensions table.

● Low noise and vibrations

Compared to our conventional products, the average noise level has been reduced by more than 6 dB(A), reducing the number of colliding balls and recirculation parts thanks to high speed, low noise technology.

The vibration level of the nut has also been reduced drastically.



Noise level measurement result
(Shaft dia 40, lead 16mm)

Vibration level measurement result
(Shaft dia 40, lead 16mm)

Table 2

● Installation

Installation dimensions are the same as those of a conventional SS model.

● Compact

Achieved high-level stiffness and high load capacity equivalent to that of double nut preload by changing the double nut preload to the offset preload of a single nut, and compact sized nut. Adopted thin seals axially and shorten nut length.

● Blank shaft ends

The blank shaft ends can be customized according to customers' requests. See page B27 in NSK's recommended design when drawing up plans for a shaft end. The support units available on page B377 in the case of NSK's recommended design. See "Technical Description: Shaft End Processing" (page B86) for procedures of shaft end processing and precautions.

● Oil supply

2 oil holes, M6×1.0, are provided in the nut flange periphery are the end of the nut flange.

A plug is standardly screwed into the periphery of the nut flange.

◇ Specifications

● Accuracy grade and axial play

The available standard accuracy grade and axial play are shown in Table 2.

Table 2 Accuracy grade and axial play

Accuracy grade	C5
Axial play	0 mm (preloaded)

● Dimension tables

Dimensions, shapes, and specifications are listed by shaft diameter/lead combinations. See Table 3 for the relevant pages to reference.

◇ Other

The seal of the ball screw and recirculation parts are made of synthetic resin. Consult NSK when using the ball screws under extreme environments or special environments, or using special lubricants or oil.

For special environments, see pages B70 and D2. See pages B67 and D13 for lubricants.

Table 3 Combinations of screw shaft diameter and lead

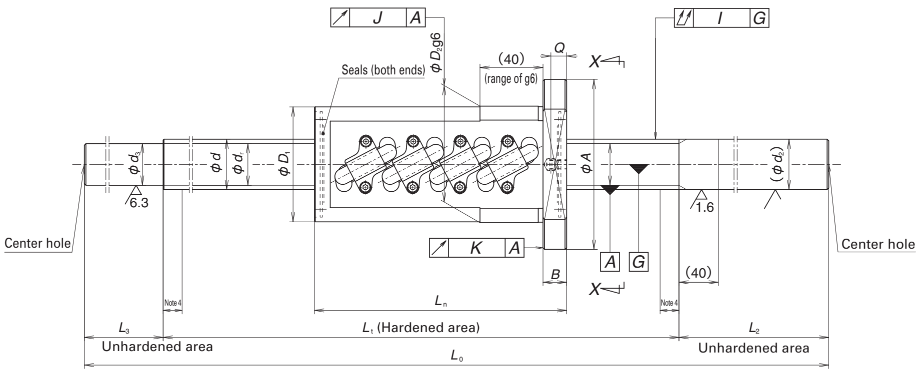
Screw shaft diameter [mm] \ Lead [mm]	5	10	12	16	20
32	B149	B149			
40		B151	B151	B153	B153
45		B155			
50		B155	B155		

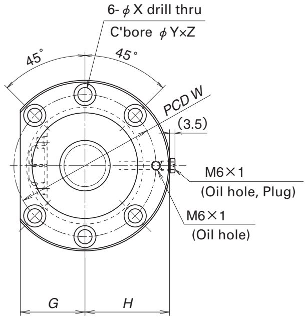
High-Speed SS (HSS) Model (Fine lead)

Nut: ZFRC

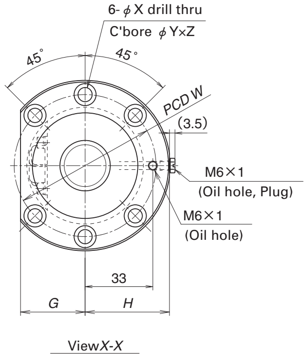
NSK

Screw shaft ϕ32
Lead 5,10





View*X-X*
(HSS3210)



View*X-X*
(HSS3205)

Unit : mm

Reference No.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings(N)		Preload	Dynamic friction torque, standard	Ball nut dimensions							
						Turns × Circuits	Dynamic	Static			Diameter		Flange				Overall length	
	d	l	D_w	d_m	d_r		C_a	C_{0a}	(N)	(N·cm)	D_1	D_2	A	G	H	B	L_n	W
HSS3205N1D0650	32	5	3.175	32.5	29.2	2.5X2	21 800	56 000	920	17.0	57	58	85	32	42	13	89	71
HSS3205N1D0950																		
HSS3205N1D1250																		
HSS3205N1D1550																		
HSS3205N1D1850																		
HSS3210N1D0850	32	10	6.350	33.0	26.4	2.5X2	54 500	110 000	2 310	59.5	73	74	108	41	53.5	15	160	90
HSS3210N1D1050																		
HSS3210N1D1450																		
HSS3210N1D1850																		
HSS3210N1D2250																		

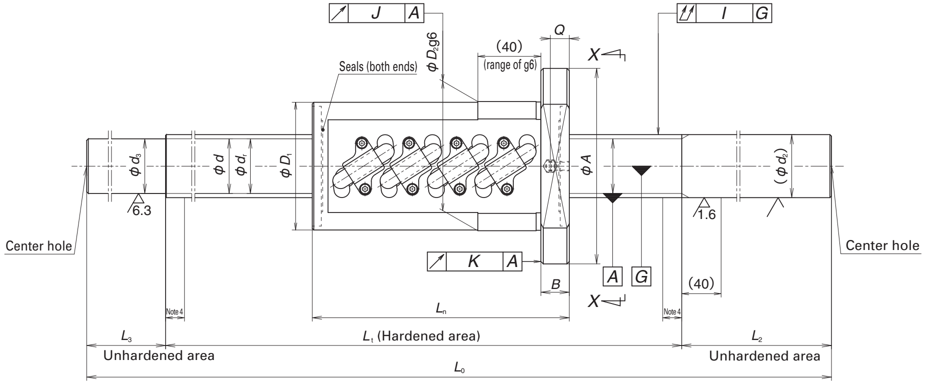
Reference No.	Bolt hole			Oil hole	Screw shaft dimensions						Lead accuracy			Run-out			Mass	Permissible rotational speed (min^{-1})		Nut internal space	Standard grease replenishment
					Threaded length	Shaft end, right		Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out			Configuration			
	X	Y	Z	Q	L_t	d_2	L_2	d_3	L_3	L_0	T	e_p	V_u	I	J	K	(kg)	Fixed-Simple	Fixed-Fixed	(cm^3)	(cm^3)
HSS3205N1D0650	6.6	11	6.5	8	400	32	200	29.2	50	650	-0.010	0.025	0.020	0.055	0.019	0.013	5.2	5 000	5 000	10	5
HSS3205N1D0950					600		250		100	950	-0.014	0.030	0.023	0.065			7.0	5 000	5 000		
HSS3205N1D1250					900		250		100	1 250	-0.022	0.040	0.027	0.080			8.7	5 000	5 000		
HSS3205N1D1550					1 150		300		100	1 550	-0.028	0.046	0.030	0.100			10.5	3 500	4 700		
HSS3205N1D1850					1 450		300		100	1 850	-0.035	0.054	0.035	0.130			12.2	2 200	2 900		
HSS3210N1D0850	9	14	8.5	10	500	32	250	26.4	100	850	-0.012	0.027	0.020	0.065	0.019	0.013	8.9	5 000	5 000	43	22
HSS3210N1D1050					700		250		100	1 050	-0.017	0.035	0.025	0.080			10.0	5 000	5 000		
HSS3210N1D1450					1 050		300		100	1 450	-0.025	0.046	0.030	0.100			12.2	4 100	5 000		
HSS3210N1D1850					1 450		300		100	1 850	-0.035	0.054	0.035	0.130			14.3	2 100	2 800		
HSS3210N1D2250					1 850		300		100	2 250	-0.045	0.065	0.040	0.170			16.5	1 200	1 700		

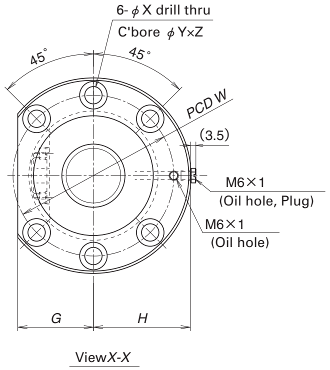
Notes:
1. These ball screws are suitable for operating temperatures from 0 to 60 °C.
2. We recommend using NSK support units. Refer to Page B377 for details.
3. Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use. See Page D13 for details.
4. Note that hardening imperfections occur at both screw ends of one lead. Keep this in mind when setting the stroke.
5. Permissible rotational speeds consider critical speeds for threaded lengths in the tables and NSK recommended shaft end designs (See Page B27).
   For details on critical speeds, see Page B47.

High-Speed SS (HSS) Model (Fine lead)

Nut: ZFRC

Screw shaft ϕ40
Lead 10, 12





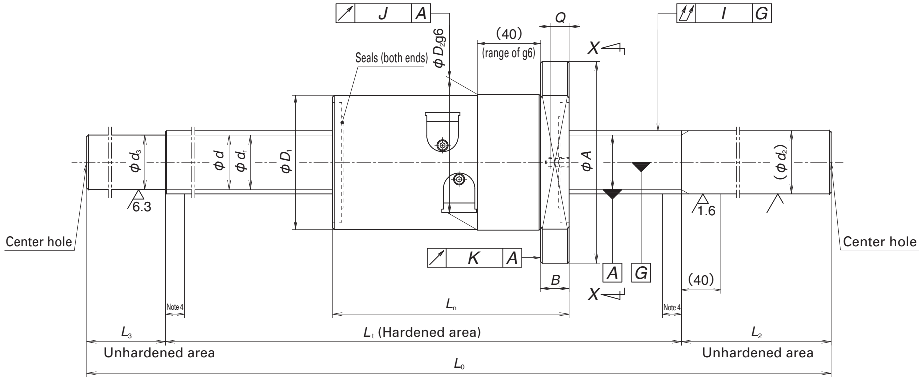
View X-X

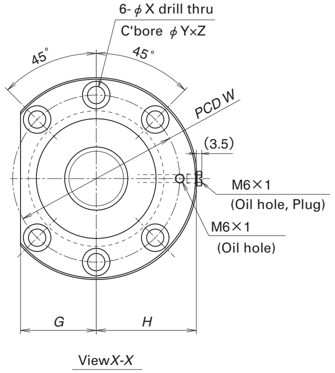
Unit : mm

Reference No.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Preload	Dynamic friction torque, standard	Ball nut dimensions								Bolt hole			Oil hole	Screw shaft dimensions						Lead accuracy			Run-out			Mass	Permissible rotational speed (min^{-1})		Nut internal space	Standard grease replenishment
						Turns × Circuits	Dynamic	Static			Diameter		Flange				Overall length						Threaded length	Shaft end, right		Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out			Configuration			
	d	l	D_w	d_m	d_r		C_a	C_{oa}	(N)	(N·cm)	D_1	D_2	A	G	H	B	L_n	W	X	Y	Z	Q	L_t	d_2	L_2	d_3	L_3	L_0	T	e_p	V_u	I	J	K	(kg)	Fixed-Simple	Fixed-Fixed	(cm^3)	(cm^3)
HSS4010N1D0950	40	10	6.350	41.0	34.4	2.5X2	61 200	137 000	2 600	74.5	81	82	124	47	61.5	18	163	102	11	17.5	11	12	600	40	250	34.4	100	950	-0.014	0.030	0.023	0.050	0.025	0.015	13.5	4 000	4 000	52	26
HSS4010N1D1450																							1 050		300		100	1 450	-0.025	0.046	0.030	0.070			17.9	4 000	4 000		
HSS4010N1D2100																							1 600		350		150	2 100	-0.039	0.054	0.035	0.110			23.5	2 200	3 000		
HSS4010N1D2900																							2 400		350		150	2 900	-0.058	0.077	0.046	0.140			30.5	900	1 300		
HSS4012N1D1450	40	12	7.144	41.5	34.1	2.5X2	71 700	154 000	3 050	96.0	85	86	128	48	63.5	18	187	106	11	17.5	11	12	1 050	40	300	34.1	100	1 450	-0.025	0.046	0.030	0.070	0.025	0.015	19.1	4 000	4 000	67	34
HSS4012N1D2100																							1 600		350		150	2 100	-0.039	0.054	0.035	0.110			24.8	2 200	3 000		
HSS4012N1D2900																							2 400		350		150	2 900	-0.058	0.077	0.046	0.140			31.8	900	1 300		

Notes:
1. These ball screws are suitable for operating temperatures from 0 to 60 °C.
2. We recommend using NSK support units. Refer to Page B377 for details.
3. Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use. See Page D13 for details.
4. Note that hardening imperfections occur at both screw ends of one lead. Keep this in mind when setting the stroke.
5. Permissible rotational speeds consider critical speeds for threaded lengths in the tables and NSK recommended shaft end designs (See Page B27).
   For details on critical speeds, see Page B47.

Screw shaft ϕ40
Lead 16, 20





Unit : mm

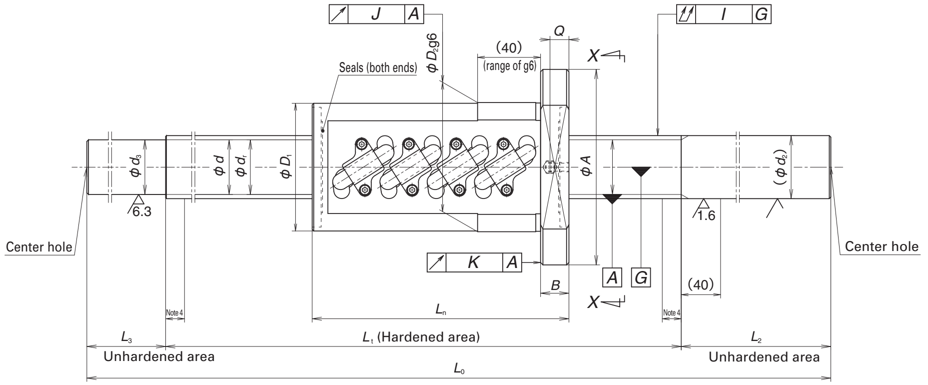
Reference No.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings(N)		Preload	Dynamic friction torque, standard	Ball nut dimensions								Bolt hole			Oil hole	Screw shaft dimensions						Lead accuracy			Run-out			Mass	Permissible rotational speed (min^{-1})		Nut internal space	Standard grease replenishment
						Turns × Circuits	Dynamic	Static			Diameter		Flange				Overall length						Threaded length	Shaft end, right		Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out			Configuration			
	d	l	D_w	d_m	d_r		C_a	C_{oa}	(N)	(N·cm)	D_1	D_2	A	G	H	B	L_n	W	X	Y	Z	Q	L_t	d_2	L_2	d_3	L_3	L_0	T	e_p	V_u	I	J	K	(kg)	Fixed-Simple	Fixed-Fixed	(cm^3)	(cm^3)
HSS4016N1D1450	40	16	7.144	41.5	34.1	3.7X1	66 900	131 000	2 850	104.0	85	86	128	48	63.5	18	160	106	11	17.5	11	11	1 050	40	300	34.1	100	1 450	-0.025	0.046	0.030	0.070	0.025	0.015	19.2	4 000	4 000	40	20
HSS4016N1D2100																							1 600		350		150	2 100	-0.039	0.054	0.035	0.110			25.0	2 200	3 000		
HSS4016N1D2900																							2 400		350		150	2 900	-0.058	0.077	0.046	0.140			32.2	900	1 300		
HSS4020N1D1450	40	20	7.144	41.5	34.1	3.7X1	66 500	131 000	2 850	116.5	85	86	128	48	63.5	18	192	106	11	17.5	11	11	1 050	40	300	34.4	100	1 450	-0.025	0.046	0.030	0.070	0.025	0.015	20.3	4 000	4 000	47	24
HSS4020N1D2100																							1 600		350		150	2 100	-0.039	0.054	0.035	0.110			26.2	2 200	3 000		
HSS4020N1D2900																							2 400		350		150	2 900	-0.058	0.077	0.046	0.140			33.5	900	1 300		

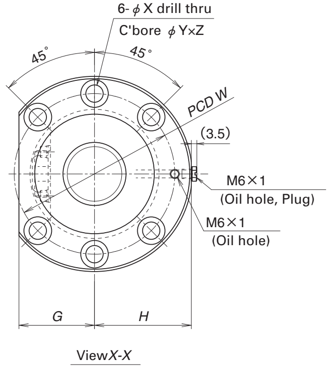
Notes:
1. These ball screws are suitable for operating temperatures from 0 to 60 °C.
2. We recommend using NSK support units. Refer to Page B377 for details.
3. Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use. See Page D13 for details.
4. Note that hardening imperfections occur at both screw ends of one lead. Keep this in mind when setting the stroke.
5. Permissible rotational speeds consider critical speeds for threaded lengths in the tables and NSK recommended shaft end designs (See Page B27).
   For details on critical speeds, see Page B47.

High-Speed SS (HSS) Model (Fine lead)

Nut: ZFRC

Screw shaft φ45, 50
Lead 10, 12





View X-X

Unit : mm

Reference No.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Preload	Dynamic friction torque, standard	Ball nut dimensions												Screw shaft dimensions						Lead accuracy			Run-out			Mass	Permissible rotational speed (min^{-1})		Nut internal space	Standard grease replenishment
						Turns × Circuits	Dynamic	Static			Diameter		Flange				Overall length		Bolt hole			Oil hole	Threaded length	Shaft end, right		Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out			Configuration			
	d	l	D_w	d_m	d_r		C_a	C_{oa}	(N)	(N·cm)	D_1	D_2	A	G	H	B	L_n	W	X	Y	Z	Q	L_t	d_2	L_2	d_3	L_3	L_0	T	e_p	V_u	I	J	K	(kg)	Fixed-Simple	Fixed-Fixed	(cm^3)	(cm^3)
HSS4510N1D1450	45	10	6.350	46.0	39.4	2.5X2	65 800	157 000	2 710	82.0	87	88	132	50	65.5	18	163	110	11	17.5	11	12	1 050	45	300	39.4	100	1 450	-0.025	0.046	0.030	0.070	0.025	0.015	22.0	3 500	3 500	58	29
HSS4510N1D2100																							1 600		350		150	2 100	-0.039	0.054	0.035	0.110			29.2	2 500	3 400		
HSS4510N1D2900																							2 400		350		150	2 900	-0.058	0.077	0.046	0.140			38.2	1 100	1 500		
HSS5010N1D1450	50	10	6.350	51.0	44.4	2.5X2	68 100	174 000	2 880	92.0	92	93	135	51	67	18	163	113	11	17.5	11	12	1 050	50	300	44.4	100	1 450	-0.025	0.046	0.030	0.070	0.025	0.015	26.3	3 200	3 200	64	32
HSS5010N1D1850																							1 450		300		100	1 850	-0.035	0.054	0.035	0.090			31.9	3 200	3 200		
HSS5010N1D2350																							1 850		350		150	2 350	-0.045	0.065	0.040	0.110			38.8	2 100	2 900		
HSS5010N1D2900																							2 400		350		150	2 900	-0.058	0.077	0.046	0.140			46.5	1 200	1 700		
HSS5012N1D1450	50	12	7.938	51.5	43.2	2.5X2	91 500	218 000	3 880	136.5	99	100	146	55	72.5	22	193	122	14	20	13	12	1 050	50	300	43.2	100	1 450	-0.025	0.046	0.030	0.070	0.025	0.015	28.5	3 200	3 200	99	50
HSS5012N1D2100																							1 600		350		150	2 100	-0.039	0.054	0.035	0.110			37.3	2 800	3 200		
HSS5012N1D2900																							2 400		350		150	2 900	-0.058	0.077	0.046	0.140			48.2	1 200	1 600		

Notes:
1. These ball screws are suitable for operating temperatures from 0 to 60 °C.
2. We recommend using NSK support units. Refer to Page B377 for details.
3. Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use. See Page D13 for details.
4. Note that hardening imperfections occur at both screw ends of one lead. Keep this in mind when setting the stroke.
5. Permissible rotational speeds consider critical speeds for threaded lengths in the tables and NSK recommended shaft end designs (See Page B27).
   For details on critical speeds, see Page B47.

B-3-1.3 Finished Shaft End MA, FA, and SA Models

1. Order of the dimension tables

Tables are arranged by model in order of increasing shaft diameter. If ball screws have the same shaft diameter, those with smaller leads appear first. Page numbers for shaft diameter and lead combinations are shown in Table 1.

2. Dimension tables

Dimensions, shapes, and specifications are listed by shaft diameter/lead combinations. The following tables also contain data regarding:

●Stroke

Nominal stroke: A reference for use.

Maximum stroke: The limit stroke that the nut can move. The value is obtained by subtracting the nut length from effective threaded length.

●Lead accuracy

Lead accuracy is either C3 or C5 grade.

T : Travel compensation

e_p : Tolerance on specified travel

υ_u : Travel variation

See "Technical Description: Lead Accuracy" (page B37) for details of the codes.

●Permissible rotational speed

$d \bullet n$: Limited by the relative peripheral speed between the screw shaft and nut.

Critical speed: Limited by the natural frequency of the ball screw shaft. Critical speed depends on the support configuration of the screw shaft.

The lower of the two criteria, $d{\cdot}n$ and critical speed, will determine the overall permissible rotational speed of the ball screw. For details, see "Technical Description: Permissible Rotational Speed" (page B47).

3. Other

The seal of the ball screw, ball recirculating deflector, and end cap are made of synthetic resin. Consult NSK when using our ball screws under extreme environments, in special environments, or if using special lubricants or oil.

For special environments, see pages B70 and D2. For lubricants, see pages B67 and D13.

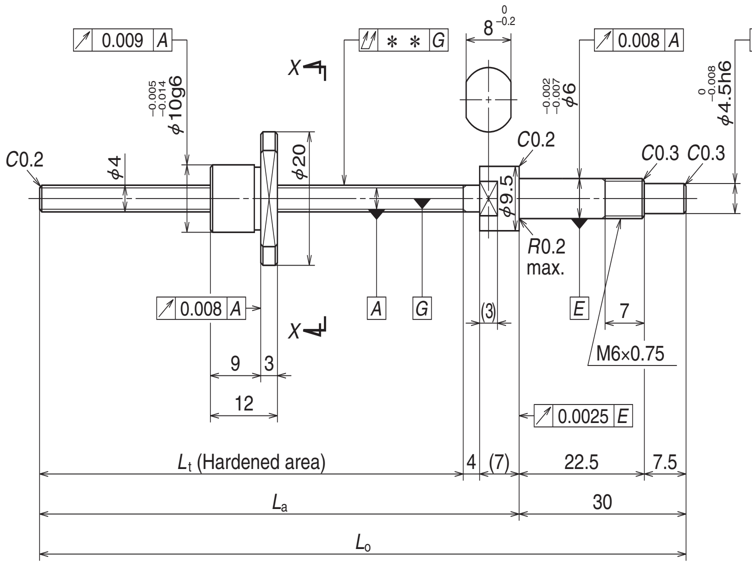
Note: For details about standard stock products, contact NSK.

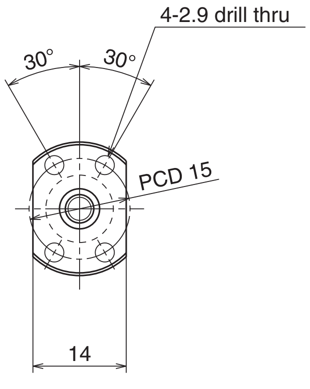
Table 1 Combinations of screw shaft diameter and lead

Lead (mm) Screw shaft diameter (mm)	1	1.5	2	2.5	4	5	6	8	10	12	16	20	25	32	40	50
4	B159															
6	B161															
8	B163	B165	B167													
10			B169	B171	B181											
12			B173	B175		B183			B185							
14						B187		B189								
15									B191							
16			B177	B179		B193					B195					
20					B209	B211			B197			B199				
25					B213	B215	B217		B219			B201	B203			
28						B221 B223	B225 B227									
32						B229 B231	B233 B235	B237	B239 B241				B205	B207		
36									B243 B245							
40						B247		B249	B251 B253	B255 B257						
45									B259							
50									B261 B263							

Screw shaft ø4

Lead 1





View X-X

Unit: mm

Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	4 × 1 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	0.800 / 4.2	
Screw shaft root diameter	3.2	
Effective ball turns	1 × 2	
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T
Basic load ratings (N) Dynamic C_a	370	
Basic load ratings (N) Static C_{0a}	370	
Axial play	0	0.005 or less
Preload (N)	19.6	—
Dynamic friction torque (N·cm)	1.0 or less	0.3 or less
Spacer ball	None	
Factory-packed grease	NSK grease PS2	

Recommended support unit

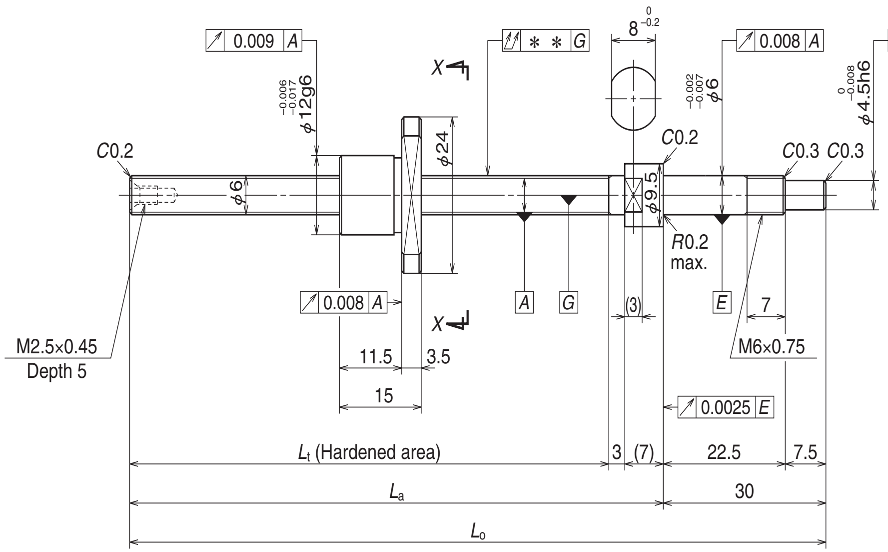
For drive side (Fixed)
WBK06-01A (square)
WBK06-11 (round)

Unit: mm

Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Configuration
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Free
W0400MA-1PY-C3Z1	**W0400MA-2Y-C3T1**	20	32	44	55	85	0	0.008	0.008	0.015	0.024	3 000
W0400MA-3PY-C3Z1	**W0400MA-4Y-C3T1**	40	52	64	75	105	0	0.008	0.008	0.020	0.026	3 000
W0401MA-1PY-C3Z1	**W0401MA-2Y-C3T1**	70	82	94	105	135	0	0.008	0.008	0.025	0.028	3 000

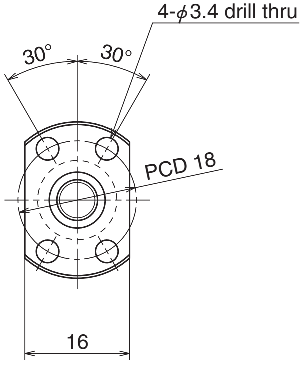
Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease PS2. Apply the grease to the screw shaft surface during replenishment. See Page D16 for details.
3. These ball nuts do not have seals.
4. Contact NSK if permissible rotational speed *N* will be exceeded.

Finished Shaft End MA Model (Fine lead)



Nut: MPFD, MSFD

Screw shaft ø6
Lead 1



View X-X

Unit: mm

Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		6 × 1 / Right	
Preload / Ball recirculation		P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.		0.800 / 6.2	
Screw shaft root diameter		5.2	
Effective ball turns		1 × 3	
Accuracy grade / Preload / Axial play		C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_a	680	
	Static C_{0a}	920	
Axial play		0	0.005 or less
Preload (N)		24.5	—
Dynamic friction torque (N·cm)		1.3 or less	0.3 or less
Spacer ball		None	
Factory-packed grease		NSK grease PS2	

Recommended support unit

For drive side (Fixed)
WBK06-01A (square)
WBK06-11 (round)

Reference No.		Stroke	
		Nominal	Maximum
Preloaded (MPFD)	Precise clearance (MSFD)		
W0600MA-1PY-C3Z1	**W0600MA-2Y-C3T1**	40	50
W0601MA-1PY-C3Z1	**W0601MA-2Y-C3T1**	70	80
W0601MA-3PY-C3Z1	**W0601MA-4Y-C3T1**	100	110

Unit: mm

Screw shaft length			Lead accuracy			Shaft run-out ** ↗↗	Mass (kg)	Permissible rotational speed N (min⁻¹) Configuration
L_t	L_a	L_o	T	e_p	υ_u			Fixed - Free
65	75	105	0	0.008	0.008	0.015	0.039	3 000
95	105	135	0	0.008	0.008	0.020	0.045	3 000
125	135	165	0	0.010	0.008	0.025	0.051	3 000

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease PS2. Apply the grease to the screw shaft surface during replenishment. See Page D16 for details.
3. These ball nuts do not have seals.
4. Contact NSK if permissible rotational speed *N* will be exceeded.

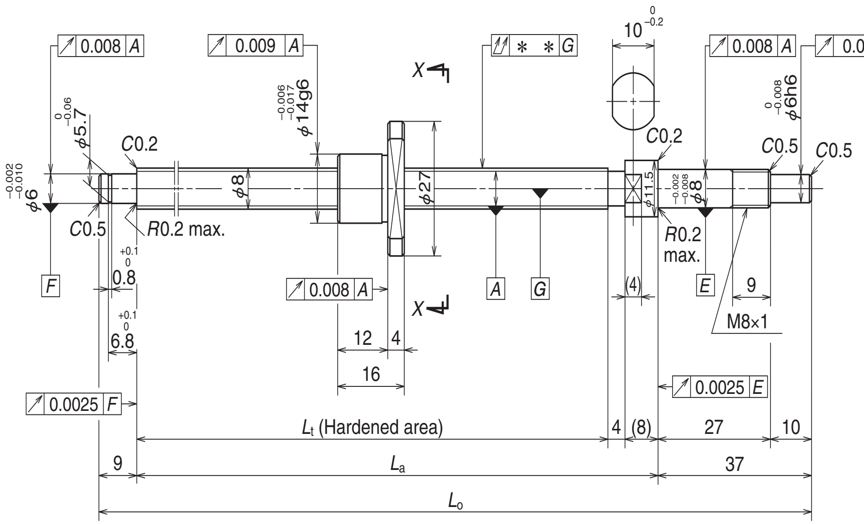
Finished Shaft End MA Model (Fine lead)

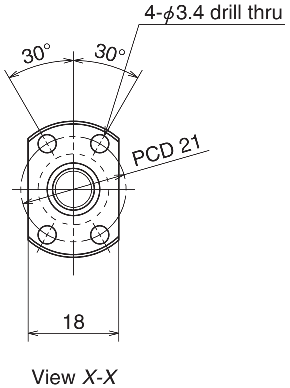
Nut: MPFD, MSFD

NSK

Screw shaft ø8

Lead 1





View X-X

Unit: mm

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		8 × 1 / Right	
Preload / Ball recirculation		P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.		0.800 / 8.2	
Screw shaft root diameter		7.2	
Effective ball turns		1 × 3	
Accuracy grade / Preload / Axial play		C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_a	790	
	Static C_{0a}	1 290	
Axial play		0	0.005 or less
Preload (N)		29.4	—
Dynamic friction torque (N·cm)		1.8 or less	0.5 or less
Spacer ball		None	
Factory-packed grease		NSK grease PS2	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK08-01A (square)	WBK08S-01 (square)
WBK08-11 (round)	

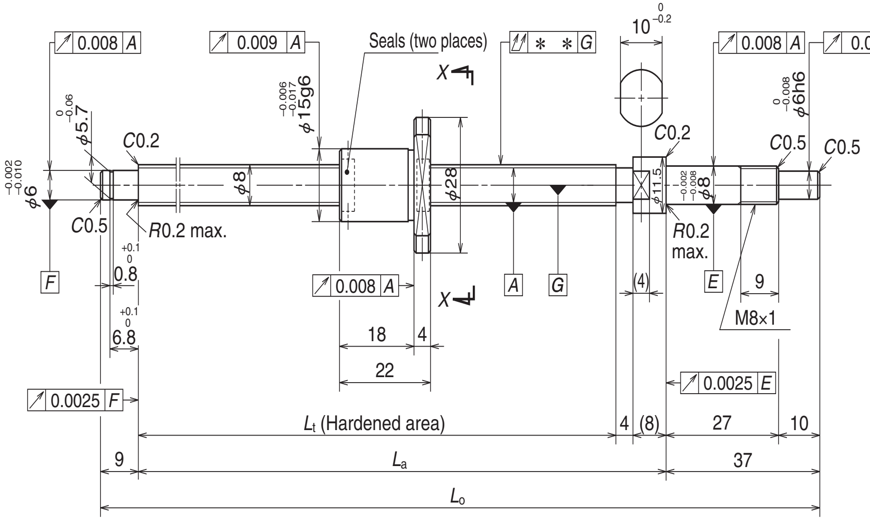
Unit: mm

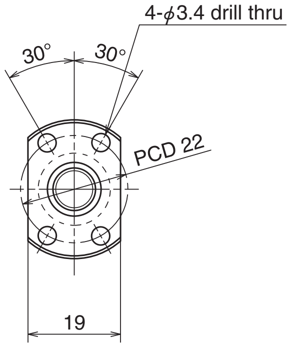
Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ↗	Mass (kg)	Permissible rotational speed N (min⁻¹) Configuration
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple
W0800MA-1PY-C3Z1	**W0800MA-2Y-C3T1**	40	59	80	92	138	0	0.008	0.008	0.025	0.073	3 000
W0801MA-1PY-C3Z1	**W0801MA-2Y-C3T1**	70	89	110	122	168	0	0.010	0.008	0.030	0.084	3 000
W0801MA-3PY-C3Z1	**W0801MA-4Y-C3T1**	100	119	140	152	198	0	0.010	0.008	0.030	0.095	3 000
W0802MA-1PY-C3Z1	**W0802MA-2Y-C3T1**	150	169	190	202	248	0	0.010	0.008	0.035	0.11	3 000

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease PS2. Apply the grease to the screw shaft surface during replenishment. See Page D16 for details.
3. These ball nuts do not have seals.
4. Contact NSK if permissible rotational speed *N* will be exceeded.

Screw shaft ø8

Lead 1.5





View X-X

Unit: mm

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		8 × 1.5 / Right	
Preload / Ball recirculation		P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.		1.000 / 8.3	
Screw shaft root diameter		7.0	
Effective ball turns		1 × 3	
Accuracy grade / Preload / Axial play		C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_a	1 270	
	Static C_{0a}	1 970	
Axial play		0	0.005 or less
Preload (N)		49.0	—
Dynamic friction torque, (N·cm)		2.0 or less	0.5 or less
Spacer ball		None	
Factory-packed grease		NSK grease PS2	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK08-01A (square)	WBK08S-01 (square)
WBK08-11 (round)	

Reference No.		Stroke	
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum
W0800MA-3PY-C3Z1.5	**W0800MA-4Y-C3T1.5**	40	53
W0801MA-5PY-C3Z1.5	**W0801MA-6Y-C3T1.5**	70	83
W0801MA-7PY-C3Z1.5	**W0801MA-8Y-C3T1.5**	100	113
W0802MA-3PY-C3Z1.5	**W0802MA-4Y-C3T1.5**	150	163

Unit: mm

Screw shaft length			Lead accuracy			Shaft run-out ** ↗↗	Mass (kg)	Permissible rotational speed N (min^{-1}) Configuration
L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple
80	92	138	0	0.008	0.008	0.025	0.082	3 000
110	122	168	0	0.010	0.008	0.030	0.093	3 000
140	152	198	0	0.010	0.008	0.030	0.10	3 000
190	202	248	0	0.010	0.008	0.035	0.12	3 000

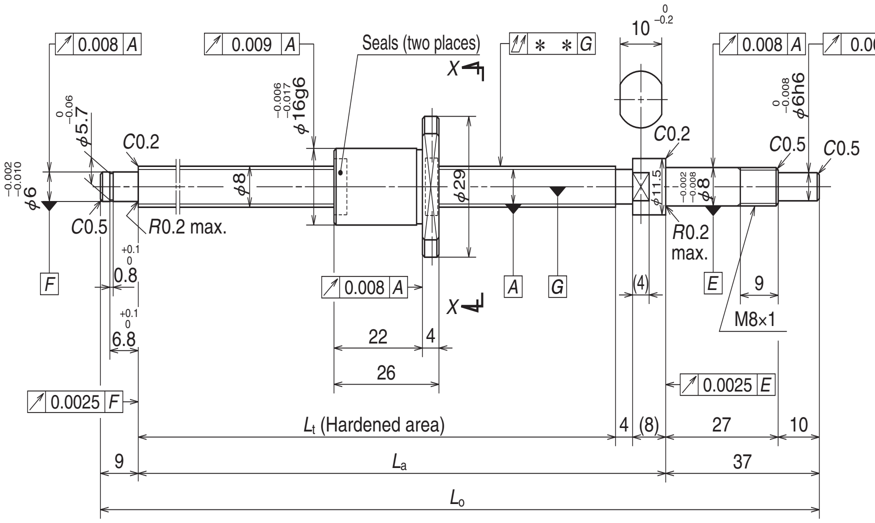
Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease PS2. Apply the grease to the screw shaft surface during replenishment. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

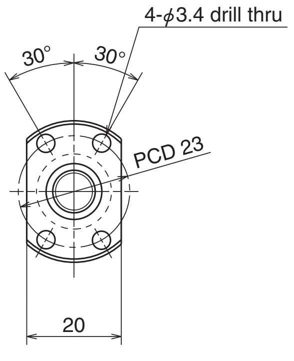
Finished Shaft End MA Model (Fine lead)

Nut: MPFD, MSFD

Screw shaft ø8

Lead 2





View *X-X*

Unit: mm

Ball screw specifications

Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	8 × 2 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	1.200 / 8.3	
Screw shaft root diameter	6.9	
Effective ball turns	1 × 3	
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T
Basic load ratings (N) Dynamic C_a	1 560	
Basic load ratings (N) Static C_{0a}	2 200	
Axial play	0	0.005 or less
Preload (N)	49.0	—
Dynamic friction torque, (N·cm)	2.0 or less	0.5 or less
Spacer ball	None	
Factory-packed grease	NSK grease PS2	

Recommended support unit

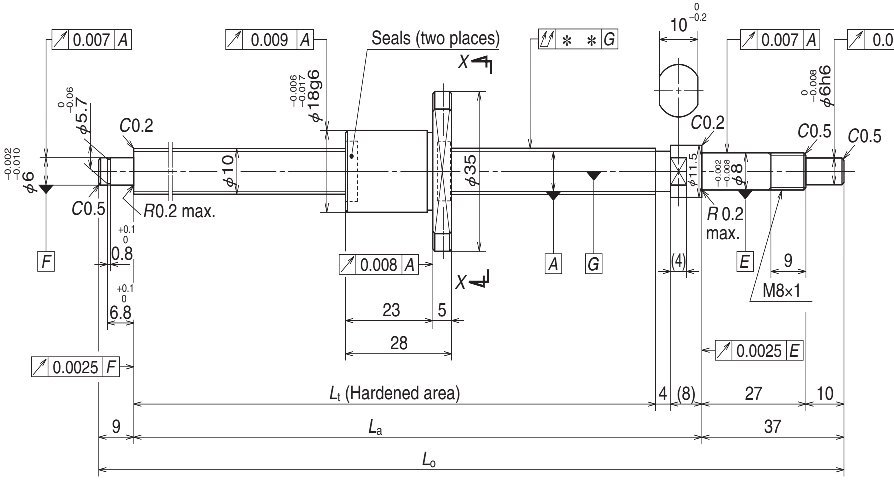
For drive side (Fixed)	For non-drive side (Simple)
WBK08-01A (square)	WBK08S-01 (square)
WBK08-11 (round)	

Unit: mm

Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ↗	Mass (kg)	Permissible rotational speed N (min⁻¹)
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Configuration Fixed - Simple
W0800MA-5PY-C3Z2	**W0800MA-6Y-C3T2**	40	49	80	92	138	0	0.008	0.008	0.025	0.09	3 000
W0801MA-9PY-C3Z2	**W0801MA-10Y-C3T2**	70	79	110	122	168	0	0.010	0.008	0.030	0.10	3 000
W0801MA-11PY-C3Z2	**W0801MA-12Y-C3T2**	100	109	140	152	198	0	0.010	0.008	0.030	0.11	3 000
W0802MA-5PY-C3Z2	**W0802MA-6Y-C3T2**	150	159	190	202	248	0	0.010	0.008	0.035	0.13	3 000

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease PS2. Apply the grease to the screw shaft surface during replenishment. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Finished Shaft End MA Model (Fine lead)



Unit: mm

Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ⌰	Mass (kg)	Permissible rotational speed N (min^{-1}) Configuration
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple
W1001MA-1PY-C3Z2	**W1001MA-2Y-C3T2**	50	67	100	112	158	0	0.008	0.008	0.020	0.13	3 000
W1001MA-3PY-C3Z2	**W1001MA-4Y-C3T2**	100	117	150	162	208	0	0.010	0.008	0.030	0.16	3 000
W1002MA-1PY-C3Z2	**W1002MA-2Y-C3T2**	150	167	200	212	258	0	0.010	0.008	0.030	0.19	3 000
W1002MA-3PY-C3Z2	**W1002MA-4Y-C3T2**	200	217	250	262	308	0	0.012	0.008	0.030	0.22	3 000

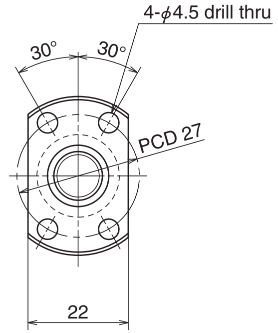
Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease PS2. Apply the grease to the screw shaft surface during replenishment. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Nut: MPFD, MSFD

Screw shaft ø10

Lead 2

Unit: mm



View *X-X*

Ball screw specifications

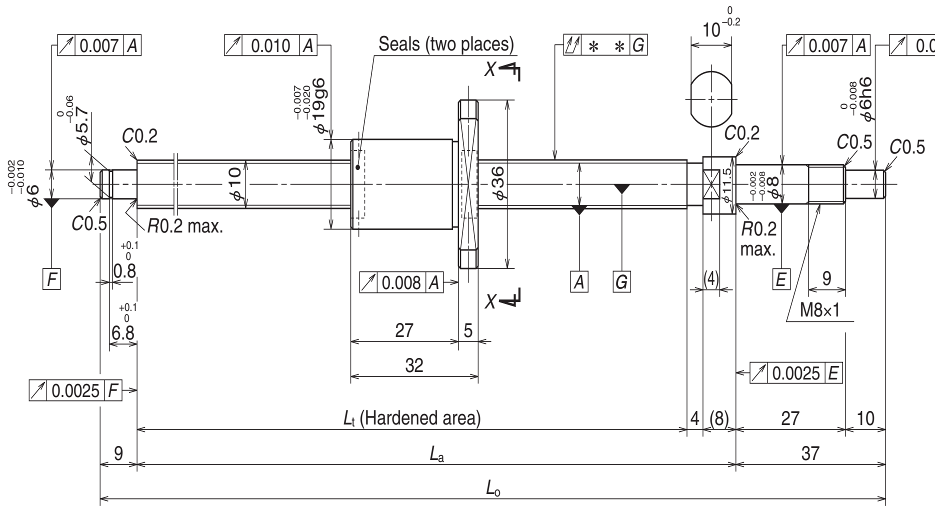
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	10 × 2 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	1.200 / 10.3	
Screw shaft root diameter	8.9	
Effective ball turns	1 × 3	
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T
Basic load ratings (N) Dynamic C_a	1 800	
Static C_{0a}	2 970	
Axial play	0	0.005 or less
Preload (N)	58.8	—
Dynamic friction torque, (N·cm)	0.1 – 2.4	0.5 or less
Spacer ball	None	
Factory-packed grease	NSK grease PS2	

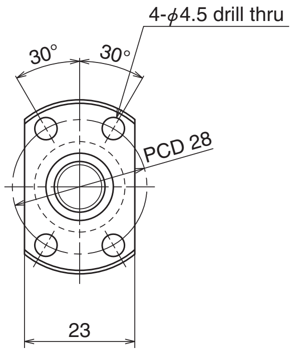
Recommended support unit

For drive side (Fixed)	**For non-drive side (Simple)**
WBK08-01A (square)	WBK08S-01 (square)
WBK08-11 (round)	

Screw shaft ø10
Lead 2.5

Unit: mm





View X-X

Ball screw specifications

Product classification	Preloaded	Precise clearance
Shaft dia. × Lead / Direction of turn	10 × 2.5 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	1.588 / 10.4	
Screw shaft root diameter	8.6	
Effective ball turns	1 × 3	
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T
Basic load ratings (N) Dynamic C_a	2 500	
Basic load ratings (N) Static C_{0a}	3 630	
Axial play	0	0.005 or less
Preload (N)	98.1	—
Dynamic friction torque, (N·cm)	0.2 – 2.9	0.5 or less
Spacer ball	None	
Factory-packed grease	NSK grease PS2	

Recommended support unit

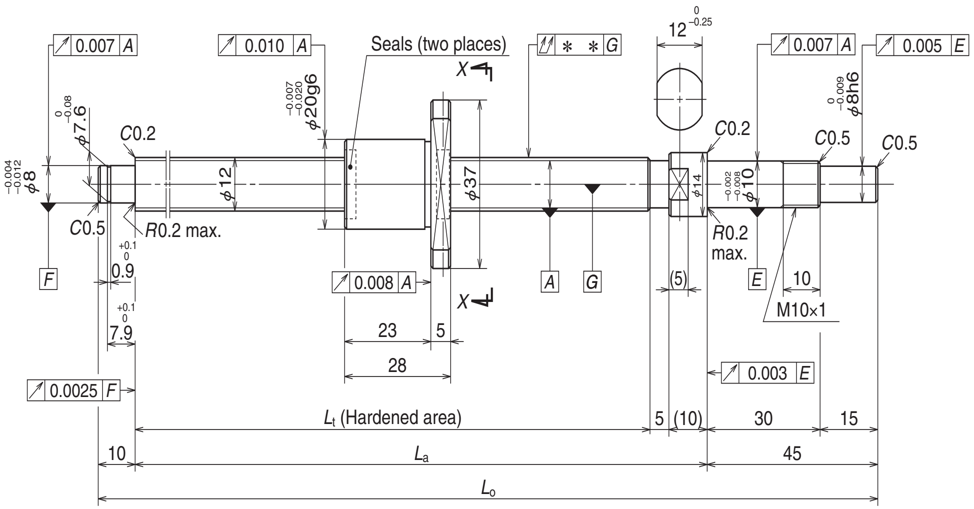
For drive side (Fixed)	For non-drive side (Simple)
WBK08-01A (square)	WBK08S-01 (square)
WBK08-11 (round)	

Unit: mm

Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ↗	Mass (kg)	Permissible rotational speed N (min⁻¹) Configuration
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple
W1001MA-5PY-C3Z2.5	**W1001MA-6Y-C3T2.5**	50	63	100	112	158	0	0.008	0.008	0.020	0.14	3 000
W1001MA-7PY-C3Z2.5	**W1001MA-8Y-C3T2.5**	100	113	150	162	208	0	0.010	0.008	0.030	0.17	3 000
W1002MA-5PY-C3Z2.5	**W1002MA-6Y-C3T2.5**	150	163	200	212	258	0	0.010	0.008	0.030	0.20	3 000
W1002MA-7PY-C3Z2.5	**W1002MA-8Y-C3T2.5**	200	213	250	262	308	0	0.012	0.008	0.030	0.23	3 000

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease PS2. Apply the grease to the screw shaft surface during replenishment. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Finished Shaft End MA Model (Fine lead)

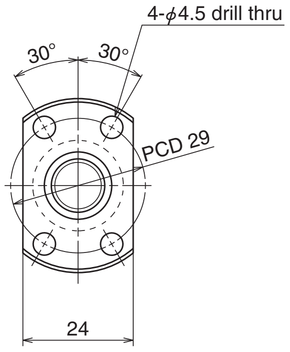


Nut: MPFD, MSFD

Screw shaft ø12

Lead 2

Unit: mm



View *X-X*

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		12 × 2 / Right	
Preload / Ball recirculation		P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.		1.200 / 12.3	
Screw shaft root diameter		10.9	
Effective ball turns		1 × 3	
Accuracy grade / Preload / Axial play		C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_a	1 960	
	Static C_{0a}	3 620	
Axial play		0	0.005 or less
Preload (N)		98.1	—
Dynamic friction torque, (N·cm)		0.4 – 3.4	1.0 or less
Spacer ball		None	
Factory-packed grease		NSK grease PS2	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK10-01A (square)	WBK10S-01 (square)
WBK10-11 (round)	

Unit: mm

Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Configuration
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple
W1201MA-1PY-C3Z2	**W1201MA-2Y-C3T2**	50	75	110	125	180	0	0.010	0.008	0.020	0.20	3 000
W1201MA-3PY-C3Z2	**W1201MA-4Y-C3T2**	100	125	160	175	230	0	0.010	0.008	0.030	0.24	3 000
W1202MA-1PY-C3Z2	**W1202MA-2Y-C3T2**	150	175	210	225	280	0	0.012	0.008	0.030	0.28	3 000
W1202MA-3PY-C3Z2	**W1202MA-4Y-C3T2**	200	225	260	275	330	0	0.012	0.008	0.040	0.32	3 000
W1203MA-1PY-C3Z2	**W1203MA-2Y-C3T2**	250	275	310	325	380	0	0.012	0.008	0.040	0.36	3 000

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease PS2. Apply the grease to the screw shaft surface during replenishment. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

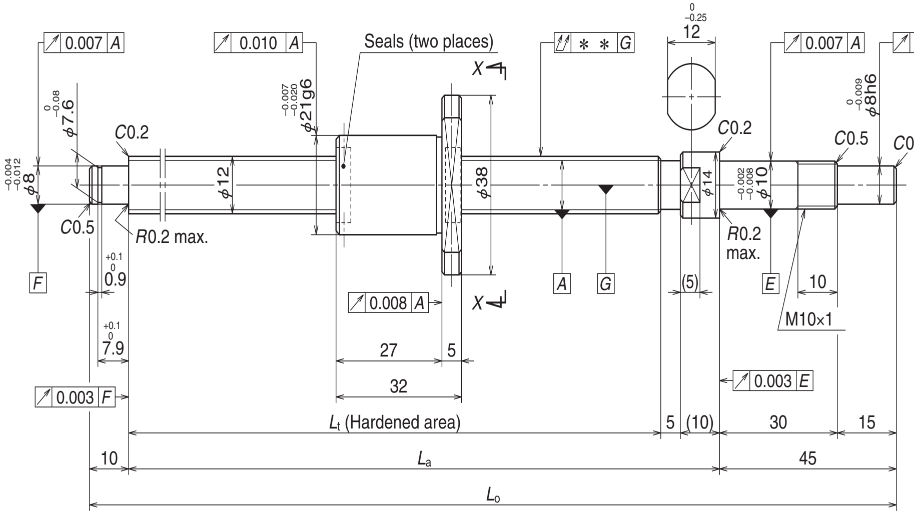
Finished Shaft End MA Model (Fine lead)

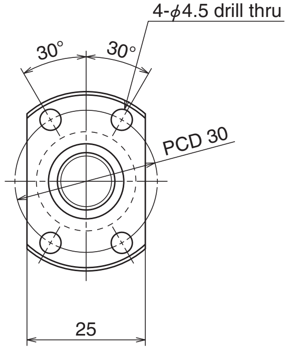
Nut: MPFD, MSFD

NSK

Screw shaft ø12

Lead 2.5





View *X*-*X*

Unit: mm

Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	12 × 2.5 / Right	
Preload / Ball recirculation	P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.	1.588 / 12.4	
Screw shaft root diameter	10.6	
Effective ball turns	1 × 3	
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T
Basic load ratings (N) Dynamic C_a	2 790	
Basic load ratings (N) Static C_{0a}	4 530	
Axial play	0	0.005 or less
Preload (N)	98.1	—
Dynamic friction torque, (N·cm)	0.4 – 3.4	1.0 or less
Spacer ball	None	
Factory-packed grease	NSK grease PS2	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK10-01A (square)	WBK10S-01 (square)
WBK10-11 (round)	

Unit: mm

Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ∗∗	Mass (kg)	Permissible rotational speed *N* (min⁻¹) Configuration
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple
W1201MA-5PY-C3Z2.5	**W1201MA-6Y-C3T2.5**	50	71	110	125	180	0	0.010	0.008	0.020	0.21	3 000
W1201MA-7PY-C3Z2.5	**W1201MA-8Y-C3T2.5**	100	121	160	175	230	0	0.010	0.008	0.030	0.25	3 000
W1202MA-5PY-C3Z2.5	**W1202MA-6Y-C3T2.5**	150	171	210	225	280	0	0.012	0.008	0.030	0.29	3 000
W1202MA-7PY-C3Z2.5	**W1202MA-8Y-C3T2.5**	200	221	260	275	330	0	0.012	0.008	0.040	0.33	3 000
W1203MA-3PY-C3Z2.5	**W1203MA-4Y-C3T2.5**	250	271	310	325	380	0	0.012	0.008	0.040	0.37	3 000

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease PS2. Apply the grease to the screw shaft surface during replenishment. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

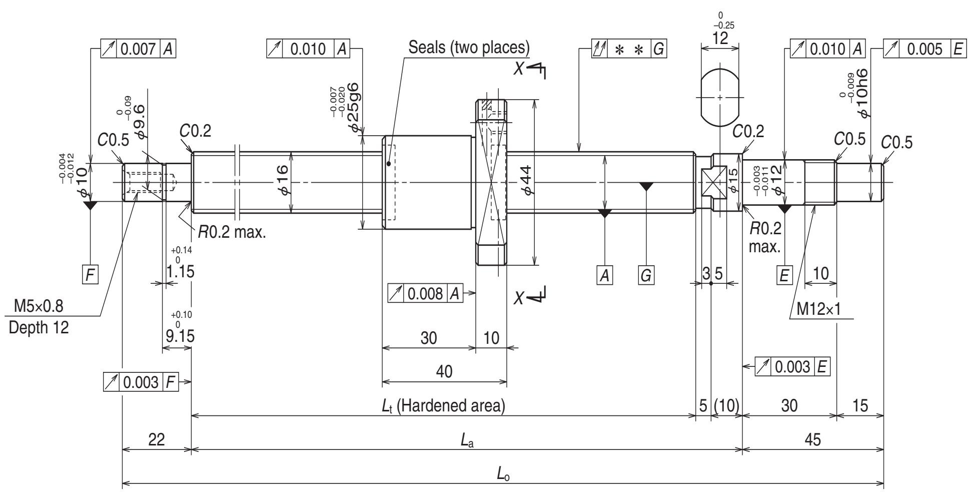
Finished Shaft End MA Model (Fine lead)

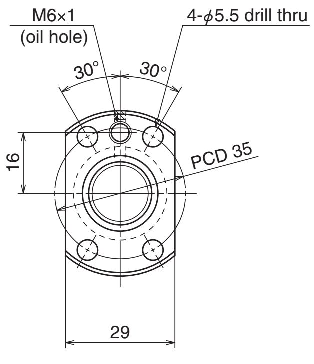
Nut: MPFD, MSFD

NSK

Screw shaft ø16

Lead 2





View *X-X*

Unit: mm

Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. × Lead / Direction of turn		16 × 2 / Right	
Preload / Ball recirculation		P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.		1.588 / 16.4	
Screw shaft root diameter		14.6	
Effective ball turns		1 × 4	
Accuracy grade / Preload / Axial play		C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_a	4 150	
	Static C_{0a}	8 450	
Axial play		0	0.005 or less
Preload (N)		147	—
Dynamic friction torque (N·cm)		0.5 – 4.9	1.5 or less
Spacer ball		None	
Factory-packed grease		NSK grease PS2	
Nut internal space (cm^3)		1.6	
Standard grease replenishment (cm^3)		0.8	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

Unit: mm

Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})	
		Nominal	Maximum									Configuration	
Preloaded (MPFD)	Precise clearance (MSFD)			L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W1601MA-1PY-C3Z2	**W1601MA-2Y-C3T2**	50	93	139	154	221	0	0.010	0.008	0.020	0.41	3 000	3 000
W1601MA-3PY-C3Z2	**W1601MA-4Y-C3T2**	100	143	189	204	271	0	0.010	0.008	0.020	0.48	3 000	3 000
W1602MA-1PY-C3Z2	**W1602MA-2Y-C3T2**	150	193	239	254	321	0	0.012	0.008	0.030	0.55	3 000	3 000
W1602MA-3PY-C3Z2	**W1602MA-4Y-C3T2**	200	243	289	304	371	0	0.012	0.008	0.030	0.62	3 000	3 000
W1603MA-1PY-C3Z2	**W1603MA-2Y-C3T2**	300	343	389	404	471	0	0.013	0.010	0.035	0.77	3 000	3 000

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease PS2. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.
4. The user must design the support bearing structure if the non-drive side is fixed.
5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)

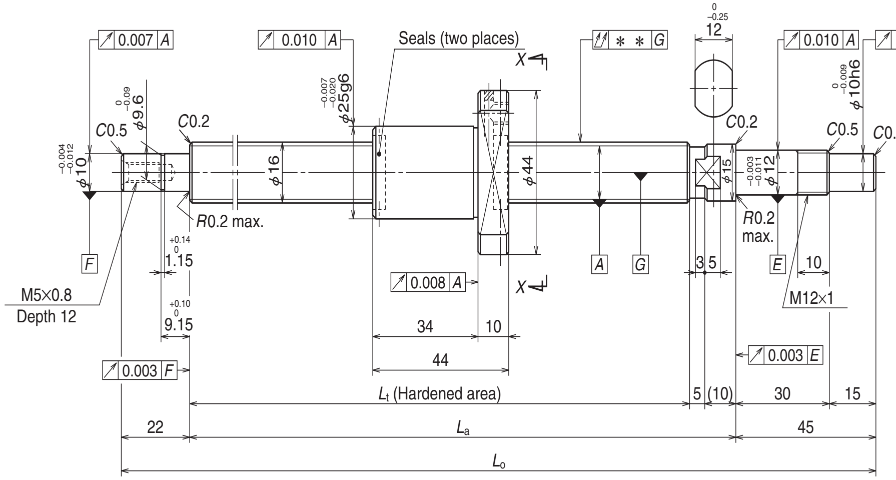
Finished Shaft End MA Model (Fine lead)

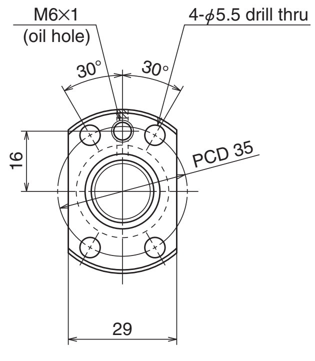
Nut: MPFD, MSFD

NSK

Screw shaft ø16

Lead 2.5





View *X-X*

Unit: mm

Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		16 × 2.5 / Right	
Preload / Ball recirculation		P-preload / Deflector (bridge)	
Ball dia. / Ball circle dia.		1.588 / 16.4	
Screw shaft root diameter		14.6	
Effective ball turns		1 × 4	
Accuracy grade / Preload / Axial play		C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_a	4 150	
	Static C_{0a}	8 440	
Axial play		0	0.005 or less
Preload (N)		147	—
Dynamic friction torque (N·cm)		0.5 – 4.9	1.5 or less
Spacer ball		None	
Factory-packed grease		NSK grease PS2	
Nut internal space (cm^3)		1.6	
Standard grease replenishment (cm^3)		0.8	

Recommended support unit

For drive side (Fixed)	non-drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

MA

Unit: mm

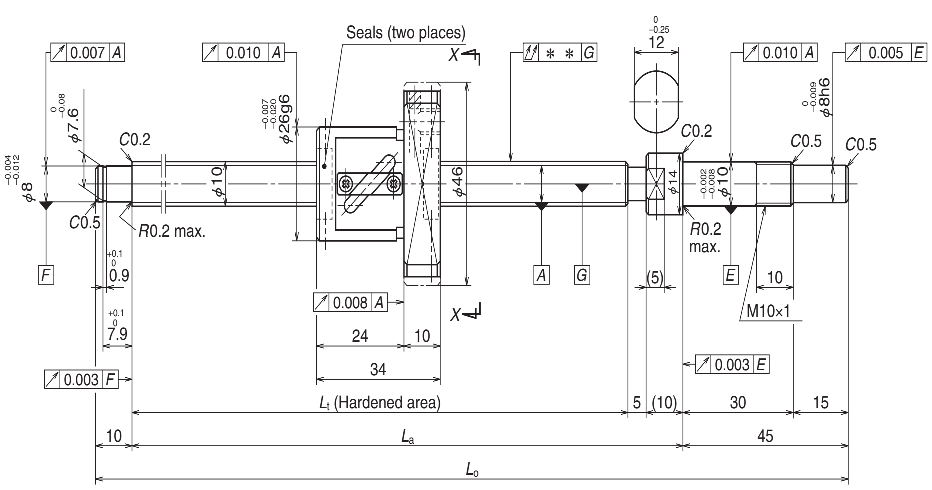
Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Configuration	
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W1601MA-5PY-C3Z2.5	**W1601MA-6Y-C3T2.5**	50	89	139	154	221	0	0.010	0.008	0.020	0.42	3 000	3 000
W1601MA-7PY-C3Z2.5	**W1601MA-8Y-C3T2.5**	100	139	189	204	271	0	0.010	0.008	0.020	0.49	3 000	3 000
W1602MA-5PY-C3Z2.5	**W1602MA-6Y-C3T2.5**	150	189	239	254	321	0	0.012	0.008	0.030	0.57	3 000	3 000
W1602MA-7PY-C3Z2.5	**W1602MA-8Y-C3T2.5**	200	239	289	304	371	0	0.012	0.008	0.030	0.64	3 000	3 000
W1603MA-3PY-C3Z2.5	**W1603MA-4Y-C3T2.5**	300	339	389	404	471	0	0.013	0.010	0.035	0.79	3 000	3 000

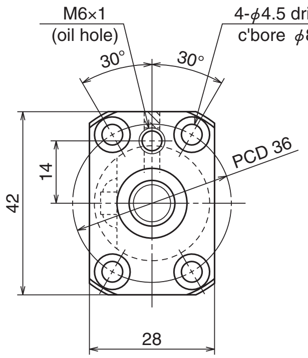
Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease PS2. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.
4. The user must design the support bearing structure if the non-drive side is fixed.
5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)

Screw shaft ø10

Lead 4

Unit: mm





View X-X

Unit: mm

Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		10 × 4 / Right	
Preload / Ball recirculation		P-preload / Tube	
Ball dia. / Ball circle dia.		2.000 / 10.3	
Screw shaft root diameter		8.2	
Effective ball turns		2.5 × 1	
Accuracy grade / Preload / Axial play		C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_a	2 020	3 210
	Static C_{0a}	2 210	4 420
Axial play		0	0.005 or less
Preload (N)		98.1	—
Dynamic friction torque (N·cm)		0.5 – 3.9	1.0 or less
Spacer ball		Yes	None
Factory-packed grease		NSK grease PS2	
Nut internal space (cm^3)		0.8	
Standard grease replenishment (cm^3)		0.4	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK10-01A (square)	WBK10S-01 (square)
WBK10-11 (round)	

Unit: mm

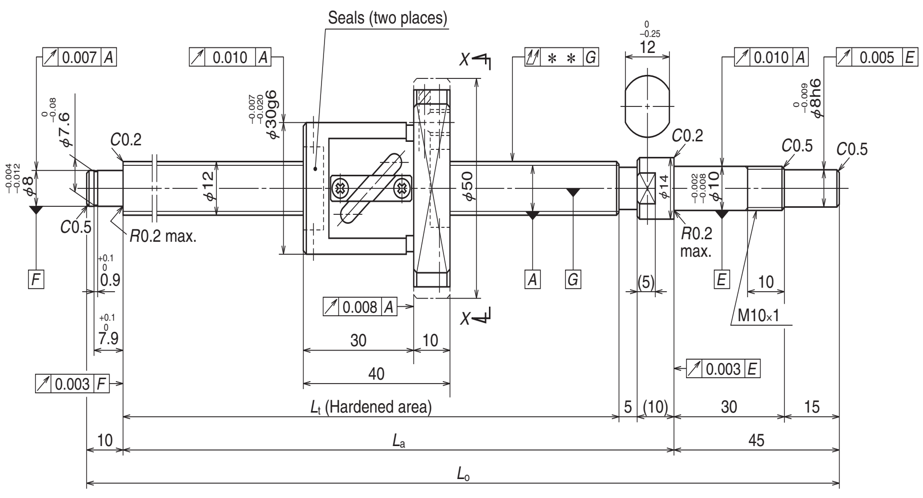
Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ✱✱ ↗↗	Mass (kg)	Permissible rotational speed N (min^{-1})
		Nominal	Maximum									Configuration
Preloaded (PFT)	Precise clearance (SFT)			L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple
W1001FA-1P-C3Z4	**W1001FA-2-C3T4**	50	69	110	125	180	0	0.010	0.008	0.020	0.26	3 000
W1001FA-3P-C3Z4	**W1001FA-4-C3T4**	100	119	160	175	230	0	0.010	0.008	0.030	0.28	3 000
W1002FA-1P-C3Z4	**W1002FA-2-C3T4**	150	169	210	225	280	0	0.012	0.008	0.030	0.31	3 000
W1002FA-3P-C3Z4	**W1002FA-4-C3T4**	200	219	260	275	330	0	0.012	0.008	0.040	0.34	3 000
W1003FA-1P-C3Z4	**W1003FA-2-C3T4**	250	269	310	325	380	0	0.012	0.008	0.040	0.37	3 000
W1003FA-3P-C3Z4	**W1003FA-4-C3T4**	300	319	360	375	430	0	0.013	0.010	0.050	0.39	3 000

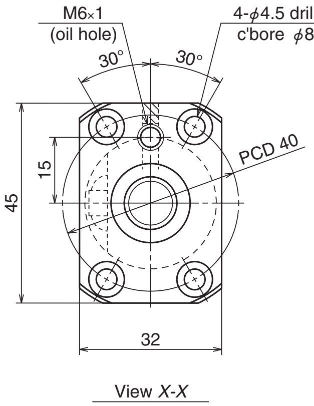
Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease PS2. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Screw shaft ø12

Lead 5

Unit: mm





View *X*-*X*

Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		12 × 5 / Right	
Preload / Ball recirculation		P-preload / Tube	
Ball dia. / Ball circle dia.		2.381 / 12.3	
Screw shaft root diameter		9.8	
Effective ball turns		2.5 × 1	
Accuracy grade / Preload / Axial play		C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_a	2 770	4 390
	Static C_{0a}	3 130	6 260
Axial play		0	0.005 or less
Preload (N)		98.1	—
Dynamic friction torque (N·cm)		1.0 – 4.4	1.0 or less
Spacer ball		Yes	None
Factory-packed grease		NSK grease PS2	
Nut internal space (cm^3)		1.2	
Standard grease replenishment (cm^3)		0.6	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK10-01A (square)	WBK10S-01 (square)
WBK10-11 (round)	

Unit: mm

Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ↗↗	Mass (kg)	Permissible rotational speed N (min^{-1}) Configuration
Preloaded (PFT)	Precise clearance (SFT)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple
W1201FA-1P-C3Z5	**W1201FA-2-C3T5**	50	63	110	125	180	0	0.010	0.008	0.020	0.35	3 000
W1201FA-3P-C3Z5	**W1201FA-4-C3T5**	100	113	160	175	230	0	0.010	0.008	0.030	0.38	3 000
W1202FA-1P-C3Z5	**W1202FA-2-C3T5**	150	163	210	225	280	0	0.012	0.008	0.030	0.42	3 000
W1202FA-3P-C3Z5	**W1202FA-4-C3T5**	200	213	260	275	330	0	0.012	0.008	0.040	0.46	3 000
W1203FA-1P-C3Z5	**W1203FA-2-C3T5**	250	263	310	325	380	0	0.012	0.008	0.040	0.50	3 000
W1204FA-1P-C3Z5	**W1204FA-2-C3T5**	350	363	410	425	480	0	0.015	0.010	0.050	0.58	3 000
W1205FA-1P-C3Z5	**W1205FA-2-C3T5**	450	463	510	525	580	0	0.016	0.012	0.065	0.66	3 000

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease PS2. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Finished Shaft End FA Model (Medium lead)

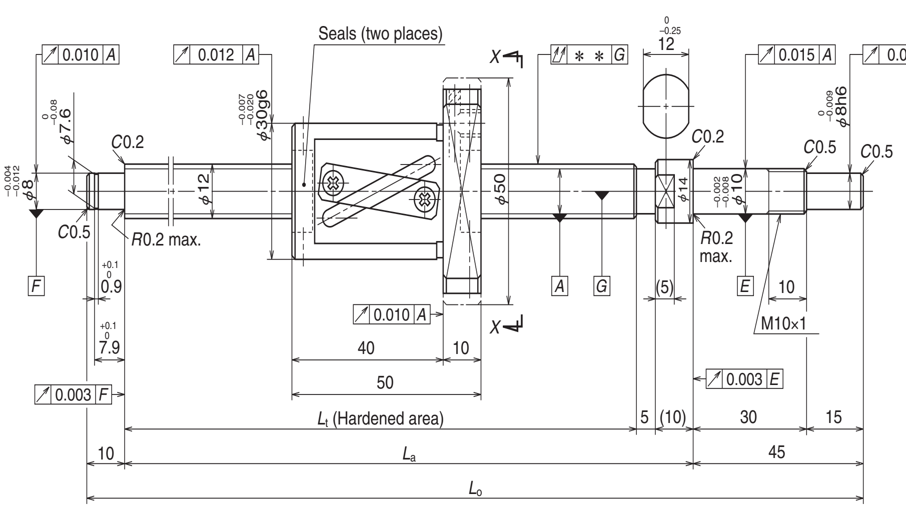
Nut: LPFT, LSFT

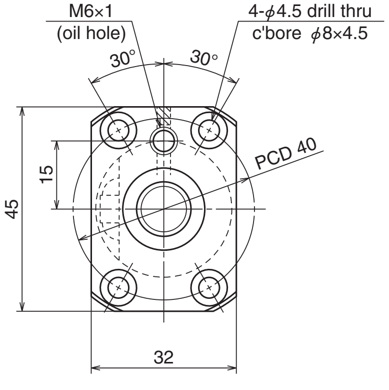
NSK

Screw shaft ø12

Lead 10

Unit: mm





View X-X

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		12 × 10 / Right	
Preload / Ball recirculation		P-preload / Tube	
Ball dia. / Ball circle dia.		2.381 / 12.5	
Screw shaft root diameter		10.0	
Effective ball turns		2.5 × 1	
Accuracy grade / Preload / Axial play		C5 / Z	C5 / T
Basic load ratings (N)	Dynamic C_a	2 790	4 430
	Static C_{0a}	3 220	6 430
Axial play		0	0.005 or less
Preload (N)		98.1	—
Dynamic friction torque (N·cm)		1.0 – 4.9	1.5 or less
Spacer ball		Yes	None
Factory-packed grease		NSK grease LR3	
Nut internal space (cm^3)		1.4	
Standard grease replenishment (cm^3)		0.7	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK10-01A (square)	WBK10S-01 (square)
WBK10-11 (round)	

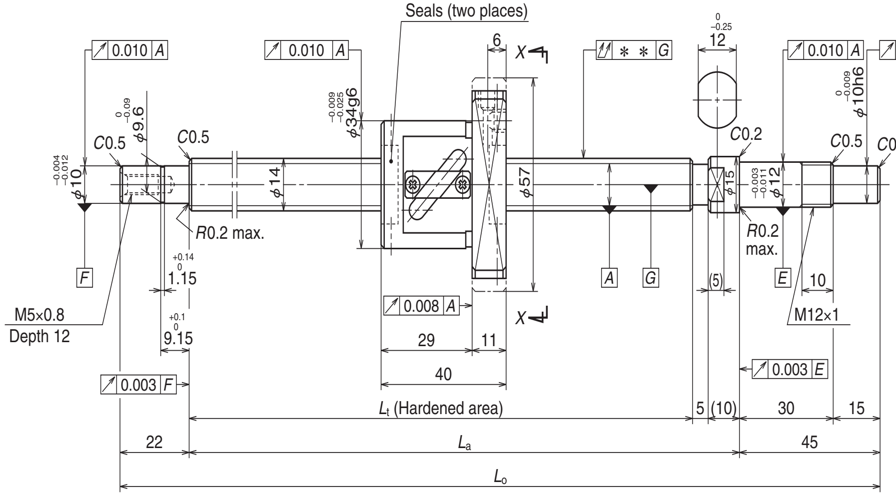
FA

Unit: mm

Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ∗∗ ↗↗	Mass (kg)	Permissible rotational speed N (min^{-1}) Configuration
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple
W1201FA-5P-C5Z10	**W1201FA-6-C5T10**	100	103	160	175	230	0	0.020	0.018	0.035	0.43	3 000
W1202FA-5P-C5Z10	**W1202FA-6-C5T10**	150	153	210	225	280	0	0.023	0.018	0.035	0.47	3 000
W1203FA-3P-C5Z10	**W1203FA-4-C5T10**	250	253	310	325	380	0	0.023	0.018	0.050	0.56	3 000
W1204FA-3P-C5Z10	**W1204FA-4-C5T10**	350	353	410	425	480	0	0.027	0.020	0.060	0.64	3 000
W1205FA-3P-C5Z10	**W1205FA-4-C5T10**	450	453	510	525	580	0	0.030	0.023	0.075	0.72	3 000

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Finished Shaft End FA Model (Fine lead)



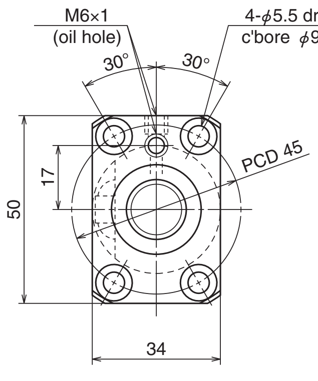
Nut: PFT, SFT

NSK

Screw shaft ø14

Lead 5

Unit: mm



View X-X

Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		14 × 5 / Right	
Preload / Ball recirculation		P-preload / Tube	
Ball dia. / Ball circle dia.		3.175 / 14.5	
Screw shaft root diameter		11.2	
Effective ball turns		2.5 × 1	
Accuracy grade / Preload / Axial play		C3 / Z	C3 / T
Basic load ratings (N)	Dynamic C_a	5 020	7 970
	Static C_{0a}	5 970	11 900
Axial play		0	0.005 or less
Preload (N)		147	—
Dynamic friction torque (N·cm)		1.5 – 6.9	2.0 or less
Spacer ball		Yes	None
Factory-packed grease		NSK grease LR3	
Nut internal space (cm^3)		2.2	
Standard grease replenishment (cm^3)		1.1	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

Unit: mm

Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})	
		Nominal	Maximum									Configuration	
Preloaded (PFT)	Precise clearance (SFT)			L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W1401FA-1P-C3Z5	**W1401FA-2-C3T5**	100	143	189	204	271	0	0.010	0.008	0.020	0.52	3 000	3 000
W1402FA-1P-C3Z5	**W1402FA-2-C3T5**	150	193	239	254	321	0	0.012	0.008	0.030	0.57	3 000	3 000
W1403FA-1P-C3Z5	**W1403FA-2-C3T5**	250	293	339	354	421	0	0.013	0.010	0.035	0.67	3 000	3 000
W1404FA-1P-C3Z5	**W1404FA-2-C3T5**	350	393	439	454	521	0	0.015	0.010	0.045	0.77	3 000	3 000
W1405FA-1P-C3Z5	**W1405FA-2-C3T5**	450	493	539	554	621	0	0.016	0.012	0.045	0.87	3 000	3 000
W1406FA-1P-C3Z5	**W1406FA-2-C3T5**	600	643	689	704	771	0	0.018	0.013	0.055	1.0	3 000	3 000

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
3. Contact NSK if permissible rotational speed N will be exceeded.

Notes:
4. The user must design the support bearing structure if the non-drive side is fixed.
5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)

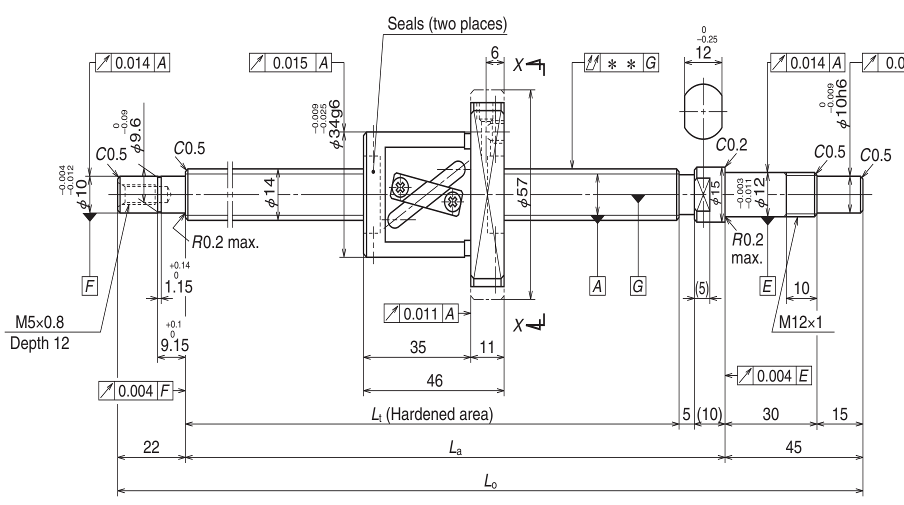
Finished Shaft End FA Model (Medium lead)

Nut: LPFT, LSFT

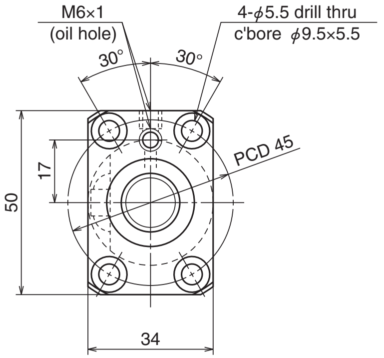
NSK

Screw shaft ø14

Lead 8



Unit: mm



View *X-X*

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		14 × 8 / Right	
Preload / Ball recirculation		P-preload / Tube	
Ball dia. / Ball circle dia.		3.175 / 14.5	
Screw shaft root diameter		11.2	
Effective ball turns		2.5 × 1	
Accuracy grade / Preload / Axial play		C5 / Z	C5 / T
Basic load ratings (N)	Dynamic C_a	4 960	7 880
	Static C_{0a}	5 920	11 800
Axial play		0	0.005 or less
Preload (N)		147	—
Dynamic friction torque (N·cm)		1.5 – 7.8	2.4 or less
Spacer ball		Yes	None
Factory-packed grease		NSK grease LR3	
Nut internal space (cm^3)		2.1	
Standard grease replenishment (cm^3)		1.1	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

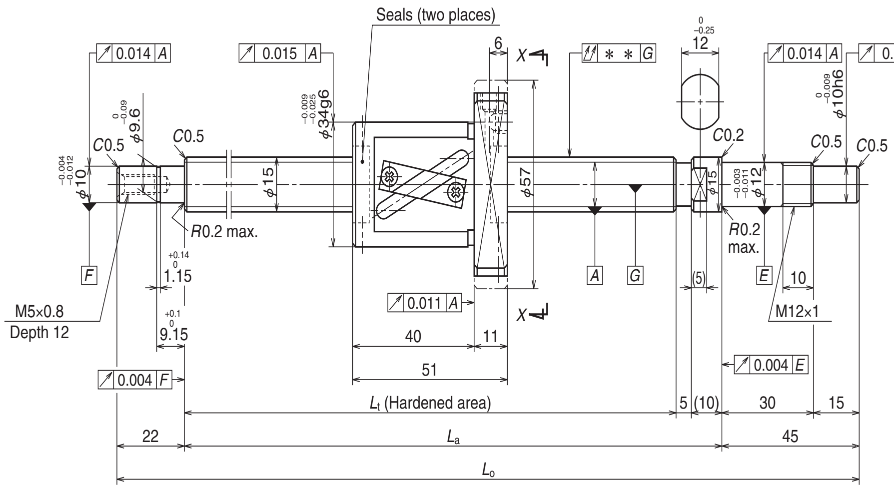
Unit: mm

Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed *N* (min^{-1}) Configuration	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W1401FA-3P-C5Z8	**W1401FA-4-C5T8**	100	137	189	204	271	0	0.020	0.018	0.025	0.56	3 000	3 000
W1402FA-3P-C5Z8	**W1402FA-4-C5T8**	150	187	239	254	321	0	0.023	0.018	0.035	0.61	3 000	3 000
W1402FA-5P-C5Z8	**W1402FA-6-C5T8**	200	237	289	304	371	0	0.023	0.018	0.035	0.67	3 000	3 000
W1403FA-3P-C5Z8	**W1403FA-4-C5T8**	250	287	339	354	421	0	0.025	0.020	0.040	0.72	3 000	3 000
W1403FA-5P-C5Z8	**W1403FA-6-C5T8**	300	337	389	404	471	0	0.025	0.020	0.040	0.78	3 000	3 000
W1404FA-3P-C5Z8	**W1404FA-4-C5T8**	350	387	439	454	521	0	0.027	0.020	0.050	0.83	3 000	3 000
W1404FA-5P-C5Z8	**W1404FA-6-C5T8**	400	437	489	504	571	0	0.027	0.020	0.050	0.88	3 000	3 000
W1405FA-3P-C5Z8	**W1405FA-4-C5T8**	450	487	539	554	621	0	0.030	0.023	0.050	0.94	3 000	3 000
W1405FA-5P-C5Z8	**W1405FA-6-C5T8**	500	537	589	604	671	0	0.030	0.023	0.065	0.99	3 000	3 000
W1406FA-3P-C5Z8	**W1406FA-4-C5T8**	550	587	639	654	721	0	0.035	0.025	0.065	1.0	3 000	3 000
W1406FA-5P-C5Z8	**W1406FA-6-C5T8**	600	637	689	704	771	0	0.035	0.025	0.065	1.1	3 000	3 000
W1407FA-1P-C5Z8	**W1407FA-2-C5T8**	700	737	789	804	871	0	0.035	0.025	0.085	1.2	2 830	3 000

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

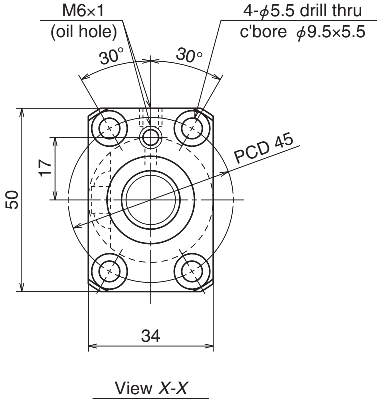
Notes:
4. The user must design the support bearing structure if the non-drive side is fixed.
5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)

Finished Shaft End FA Model (Medium lead)



Nut: LPFT, LSFT

Screw shaft ø15
Lead 10



View *X-X*

Unit: mm

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		15 × 10 / Right	
Preload / Ball recirculation		P-preload / Tube	
Ball dia. / Ball circle dia.		3.175 / 15.5	
Screw shaft root diameter		12.2	
Effective ball turns		2.5 × 1	
Accuracy grade / Preload / Axial play		C5 / Z	C5 / T
Basic load ratings (N)	Dynamic C_a	5 130	8 140
	Static C_{0a}	6 420	12 800
Axial play		0	0.005 or less
Preload (N)		147	—
Dynamic friction torque (N·cm)		1.5 – 7.8	2.4 or less
Spacer ball		Yes	None
Factory-packed grease		NSK grease LR3	
Nut internal space (cm³)		2.3	
Standard grease replenishment (cm³)		1.2	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

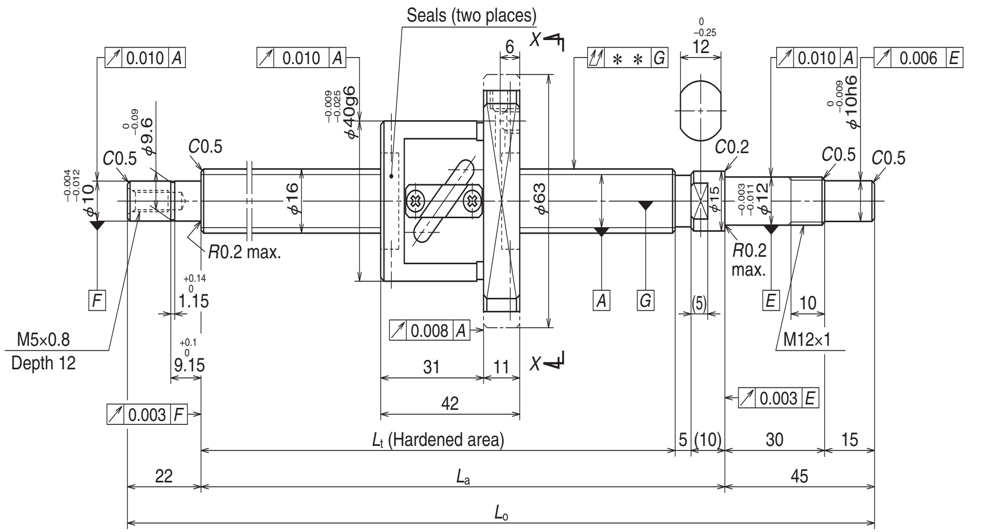
Unit: mm

Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Configuration	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W1501FA-1P-C5Z10	**W1501FA-2-C5T10**	100	132	189	204	271	0	0.020	0.018	0.025	0.61	3 000	3 000
W1502FA-1P-C5Z10	**W1502FA-2-C5T10**	150	182	239	254	321	0	0.023	0.018	0.035	0.67	3 000	3 000
W1502FA-3P-C5Z10	**W1502FA-4-C5T10**	200	232	289	304	371	0	0.023	0.018	0.035	0.74	3 000	3 000
W1503FA-1P-C5Z10	**W1503FA-2-C5T10**	250	282	339	354	421	0	0.025	0.020	0.040	0.80	3 000	3 000
W1503FA-3P-C5Z10	**W1503FA-4-C5T10**	300	332	389	404	471	0	0.025	0.020	0.040	0.86	3 000	3 000
W1504FA-1P-C5Z10	**W1504FA-2-C5T10**	350	382	439	454	521	0	0.027	0.020	0.050	0.93	3 000	3 000
W1504FA-3P-C5Z10	**W1504FA-4-C5T10**	400	432	489	504	571	0	0.027	0.020	0.050	1.0	3 000	3 000
W1505FA-1P-C5Z10	**W1505FA-2-C5T10**	450	482	539	554	621	0	0.030	0.023	0.050	1.1	3 000	3 000
W1505FA-3P-C5Z10	**W1505FA-4-C5T10**	500	532	589	604	671	0	0.030	0.023	0.065	1.1	3 000	3 000
W1506FA-1P-C5Z10	**W1506FA-2-C5T10**	550	582	639	654	721	0	0.035	0.025	0.065	1.2	3 000	3 000
W1506FA-3P-C5Z10	**W1506FA-4-C5T10**	600	632	689	704	771	0	0.035	0.025	0.065	1.2	3 000	3 000
W1507FA-1P-C5Z10	**W1507FA-2-C5T10**	700	732	789	804	871	0	0.035	0.025	0.085	1.4	3 000	3 000
W1508FA-1P-C5Z10	**W1508FA-2-C5T10**	800	832	889	904	971	0	0.040	0.027	0.085	1.5	2 430	3 000
W1510FA-1P-C5Z10	**W1510FA-2-C5T10**	1 000	1 032	1 089	1 104	1 171	0	0.046	0.030	0.110	1.8	1 600	2 250

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Notes:
4. The user must design the support bearing structure if the non-drive side is fixed.
5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)

Finished Shaft End FA Model (Fine lead)



Unit: mm

Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Configuration	
Preloaded (PFT)	Precise clearance (SFT)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W1601FA-1P-C3Z5	**W1601FA-2-C3T5**	100	141	189	204	271	0	0.010	0.008	0.020	0.70	3 000	3 000
W1602FA-1P-C3Z5	**W1602FA-2-C3T5**	200	241	289	304	371	0	0.012	0.008	0.030	0.83	3 000	3 000
W1603FA-1P-C3Z5	**W1603FA-2-C3T5**	300	341	389	404	471	0	0.013	0.010	0.035	0.97	3 000	3 000
W1604FA-1P-C3Z5	**W1604FA-2-C3T5**	400	441	489	504	571	0	0.015	0.010	0.045	1.1	3 000	3 000
W1606FA-1P-C3Z5	**W1606FA-2-C3T5**	600	641	689	704	771	0	0.018	0.013	0.055	1.4	3 000	3 000
W1608FA-1P-C3Z5	**W1608FA-2-C3T5**	800	841	889	904	971	0	0.021	0.015	0.075	1.6	2 570	3 000

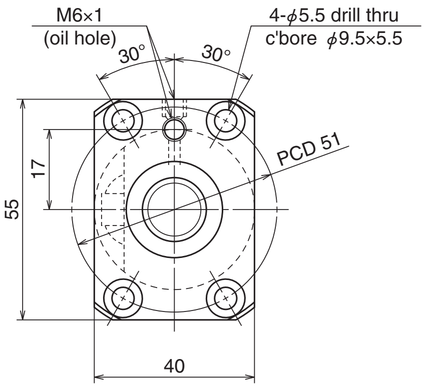
Notes: 1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.
4. The user must design the support bearing structure if the non-drive side is fixed.
5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)

Nut: PFT, SFT

NSK

Screw shaft ø16

Lead 5



View *X*-*X*

Unit: mm

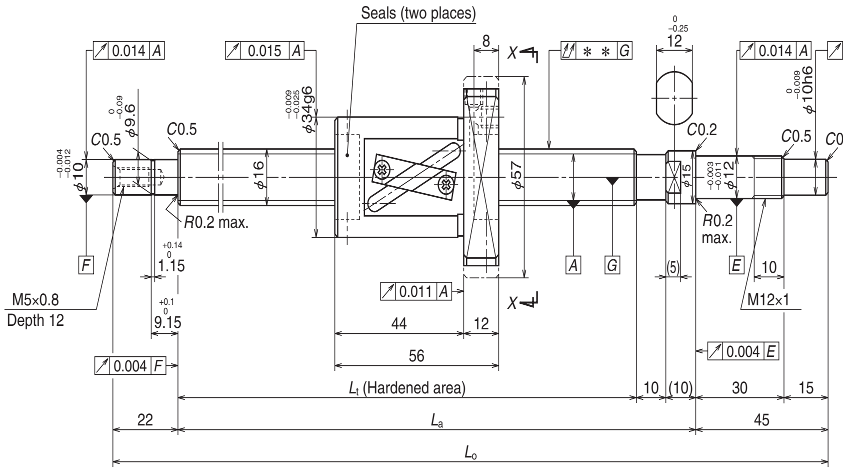
Ball screw specifications

Product classification	Preloaded	Precise clearance
Shaft dia. × Lead / Direction of turn	16 × 5 / Right	
Preload / Ball recirculation	P-preload / Tube	
Ball dia. / Ball circle dia.	3.175 / 16.5	
Screw shaft root diameter	13.2	
Effective ball turns	2.5 × 1	
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T
Basic load ratings (N) Dynamic C_a	5 430	8 620
Basic load ratings (N) Static C_{0a}	6 890	13 800
Axial play	0	0.005 or less
Preload (N)	147	—
Dynamic friction torque (N·cm)	1.5 – 7.8	2.0 or less
Spacer ball	Yes	None
Factory-packed grease	NSK grease LR3	
Nut internal space (cm^3)	2.6	
Standard grease replenishment (cm^3)	1.3	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

Finished Shaft End FA Model (High helix lead)



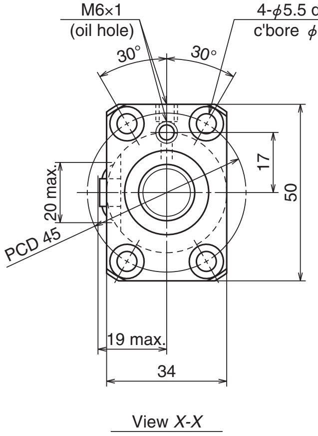
Nut: LPFT, LSFT

NSK

Screw shaft ø16

Lead 16

Unit: mm



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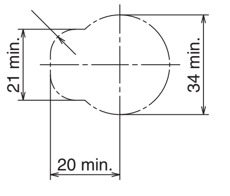


Housing hole and its clearance

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		16 × 16 / Right	
Preload / Ball recirculation		P-preload / Tube	
Ball dia. / Ball circle dia.		3.175 / 16.75	
Screw shaft root diameter		13.4	
Effective ball turns		1.5 × 1	
Accuracy grade / Preload / Axial play		C5 / Z	C5 / T
Basic load ratings (N)	Dynamic C_a	4 180	5 480
	Static C_{0a}	5 390	8 080
Axial play		0	0.005 or less
Preload (N)		147	—
Dynamic friction torque (N·cm)		1.5 – 7.8	2.4 or less
Spacer ball		Yes	None
Factory-packed grease		NSK grease LR3	
Nut internal space (cm^3)		2.1	
Standard grease replenishment (cm^3)		1.1	

Unit: mm

Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ↗↗	Mass (kg)	Permissible rotational speed N (min^{-1})	
												Configuration	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W1601FA-3P-C5Z16	**W1601FA-4-C5T16**	100	122	184	204	271	0	0.020	0.018	0.025	0.69	3 000	3 000
W1602FA-3P-C5Z16	**W1602FA-4-C5T16**	150	172	234	254	321	0	0.023	0.018	0.035	0.77	3 000	3 000
W1602FA-5P-C5Z16	**W1602FA-6-C5T16**	200	222	284	304	371	0	0.023	0.018	0.035	0.84	3 000	3 000
W1603FA-3P-C5Z16	**W1603FA-4-C5T16**	250	272	334	354	421	0	0.025	0.020	0.040	0.92	3 000	3 000
W1603FA-5P-C5Z16	**W1603FA-6-C5T16**	300	322	384	404	471	0	0.025	0.020	0.040	0.99	3 000	3 000
W1604FA-3P-C5Z16	**W1604FA-4-C5T16**	350	372	434	454	521	0	0.027	0.020	0.050	1.1	3 000	3 000
W1604FA-5P-C5Z16	**W1604FA-6-C5T16**	400	422	484	504	571	0	0.027	0.020	0.050	1.1	3 000	3 000
W1605FA-1P-C5Z16	**W1605FA-2-C5T16**	450	472	534	554	621	0	0.030	0.023	0.050	1.2	3 000	3 000
W1605FA-3P-C5Z16	**W1605FA-4-C5T16**	500	522	584	604	671	0	0.030	0.023	0.065	1.3	3 000	3 000
W1606FA-3P-C5Z16	**W1606FA-4-C5T16**	550	572	634	654	721	0	0.035	0.025	0.065	1.4	3 000	3 000
W1606FA-5P-C5Z16	**W1606FA-6-C5T16**	600	622	684	704	771	0	0.035	0.025	0.065	1.4	3 000	3 000
W1607FA-1P-C5Z16	**W1607FA-2-C5T16**	700	722	784	804	871	0	0.035	0.025	0.085	1.6	3 000	3 000
W1608FA-3P-C5Z16	**W1608FA-4-C5T16**	800	822	884	904	971	0	0.040	0.027	0.085	1.7	2 720	3 000
W1610FA-1P-C5Z16	**W1610FA-2-C5T16**	1 000	1 022	1 084	1 104	1 171	0	0.046	0.030	0.110	2.0	1 790	2 480

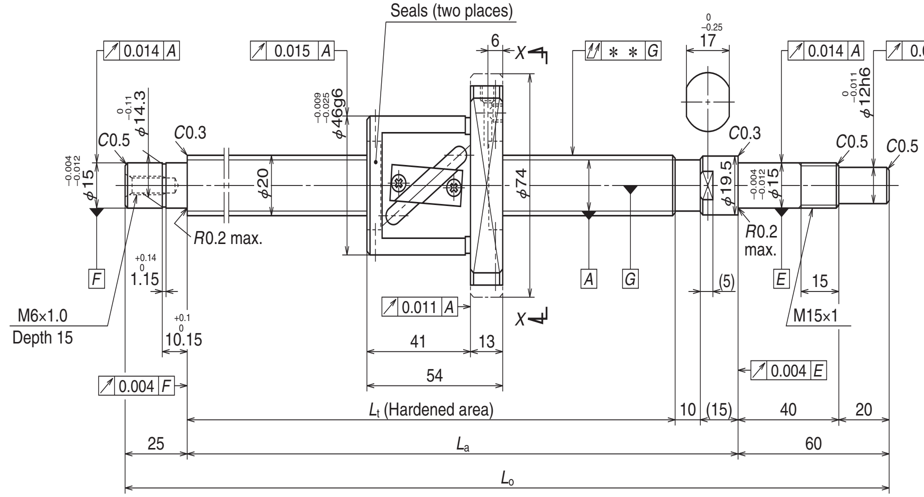
Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

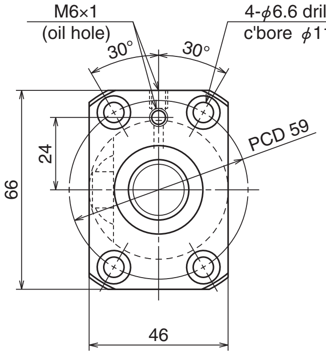
Notes:
4. The user must design the support bearing structure if the non-drive side is fixed.
5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)

Screw shaft ø20

Lead 10

Unit: mm





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Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		20 × 10 / Right	
Preload / Ball recirculation		P-preload / Tube	
Ball dia. / Ball circle dia.		3.969 / 21	
Screw shaft root diameter		16.9	
Effective ball turns		2.5 × 1	
Accuracy grade / Preload / Axial play		C5 / Z	C5 / T
Basic load ratings (N)	Dynamic C_a	8 350	13 300
	Static C_{0a}	11 000	21 900
Axial play		0	0.005 or less
Preload (N)		196	—
Dynamic friction torque (N·cm)		2.0 – 11.8	2.9 or less
Spacer ball		Yes	None
Factory-packed grease		NSK grease LR3	
Nut internal space (cm³)		4.7	
Standard grease replenishment (cm³)		2.4	

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK15-01A (square)	WBK15S-01 (square)
WBK15-11 (round)	

Unit: mm

Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Configuration	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W2002FA-1P-C5Z10	**W2002FA-2-C5T10**	200	229	289	314	399	0	0.023	0.018	0.035	1.4	3 000	3 000
W2003FA-1P-C5Z10	**W2003FA-2-C5T10**	300	329	389	414	499	0	0.025	0.020	0.040	1.6	3 000	3 000
W2004FA-1P-C5Z10	**W2004FA-2-C5T10**	400	429	489	514	599	0	0.027	0.020	0.050	1.9	3 000	3 000
W2005FA-1P-C5Z10	**W2005FA-2-C5T10**	500	529	589	614	699	0	0.030	0.023	0.065	2.1	3 000	3 000
W2006FA-1P-C5Z10	**W2006FA-2-C5T10**	600	629	689	714	799	0	0.035	0.025	0.065	2.3	3 000	3 000
W2007FA-1P-C5Z10	**W2007FA-2-C5T10**	700	729	789	814	899	0	0.035	0.025	0.085	2.5	3 000	3 000
W2008FA-1P-C5Z10	**W2008FA-2-C5T10**	800	829	889	914	999	0	0.040	0.027	0.085	2.8	3 000	3 000
W2009FA-1P-C5Z10	**W2009FA-2-C5T10**	900	929	989	1 014	1 099	0	0.040	0.027	0.110	3.0	2 710	3 000
W2010FA-1P-C5Z10	**W2010FA-2-C5T10**	1 000	1 029	1 089	1 114	1 199	0	0.046	0.030	0.110	3.2	2 220	3 000
W2011FA-1P-C5Z10	**W2011FA-2-C5T10**	1 100	1 129	1 189	1 214	1 299	0	0.046	0.030	0.150	3.4	1 860	2 570
W2012FA-1P-C5Z10	**W2012FA-2-C5T10**	1 200	1 229	1 289	1 314	1 399	0	0.054	0.035	0.150	3.7	1 580	2 190

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
3. Contact NSK if permissible rotational speed N will be exceeded.

Notes:
4. The user must design the support bearing structure if the non-drive side is fixed.
5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)

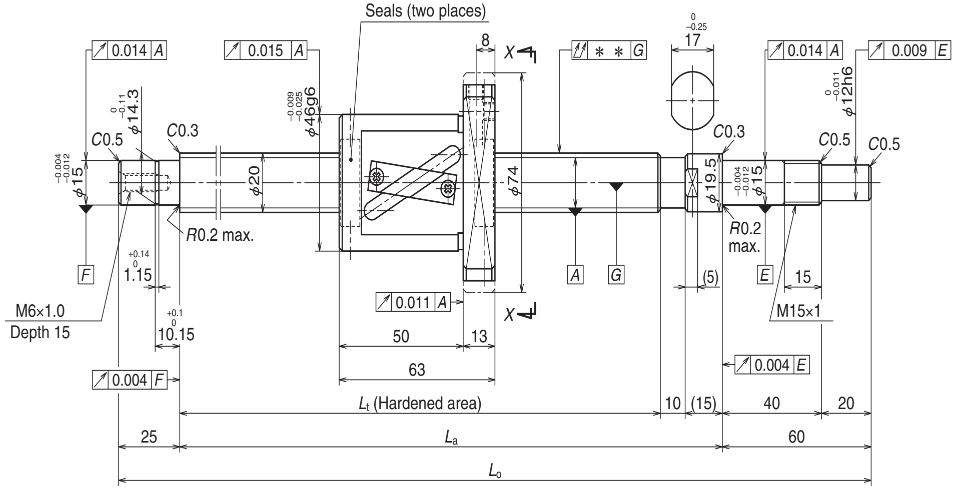
Finished Shaft End FA Model (High helix lead)

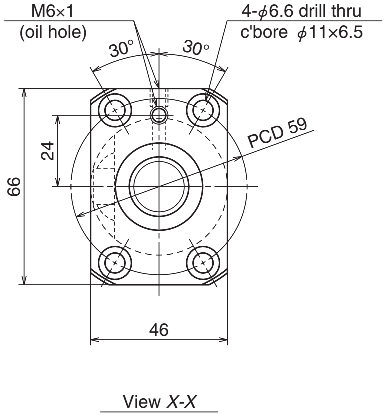
Nut: LPFT, LSFT

Screw shaft ø20

Lead 20

Unit: mm





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Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK15-01A (square)	WBK15S-01 (square)
WBK15-11 (round)	

Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		20 × 20 / Right	
Preload / Ball recirculation		P-preload / Tube	
Ball dia. / Ball circle dia.		3.969 / 21	
Screw shaft root diameter		16.9	
Effective ball turns		1.5 × 1	
Accuracy grade / Preload / Axial play		C5 / Z	C5 / T
Basic load ratings (N)	Dynamic C_a	6 250	8 190
	Static C_{0a}	8 760	13 100
Axial play		0	0.005 or less
Preload (N)		196	—
Dynamic friction torque (N·cm)		2.0 – 11.8	2.9 or less
Spacer ball		Yes	None
Factory-packed grease		NSK grease LR3	
Nut internal space (cm^3)		4.2	
Standard grease replenishment (cm^3)		2.1	

Unit: mm

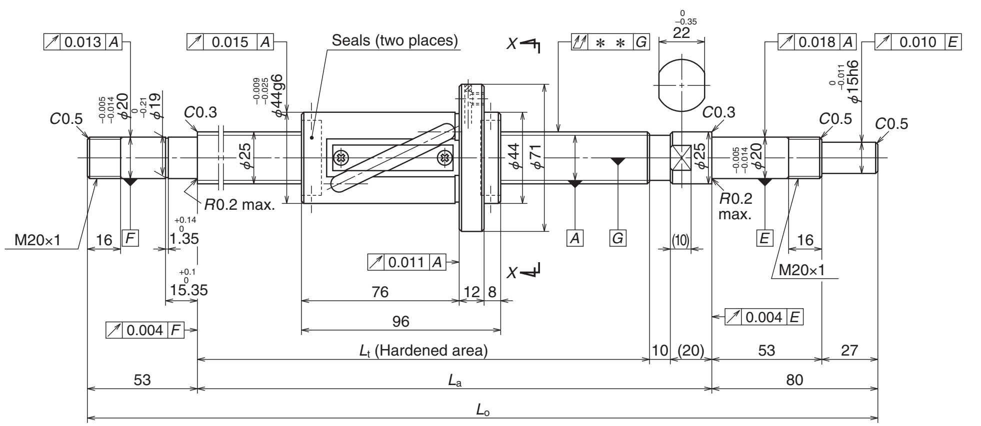
Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed *N* (min^{-1}) Configuration	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W2003FA-3P-C5Z20	**W2003FA-4-C5T20**	200	241	310	335	420	0	0.023	0.018	0.040	1.6	3 000	3 000
W2004FA-3P-C5Z20	**W2004FA-4-C5T20**	300	341	410	435	520	0	0.027	0.020	0.050	1.8	3 000	3 000
W2005FA-3P-C5Z20	**W2005FA-4-C5T20**	400	441	510	535	620	0	0.030	0.023	0.050	2.0	3 000	3 000
W2006FA-3P-C5Z20	**W2006FA-4-C5T20**	500	541	610	635	720	0	0.030	0.023	0.065	2.3	3 000	3 000
W2007FA-3P-C5Z20	**W2007FA-4-C5T20**	600	641	710	735	820	0	0.035	0.025	0.085	2.5	3 000	3 000
W2008FA-3P-C5Z20	**W2008FA-4-C5T20**	700	741	810	835	920	0	0.040	0.027	0.085	2.7	3 000	3 000
W2009FA-3P-C5Z20	**W2009FA-4-C5T20**	800	841	910	935	1 020	0	0.040	0.027	0.110	3.0	3 000	3 000
W2010FA-3P-C5Z20	**W2010FA-4-C5T20**	900	941	1 010	1 035	1 120	0	0.046	0.030	0.110	3.2	2 630	3 000
W2011FA-3P-C5Z20	**W2011FA-4-C5T20**	1 000	1 041	1 110	1 135	1 220	0	0.046	0.030	0.110	3.4	2 160	2 970
W2012FA-3P-C5Z20	**W2012FA-4-C5T20**	1 100	1 141	1 210	1 235	1 320	0	0.046	0.030	0.150	3.7	1 810	2 500
W2015FA-1P-C5Z20	**W2015FA-2-C5T20**	1 400	1 441	1 510	1 535	1 620	0	0.054	0.035	0.180	4.4	1 150	1 610

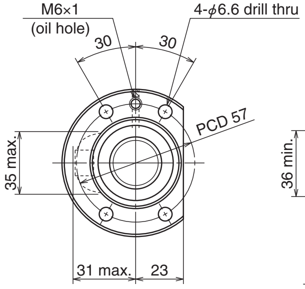
Notes: 1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Notes: 4. The user must design the support bearing structure if the non-drive side is fixed.
5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)

Screw shaft ø25

Lead 20





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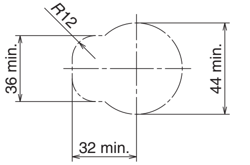


Housing hole and its clearance

Unit: mm

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		25 × 20 / Right	
Preload / Ball recirculation		P-preload / Tube	
Ball dia. / Ball circle dia.		4.762 / 26.25	
Screw shaft root diameter		21.3	
Effective ball turns		2.5 × 1	
Accuracy grade / Preload / Axial play		C5 / Z	C5 / T
Basic load ratings (N)	Dynamic C_a	11 700	18 600
	Static C_{0a}	16 300	32 600
Axial play		0	0.005 or less
Preload (N)		343	—
Dynamic friction torque (N·cm)		3.9 – 24.5	4.9 or less
Spacer ball		Yes	None
Factory-packed grease		NSK grease LR3	
Nut internal space (cm^3)		12	
Standard grease replenishment (cm^3)		6	

Recommended support unit

For drive side (Fixed)	For non-drive side (Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

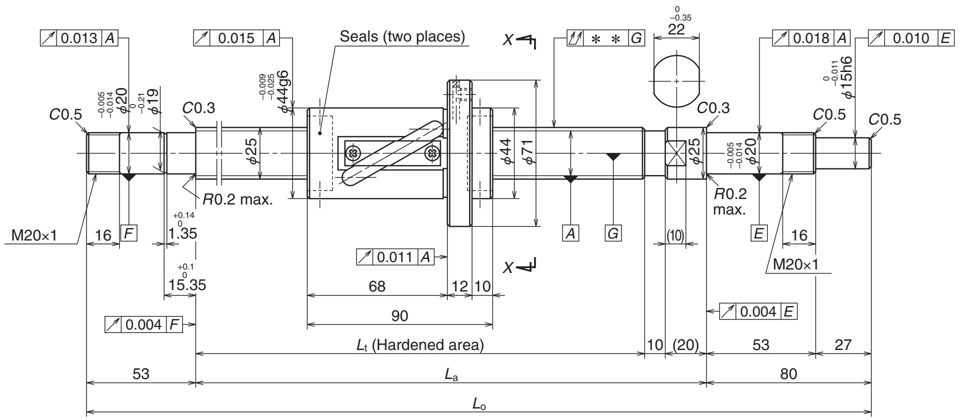
Unit: mm

Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Configuration	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W2507FA-1P-C5Z20	**W2507FA-2-C5T20**	600	640	750	780	913	0	0.035	0.025	0.055	4.0	2 800	2 800
W2509FA-1P-C5Z20	**W2509FA-2-C5T20**	800	840	950	980	1 113	0	0.040	0.027	0.070	4.7	2 800	2 800
W2511FA-1P-C5Z20	**W2511FA-2-C5T20**	1 000	1 040	1 150	1 180	1 313	0	0.046	0.030	0.090	5.4	2 590	2 800
W2513FA-1P-C5Z20	**W2513FA-2-C5T20**	1 200	1 240	1 350	1 380	1 513	0	0.054	0.035	0.090	6.2	1 860	2 550
W2515FA-1P-C5Z20	**W2515FA-2-C5T20**	1 400	1 440	1 550	1 580	1 713	0	0.054	0.035	0.120	6.9	1 400	1 940
W2517FA-1P-C5Z20	**W2517FA-2-C5T20**	1 600	1 640	1 750	1 780	1 913	0	0.065	0.040	0.120	7.6	1 090	1 520
W2521FA-1P-C5Z20	**W2521FA-2-C5T20**	2 000	2 040	2 150	2 180	2 313	0	0.077	0.046	0.160	9.1	720	1 000

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
3. Contact NSK if permissible rotational speed N will be exceeded.

Screw shaft ø25

Lead 25



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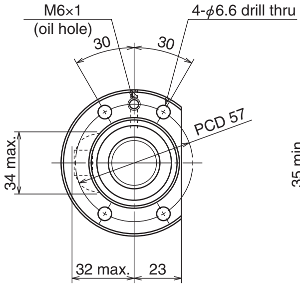

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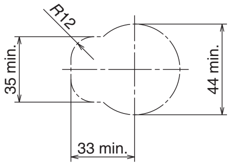


Housing hole and its clearance

Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		25 × 25 / Right	
Preload / Ball recirculation		P-preload / Tube	
Ball dia. / Ball circle dia.		4.762 / 26.25	
Screw shaft root diameter		21.3	
Effective ball turns		1.5 × 1	
Accuracy grade / Preload / Axial play		C5 / Z	C5 / T
Basic load ratings (N)	Dynamic C_a	8 970	11 700
	Static C_{0a}	13 100	19 700
Axial play		0	0.005 or less
Preload (N)		294	—
Dynamic friction torque (N·cm)		3.9 – 24.5	4.9
Spacer ball		Yes	None
Factory-packed grease		NSK grease LR3	
Nut internal space (cm^3)		7.5	
Standard grease replenishment (cm^3)		3.8	

Recommended support unit

For drive side	For non-drive side	
(Fixed)	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

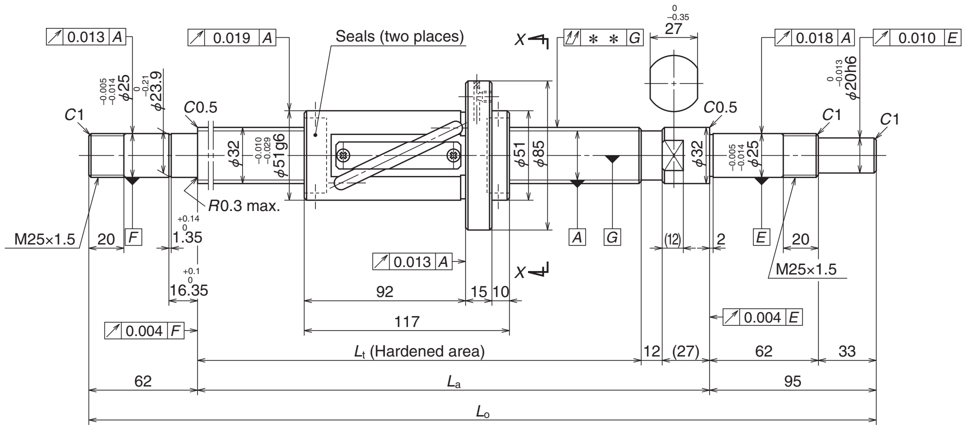
Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Configuration	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W2507FA-3P-C5Z25	**W2507FA-4-C5T25**	600	646	750	780	913	0	0.035	0.025	0.055	4.0	2 800	2 800
W2509FA-3P-C5Z25	**W2509FA-4-C5T25**	800	846	950	980	1 113	0	0.040	0.027	0.070	4.7	2 800	2 800
W2511FA-3P-C5Z25	**W2511FA-4-C5T25**	1 000	1 046	1 150	1 180	1 313	0	0.046	0.030	0.090	5.4	2 580	2 800
W2513FA-3P-C5Z25	**W2513FA-4-C5T25**	1 200	1 246	1 350	1 380	1 513	0	0.054	0.035	0.090	6.2	1 850	2 550
W2515FA-3P-C5Z25	**W2515FA-4-C5T25**	1 400	1 446	1 550	1 580	1 713	0	0.054	0.035	0.120	7.0	1 400	1 930
W2517FA-3P-C5Z25	**W2517FA-4-C5T25**	1 600	1 646	1 750	1 780	1 913	0	0.065	0.040	0.120	7.7	1 090	1 510
W2521FA-3P-C5Z25	**W2521FA-4-C5T25**	2 000	2 046	2 150	2 180	2 313	0	0.077	0.046	0.160	9.1	710	1 000

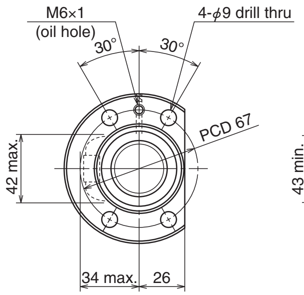
Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Screw shaft ø32

Lead 25

Unit: mm





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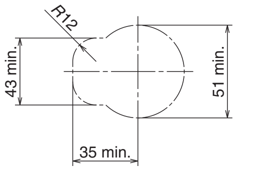


Housing hole and its clearance

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		32 × 25 / Right	
Preload / Ball recirculation		P-preload / Tube	
Ball dia. / Ball circle dia.		4.762 / 33.25	
Screw shaft root diameter		28.3	
Effective ball turns		2.5 × 1	
Accuracy grade / Preload / Axial play		C5 / Z	C5 / T
Basic load ratings (N)	Dynamic C_a	12 900	20 400
	Static C_{0a}	21 100	42 200
Axial play		0	0.005 or less
Preload (N)		441	—
Dynamic friction torque (N·cm)		6.8 – 31.5	7.8 or less
Spacer ball		Yes	None
Factory-packed grease		NSK grease LR3	
Nut internal space (cm³)		17.5	
Standard grease replenishment (cm³)		8.8	

Recommended support unit

For drive side (Fixed)	For non-drive side (Fixed)	For non-drive side (Simple)
WBK25-01W (square)	WBK25-01W (square)	WBK25S-01W (square)
WBK25-11 (round)	WBK25-11 (round)	

Unit: mm

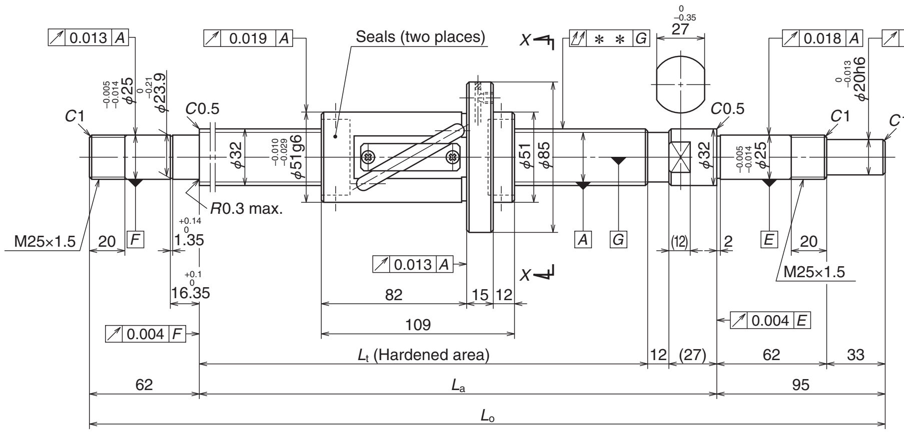
Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Configuration	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W3211FA-1P-C5Z25	**W3211FA-2-C5T25**	1 000	1 046	1 180	1 219	1 376	0	0.046	0.030	0.090	9.3	2 180	2 180
W3216FA-1P-C5Z25	**W3216FA-2-C5T25**	1 500	1 546	1 680	1 719	1 876	0	0.065	0.040	0.120	12.3	1 600	2 180
W3221FA-1P-C5Z25	**W3221FA-2-C5T25**	2 000	2 046	2 180	2 219	2 376	0	0.077	0.046	0.160	15.4	930	1 300
W3227FA-1P-C5Z25	**W3227FA-2-C5T25**	2 600	2 646	2 780	2 819	2 976	0	0.093	0.054	0.200	19.1	570	800

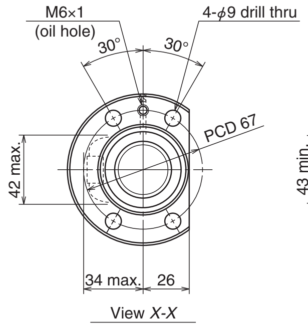
Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
3. Contact NSK if permissible rotational speed N will be exceeded.

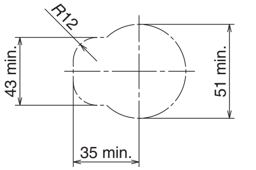
Screw shaft ø32

Lead 32

Unit: mm







Housing hole and its clearance

Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. × Lead / Direction of turn		32 × 32 / Right	
Preload / Ball recirculation		P-preload / Tube	
Ball dia. / Ball circle dia.		4.762 / 33.25	
Screw shaft root diameter		28.3	
Effective ball turns		1.5 × 1	
Accuracy grade / Preload / Axial play		C5 / Z	C5 / T
Basic load ratings (N)	Dynamic C_a	10 100	13 300
	Static C_{0a}	16 800	25 200
Axial play		0	0.005 or less
Preload (N)		392	—
Dynamic friction torque (N·cm)		6.9 – 31.5	7.8 or less
Spacer ball		Yes	None
Factory-packed grease		NSK grease LR3	
Nut internal space (cm³)		14	
Standard grease replenishment (cm³)		7	

Recommended support unit

For drive side (Fixed)	For non-drive side (Fixed)	For non-drive side (Simple)
WBK25-01W (square)	WBK25-01W (square)	WBK25S-01W (square)
WBK25-11 (round)	WBK25-11 (round)	

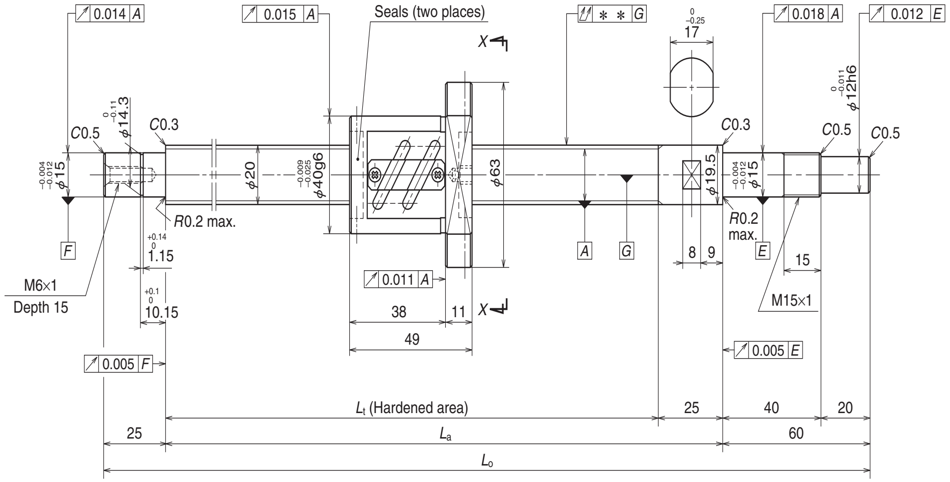
Unit: mm

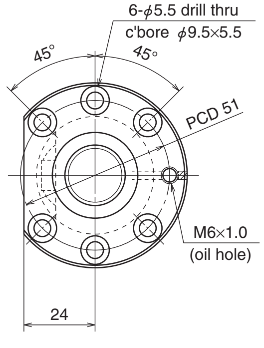
Reference No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)	
												Configuration	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u	⌰		Fixed - Simple	Fixed - Fixed
W3211FA-3P-C5Z32	**W3211FA-4-C5T32**	1 000	1 054	1 180	1 219	1 376	0	0.046	0.030	0.090	9.3	2 180	2 180
W3216FA-3P-C5Z32	**W3216FA-4-C5T32**	1 500	1 554	1 680	1 719	1 876	0	0.065	0.040	0.120	12.3	1 590	2 180
W3221FA-3P-C5Z32	**W3221FA-4-C5T32**	2 000	2 054	2 180	2 219	2 376	0	0.077	0.046	0.160	15.4	930	1 290
W3227FA-3P-C5Z32	**W3227FA-4-C5T32**	2 600	2 654	2 780	2 819	2 976	0	0.093	0.054	0.200	19.1	570	790

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. We recommend using NSK Grease LR3. The standard quantity for replenishment is about 50% of the nut's internal space. See Page D16 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Screw shaft ø20

Lead 4





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		20 × 4 / Right
Preload / Ball recirculation		P-preload / Tube
Ball dia. / Ball circle dia.		2.381 / 20.3
Effective ball turns		2.5 × 2
Screw shaft root diameter		17.8
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	6 550
	Static C_{0a}	10 900
Preload (N)		294
Standard dynamic friction torque (N·cm)		3.9
Spacer ball		Yes
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		2.7
Standard grease replenishment (cm³)		1.4

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK15-01A (square)	WBK15S-01 (square)
WBK15-11 (round)	

Unit: mm

Reference No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)	
											Configuration	
	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W2002SA-1P-C5Z4	150	170	225	250	335	–0.005	0.023	0.018	0.045	1.1	3 000	3 000
W2002SA-2P-C5Z4	200	220	275	300	385	–0.007	0.023	0.018	0.045	1.2	3 000	3 000
W2003SA-1P-C5Z4	300	320	375	400	485	–0.009	0.025	0.020	0.055	1.5	3 000	3 000
W2004SA-1P-C5Z4	400	420	475	500	585	–0.011	0.027	0.020	0.070	1.7	3 000	3 000
W2005SA-1P-C5Z4	500	520	575	600	685	–0.014	0.030	0.023	0.085	1.9	3 000	3 000
W2006SA-1P-C5Z4	600	620	675	700	785	–0.016	0.035	0.025	0.085	2.1	3 000	3 000

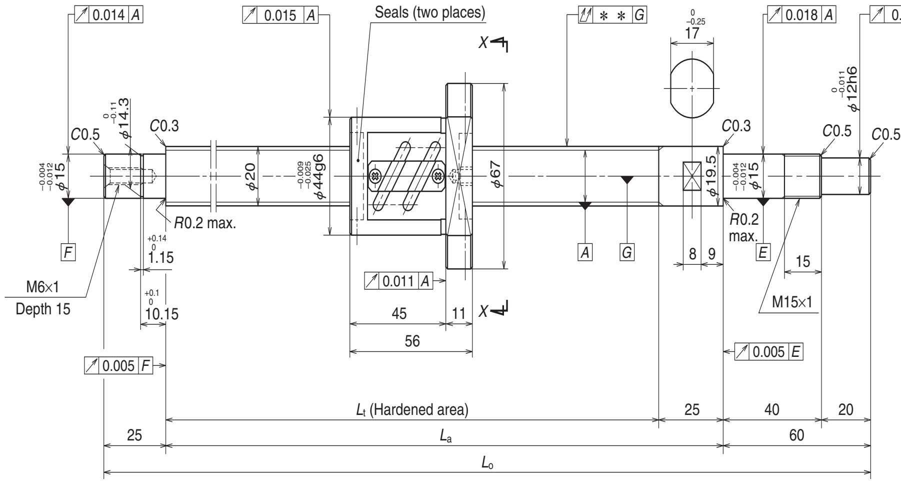
Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed N will be exceeded.
4. If the non-drive side is fixed, the user must design the configuration of the support bearing area.
5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)

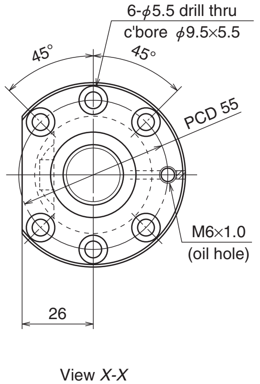
Finished Shaft End SA Model (Fine lead)

Nut: PFT

Screw shaft ø20

Lead 5





View *X*-*X*

Unit: mm

Ball screw specifications		
Shaft dia. × Lead / Direction of turn		20 × 5 / Right
Preload / Ball recirculation		P-preload / Tube
Ball dia. / Ball circle dia.		3.175 / 20.5
Screw shaft root diameter		17.2
Effective ball turns		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	11 100
	Static C_{0a}	17 100
Preload (N)		490
Standard dynamic friction torque (N·cm)		7.8
Spacer ball		Yes
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		4.3
Standard grease replenishment (cm³)		2.2

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK15-01A (square)	WBK15S-01 (square)
WBK15-11 (round)	

Unit: mm

Reference No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed *N* (min⁻¹)	
											Configuration	
	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W2002SA-3P-C5Z5	150	163	225	250	335	-0.005	0.023	0.018	0.045	1.3	3 000	3 000
W2002SA-4P-C5Z5	200	213	275	300	385	-0.007	0.023	0.018	0.045	1.4	3 000	3 000
W2003SA-2P-C5Z5	300	313	375	400	485	-0.009	0.025	0.020	0.055	1.6	3 000	3 000
W2004SA-2P-C5Z5	400	413	475	500	585	-0.011	0.027	0.020	0.070	1.8	3 000	3 000
W2005SA-2P-C5Z5	500	513	575	600	685	-0.014	0.030	0.023	0.085	2.0	3 000	3 000
W2007SA-1P-C5Z5	700	713	775	800	885	-0.019	0.035	0.025	0.110	2.5	3 000	3 000

Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.
4. If the non-drive side is fixed, the user must design the configuration of the support bearing area.
5. See Pages B51 and B52 for details on support configurations (Fixed-Simple, Fixed-Fixed, etc.)

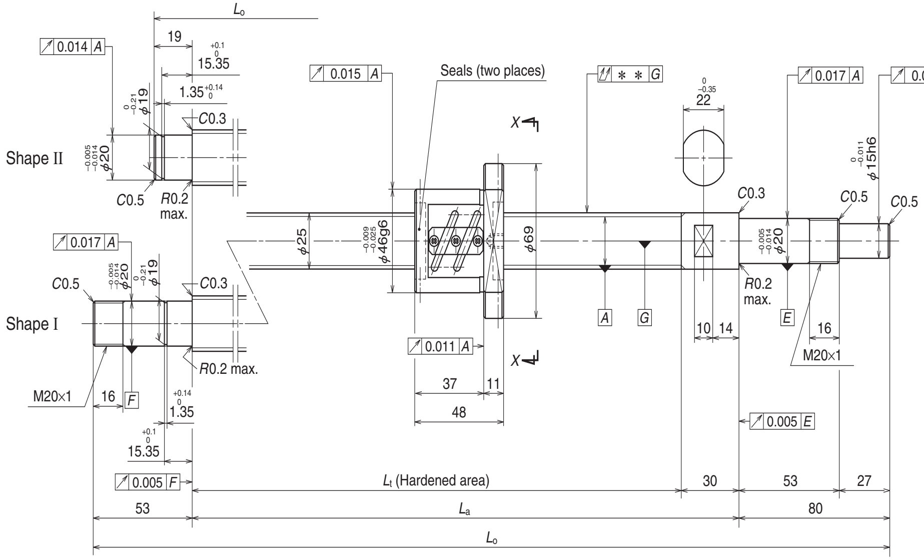
Finished Shaft End SA Model (Fine lead)

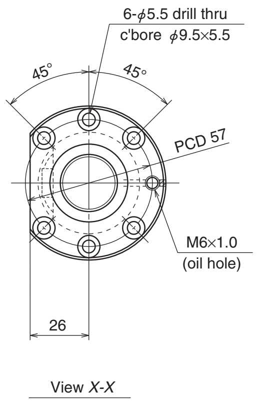
Nut: PFT

NSK

Screw shaft ø25

Lead 4





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		25 × 4 / Right
Preload / Ball recirculation		P-preload / Tube
Ball dia. / Ball circle dia.		2.381 / 25.3
Screw shaft root diameter		22.8
Effective ball turns		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	7 110
	Static C_{0a}	13 600
Preload (N)		290
Standard dynamic friction torque (N·cm)		4.9
Spacer ball		Yes
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		3.2
Standard grease replenishment (cm³)		1.6

Recommended support unit

For drive side (Fixed)	**For non-drive side (Fixed)**	**For non-drive side (Simple)**
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

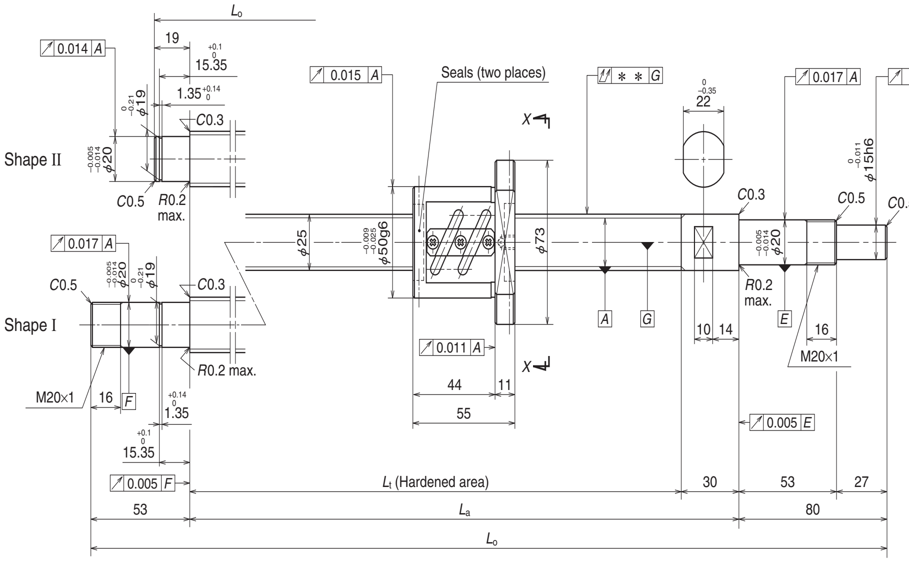
Reference No.	Stroke		Screw shaft length			Left shaft end shape	Lead accuracy			Shaft run-out ** ↗	Mass (kg)	Permissible rotational speed N (min⁻¹) Configuration	
	Nominal	Maximum	L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W2502SA-1P-C5Z4	150	166	220	250	349	Ⅱ	–0.005	0.023	0.018	0.035	1.6	2 800	—
W2502SA-2P-C5Z4	200	216	270	300	399	Ⅱ	–0.006	0.023	0.018	0.035	1.8	2 800	—
W2503SA-1P-C5Z4	300	316	370	400	499	Ⅱ	–0.009	0.025	0.020	0.040	2.2	2 800	—
W2504SA-1P-C5Z4	400	416	470	500	599	Ⅱ	–0.011	0.027	0.020	0.050	2.5	2 800	—
W2505SA-1P-C5Z4	500	516	570	600	733	Ⅰ	–0.014	0.030	0.023	0.060	3.0	2 800	2 800
W2507SA-1P-C5Z4	700	716	770	800	933	Ⅰ	–0.018	0.035	0.025	0.075	3.7	2 800	2 800

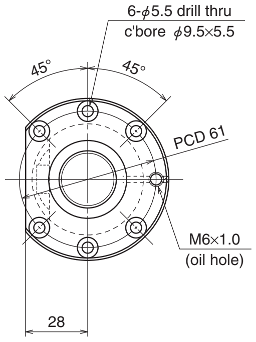
Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed N will be exceeded.
4. The maximum stroke is -8 mm when a Fixed-Fixed configuration is used with left shaft end shape Ⅰ.

Screw shaft ø25

Lead 5

Unit: mm





View X-X

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		25 × 5 / Right
Preload / Ball recirculation		P-preload / Tube
Ball dia. / Ball circle dia.		3.175 / 25.5
Screw shaft root diameter		22.2
Effective ball turns		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	12 300
	Static C_{0a}	21 800
Preload (N)		540
Standard dynamic friction torque (N·cm)		8.8
Spacer ball		Yes
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		5.0
Standard grease replenishment (cm³)		2.5

Recommended support unit

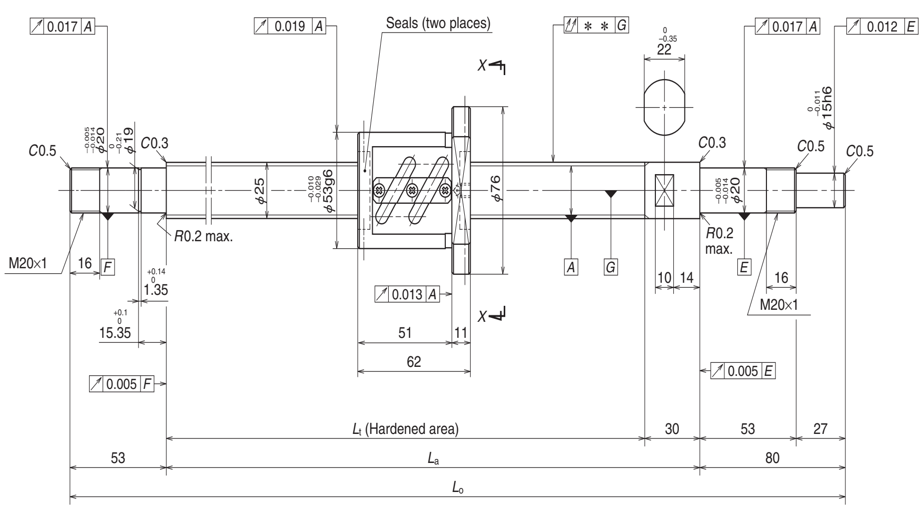
For drive side	**For non-drive side**	
(Fixed)	**(Fixed)**	**(Simple)**
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

Reference No.	Stroke		Screw shaft length			Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed *N* (min⁻¹)	
												Configuration	
	Nominal	Maximum	L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W2502SA-3P-C5Z5	150	159	220	250	349	II	–0.005	0.023	0.018	0.035	1.8	2 800	—
W2502SA-4P-C5Z5	200	209	270	300	399	II	–0.006	0.023	0.018	0.035	2.0	2 800	—
W2503SA-2P-C5Z5	300	309	370	400	499	II	–0.009	0.025	0.020	0.040	2.3	2 800	—
W2504SA-2P-C5Z5	400	409	470	500	599	II	–0.011	0.027	0.020	0.050	2.7	2 800	—
W2505SA-2P-C5Z5	500	509	570	600	733	I	–0.014	0.030	0.023	0.060	3.1	2 800	2 800
W2506SA-1P-C5Z5	600	609	670	700	833	I	–0.016	0.035	0.025	0.075	3.4	2 800	2 800
W2507SA-2P-C5Z5	700	709	770	800	933	I	–0.018	0.035	0.025	0.075	3.8	2 800	2 800
W2509SA-1P-C5Z5	900	909	970	1 000	1 133	I	–0.023	0.040	0.027	0.090	4.5	2 800	2 800
W2511SA-1P-C5Z5	1 100	1 109	1 170	1 200	1 333	I	–0.028	0.046	0.030	0.120	5.2	2 520	2 800

Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.
4. The maximum stroke is -8 mm when a Fixed-Fixed configuration is used with left shaft end shape I.

Finished Shaft End SA Model (Fine lead)



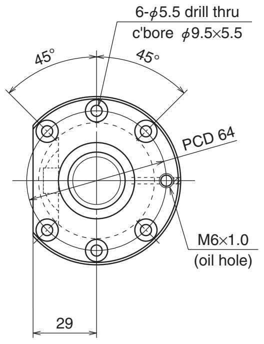
Nut: PFT

NSK

Screw shaft ø25

Lead 6

Unit: mm



View X-X

Ball screw specifications		
Shaft dia. × Lead / Direction of turn		25 × 6 / Right
Preload / Ball recirculation		P-preload / Tube
Ball dia. / Ball circle dia.		3.969 / 25.5
Screw shaft root diameter		21.4
Effective ball turns		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	16 600
	Static C_{0a}	26 700
Preload (N)		685
Standard dynamic friction torque (N·cm)		13.8
Spacer ball		Yes
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		7.0
Standard grease replenishment (cm³)		3.5

Recommended support unit

For drive side (Fixed)	**For non-drive side (Fixed)**	**(Simple)**
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

Reference No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out ∗∗	Mass (kg)	Permissible rotational speed N (min⁻¹) Configuration	
	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W2503SA-3P-C5Z6	250	302	370	400	533	–0.009	0.025	0.020	0.050	2.5	2 800	2 800
W2505SA-3P-C5Z6	450	502	570	600	733	–0.014	0.030	0.023	0.060	3.2	2 800	2 800
W2507SA-3P-C5Z6	650	702	770	800	933	–0.018	0.035	0.025	0.075	3.9	2 800	2 800
W2511SA-2P-C5Z6	1 050	1 102	1 170	1 200	1 333	–0.028	0.046	0.030	0.120	5.2	2 450	2 800

Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed N will be exceeded.
4. The maximum stroke is -8 mm when a Fixed-Fixed configuration is used with left shaft end shape I.

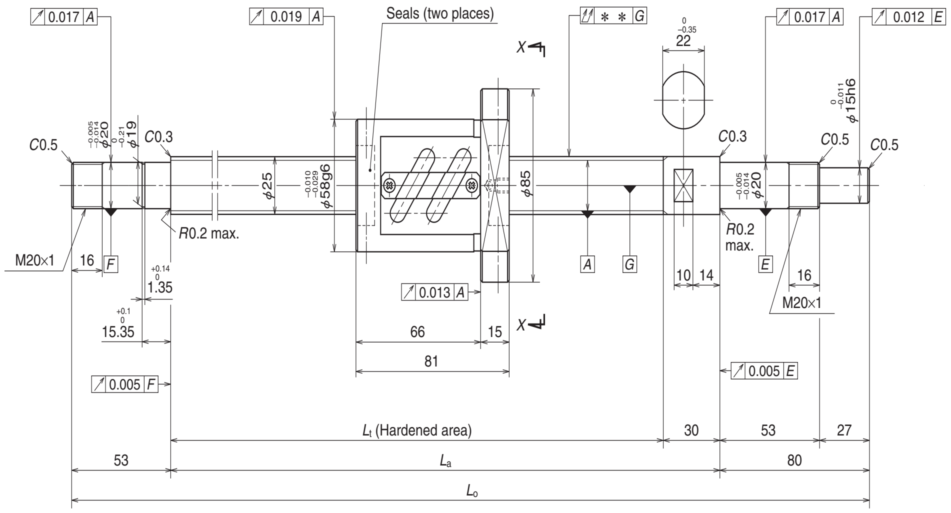
Finished Shaft End SA Model (Fine lead)

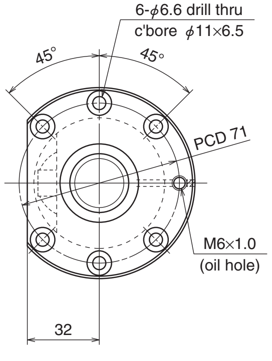
Nut: PFT

NSK

Screw shaft ø25

Lead 10





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		25 × 10 / Right
Preload / Ball recirculation		P-preload / Tube
Ball dia. / Ball circle dia.		4.762 / 25.5
Screw shaft root diameter		20.5
Effective ball turns		1.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	13 600
	Static C_{0a}	18 900
Preload (N)		585
Standard dynamic friction torque (N·cm)		13.8
Spacer ball		Yes
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		9.5
Standard grease replenishment (cm³)		4.8

Recommended support unit

For drive side	For non-drive side	
(Fixed)	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

Reference No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)	
											Configuration	
	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W2503SA-4P-C5Z10	250	283	370	400	533	–0.009	0.025	0.020	0.050	3.2	2 800	2 800
W2505SA-4P-C5Z10	450	483	570	600	733	–0.014	0.030	0.023	0.060	3.8	2 800	2 800
W2507SA-4P-C5Z10	650	683	770	800	933	–0.018	0.035	0.025	0.075	4.5	2 800	2 800
W2509SA-2P-C5Z10	850	883	970	1 000	1 133	–0.023	0.040	0.027	0.090	5.2	2 800	2 800
W2511SA-3P-C5Z10	1 050	1 083	1 170	1 200	1 333	–0.028	0.046	0.030	0.120	5.9	2 390	2 800
W2514SA-1P-C5Z10	1 350	1 383	1 470	1 500	1 633	–0.035	0.054	0.035	0.150	6.9	1 490	2 060

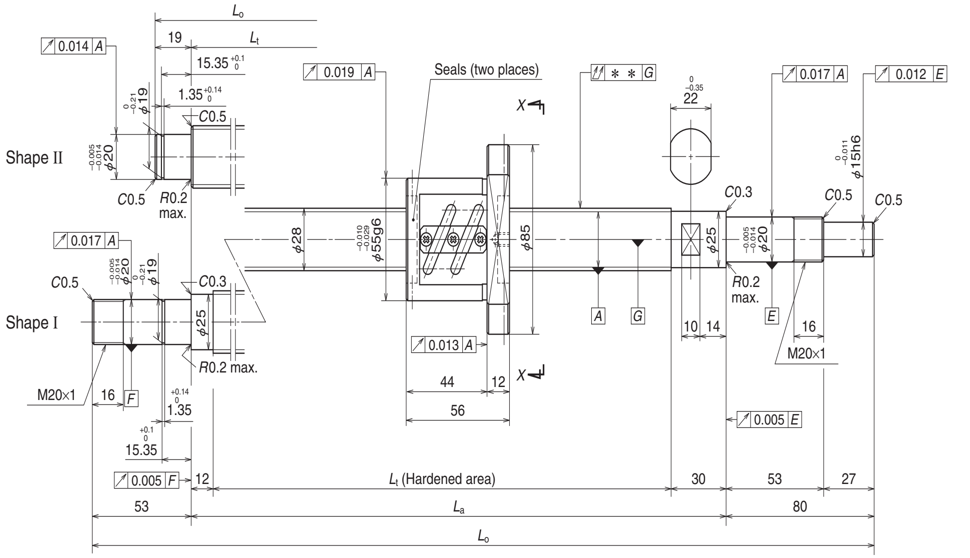
Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.
4. The maximum stroke is -8 mm when a Fixed-Fixed configuration is used with left shaft end shape I.

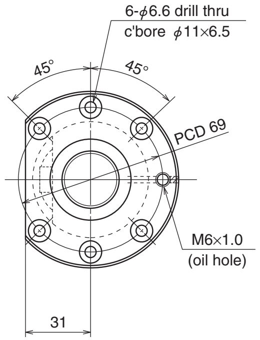
Finished Shaft End SA Model (Fine lead)

Nut: PFT

Screw shaft ø28

Lead 5





View X-X

Unit: mm

Ball screw specifications

Shaft dia. × Lead / Direction of turn		28 × 5 / Right
Preload / Ball recirculation		P-preload / Tube
Ball dia. / Ball circle dia.		3.175 / 28.5
Screw shaft root diameter		25.2
Effective ball turns		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	13 000
	Static C_{0a}	24 400
Preload (N)		540
Standard dynamic friction torque (N·cm)		9.8
Spacer ball		Yes
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm^3)		6.0
Standard grease replenishment (cm^3)		3.0

Recommended support unit

For drive side	**For non-drive side**	
(Fixed)	**(Fixed)**	**(Simple)**
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

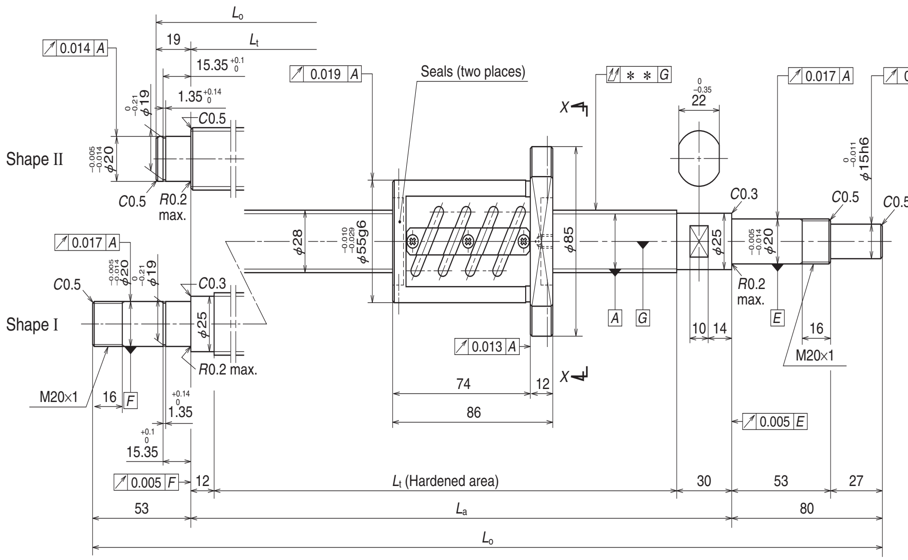
Unit: mm

Reference No.	Stroke		Screw shaft length			Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})	
												Configuration	
	Nominal	Maximum	L_t	L_a	L_o		T	e_p	υ_u	↗↗		Fixed - Simple	Fixed - Fixed
W2802SA-1P-C5Z5	200	208	270	300	399	Ⅱ	–0.006	0.023	0.018	0.035	2.5	2 500	—
W2803SA-1P-C5Z5	300	308	370	400	499	Ⅱ	–0.009	0.025	0.020	0.040	2.9	2 500	—
W2804SA-1P-C5Z5	400	408	470	500	599	Ⅱ	–0.011	0.027	0.020	0.050	3.3	2 500	—
W2805SA-1P-C5Z5	450	502	558	600	733	Ⅰ	–0.014	0.030	0.023	0.060	3.8	2 500	2 500
W2807SA-1P-C5Z5	650	702	758	800	933	Ⅰ	–0.018	0.035	0.025	0.075	4.7	2 500	2 500
W2809SA-1P-C5Z5	850	902	958	1 000	1 133	Ⅰ	–0.024	0.040	0.027	0.090	5.6	2 500	2 500
W2811SA-1P-C5Z5	1 050	1 102	1 158	1 200	1 333	Ⅰ	–0.028	0.046	0.030	0.120	6.5	2 500	2 500

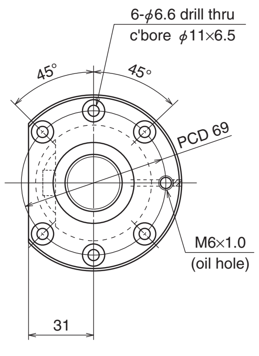
Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.
4. The maximum stroke is -2 mm when a Fixed-Fixed configuration is used with left shaft end shape Ⅰ.

Screw shaft ø28

Lead 5



Unit: mm



View X-X

Ball screw specifications	
Shaft dia. × Lead / Direction of turn	28 × 5 / Right
Preload / Ball recirculation	Z-preload / Tube
Ball dia. / Ball circle dia.	3.175 / 28.5
Screw shaft root diameter	25.2
Effective ball turns	2.5 × 2
Accuracy grade / Preload	C5 / Z
Basic load ratings (N) Dynamic C_a	20 600
Basic load ratings (N) Static C_{0a}	48 700
Preload (N)	1 220
Standard dynamic friction torque (N·cm)	21.5
Spacer ball	None
Factory-packed grease	**Refer to Note 2.**
Nut internal space (cm³)	9.0
Standard grease replenishment (cm³)	4.5

Recommended support unit

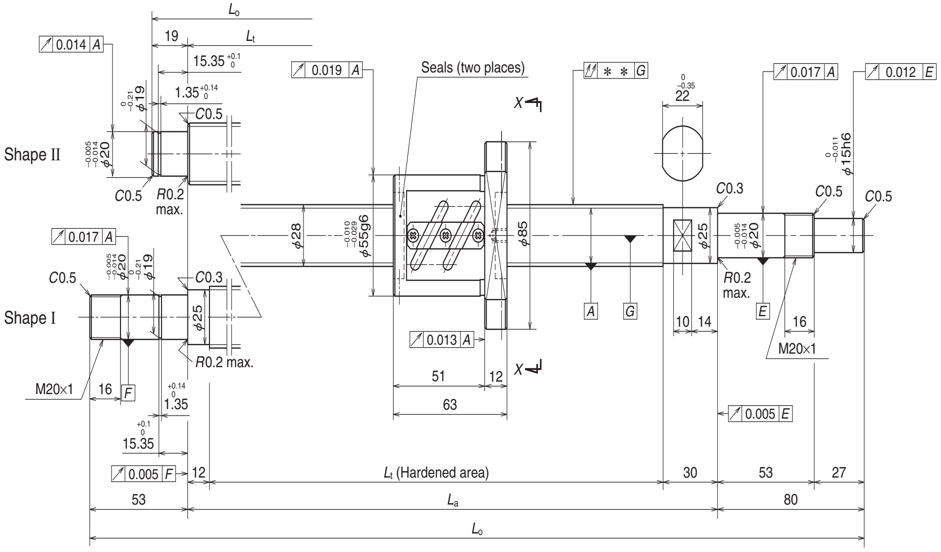
For drive side (Fixed)	**For non-drive side (Fixed)**	**For non-drive side (Simple)**
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

Reference No.	Stroke		Screw shaft length			Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Configuration	
	Nominal	Maximum	L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W2802SA-2Z-C5Z5	150	178	270	300	399	Ⅱ	–0.006	0.023	0.018	0.035	2.8	2 500	—
W2803SA-2Z-C5Z5	250	278	370	400	499	Ⅱ	–0.009	0.025	0.020	0.040	3.2	2 500	—
W2804SA-2Z-C5Z5	350	378	470	500	599	Ⅱ	–0.011	0.027	0.020	0.050	3.7	2 500	—
W2805SA-2Z-C5Z5	450	472	558	600	733	Ⅰ	–0.013	0.030	0.023	0.060	4.2	2 500	2 500
W2807SA-2Z-C5Z5	650	672	758	800	933	Ⅰ	–0.018	0.035	0.025	0.075	5.1	2 500	2 500
W2809SA-2Z-C5Z5	850	872	958	1 000	1 133	Ⅰ	–0.023	0.040	0.027	0.090	5.9	2 500	2 500
W2811SA-2Z-C5Z5	1 050	1 072	1 158	1 200	1 333	Ⅰ	–0.028	0.046	0.030	0.120	6.8	2 500	2 500

Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.
4. The maximum stroke is -2 mm when a Fixed-Fixed configuration is used with left shaft end shape Ⅰ.

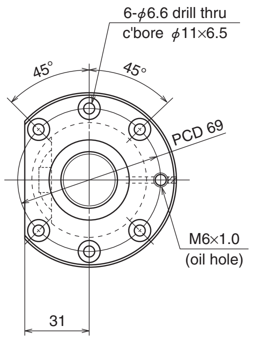
Finished Shaft End SA Model (Fine lead)



Nut: PFT

Screw shaft ø28

Lead 6



View *X-X*

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		28 × 6 / Right
Preload / Ball recirculation		P-preload / Tube
Ball dia. / Ball circle dia.		3.175 / 28.5
Screw shaft root diameter		25.2
Effective ball turns		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	12 900
	Static C_{0a}	24 300
Preload (N)		540
Standard dynamic friction torque (N·cm)		11.8
Spacer ball		Yes
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		6.0
Standard grease replenishment (cm³)		3.0

Recommended support unit

For drive side (Fixed)	For non-drive side (Fixed)	For non-drive side (Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

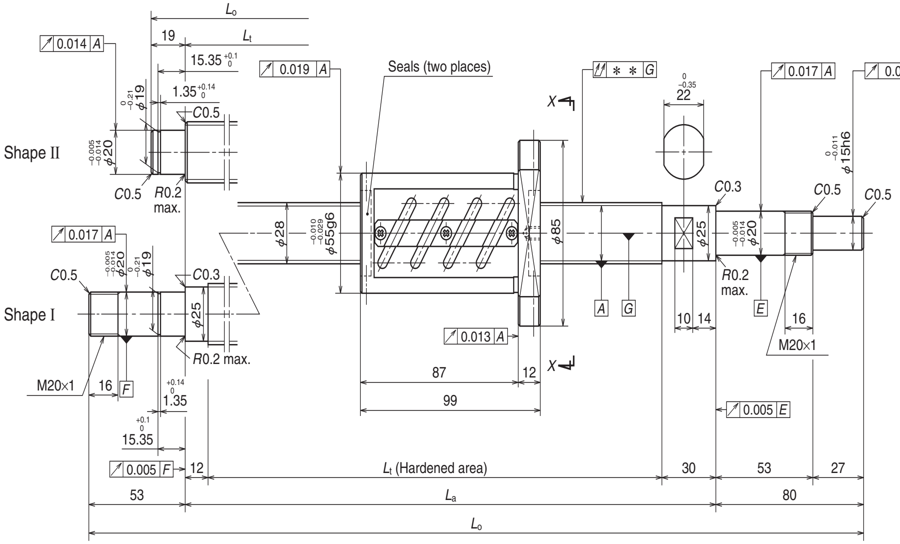
Reference No.	Stroke		Screw shaft length			Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Configuration	
	Nominal	Maximum	L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W2803SA-3P-C5Z6	250	301	370	400	499	Ⅱ	–0.009	0.025	0.020	0.040	3.0	2 500	—
W2805SA-3P-C5Z6	450	501	570	600	699	Ⅱ	–0.014	0.030	0.023	0.060	3.9	2 500	—
W2807SA-3P-C5Z6	650	695	758	800	933	Ⅰ	–0.018	0.035	0.025	0.075	4.9	2 500	2 500
W2809SA-3P-C5Z6	850	895	958	1 000	1 133	Ⅰ	–0.023	0.040	0.027	0.090	5.8	2 500	2 500
W2811SA-3P-C5Z6	1 050	1 095	1 158	1 200	1 333	Ⅰ	–0.028	0.046	0.030	0.120	6.6	2 500	2 500

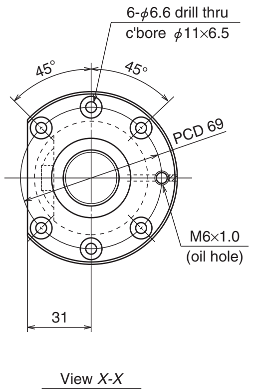
Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.
4. The maximum stroke is -2 mm when a Fixed-Fixed configuration is used with left shaft end shape Ⅰ.

Nut: ZFT

Screw shaft ø28

Lead 6





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		28 × 6 / Right
Preload / Ball recirculation		Z-preload / Tube
Ball dia. / Ball circle dia.		3.175 / 28.5
Screw shaft root diameter		25.2
Effective ball turns		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	20 600
	Static C_{0a}	48 700
Preload (N)		1 220
Standard dynamic friction torque (N·cm)		23.5
Spacer ball		None
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		9.5
Standard grease replenishment (cm³)		4.8

Recommended support unit

For drive side (Fixed)	**For non-drive side (Fixed)**	**For non-drive side (Simple)**
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

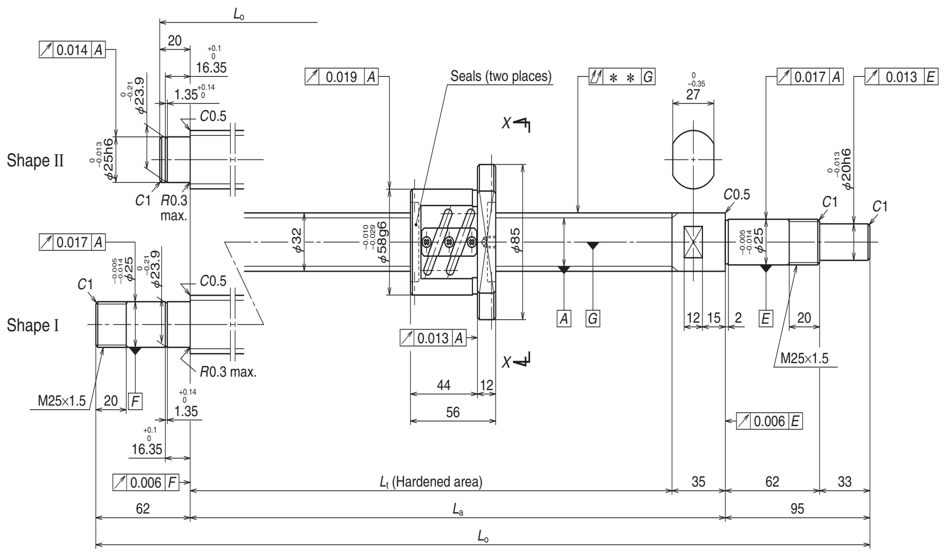
Unit: mm

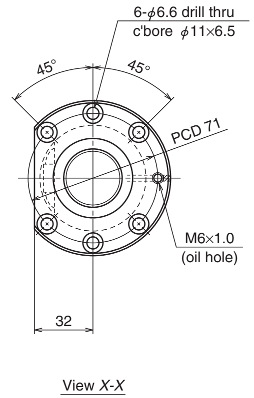
Reference No.	Stroke		Screw shaft length			Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})	
	Nominal	Maximum										Configuration	
			L_t	L_a	L_o		T	e_p	υ_u	↗		Fixed - Simple	Fixed - Fixed
W2803SA-4Z-C5Z6	250	265	370	400	499	II	–0.009	0.025	0.020	0.040	3.4	2 500	—
W2805SA-4Z-C5Z6	450	465	570	600	699	II	–0.014	0.030	0.023	0.060	4.3	2 500	—
W2807SA-4Z-C5Z6	650	659	758	800	933	I	–0.018	0.035	0.025	0.075	5.3	2 500	2 500
W2809SA-4Z-C5Z6	850	859	958	1 000	1 133	I	–0.023	0.040	0.027	0.090	6.2	2 500	2 500
W2811SA-4Z-C5Z6	1 050	1 059	1 158	1 200	1 333	I	–0.028	0.046	0.030	0.120	7.1	2 500	2 500

Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.
4. The maximum stroke is -2 mm when a Fixed-Fixed configuration is used with left shaft end shape I.

Screw shaft ø32

Lead 5





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		32 × 5 / Right
Preload / Ball recirculation		P-preload / Tube
Ball dia. / Ball circle dia.		3.175 / 32.5
Screw shaft root diameter		29.2
Effective ball turns		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	13 700
	Static C_{0a}	28 000
Preload (N)		590
Standard dynamic friction torque (N·cm)		11.8
Spacer ball		Yes
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		7.0
Standard grease replenishment (cm³)		3.5

Recommended support unit

For drive side	For non-drive side	
(Fixed)	(Fixed)	(Simple)
WBK25-01W (square)	WBK25-01W (square)	WBK25S-01W (square)
WBK25-11 (round)	WBK25-11 (round)	

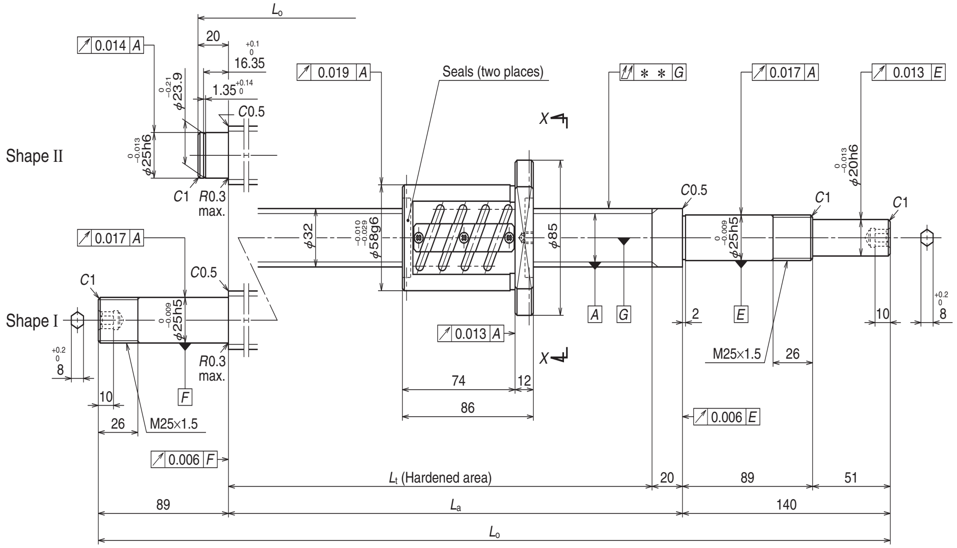
Unit: mm

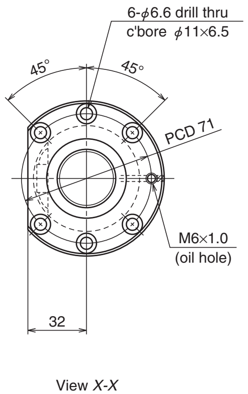
Reference No.	Stroke		Screw shaft length			Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)	
												Configuration	
	Nominal	Maximum	L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W3202SA-1P-C5Z5	150	201	265	300	415	II	–0.006	0.023	0.018	0.040	3.1	2 180	—
W3203SA-1P-C5Z5	250	301	365	400	515	II	–0.009	0.025	0.020	0.050	3.7	2 180	—
W3204SA-1P-C5Z5	350	401	465	500	615	II	–0.011	0.027	0.020	0.050	4.2	2 180	—
W3205SA-1P-C5Z5	450	501	565	600	715	II	–0.014	0.030	0.023	0.060	4.8	2 180	—
W3206SA-1P-C5Z5	550	601	665	700	857	I	–0.016	0.035	0.025	0.075	5.6	2 180	2 180
W3207SA-1P-C5Z5	650	701	765	800	957	I	–0.018	0.035	0.025	0.075	6.1	2 180	2 180
W3209SA-1P-C5Z5	850	901	965	1 000	1 157	I	–0.023	0.040	0.027	0.090	7.3	2 180	2 180
W3211SA-1P-C5Z5	1 050	1 101	1 165	1 200	1 357	I	–0.028	0.046	0.030	0.120	8.5	2 180	2 180
W3214SA-1P-C5Z5	1 350	1 401	1 465	1 500	1 657	I	–0.035	0.054	0.035	0.150	10.2	2 100	2 180

Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.
4. The maximum stroke is -9 mm when a Fixed-Fixed configuration is used with left shaft end shape I.

Screw shaft ø32

Lead 5





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. × Lead / Direction of turn		32 × 5 / Right
Preload / Ball recirculation		Z-preload / Tube
Ball dia. / Ball circle dia.		3.175 / 32.5
Screw shaft root diameter		29.2
Effective ball turns		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	21 800
	Static C_{0a}	56 000
Preload (N)		1 270
Standard dynamic friction torque (N·cm)		23.5
Spacer ball		None
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm^3)		10
Standard grease replenishment (cm^3)		5

Recommended support unit

For drive side, for non-drive side (Fixed)
WBK25DF-31H (round)

Unit: mm

Reference No.	Stroke		Screw shaft length			Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})	
	Nominal	Maximum										Configuration	
			L_t	L_a	L_o		T	e_p	υ_u	↗↗		Fixed - Simple	Fixed - Fixed
W3202SA-2Z-C5Z5	150	186	280	300	460	Ⅱ	–0.007	0.023	0.018	0.040	3.5	2 180	—
W3203SA-2Z-C5Z5	250	286	380	400	560	Ⅱ	–0.009	0.025	0.020	0.050	4.1	2 180	—
W3204SA-2Z-C5Z5	350	386	480	500	660	Ⅱ	–0.012	0.027	0.020	0.060	4.7	2 180	—
W3205SA-2Z-C5Z5	450	486	580	600	760	Ⅱ	–0.014	0.030	0.023	0.060	5.3	2 180	—
W3206SA-2Z-C5Z5	550	586	680	700	929	Ⅰ	–0.016	0.035	0.025	0.075	6.1	2 180	2 180
W3207SA-2Z-C5Z5	650	686	780	800	1 029	Ⅰ	–0.019	0.035	0.025	0.090	6.7	2 180	2 180
W3209SA-2Z-C5Z5	850	886	980	1 000	1 229	Ⅰ	–0.024	0.040	0.027	0.090	7.9	2 180	2 180
W3211SA-2Z-C5Z5	1 050	1 086	1 180	1 200	1 429	Ⅰ	–0.028	0.046	0.030	0.120	9.0	2 180	2 180
W3214SA-2Z-C5Z5	1 350	1 386	1 480	1 500	1 729	Ⅰ	–0.036	0.054	0.035	0.150	10.8	2 100	2 180

Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed N will be exceeded.
4. The maximum stroke is -9 mm when a Fixed-Fixed configuration is used with left shaft end shape Ⅰ.

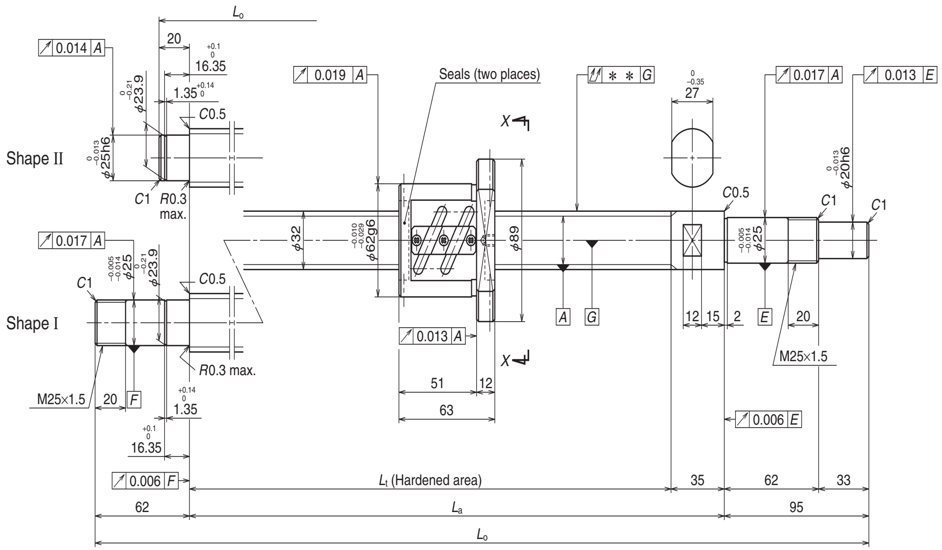
Finished Shaft End SA Model (Fine lead)

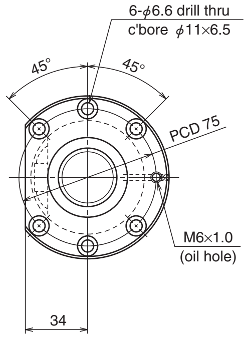
Nut: PFT

NSK

Screw shaft ø32

Lead 6





View *X-X*

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		32 × 6 / Right
Preload / Ball recirculation		P-preload / Tube
Ball dia. / Ball circle dia.		3.969 / 32.5
Screw shaft root diameter		28.4
Effective ball turns		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	18 300
	Static C_{0a}	34 700
Preload (N)		780
Standard dynamic friction torque (N·cm)		15.7
Spacer ball		Yes
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		9.5
Standard grease replenishment (cm³)		4.8

Recommended support unit

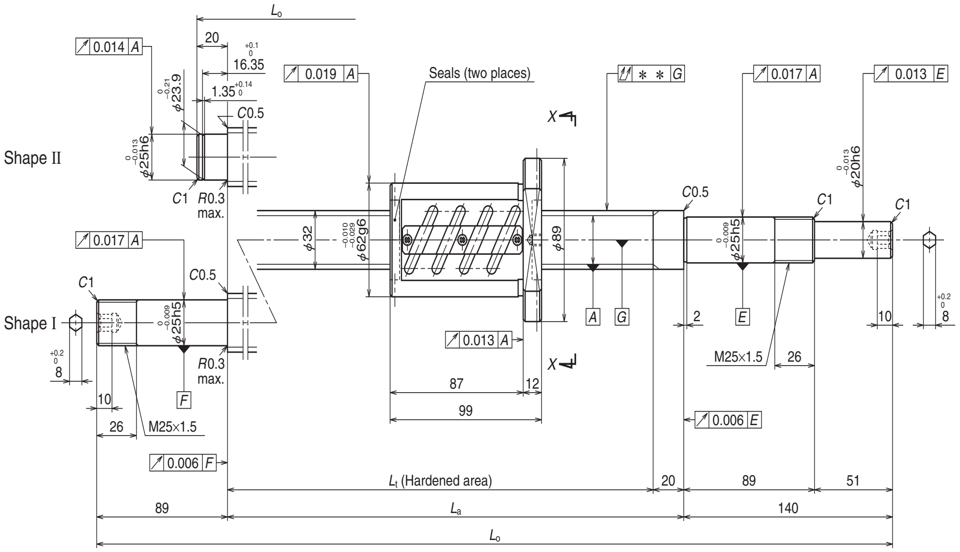
For drive side	**For non-drive side**	
(Fixed)	**(Fixed)**	**(Simple)**
WBK25-01W (square)	WBK25-01W (square)	WBK25S-01W (square)
WBK25-11 (round)	WBK25-11 (round)	

Unit: mm

Reference No.	Stroke		Screw shaft length			Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed *N* (min⁻¹)	
	Nominal	Maximum	L_t	L_a	L_o		T	e_p	υ_u			Configuration	
												Fixed - Simple	Fixed - Fixed
W3203SA-3P-C5Z6	250	294	365	400	515	II	–0.009	0.025	0.020	0.050	3.8	2 180	—
W3205SA-3P-C5Z6	450	494	565	600	715	II	–0.014	0.030	0.023	0.060	5.0	2 180	—
W3207SA-3P-C5Z6	650	694	765	800	957	I	–0.018	0.035	0.025	0.075	6.3	2 180	2 180
W3209SA-3P-C5Z6	850	894	965	1 000	1 157	I	–0.023	0.040	0.027	0.090	7.4	2 180	2 180
W3211SA-3P-C5Z6	1 050	1 094	1 165	1 200	1 357	I	–0.028	0.046	0.030	0.120	8.5	2 180	2 180
W3214SA-3P-C5Z6	1 350	1 394	1 465	1 500	1 657	I	–0.035	0.054	0.035	0.150	10.2	2 050	2 180

Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.
4. The maximum stroke is -9 mm when a Fixed-Fixed configuration is used with left shaft end shape I.

Finished Shaft End SA Model (Fine lead)



Reference No.	Stroke		Screw shaft length		
	Nominal	Maximum	L_t	L_a	L_o
W3203SA-4Z-C5Z6	250	273	380	400	560
W3205SA-4Z-C5Z6	450	473	580	600	760
W3207SA-4Z-C5Z6	650	673	780	800	1 029
W3209SA-4Z-C5Z6	850	873	980	1 000	1 229
W3211SA-4Z-C5Z6	1 050	1 073	1 180	1 200	1 429
W3214SA-4Z-C5Z6	1 350	1 373	1 480	1 500	1 729

Notes: 1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

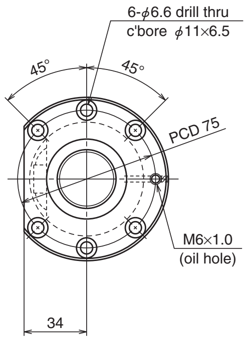
Nut: ZFT

NSK

Screw shaft ø32

Lead 6

Unit: mm



View *X-X*

Ball screw specifications		
Shaft dia. × Lead / Direction of turn		32 × 6 / Right
Preload / Ball recirculation		Z-preload / Tube
Ball dia. / Ball circle dia.		3.969 / 32.5
Screw shaft root diameter		28.4
Effective ball turns		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	29 100
	Static C_{0a}	69 300
Preload (N)		1 710
Standard dynamic friction torque (N·cm)		35.0
Spacer ball		None
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		14
Standard grease replenishment (cm³)		7

Recommended support unit

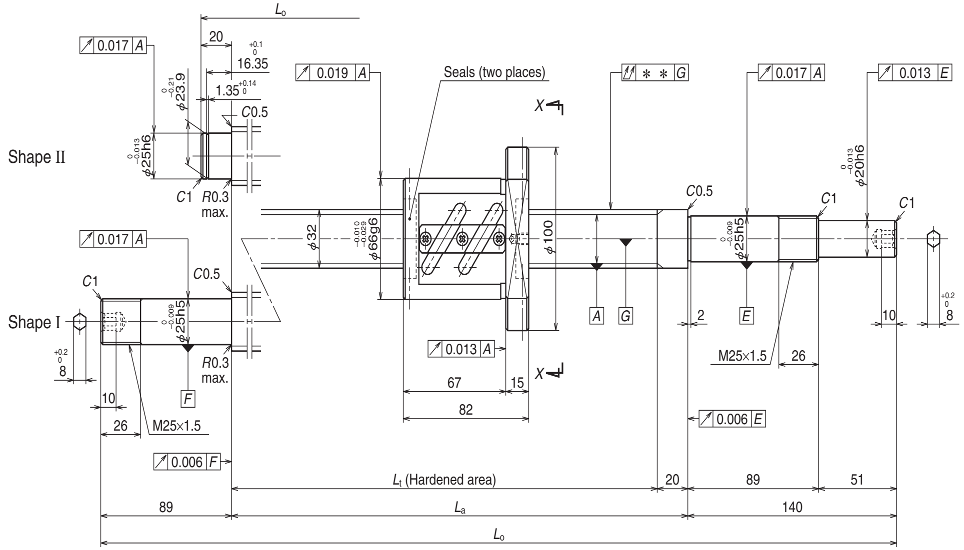
For drive side, for non-drive side (Fixed)
WBK25DF-31H (round)

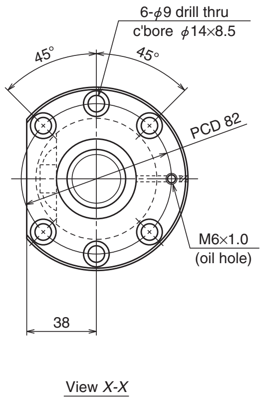
Unit: mm

Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed *N* (min⁻¹)	
						Configuration	
	T	e_p	υ_u	↗↗		Fixed - Simple	Fixed - Fixed
Ⅱ	–0.009	0.025	0.020	0.050	4.5	2 180	—
Ⅱ	–0.014	0.030	0.023	0.060	5.6	2 180	—
Ⅰ	–0.019	0.035	0.025	0.090	7.0	2 180	2 180
Ⅰ	–0.024	0.040	0.027	0.090	8.1	2 180	2 180
Ⅰ	–0.028	0.046	0.030	0.120	9.3	2 180	2 180
Ⅰ	–0.036	0.054	0.035	0.150	11.0	2 060	2 180

Screw shaft ø32

Lead 8





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		32 × 8 / Right
Preload / Ball recirculation		Z-preload / Tube
Ball dia. / Ball circle dia.		4.762 / 32.5
Screw shaft root diameter		27.5
Effective ball turns		2.5 × 1
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	20 600
	Static C_{0a}	40 900
Preload (N)		1 320
Standard dynamic friction torque (N·cm)		31.0
Spacer ball		None
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm^3)		13
Standard grease replenishment (cm^3)		6.5

Recommended support unit

For drive side, for non-drive side (Fixed)
WBK25DF-31H (round)

Unit: mm

Reference No.	Stroke		Screw shaft length			Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})	
												Configuration	
	Nominal	Maximum	L_t	L_a	L_o		T	e_p	υ_u	⌰		Fixed - Simple	Fixed - Fixed
W3203SA-5Z-C5Z8	250	290	380	400	560	II	–0.009	0.025	0.020	0.050	4.7	2 180	—
W3205SA-5Z-C5Z8	450	490	580	600	760	II	–0.014	0.030	0.023	0.060	5.8	2 180	—
W3207SA-5Z-C5Z8	650	690	780	800	1 029	I	–0.019	0.035	0.025	0.090	7.2	2 180	2 180
W3209SA-5Z-C5Z8	850	890	980	1 000	1 229	I	–0.024	0.040	0.027	0.090	8.3	2 180	2 180
W3214SA-5Z-C5Z8	1 350	1 390	1 480	1 500	1 729	I	–0.036	0.054	0.035	0.150	11.1	1 960	2 180

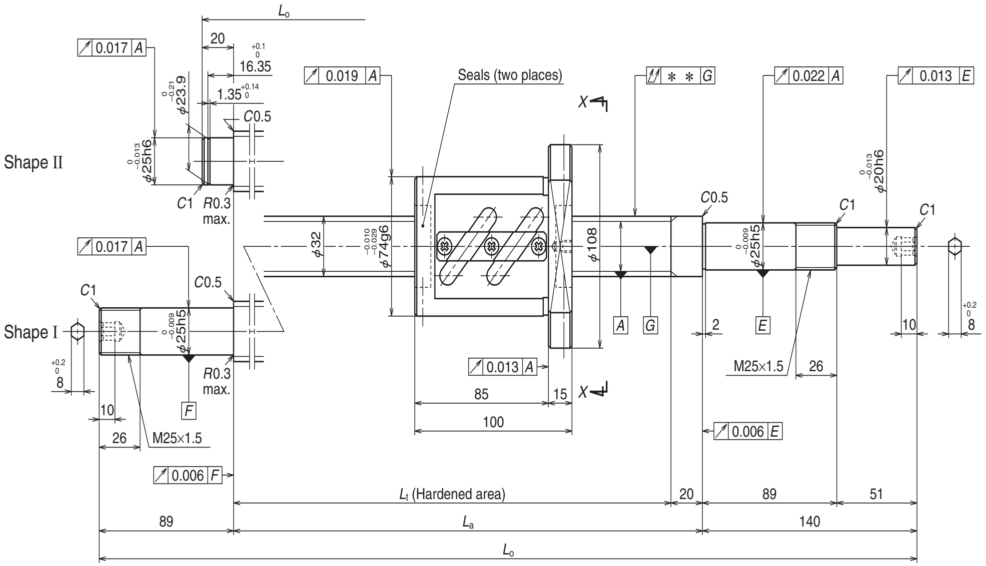
Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

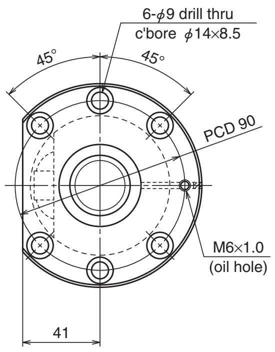
Finished Shaft End SA Model (Fine lead)

Nut: ZFT

Screw shaft ø32

Lead 10





View *X-X*

Unit: mm

Ball screw specifications	
Shaft dia. x Lead / Direction of turn	32 × 10 / Right
Preload / Ball recirculation	Z-preload / Tube
Ball dia. / Ball circle dia.	6.35 / 33
Screw shaft root diameter	26.4
Effective ball turns	2.5 × 1
Accuracy grade / Preload	C5 / Z
Basic load ratings (N) Dynamic C_a	30 000
Basic load ratings (N) Static C_{0a}	55 100
Preload (N)	1 960
Standard dynamic friction torque (N·cm)	54.0
Spacer ball	None
Factory-packed grease	**Refer to Note 2.**
Nut internal space (cm^3)	22
Standard grease replenishment (cm^3)	11

Recommended support unit

For drive side, for non-drive side (Fixed)
WBK25DF-31H (round)

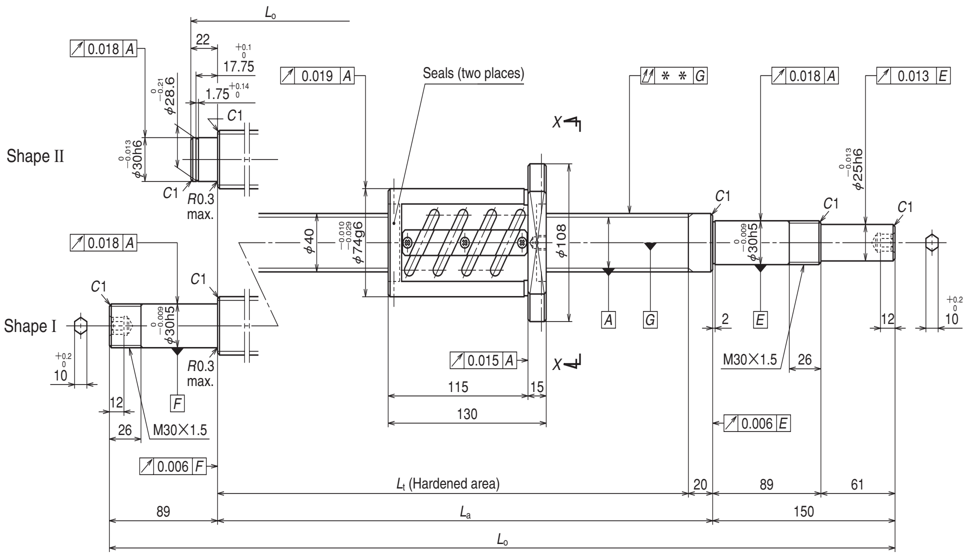
Unit: mm

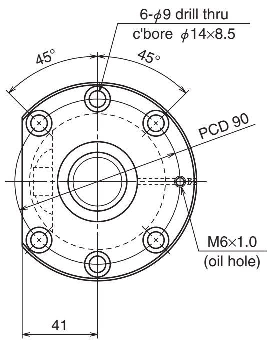
Reference No.	Stroke		Screw shaft length			Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})	
												Configuration	
	Nominal	Maximum	L_t	L_a	L_o		T	e_p	υ_u	↗		Fixed - Simple	Fixed - Fixed
W3203SA-6Z-C5Z10	250	272	380	400	560	Ⅱ	–0.009	0.025	0.020	0.050	5.5	2 180	—
W3204SA-3Z-C5Z10	350	372	480	500	660	Ⅱ	–0.012	0.027	0.020	0.060	6.0	2 180	—
W3205SA-6Z-C5Z10	450	472	580	600	760	Ⅱ	–0.014	0.030	0.023	0.060	6.6	2 180	—
W3206SA-3Z-C5Z10	550	572	680	700	929	Ⅰ	–0.016	0.035	0.025	0.075	7.4	2 180	2 180
W3207SA-6Z-C5Z10	650	672	780	800	1 029	Ⅰ	–0.019	0.035	0.025	0.090	7.9	2 180	2 180
W3209SA-6Z-C5Z10	850	872	980	1 000	1 229	Ⅰ	–0.024	0.040	0.027	0.090	9.0	2 180	2 180
W3211SA-5Z-C5Z10	1 050	1 072	1 180	1 200	1 429	Ⅰ	–0.028	0.046	0.030	0.120	10.1	2 180	2 180
W3214SA-6Z-C5Z10	1 350	1 372	1 480	1 500	1 729	Ⅰ	–0.036	0.054	0.035	0.150	11.7	1 920	2 180
W3217SA-1Z-C5Z10	1 650	1 672	1 780	1 800	2 029	Ⅰ	–0.043	0.065	0.040	0.200	13.3	1 310	1 810

Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Screw shaft ø32

Lead 10





View *X-X*

Unit: mm

Ball screw specifications		
Shaft dia. × Lead / Direction of turn		32 × 10 / Right
Preload / Ball recirculation		Z-preload / Tube
Ball dia. / Ball circle dia.		6.35 / 33
Screw shaft root diameter		26.4
Effective ball turns		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	54 500
	Static C_{0a}	110 000
Preload (N)		2 320
Standard dynamic friction torque (N·cm)		59.0
Spacer ball		None
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm^3)		44
Standard grease replenishment (cm^3)		22

Recommended support unit

For drive side, for non-drive side (Fixed)
WBK25DFD-31H (round)

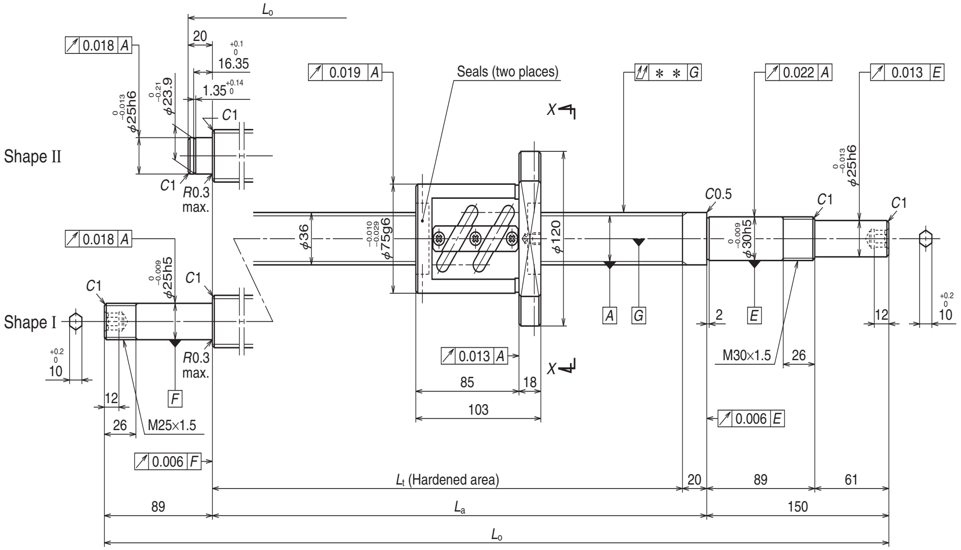
Unit: mm

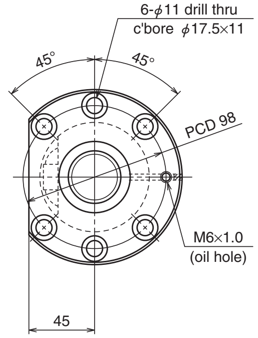
Reference No.	Stroke		Screw shaft length			Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})	
												Configuration	
	Nominal	Maximum	L_t	L_a	L_o		T	e_p	υ_u	↗		Fixed - Simple	Fixed - Fixed
W3203SA-8Z-C5Z10	150	182	380	400	575	Ⅱ	–0.009	0.025	0.020	0.050	7.5	2 180	—
W3204SA-5Z-C5Z10	250	282	480	500	675	Ⅱ	–0.012	0.027	0.020	0.060	8.1	2 180	—
W3205SA-8Z-C5Z10	350	382	580	600	775	Ⅱ	–0.014	0.030	0.023	0.060	8.6	2 180	—
W3206SA-5Z-C5Z10	450	482	680	700	959	Ⅰ	–0.016	0.035	0.025	0.075	9.5	2 180	2 180
W3207SA-8Z-C5Z10	550	582	780	800	1 059	Ⅰ	–0.019	0.035	0.025	0.090	10.0	2 180	2 180
W3209SA-8Z-C5Z10	750	782	980	1 000	1 259	Ⅰ	–0.024	0.040	0.027	0.120	11.1	2 180	2 180
W3211SA-7Z-C5Z10	950	982	1 180	1 200	1 459	Ⅰ	–0.028	0.046	0.030	0.120	12.2	2 180	2 180
W3214SA-8Z-C5Z10	1 250	1 282	1 480	1 500	1 759	Ⅰ	–0.036	0.054	0.035	0.150	13.8	2 050	2 180
W3217SA-3Z-C5Z10	1 550	1 582	1 780	1 800	2 059	Ⅰ	–0.043	0.065	0.040	0.200	15.4	1 380	1 910

Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Screw shaft ø36

Lead 10





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. × Lead / Direction of turn		36 × 10 / Right
Preload / Ball recirculation		Z-preload / Tube
Ball dia. / Ball circle dia.		6.35 / 37
Screw shaft root diameter		30.4
Effective ball turns		2.5 × 1
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	32 000
	Static C_{0a}	61 100
Preload (N)		2 060
Standard dynamic friction torque (N·cm)		59.0
Spacer ball		None
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		27
Standard grease replenishment (cm³)		16

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK30DF-31H (round)	WBK25DF-31H (round)

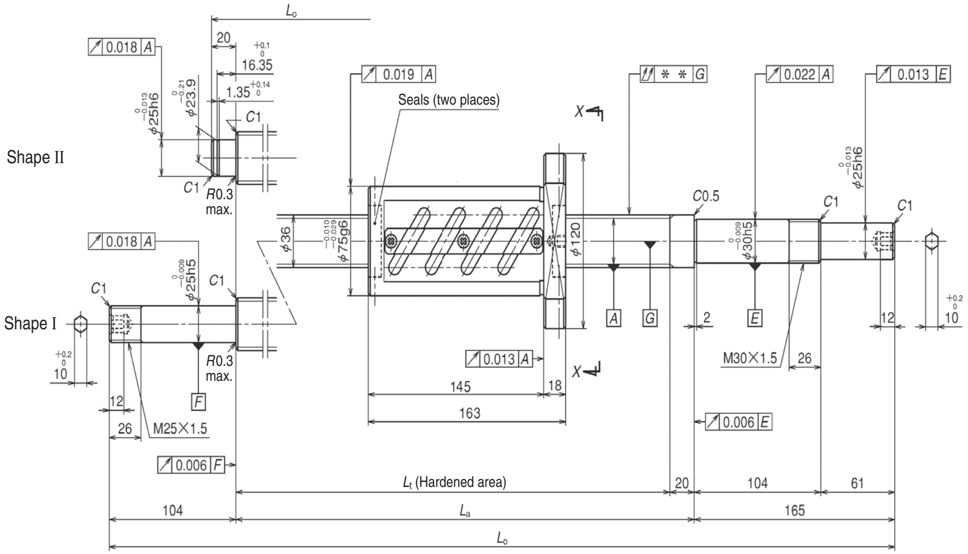
Unit: mm

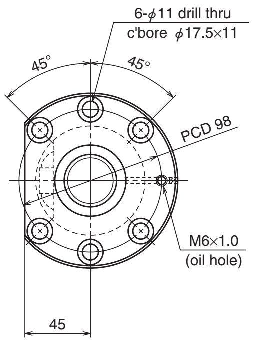
Reference No.	Stroke		Screw shaft length			Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)	
												Configuration	
	Nominal	Maximum	L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W3604SA-1Z-C5Z10	350	370	480	500	670	II	–0.012	0.027	0.020	0.040	7.4	1 940	—
W3606SA-1Z-C5Z10	550	570	680	700	870	II	–0.016	0.035	0.025	0.050	8.8	1 940	—
W3609SA-1Z-C5Z10	850	870	980	1 000	1 239	I	–0.024	0.040	0.027	0.065	11.1	1 940	1 940
W3613SA-1Z-C5Z10	1 250	1 270	1 380	1 400	1 639	I	–0.033	0.054	0.035	0.100	13.9	1 940	1 940
W3617SA-1Z-C5Z10	1 650	1 670	1 780	1 800	2 039	I	–0.043	0.065	0.040	0.130	16.6	1 510	1 940

Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Screw shaft ø36

Lead 10





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. × Lead / Direction of turn		36 × 10 / Right
Preload / Ball recirculation		Z-preload / Tube
Ball dia. / Ball circle dia.		6.35 / 37
Screw shaft root diameter		30.4
Effective ball turns		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	58 000
	Static C_{0a}	122 000
Preload (N)		2 470
Standard dynamic friction torque (N·cm)		67.0
Spacer ball		None
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		64
Standard grease replenishment (cm³)		27

Recommended support unit

For drive side (Fixed)	For non-drive side (Fixed)
WBK30DFD-31H (round)	WBK25DFD-31H (round)

Unit: mm

Reference No.	Stroke		Screw shaft length			Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)	
												Configuration	
	Nominal	Maximum	L_t	L_a	L_o		T	e_p	υ_u	↗↗		Fixed - Simple	Fixed - Fixed
W3604SA-3Z-C5Z10	250	280	480	500	685	II	–0.012	0.027	0.020	0.040	9.3	1 940	—
W3606SA-3Z-C5Z10	450	480	680	700	885	II	–0.016	0.035	0.025	0.050	10.7	1 940	—
W3609SA-3Z-C5Z10	750	780	980	1 000	1 269	I	–0.024	0.040	0.027	0.080	13.1	1 940	1 940
W3613SA-3Z-C5Z10	1 150	1 180	1 380	1 400	1 669	I	–0.033	0.054	0.035	0.100	15.9	1 940	1 940
W3617SA-3Z-C5Z10	1 550	1 580	1 780	1 800	2 069	I	–0.043	0.065	0.040	0.130	18.6	1 600	1 940

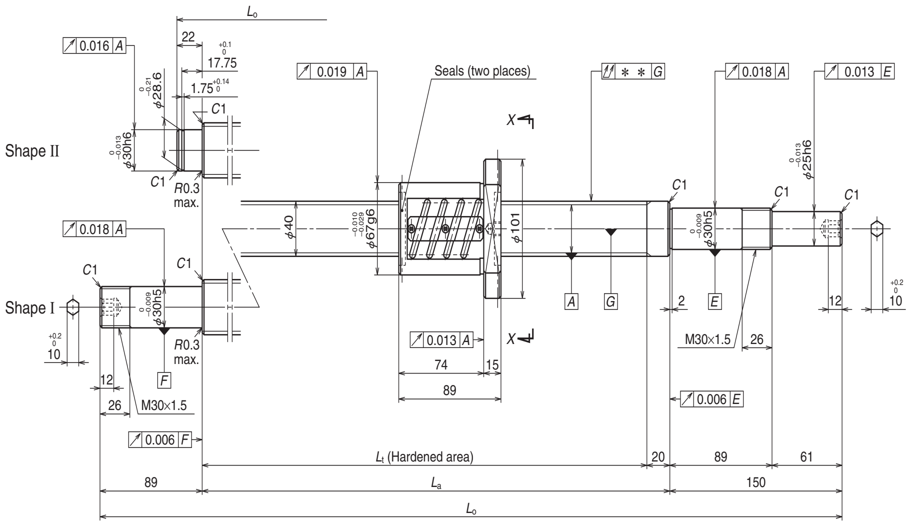
Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed N will be exceeded.

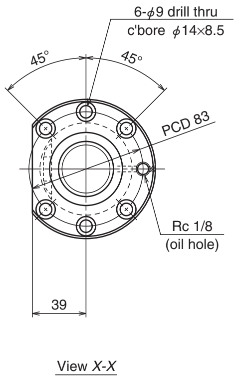
Finished Shaft End SA Model (Fine lead)

Nut: ZFT

Screw shaft ø40

Lead 5





View X-X

Unit: mm

Ball screw specifications	
Shaft dia. x Lead / Direction of turn	40 × 5 / Right
Preload / Ball recirculation	Z-preload / Tube
Ball dia. / Ball circle dia.	3.175 / 40.5
Screw shaft root diameter	37.2
Effective ball turns	2.5 × 2
Accuracy grade / Preload	C5 / Z
Basic load ratings (N) Dynamic C_a	23 900
Basic load ratings (N) Static C_{0a}	70 500
Preload (N)	1 420
Standard dynamic friction torque (N·cm)	29.5
Spacer ball	None
Factory-packed grease	**Refer to Note 2.**
Nut internal space (cm³)	14
Standard grease replenishment (cm³)	7

Recommended support unit

For drive side, for non-drive side (Fixed)
WBK30DF-31H (round)

Unit: mm

Reference No.	Stroke		Screw shaft length			Left shaft end shape	Lead accuracy			Shaft run-out ∗∗	Mass (kg)	Permissible rotational speed N (min⁻¹)	
	Nominal	Maximum	L_t	L_a	L_o		T	e_p	υ_u			Configuration: Fixed - Simple	Fixed - Fixed
W4003SA-1Z-C5Z5	250	284	380	400	572	II	–0.009	0.025	0.020	0.035	6.3	1 750	—
W4005SA-1Z-C5Z5	450	484	580	600	772	II	–0.014	0.030	0.023	0.040	8.1	1 750	—
W4007SA-1Z-C5Z5	650	684	780	800	1 039	I	–0.019	0.035	0.025	0.065	10.3	1 750	1 750
W4009SA-1Z-C5Z5	850	884	980	1 000	1 239	I	–0.024	0.040	0.027	0.065	12.2	1 750	1 750
W4011SA-1Z-C5Z5	1 050	1 084	1 180	1 200	1 439	I	–0.028	0.046	0.030	0.080	14.0	1 750	1 750
W4015SA-1Z-C5Z5	1 450	1 484	1 580	1 600	1 839	I	–0.038	0.054	0.035	0.100	17.7	1 750	1 750

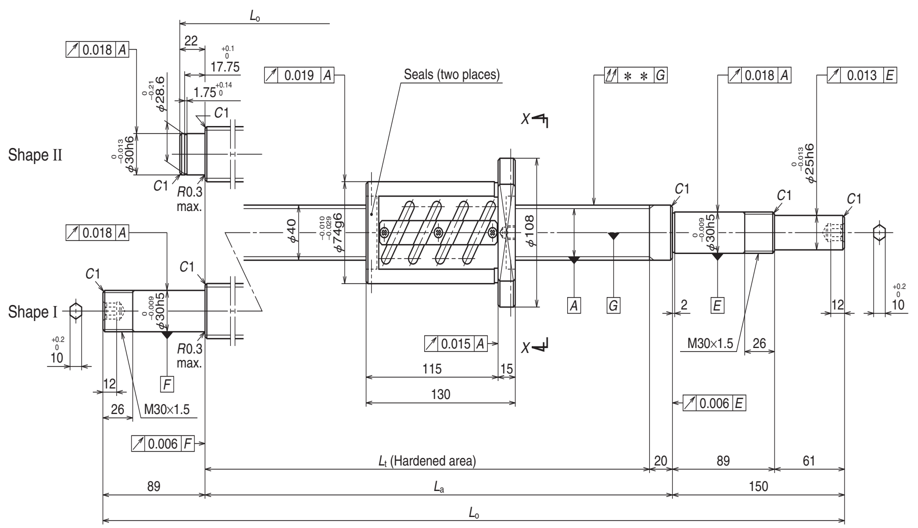
Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed N will be exceeded.

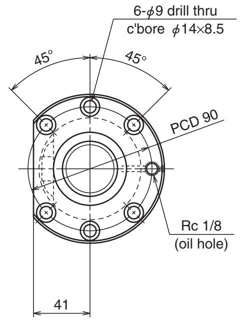
Finished Shaft End SA Model (Fine lead)

Nut: ZFT

Screw shaft ø40

Lead 8





View X-X

Unit: mm

Ball screw specifications

Shaft dia. x Lead / Direction of turn		40 × 8 / Right
Preload / Ball recirculation		Z-preload / Tube
Ball dia. / Ball circle dia.		4.762 / 40.5
Screw shaft root diameter		35.5
Effective ball turns		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	41 100
	Static C_{0a}	103 000
Preload (N)		2 450
Standard dynamic friction torque (N·cm)		64.0
Spacer ball		None
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		27
Standard grease replenishment (cm³)		14

Recommended support unit

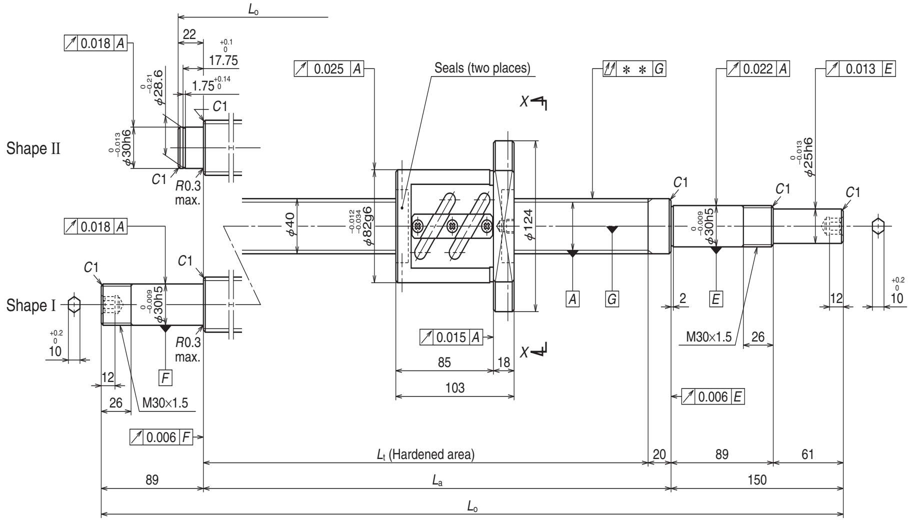
For drive side, for non-drive side (Fixed)
WBK30DF-31H (round)

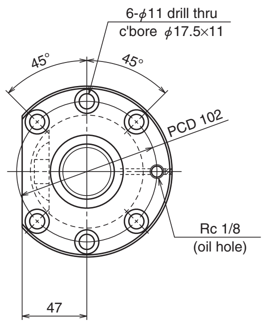
Unit: mm

Reference No.	Stroke		Screw shaft length			Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed *N* (min⁻¹)	
	Nominal	Maximum	L_t	L_a	L_o		*T*	e_p	υ_u			Configuration	
												Fixed - Simple	Fixed - Fixed
W4003SA-2Z-C5Z8	200	243	380	400	572	II	–0.009	0.025	0.020	0.035	7.4	1 750	—
W4005SA-2Z-C5Z8	400	443	580	600	772	II	–0.014	0.030	0.023	0.040	9.2	1 750	—
W4007SA-2Z-C5Z8	600	643	780	800	1 039	I	–0.019	0.035	0.025	0.065	11.3	1 750	1 750
W4009SA-2Z-C5Z8	800	843	980	1 000	1 239	I	–0.024	0.040	0.027	0.065	13.1	1 750	1 750
W4011SA-2Z-C5Z8	1 000	1 043	1 180	1 200	1 439	I	–0.028	0.046	0.030	0.080	14.9	1 750	1 750
W4015SA-2Z-C5Z8	1 400	1 443	1 580	1 600	1 839	I	–0.038	0.054	0.035	0.100	18.5	1 750	1 750

Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Screw shaft ø40
Lead 10





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		40 × 10 / Right
Preload / Ball recirculation		Z-preload / Tube
Ball dia. / Ball circle dia.		6.35 / 41
Screw shaft root diameter		34.4
Effective ball turns		2.5 × 1
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	33 700
	Static C_{0a}	68 300
Preload (N)		2 160
Standard dynamic friction torque (N·cm)		64.0
Spacer ball		None
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		30
Standard grease replenishment (cm³)		15

Recommended support unit

For drive side, for non-drive side (Fixed)
WBK30DF-31H (round)

Unit: mm

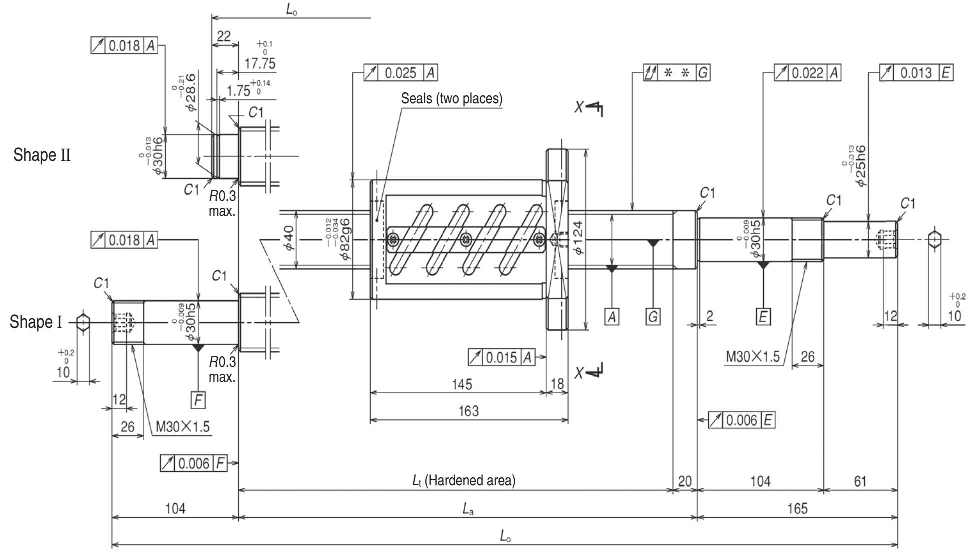
Reference No.	Stroke		Screw shaft length			Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)	
	Nominal	Maximum	L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W4004SA-1Z-C5Z10	350	370	480	500	672	II	−0.012	0.027	0.020	0.040	8.7	1 750	—
W4005SA-3Z-C5Z10	450	470	580	600	772	II	−0.014	0.030	0.023	0.040	9.6	1 750	—
W4006SA-1Z-C5Z10	550	570	680	700	872	II	−0.016	0.035	0.025	0.050	10.4	1 750	—
W4007SA-3Z-C5Z10	650	670	780	800	1 039	I	−0.019	0.035	0.025	0.065	11.7	1 750	1 750
W4009SA-3Z-C5Z10	850	870	980	1 000	1 239	I	−0.024	0.040	0.027	0.065	13.4	1 750	1 750
W4011SA-3Z-C5Z10	1 050	1 070	1 180	1 200	1 439	I	−0.028	0.046	0.030	0.080	15.1	1 750	1 750
W4013SA-1Z-C5Z10	1 250	1 270	1 380	1 400	1 639	I	−0.033	0.054	0.035	0.100	16.9	1 750	1 750
W4015SA-3Z-C5Z10	1 450	1 470	1 580	1 600	1 839	I	−0.038	0.054	0.035	0.100	18.6	1 750	1 750
W4017SA-1Z-C5Z10	1 650	1 670	1 780	1 800	2 039	I	−0.043	0.065	0.040	0.130	20.3	1 710	1 750
W4023SA-1Z-C5Z10	2 250	2 270	2 380	2 400	2 639	I	−0.057	0.077	0.046	0.170	25.5	940	1 320

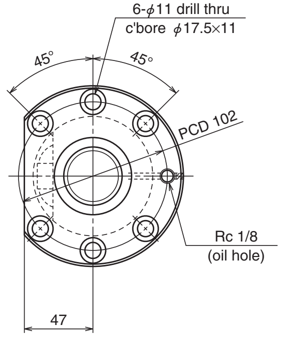
Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed N will be exceeded.

Screw shaft ø40

Lead 10

Unit: mm





View *X-X*

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		40 × 10 / Right
Preload / Ball recirculation		Z-preload / Tube
Ball dia. / Ball circle dia.		6.35 / 41
Screw shaft root diameter		34.4
Effective ball turns		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	61 200
	Static C_{0a}	137 000
Preload (N)		2 600
Standard dynamic friction torque (N·cm)		74.0
Spacer ball		None
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		59
Standard grease replenishment (cm³)		30

Recommended support unit

For drive side, for non-drive side (Fixed)
WBK30DFD-31H (round)

Unit: mm

Reference No.	Stroke		Screw shaft length			Left shaft end shape	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)	
												Configuration	
	Nominal	Maximum	L_t	L_a	L_o		T	e_p	υ_u	⌰		Fixed - Simple	Fixed - Fixed
W4004SA-3Z-C5Z10	250	280	480	500	687	Ⅱ	–0.012	0.027	0.020	0.040	11.0	1 750	—
W4005SA-5Z-C5Z10	350	380	580	600	787	Ⅱ	–0.014	0.030	0.023	0.040	11.9	1 750	—
W4006SA-5Z-C5Z10	450	480	680	700	887	Ⅱ	–0.016	0.035	0.025	0.050	12.7	1 750	—
W4007SA-5Z-C5Z10	550	580	780	800	1 069	Ⅰ	–0.019	0.035	0.025	0.065	14.1	1 750	1 750
W4009SA-7Z-C5Z10	750	780	980	1 000	1 269	Ⅰ	–0.024	0.040	0.027	0.080	15.8	1 750	1 750
W4011SA-5Z-C5Z10	950	980	1 180	1 200	1 469	Ⅰ	–0.028	0.046	0.030	0.080	17.5	1 750	1 750
W4013SA-5Z-C5Z10	1 150	1 180	1 380	1 400	1 669	Ⅰ	–0.033	0.054	0.035	0.100	19.3	1 750	1 750
W4015SA-5Z-C5Z10	1 350	1 380	1 580	1 600	1 869	Ⅰ	–0.038	0.054	0.035	0.100	21.0	1 750	1 750
W4017SA-5Z-C5Z10	1 550	1 580	1 780	1 800	2 069	Ⅰ	–0.043	0.065	0.040	0.130	22.7	1 750	1 750
W4023SA-3Z-C5Z10	2 150	2 180	2 380	2 400	2 669	Ⅰ	–0.057	0.077	0.046	0.170	27.9	980	1 370

Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

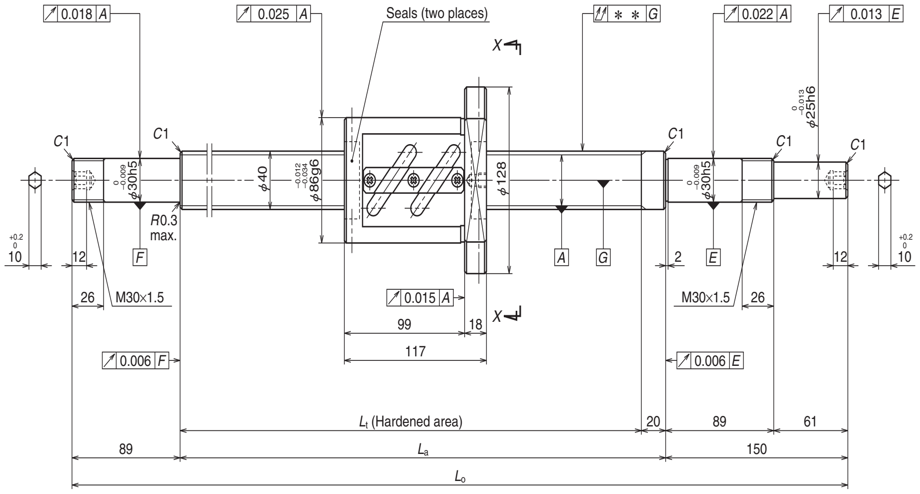
Finished Shaft End SA Model (Fine lead)

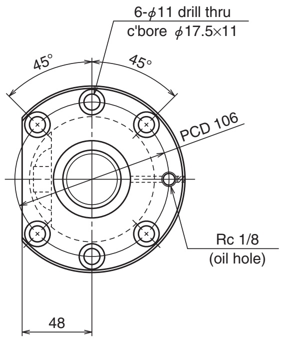
Nut: ZFT

NSK

Screw shaft ø40

Lead 12





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. × Lead / Direction of turn		40 × 12 / Right
Preload / Ball recirculation		Z-preload / Tube
Ball dia. / Ball circle dia.		7.144 / 41.5
Screw shaft root diameter		34.1
Effective ball turns		2.5 × 1
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	39 500
	Static C_{0a}	77 200
Preload (N)		2 550
Standard dynamic friction torque (N·cm)		83.0
Spacer ball		None
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		33
Standard grease replenishment (cm³)		17

Recommended support unit

For drive side, for non-drive side (Fixed)
WBK30DF-31H (round)

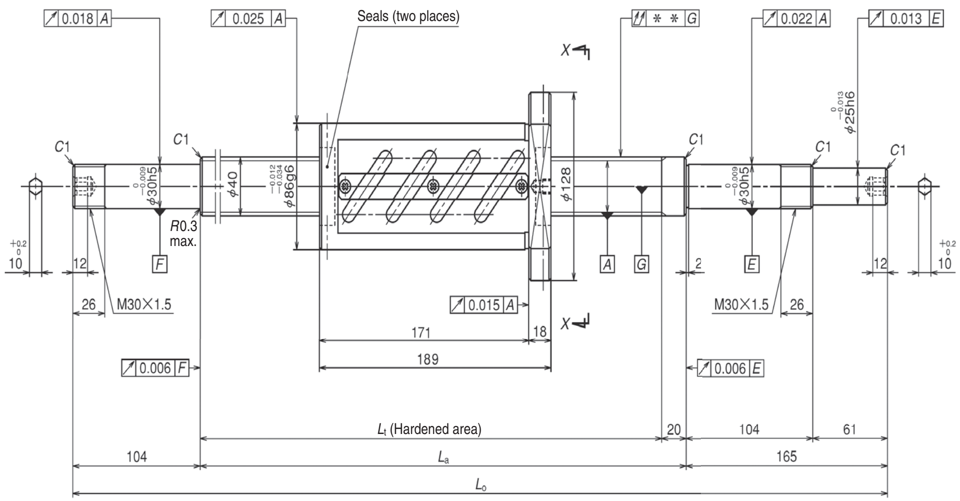
Unit: mm

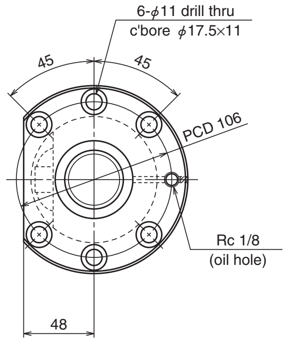
Reference No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})	
	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Configuration	
											Fixed - Simple	Fixed - Fixed
W4006SA-3Z-C5Z12	500	556	680	700	939	–0.016	0.035	0.025	0.050	11.6	1 750	1 750
W4009SA-5Z-C5Z12	800	856	980	1 000	1 239	–0.024	0.040	0.027	0.065	14.2	1 750	1 750
W4013SA-3Z-C5Z12	1 200	1 256	1 380	1 400	1 639	–0.033	0.054	0.035	0.100	17.7	1 750	1 750
W4017SA-3Z-C5Z12	1 600	1 656	1 780	1 800	2 039	–0.043	0.065	0.040	0.130	21.2	1 710	1 750
W4024SA-1Z-C5Z12	2 300	2 356	2 480	2 500	2 739	–0.060	0.077	0.046	0.170	27.2	870	1 210

Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed N will be exceeded.

Screw shaft ø40

Lead 12





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		40 × 12 / Right
Preload / Ball recirculation		Z-preload / Tube
Ball dia. / Ball circle dia.		7.144 / 41.5
Screw shaft root diameter		34.1
Effective ball turns		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	71 700
	Static C_{0a}	154 000
Preload (N)		3 050
Standard dynamic friction torque (N·cm)		96.0
Spacer ball		None
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		76
Standard grease replenishment (cm³)		38

Recommended support unit

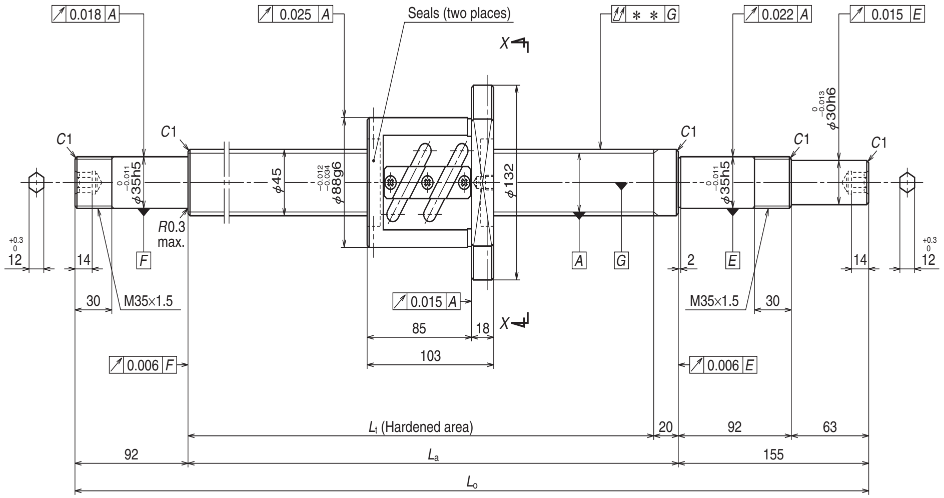
For drive side, for non-drive side (Fixed)
WBK30DFD-31H (round)

Unit: mm

Reference No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed *N* (min⁻¹)	
											Configuration	
	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W4006SA-6Z-C5Z12	400	448	680	700	969	–0.016	0.035	0.025	0.050	14.8	1 750	1 750
W4009SA-8Z-C5Z12	700	748	980	1 000	1 269	–0.024	0.040	0.027	0.080	17.4	1 750	1 750
W4013SA-6Z-C5Z12	1 100	1 148	1 380	1 400	1 669	–0.033	0.054	0.035	0.100	20.9	1 750	1 750
W4017SA-6Z-C5Z12	1 500	1 548	1 780	1 800	2 069	–0.043	0.065	0.040	0.130	24.3	1 750	1 750
W4024SA-3Z-C5Z12	2 200	2 248	2 480	2 500	2 769	–0.060	0.077	0.046	0.170	30.4	910	1 270

Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Finished Shaft End SA Model (Fine lead)

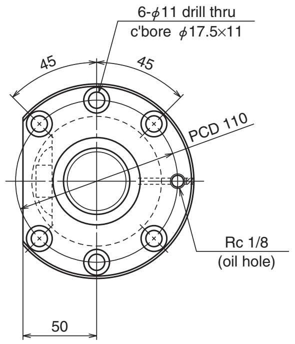


Nut: ZFT

NSK

Screw shaft ø45

Lead 10



View *X-X*

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		45 × 10 / Right
Preload / Ball recirculation		Z-preload / Tube
Ball dia. / Ball circle dia.		6.35 / 46
Screw shaft root diameter		39.4
Effective ball turns		2.5 × 1
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	36 300
	Static C_{0a}	78 500
Preload (N)		2 260
Standard dynamic friction torque (N·cm)		69.0
Spacer ball		None
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		33
Standard grease replenishment (cm³)		17

Recommended support unit

For drive side, for non-drive side (Fixed)
WBK35DF-31H (round)

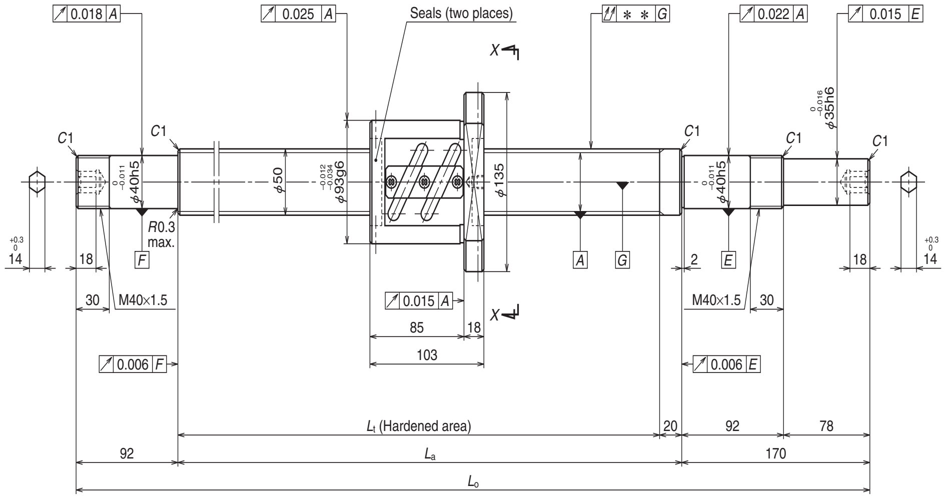
Unit: mm

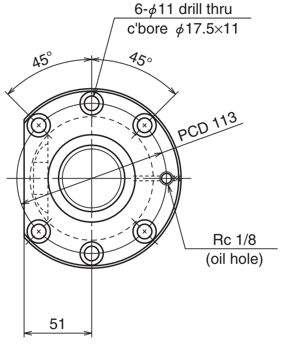
Reference No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)	
	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Configuration	
											Fixed - Simple	Fixed - Fixed
W4506SA-1Z-C5Z10	550	568	680	700	947	–0.016	0.035	0.025	0.050	13.4	1 550	1 550
W4509SA-1Z-C5Z10	850	868	980	1 000	1 247	–0.024	0.040	0.027	0.065	16.7	1 550	1 550
W4513SA-1Z-C5Z10	1 250	1 268	1 380	1 400	1 647	–0.033	0.054	0.035	0.100	21.2	1 550	1 550
W4517SA-1Z-C5Z10	1 650	1 668	1 780	1 800	2 047	–0.043	0.065	0.040	0.130	25.6	1 550	1 550
W4524SA-1Z-C5Z10	2 350	2 368	2 480	2 500	2 747	–0.060	0.077	0.046	0.170	33.4	990	1 390

Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Screw shaft ø50

Lead 10





View *X-X*

Unit: mm

Ball screw specifications		
Shaft dia. × Lead / Direction of turn		50 × 10 / Right
Preload / Ball recirculation		Z-preload / Tube
Ball dia. / Ball circle dia.		6.35 / 51
Screw shaft root diameter		44.4
Effective ball turns		2.5 × 1
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	37 500
	Static C_{0a}	87 200
Preload (N)		2 450
Standard dynamic friction torque (N·cm)		79.0
Spacer ball		None
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		37
Standard grease replenishment (cm³)		19

Recommended support unit

For drive side, for non-drive side (Fixed)
WBK40DF-31H (round)

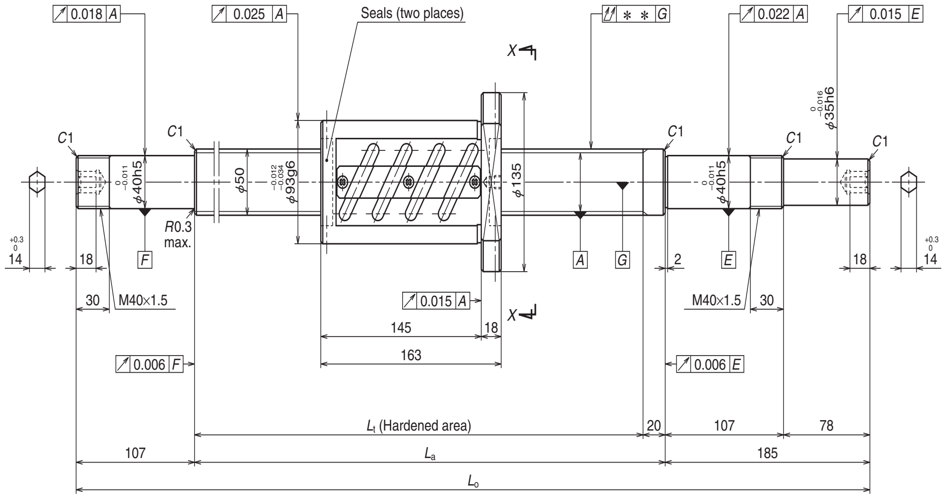
Unit: mm

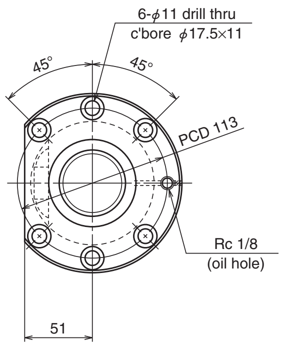
Reference No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed *N* (min⁻¹) Configuration	
	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W5005SA-1Z-C5Z10	450	468	580	600	862	–0.014	0.030	0.023	0.050	14.8	1 400	1 400
W5007SA-1Z-C5Z10	650	668	780	800	1 062	–0.019	0.035	0.025	0.065	17.6	1 400	1 400
W5009SA-1Z-C5Z10	850	868	980	1 000	1 262	–0.024	0.040	0.027	0.080	20.3	1 400	1 400
W5011SA-1Z-C5Z10	1 050	1 068	1 180	1 200	1 462	–0.028	0.046	0.030	0.080	23.1	1 400	1 400
W5014SA-1Z-C5Z10	1 350	1 368	1 480	1 500	1 762	–0.036	0.054	0.035	0.100	27.3	1 400	1 400
W5019SA-1Z-C5Z10	1 850	1 868	1 980	2 000	2 262	–0.048	0.065	0.040	0.130	34.2	1 400	1 400
W5025SA-1Z-C5Z10	2 450	2 468	2 580	2 600	2 862	–0.062	0.093	0.054	0.170	42.5	1 030	1 400

Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Screw shaft ø50

Lead 10





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		50 × 10 / Right
Preload / Ball recirculation		Z-preload / Tube
Ball dia. / Ball circle dia.		6.35 / 51
Screw shaft root diameter		44.4
Effective ball turns		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	68 100
	Static C_{0a}	174 000
Preload (N)		4 020
Standard dynamic friction torque (N·cm)		137
Spacer ball		None
Factory-packed grease		**Refer to Note 2.**
Nut internal space (cm³)		59
Standard grease replenishment (cm³)		30

Recommended support unit

For drive side, for non-drive side (Fixed)
WBK40DFD-31H (round)

Unit: mm

Reference No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ⌰	Mass (kg)	Permissible rotational speed N (min^{-1})	
	Nominal	Maximum									Configuration	
			L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple	Fixed - Fixed
W5005SA-2Z-C5Z10	350	408	580	600	892	–0.014	0.030	0.023	0.050	16.8	1 400	1 400
W5007SA-2Z-C5Z10	550	608	780	800	1 092	–0.019	0.035	0.025	0.065	19.6	1 400	1 400
W5009SA-2Z-C5Z10	750	808	980	1 000	1 292	–0.024	0.040	0.027	0.080	22.3	1 400	1 400
W5011SA-2Z-C5Z10	950	1 008	1 180	1 200	1 492	–0.028	0.046	0.030	0.080	25.1	1 400	1 400
W5014SA-2Z-C5Z10	1 250	1 308	1 480	1 500	1 792	–0.036	0.054	0.035	0.100	29.3	1 400	1 400
W5019SA-2Z-C5Z10	1 750	1 808	1 980	2 000	2 292	–0.048	0.065	0.040	0.130	36.2	1 400	1 400
W5025SA-2Z-C5Z10	2 350	2 408	2 580	2 600	2 892	–0.062	0.093	0.054	0.170	44.6	1 060	1 400

Notes:
1. We recommend use of the NSK support unit. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

B-3-1.4 Finished Shaft End Stainless Steel KA Model

1. Order of the dimension tables

Tables are arranged by model in order of increasing shaft diameter. If ball screws have the same shaft diameter, those with smaller leads appear first. Page numbers for shaft diameter and lead combinations are shown in **Table 1**.

2. Dimension tables

Dimensions, shapes, and specifications are listed by shaft diameter/lead combinations. The following tables also contain data regarding:

●Stroke

Nominal stroke : A reference for your use.
Maximum stroke : The stroke limit that the nut can move.

●Lead accuracy

Lead accuracy is C3 and C5 grades.

T : Travel compensation
e_p : Tolerance on specified travel
υ_u : Travel variation

See "Technical Description: Lead Accuracy" (page B37) for details.

●Permissible rotational speed

d • *n* : Limited by the relative peripheral speed between screw shaft and nut.
Critical speed : Limited by the natural frequency of the ball screw shaft. Critical speed depends on the support configuration of screw shaft.

The lower of the two criteria, *d·n* and critical speed, will determine the overall permissible rotational speed of the ball screw. For details, see "Technical Description: Permissible Rotational Speed" (page B47).

3. Material

A martensitic stainless steel is used. A special heat treatment technology provides the ball groove section with sufficient hardness which produces high load carrying capacity and durability.

4. Other

The seal of the ball screw, ball recirculating deflector, and end cap are made of synthetic resin. Consult NSK when using ball screws under extreme environments, special environments, or if using special lubricant or oil. For special environments, see pages B70 and D2. See pages B67 and D13 for lubricants.

Note: For details about standard stock products, contact NSK.

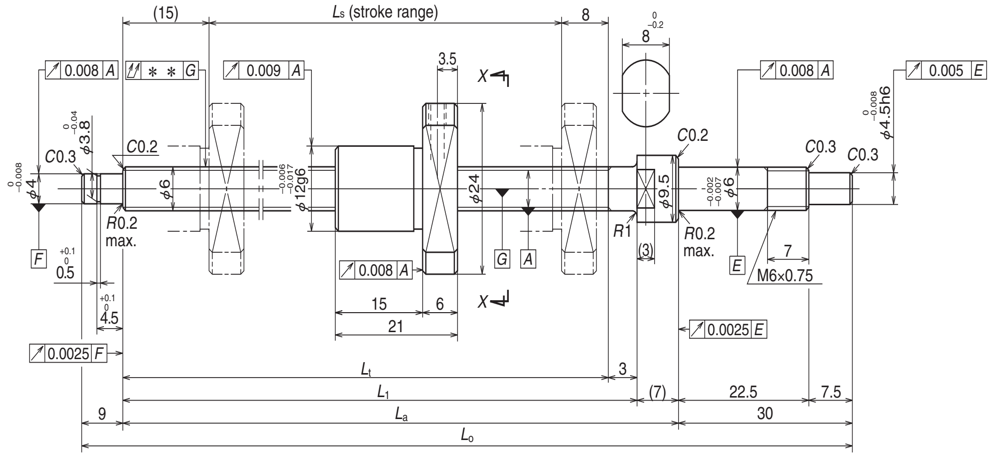
Table 1 Combinations of screw shaft diameter and lead

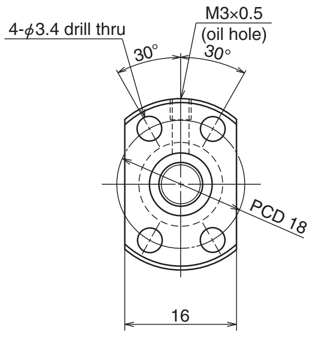
Lead (mm) / Screw shaft diameter (mm)	1	2	4	5	10	20
6	B267					
8	B269	B271				
10		B273	B275			
12		B277		B279	B281	
15					B283	
16		B285				
20						B287

Screw shaft ø6

Lead 1

Unit: mm





View *X-X*

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		6 × 1 / Right
Preload / Ball recirculation		P-preload / Deflector (bridge)
Ball dia. / Ball circle dia.		0.800 / 6.2
Screw shaft root diameter		5.2
Effective ball turns		1 × 3
Accuracy grade / Preload		C3 / Z
Basic load ratings (N)	Dynamic C_a	555
	Static C_{0a}	680
Axial play		0
Preload (N)		24.5
Dynamic friction torque (N·cm)		1.3 or less
Spacer ball		None
Factory-packed grease		**Refer to Note 1.**

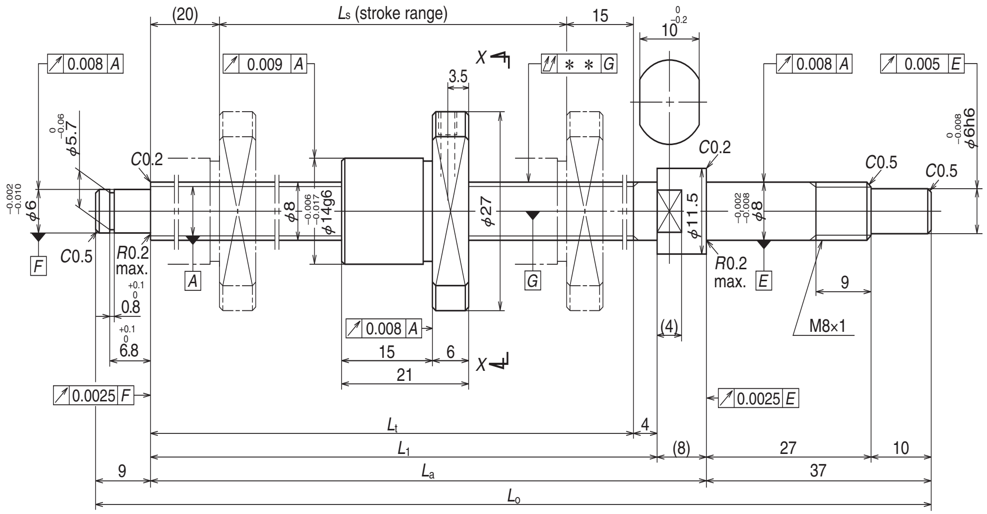
Unit: mm

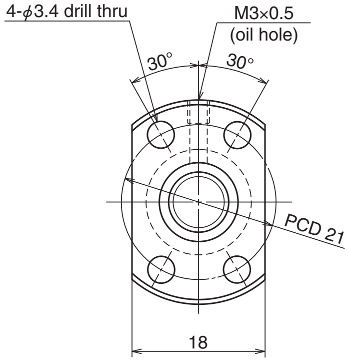
Reference No.	Stroke L_s		Thread length				Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})
	Nominal	Maximum	L_t	L_1	L_a	L_o	T	e_p	υ_u	⭿		Configuration Fixed - Simple
W0601KA-3PY-C3Z1	100	102	125	128	135	174	0	0.010	0.008	0.025	0.06	3 000

Notes:
1. **Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use.** See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
2. These ball nuts do not have seals.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Screw shaft ø8

Lead 1





View X-X

Unit: mm

Ball screw specifications

Shaft dia. x Lead / Direction of turn		8 × 1 / Right
Preload / Ball recirculation		P-preload / Deflector (bridge)
Ball dia. / Ball circle dia.		0.800 / 8.2
Screw shaft root diameter		7.2
Effective ball turns		1 × 3
Accuracy grade / Preload		C3 / Z
Basic load ratings (N)	Dynamic C_a	645
	Static C_{0a}	955
Axial play		0
Preload (N)		29.4
Dynamic friction torque (N·cm)		1.8 or less
Spacer ball		None
Factory-packed grease		**Refer to Note 1.**

Recommended support unit

For drive side (Fixed)	**For non-drive side (Simple)**
WBK08-01C (square, clean)	WBK08S-01C (square, clean)
WBK08-11C (round, clean)	

Unit: mm

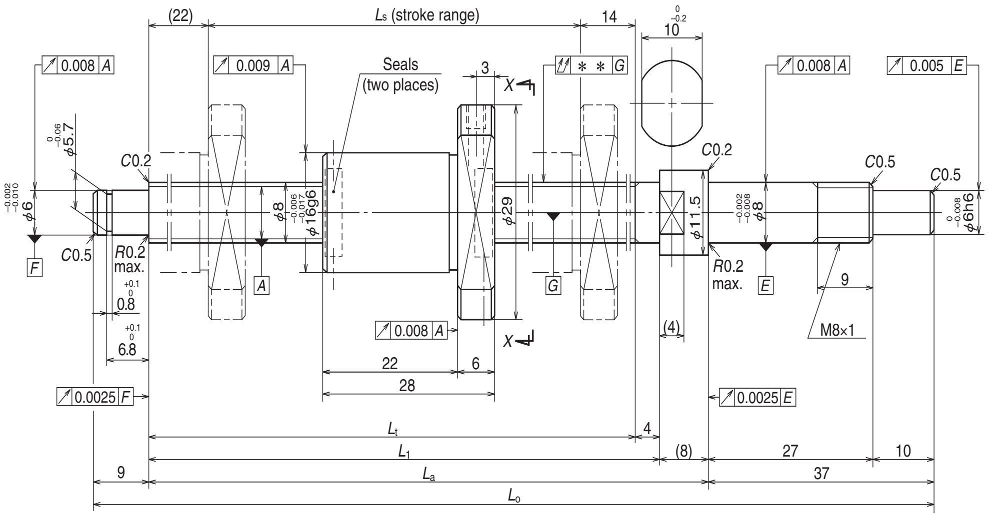
Reference No.	Stroke L_s		Thread length				Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Configuration
	Nominal	Maximum	L_t	L_1	L_a	L_o	T	e_p	υ_u	↗↗		Fixed - Simple
W0802KA-1PY-C3Z1	150	155	190	194	202	248	0	0.010	0.008	0.035	0.12	3 000

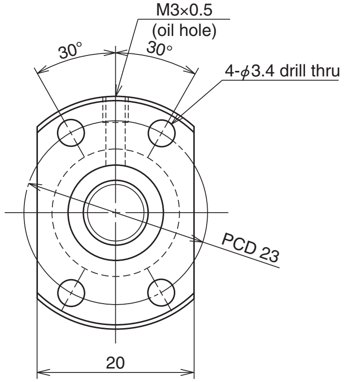
Notes:
1. **Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use.** See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
2. These ball nuts do not have seals.
3. Contact NSK if permissible rotational speed *N* will be exceeded.

Screw shaft ø8

Lead 2

Unit: mm





View X-X

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		8 × 2 / Right
Preload / Ball recirculation		P-preload / Deflector (bridge)
Ball dia. / Ball circle dia.		1.200 / 8.3
Screw shaft root diameter		6.9
Effective ball turns		1 × 3
Accuracy grade / Preload		C3 / Z
Basic load ratings (N)	Dynamic C_a	1 270
	Static C_{0a}	1 630
Axial play		0
Preload (N)		49.0
Dynamic friction torque (N·cm)		2.0 or less
Spacer ball		None
Factory-packed grease		**Refer to Note 1.**
Nut internal space (cm^3)		0.34
Standard grease replenishment (cm^3)		0.17

Recommended support unit

For drive side (Fixed)	**For non-drive side (Simple)**
WBK08-01C (square, clean)	WBK08S-01C (square, clean)
WBK08-11C (round, clean)	

Unit: mm

Reference No.	Stroke L_s		Thread length				Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})
	Nominal	Maximum										Configuration
			L_t	L_1	L_a	L_o	T	e_p	υ_u	⌰		Fixed - Simple
W0802KA-5PY-C3Z2	150	154	190	194	202	248	0	0.010	0.008	0.035	0.13	3 000

Notes:

1. **Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use.** See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
2. Contact NSK if permissible rotational speed *N* will be exceeded.

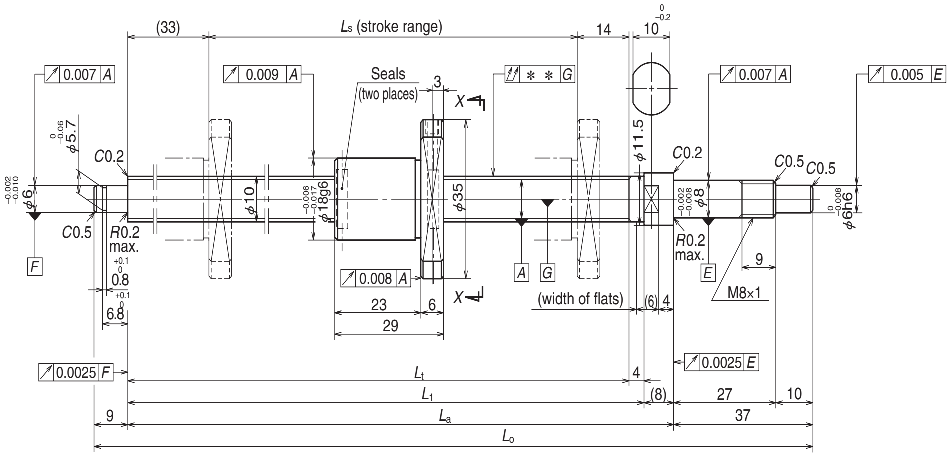
Finished Shaft End Stainless Steel KA Model (Fine lead)

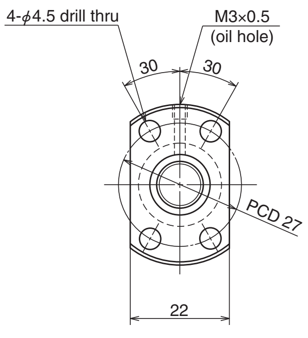
Nut: MPFD

Screw shaft ø10

Lead 2

Unit: mm





View X-X

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		10 × 2 / Right
Preload / Ball recirculation		P-preload / Deflector (bridge)
Ball dia. / Ball circle dia.		1.200 / 10.3
Screw shaft root diameter		8.9
Effective ball turns		1 × 3
Accuracy grade / Preload		C3 / Z
Basic load ratings (N)	Dynamic C_a	1 470
	Static C_{0a}	2 190
Axial play		0
Preload (N)		58.8
Dynamic friction torque (N·cm)		0.10 – 2.5
Spacer ball		None
Factory-packed grease		**Refer to Note 1.**
Nut internal space (cm^3)		0.44
Standard grease replenishment (cm^3)		0.22

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK08-01C (square, clean)	WBK08S-01C (square, clean)
WBK08-11C (round, clean)	

Unit: mm

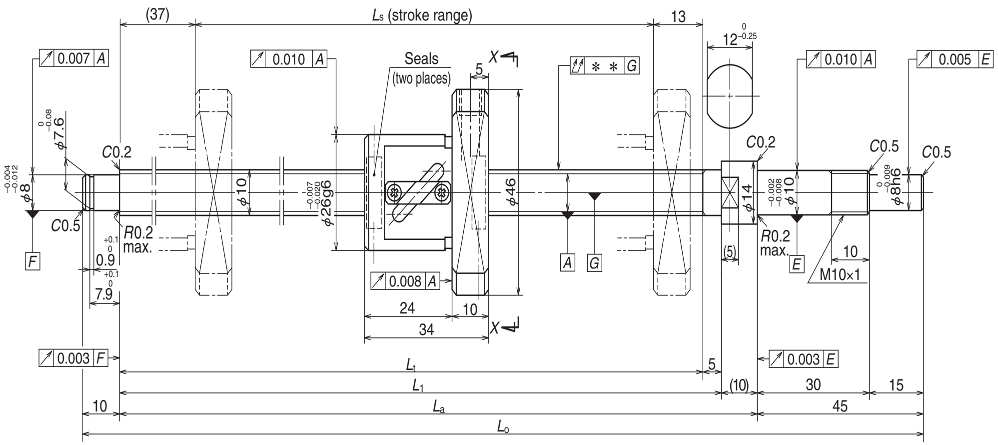
Reference No.	Stroke L_s		Thread length				Lead accuracy			Shaft run-out ** ↗↗	Mass (kg)	Permissible rotational speed N (min^{-1})
	Nominal	Maximum	L_t	L_1	L_a	L_o	T	e_p	υ_u			Configuration
												Fixed - Simple
W1002KA-3PY-C3Z2	200	203	250	254	262	308	0	0.012	0.008	0.030	0.22	3 000

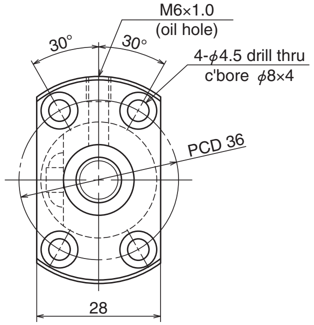
Notes:
1. **Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use.** See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
2. Contact NSK if permissible rotational speed *N* will be exceeded.

Screw shaft ø10

Lead 4

Unit: mm





View X-X

Ball screw specifications

Shaft dia. x Lead / Direction of turn		10 × 4 / Right
Preload / Ball recirculation		P-preload / Tube
Ball dia. / Ball circle dia.		2.000 / 10.3
Screw shaft root diameter		8.2
Effective ball turns		2.5 × 1
Accuracy grade / Preload		C3 / Z
Basic load ratings (N)	Dynamic C_a	2 630
	Static C_{0a}	3 270
Axial play		0
Preload (N)		98.1
Dynamic friction torque (N·cm)		0.5 – 3.9
Spacer ball		None
Factory-packed grease		**Refer to Note 1.**
Nut internal space (cm³)		0.8
Standard grease replenishment (cm³)		0.4

Recommended support unit

For drive side (Fixed)	**For non-drive side (Simple)**
WBK10-01C (square, clean)	WBK10S-01C (square, clean)
WBK10-11C (round, clean)	

Unit: mm

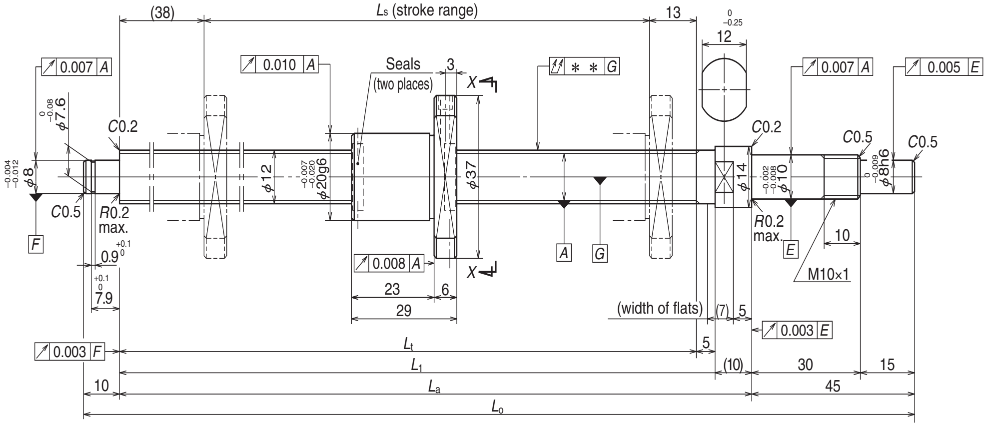
Reference No.	Stroke L_s		Thread length				Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)
	Nominal	Maximum	L_t	L_1	L_a	L_o	T	e_p	υ_u			Configuration: Fixed - Simple
W1001KA-3P-C3Z4	100	110	160	165	175	230	0	0.010	0.008	0.030	0.29	3 000
W1003KA-3P-C3Z4	300	310	360	365	375	430	0	0.013	0.008	0.050	0.39	3 000

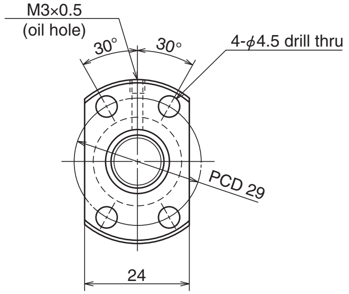
Notes:
1. **Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use.** See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
2. Contact NSK if permissible rotational speed N will be exceeded.

Screw shaft ø12

Lead 2

Unit: mm





View *X-X*

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		12 × 2 / Right
Preload / Ball recirculation		P-preload / Deflector (bridge)
Ball dia. / Ball circle dia.		1.200 / 12.3
Screw shaft root diameter		10.9
Effective ball turns		1 × 3
Accuracy grade / Preload		C3 / Z
Basic load ratings (N)	Dynamic C_a	1 600
	Static C_{0a}	2 670
Axial play		0
Preload (N)		98.1
Dynamic friction torque (N·cm)		0.4 – 3.4
Spacer ball		None
Factory-packed grease		**Refer to Note 1.**
Nut internal space (cm³)		0.53
Standard grease replenishment (cm³)		0.27

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK10-01C (square, clean)	WBK10S-01C (square, clean)
WBK10-11C (round, clean)	

Unit: mm

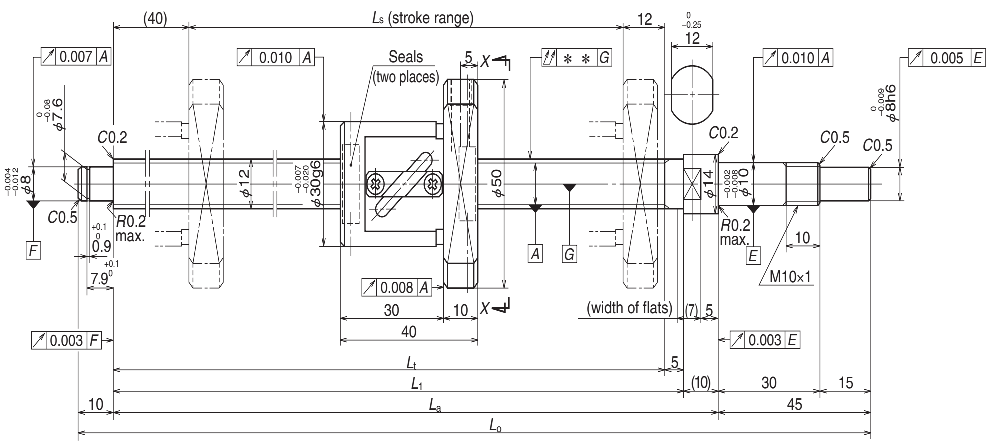
Reference No.	Stroke L_s		Thread length				Lead accuracy			Shaft run-out ** ↗↗	Mass (kg)	Permissible rotational speed *N* (min⁻¹)
												Configuration
	Nominal	Maximum	L_t	L_1	L_a	L_o	*T*	e_p	υ_u			Fixed - Simple
W1201KA-3PY-C3Z2	100	109	160	165	175	230	0	0.010	0.008	0.030	0.24	3 000
W1203KA-1PY-C3Z2	250	259	310	315	325	380	0	0.012	0.008	0.040	0.36	3 000

Notes:
1. **Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use.** See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
2. Contact NSK if permissible rotational speed *N* will be exceeded.

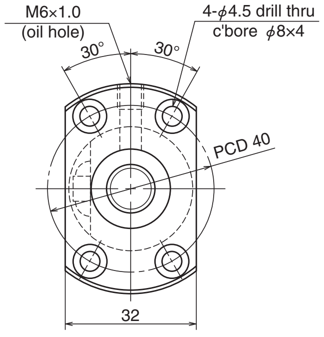
KA

Screw shaft ø12

Lead 5



Unit: mm



View X-X

Ball screw specifications

Shaft dia. x Lead / Direction of turn		12 × 5 / Right
Preload / Ball recirculation		P-preload / Tube
Ball dia. / Ball circle dia.		2.381 / 12.3
Screw shaft root diameter		9.8
Effective ball turns		2.5 × 1
Accuracy grade / Preload		C3 / Z
Basic load ratings (N)	Dynamic C_a	3 590
	Static C_{0a}	4 630
Axial play		0
Preload (N)		98.1
Dynamic friction torque (N·cm)		1.0 – 4.4
Spacer ball		None
Factory-packed grease		**Refer to Note 1.**
Nut internal space (cm^3)		1.2
Standard grease replenishment (cm^3)		0.6

Recommended support unit

For drive side (Fixed)	**For non-drive side (Simple)**
WBK10-01C (square, clean)	WBK10S-01C (square, clean)
WBK10-11C (round, clean)	

Unit: mm

Reference No.	Stroke L_s		Thread length				Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Configuration
	Nominal	Maximum	L_t	L_1	L_a	L_o	T	e_p	υ_u	⌰		Fixed - Simple
W1202KA-3P-C3Z5	200	208	260	265	275	330	0	0.012	0.008	0.040	0.47	3 000
W1205KA-1P-C3Z5	450	458	510	515	525	580	0	0.016	0.012	0.065	0.66	3 000

Notes: 1. **Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use.** See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
2. Contact NSK if permissible rotational speed N will be exceeded.

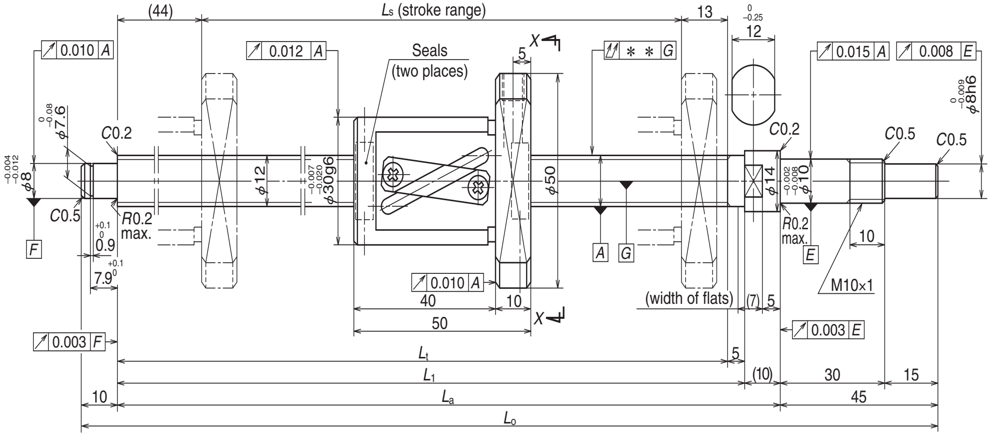
Finished Shaft End Stainless Steel KA Model (Medium lead)

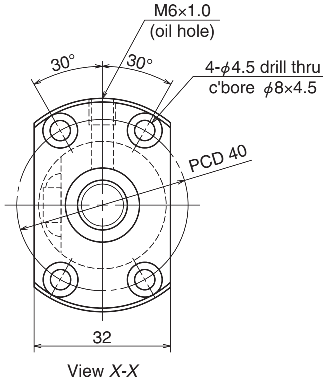
Nut: LPFT

Screw shaft ø12

Lead 10

Unit: mm





View X-X

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		12 × 10 / Right
Preload / Ball recirculation		P-preload / Tube
Ball dia. / Ball circle dia.		2.381 / 12.5
Screw shaft root diameter		10.0
Effective ball turns		2.5 × 1
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	3 620
	Static C_{0a}	4 750
Axial play		0
Preload (N)		98.1
Dynamic friction torque (N·cm)		1.0 – 4.9
Spacer ball		None
Factory-packed grease		**Refer to Note 1.**
Nut internal space (cm³)		1.4
Standard grease replenishment (cm³)		0.7

Recommended support unit

For drive side (Fixed)	**For non-drive side (Simple)**
WBK10-01C (square, clean)	WBK10S-01C (square, clean)
WBK10-11C (round, clean)	

Unit: mm

Reference No.	Stroke L_s		Thread length				Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)
	Nominal	Maximum	L_t	L_1	L_a	L_o	T	e_p	υ_u			Configuration Fixed - Simple
W1203KA-3P-C5Z10	250	253	310	315	325	380	0	0.023	0.018	0.050	0.56	3 000
W1205KA-3P-C5Z10	450	453	510	515	525	580	0	0.030	0.023	0.075	0.72	3 000

Notes:
1. **Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use.** See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
2. Contact NSK if permissible rotational speed N will be exceeded.

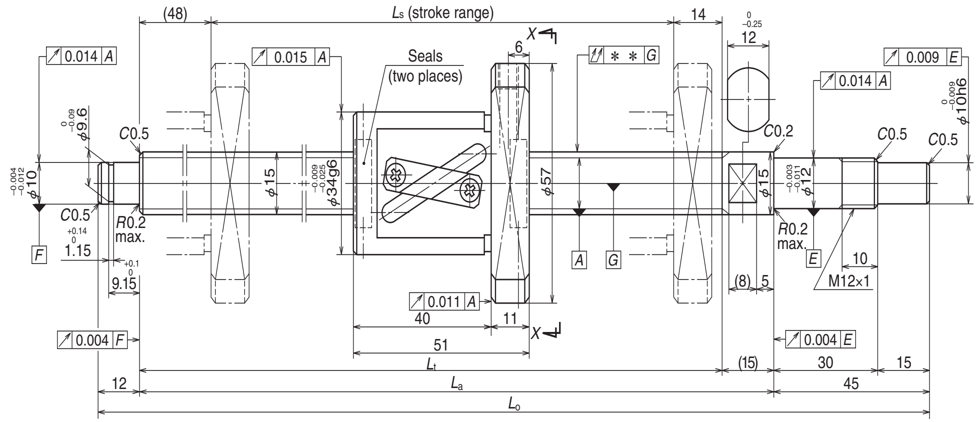
Finished Shaft End Stainless Steel KA Model (Medium lead)

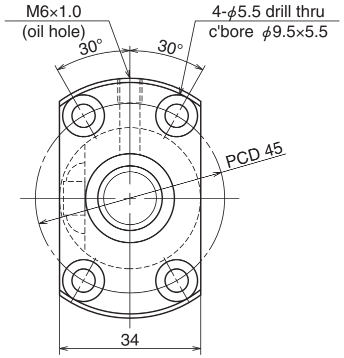
Nut: LPFT

NSK

Screw shaft ø15

Lead 10





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		15 × 10 / Right
Preload / Ball recirculation		P-preload / Tube
Ball dia. / Ball circle dia.		3.175 / 15.5
Screw shaft root diameter		12.2
Effective ball turns		2.5 × 1
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	6 660
	Static C_{0a}	9 480
Axial play		0
Preload (N)		147
Dynamic friction torque (N·cm)		1.5 – 7.9
Spacer ball		None
Factory-packed grease		**Refer to Note 1.**
Nut internal space (cm³)		2.3
Standard grease replenishment (cm³)		1.4

Recommended support unit

For drive side (Fixed)	**For non-drive side (Simple)**
WBK12-01C (square, clean)	WBK12S-01C (square, clean)
WBK12-11C (round, clean)	

Unit: mm

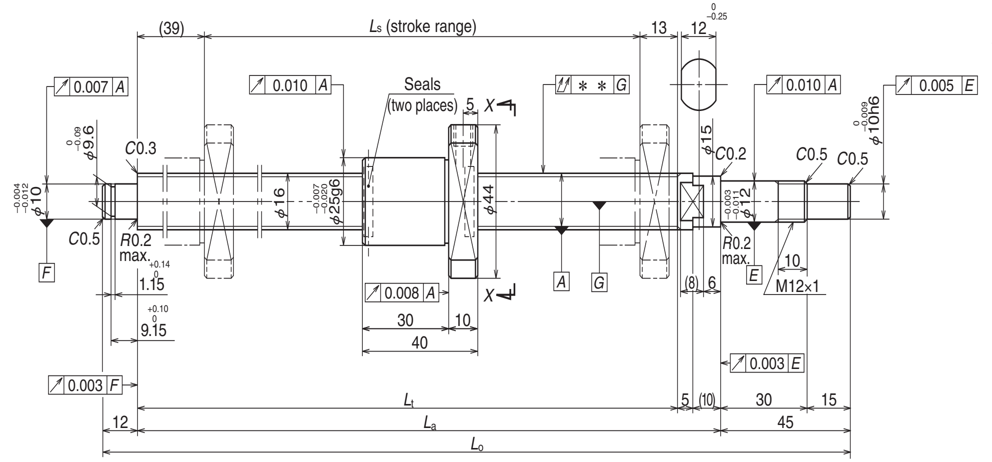
Reference No.	Stroke L_s		Thread length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)
	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Configuration: Fixed - Simple
W1504KA-3P-C5Z10	400	427	489	504	561	0	0.027	0.020	0.050	0.99	3 000
W1506KA-3P-C5Z10	600	627	689	704	761	0	0.035	0.025	0.065	1.2	3 000
W1510KA-1P-C5Z10	1 000	1 027	1 089	1 104	1 161	0	0.046	0.030	0.110	1.7	1 610

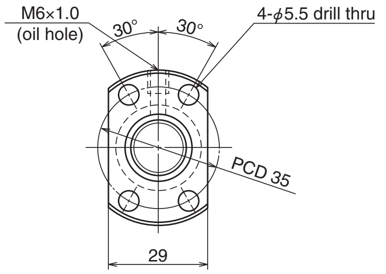
Notes:
1. **Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use.** See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
2. Contact NSK if permissible rotational speed N will be exceeded.

Screw shaft ø16

Lead 2

Unit: mm





View X-X

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		16 × 2 / Right
Preload / Ball recirculation		P-preload / Deflector (bridge)
Ball dia. / Ball circle dia.		1.588 / 16.4
Screw shaft root diameter		14.6
Effective ball turns		1 × 4
Accuracy grade / Preload		C3 / Z
Basic load ratings (N)	Dynamic C_a	3 400
	Static C_{0a}	6 240
Axial play		0
Preload (N)		147
Dynamic friction torque (N·cm)		0.5 – 4.9
Spacer ball		None
Factory-packed grease		**Refer to Note 1.**
Nut internal space (cm³)		1.6
Standard grease replenishment (cm³)		0.8

Recommended support unit

For drive side (Fixed)	**For non-drive side (Simple)**
WBK12-01C (square, clean)	WBK12S-01C (square, clean)
WBK12-11C (round, clean)	

Unit: mm

Reference No.	Stroke L_s		Thread length			Lead accuracy			Shaft run-out ** ⌰	Mass (kg)	Permissible rotational speed N (min⁻¹) Configuration
	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple
W1601KA-3PY-C3Z2	100	137	189	204	261	0	0.010	0.008	0.020	0.46	3 000
W1603KA-1PY-C3Z2	300	337	389	404	461	0	0.013	0.010	0.035	0.75	3 000

Notes:
1. **Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use.** See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
2. Contact NSK if permissible rotational speed N will be exceeded.

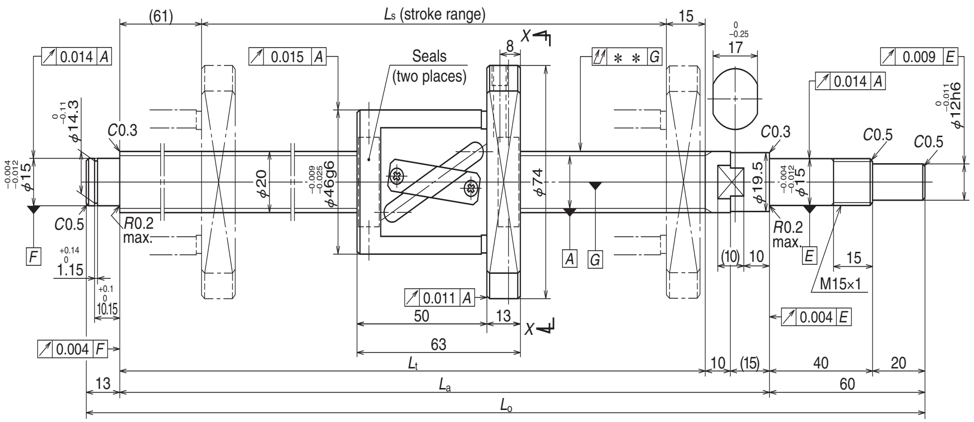
Finished Shaft End Stainless Steel KA Model (High helix lead)

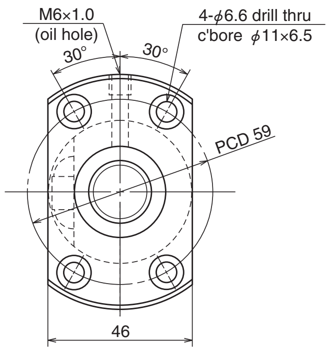
Nut: LPFT

Screw shaft ø20

Lead 20

Unit: mm





View X-X

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		20 × 20 / Right
Preload / Ball recirculation		P-preload / Tube
Ball dia. / Ball circle dia.		3.969 / 21
Screw shaft root diameter		16.9
Effective ball turns		1.5 × 1
Accuracy grade / Preload		C5 / Z
Basic load ratings (N)	Dynamic C_a	6 700
	Static C_{0a}	9 710
Axial play		0
Preload (N)		196
Dynamic friction torque (N·cm)		2.0 – 11.8
Spacer ball		None
Factory-packed grease		**Refer to Note 1.**
Nut internal space (cm³)		4.2
Standard grease replenishment (cm³)		2.1

Recommended support unit

For drive side (Fixed)	**For non-drive side (Simple)**
WBK15-01C (square, clean)	WBK15S-01C (square, clean)
WBK15-11C (round, clean)	

Unit: mm

Reference No.	Stroke L_s		Thread length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)
											Configuration
	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple
W2005KA-3P-C5Z20	400	434	510	535	608	0	0.030	0.023	0.050	2.0	3 000
W2007KA-3P-C5Z20	600	634	710	735	808	0	0.035	0.025	0.085	2.5	3 000
W2011KA-3P-C5Z20	1 000	1 034	1 110	1 135	1 208	0	0.046	0.030	0.110	3.4	2 160

Notes:
1. **Only a rust preventive is applied before delivery. Apply lubricant (oil or grease) before use.** See Page D13 for details. We recommend using NSK Grease LG2 (Cleanroom).
2. Contact NSK if permissible rotational speed N will be exceeded.

B-3-1.5 Blank Shaft End MS, FS, and SS Models

1. Order of the dimension tables

Tables are arranged by model in order of increasing shaft diameter. If ball screws have the same shaft diameter, those with smaller leads appear first. Page numbers for shaft diameter and lead combinations are shown in the **Table 1**.

2. Dimension tables

Dimensions, shapes, and specifications are listed by shaft diameter/lead combinations. The following tables also contain data regarding:

● Lead accuracy

Lead accuracy is either C3 or C5 grade.

T : Travel compensation

e_p : Tolerance of specified travel

υ_u : Travel variation

See "Technical Description: Lead Accuracy" (page B37) for details.

● Permissible rotational speed

d • *n*: Limited by the relative peripheral speed between the screw shaft and the nut.

Critical speed : Limited by the natural frequency of the ball screw shaft. Critical speed depends on the support configuration of screw shaft.

Criterion of maximum rotational speed : 3 000 min^{-1}

The lower of the two criteria, *d·n* and critical speed, will determine the overall permissible rotational speed of the ball screw. For details, see "Technical Description: Permissible Rotational Speed" (page B47).

3. Shaft end processing

MS, FS, and SS models require shaft end processing. Specialized support units (page B377) can be used for the design of shaft end support sections. See "Configuration of shaft end" (page B27 and following pages) when using a support unit. See "Technical Description: Shaft End Processing" (page B86) for procedures and precautions.

4. Other

The seals of the ball screw, ball recirculating deflectors, and end caps are made of synthetic resin. Consult NSK when using the ball screws under extreme environments, special environments, or if using special lubricant or oil. For special environments, see pages B70 and D2. See pages B67 and D13 for lubricants.

Shaft end appearance, including thread ends, may vary depending on manufacturing.

Note: For details on standard stock products, contact NSK.

Table 1 Combinations of screw shaft diameter and lead

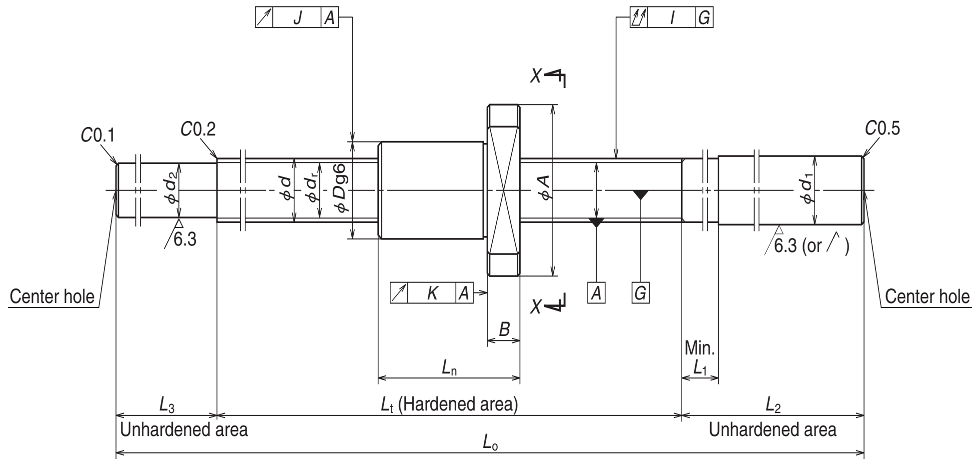
Lead(mm) / Screw shaft diameter(mm)	1	1.5	2	2.5	4	5	6	8	10	12	16	20	25	32	40	50
4	B291															
6	B291															
8	B291	B293	B293													
10			B293	B295	B299											
12			B295	B295		B299			B299							
14						B301		B301								
15									B301							
16			B297	B297		B303					B303					
20					B309	B309			B303			B303				
25					B311	B311 B313	B311		B313 B315			B305	B305			
28						B315 B317	B315 B317									
32						B319 B321 B323	B319 B321	B321	B323 B325 B327				B307	B307		
36									B325 B327							
40						B325		B329	B329 B331 B333	B329 B331						
45									B325							
50									B333 B335							

Blank Shaft End MS Model (Fine lead: Deflector (bridge) Recirculation)

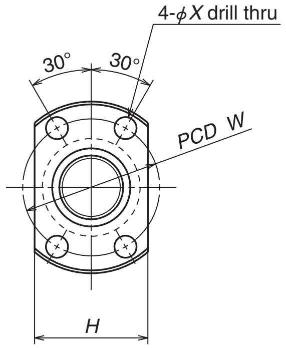
Nut: MSFD

NSK

Screw shaft ø4, ø6, ø8, Lead 1



Nut: MSFD



View X-X

Unit: mm

Model No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial play Max.	Nut				dimensions			Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed
								Dynamic	Static		Outside dia.	Flange			Overall length	Bolt hole		Threaded length	Shaft end, right			Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Radial run-out			
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	H	B	L_n	W	X	L_t	d_1	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K		N (min^{-1})
W0400MS-1Y-C3T1	68	4	1	0.8	4.2	3.2	2	370	370	0.005	10	20	14	3	12	15	2.9	80	6.0	4	40	3.3	10	130	0	0.008	0.008	0.030	0.009	0.008	0.026	3 000
W0601MS-1Y-C3T1	110	6	1	0.8	6.2	5.2	3	680	920	0.005	12	24	16	3.5	15	18	3.4	125	8.0	4	50	5.3	15	190	0	0.010	0.008	0.030	0.009	0.008	0.063	3 000
W0801MS-1Y-C3T1	94	8	1	0.8	8.2	7.2	3	790	1 290	0.005	14	27	18	4	16	21	3.4	110	10.2	4	60	7.3	25	195	0	0.010	0.008	0.030	0.009	0.008	0.11	3 000
W0802MS-1Y-C3T1	174																	190						275				0.050			0.14	

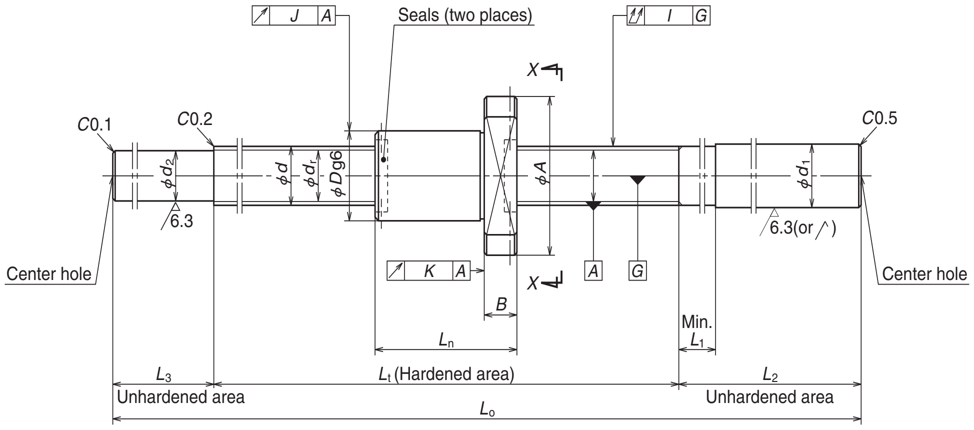
Notes: 1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. These ball nuts do not have seals.
4. The permissible rotational speed is determined by the *d·n* value, critical speed, and maximum rotational speed. See Page B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Blank Shaft End MS Model (Fine lead: Deflector (bridge) Recirculation)

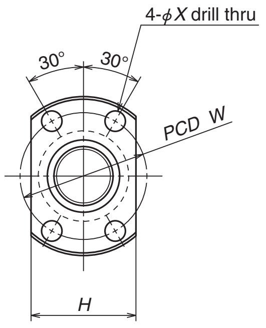
Nut: MSFD

NSK

Screw shaft ø8
Lead 1.5, 2
Screw shaft ø10
Lead 2



Nut: MSFD



View X-X

Unit: mm

Model No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial play Max.	Nut				dimensions			Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed
								Dynamic	Static		Outside dia.	Flange			Overall length	Bolt hole		Threaded length	Shaft end, right			Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Radial run-out			
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	H	B	L_n	W	X	L_t	d_1	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K		N (min^{-1})
W0801MS-2Y-C3T1.5	88	8	1.5	1.0	8.3	7.0	3	1 270	1 970	0.005	15	28	19	4	22	22	3.4	110	10.2	4	60	7.2	25	195	0	0.010	0.008	0.030	0.009	0.008	0.12	3 000
W0802MS-2Y-C3T1.5	168																	190						275				0.050			0.15	
W0801MS-3Y-C3T2	84	8	2	1.2	8.3	6.9	3	1 560	2 200	0.005	16	29	20	4	26	23	3.4	110	10.2	4	60	7.0	25	195	0	0.010	0.008	0.030	0.009	0.008	0.12	3 000
W0802MS-3Y-C3T2	164																	190						275				0.050			0.15	
W1001MS-1Y-C3T2	122	10	2	1.2	10.3	8.9	3	1 800	2 970	0.005	18	35	22	5	28	27	4.5	150	12.2	4	70	9.0	30	250	0	0.010	0.008	0.035	0.009	0.008	0.22	3 000
W1002MS-1Y-C3T2	222																	250						350		0.012		0.050			0.17	

Notes: 1. We recommend using NSK support units. See Page B377 for details.

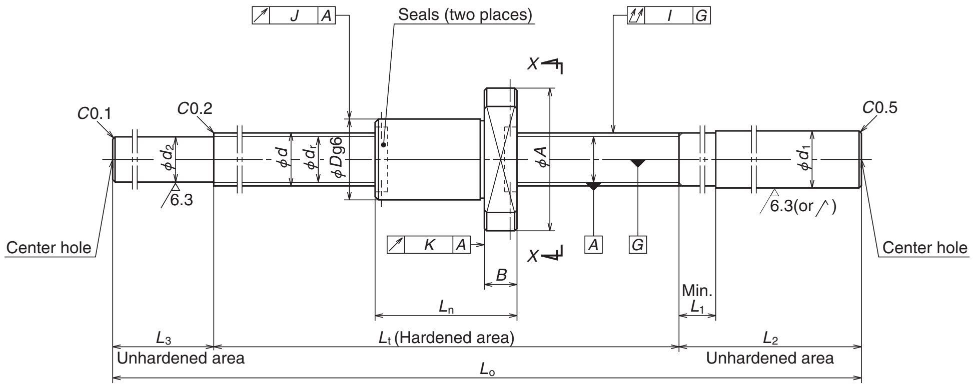
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.

3. The permissible rotational speed is determined by the *d·n* value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

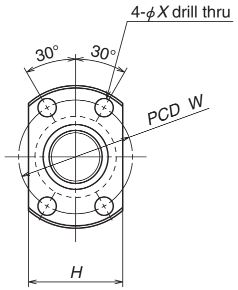
Blank Shaft End MS Model (Fine lead: Deflector (bridge) Recirculation)

Nut: MSFD

Screw shaft ø10
Lead 2.5
Screw shaft ø12
Lead 2, 2.5



Nut: MSFD

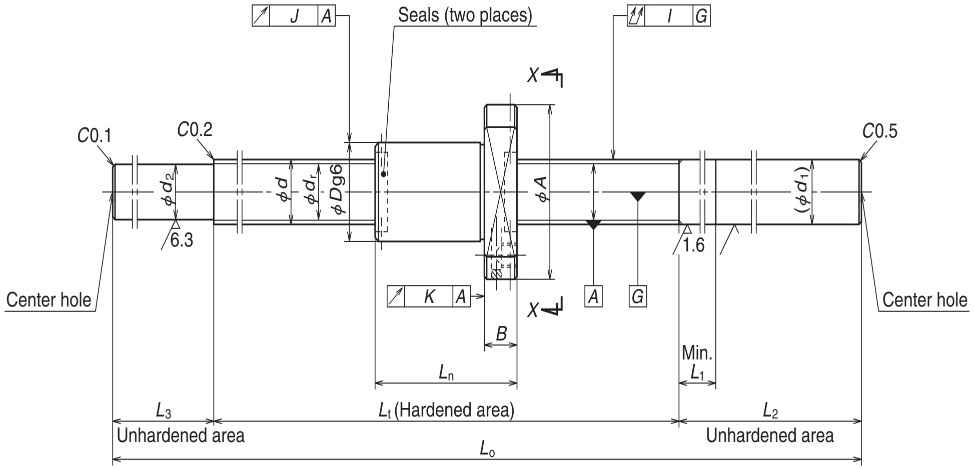


View X-X

Unit: mm

Model No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial play Max.	Nut							Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed
								Dynamic	Static		Outside dia.	Flange			dimensions																	
															Overall length	Bolt hole		Threaded length	Shaft end, right			Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Radial run-out			
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	H	B	L_n	W	X	L_t	d_1	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K		N (min^{-1})
W1001MS-2Y-C3T2.5	118	10	2.5	1.588	10.4	8.6	3	2 500	3 630	0.005	19	36	23	5	32	28	4.5	150	12.2	4	70	8.7	30	250	0	0.010	0.008	0.035	0.010	0.008	0.23	3 000
W1002MS-2Y-C3T2.5	218																	250						350		0.012		0.050			0.28	
W1202MS-1Y-C3T2	182	12	2	1.200	12.3	10.9	3	1 960	3 620	0.005	20	37	24	5	28	29	4.5	210	14.2	5	80	11.0	35	325	0	0.012	0.008	0.050	0.010	0.008	0.36	3 000
W1203MS-1Y-C3T2	282																	310						425				0.060			0.44	
W1202MS-2Y-C3T2.5	178	12	2.5	1.588	12.4	10.6	3	2 790	4 530	0.005	21	38	25	5	32	30	4.5	210	14.2	5	80	10.7	35	325	0	0.012	0.008	0.050	0.010	0.008	0.37	3 000
W1203MS-2Y-C3T2.5	278																	310						425				0.060			0.45	

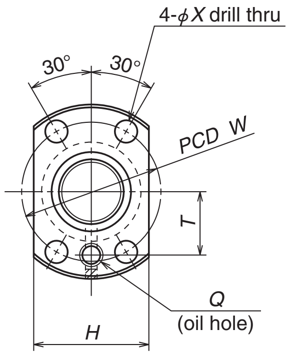
Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the *d·n* value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.



Nut: MSFD

Model No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial play Max.	Nut						
								Dynamic	Static		Outside dia.	Flange			Overall length	Bolt hole	
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	H	B	L_n	W	X
W1602MS-1Y-C3T2	210	16	2	1.588	16.4	14.6	4	4 150	8 450	0.005	25	44	29	10	40	35	5.5
W1604MS-1Y-C3T2	360																
W1602MS-2Y-C3T2.5	206	16	2.5	1.588	16.4	14.6	4	4 150	8 440	0.005	25	44	29	10	44	35	5.5
W1604MS-2Y-C3T2.5	356																

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the $d{\cdot}n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

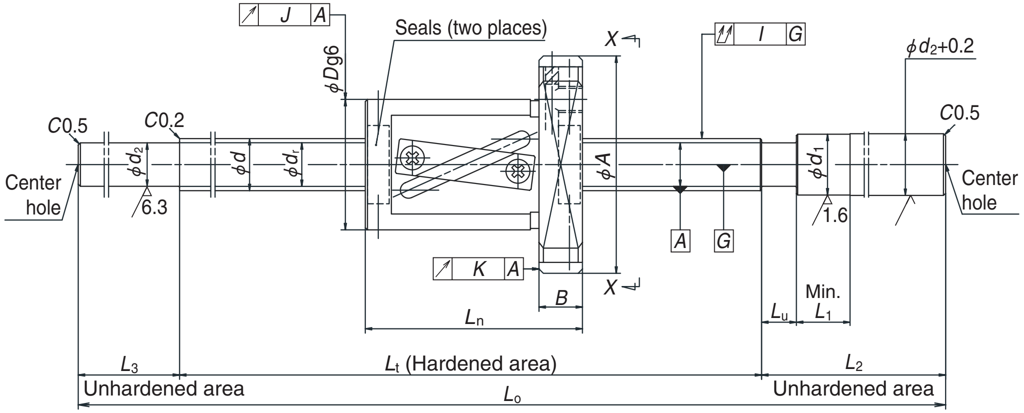


View X-X

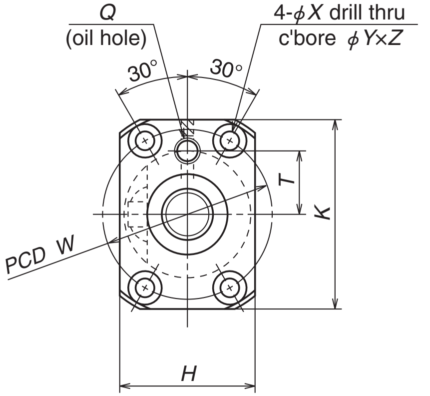
Unit: mm

Model No.	dimensions		Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min⁻¹)	Nut internal space (cm³)	Standard grease replenishment (cm³)
	Oil hole		Threaded length	Shaft end, right			Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Radial run-out					
	Q	T	L_t	d_1	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K				
W1602MS-1Y-C3T2	M6×1	16	250	16	30	100	14.7	40	390	0	0.012	0.008	0.035	0.010	0.008	0.71	3 000	1.5	0.8
W1604MS-1Y-C3T2			400						540		0.013	0.010	0.050			0.93			
W1602MS-2Y-C3T2.5	M6×1	16	250	16	30	100	14.7	40	390	0	0.012	0.008	0.035	0.010	0.008	0.73	3 000	1.5	0.8
W1604MS-2Y-C3T2.5			400						540		0.013	0.010	0.050			0.95			

Screw shaft ø10
Lead 4
Screw shaft ø12
Lead 5, 10



Nut: SFT, LSFT



View X-X

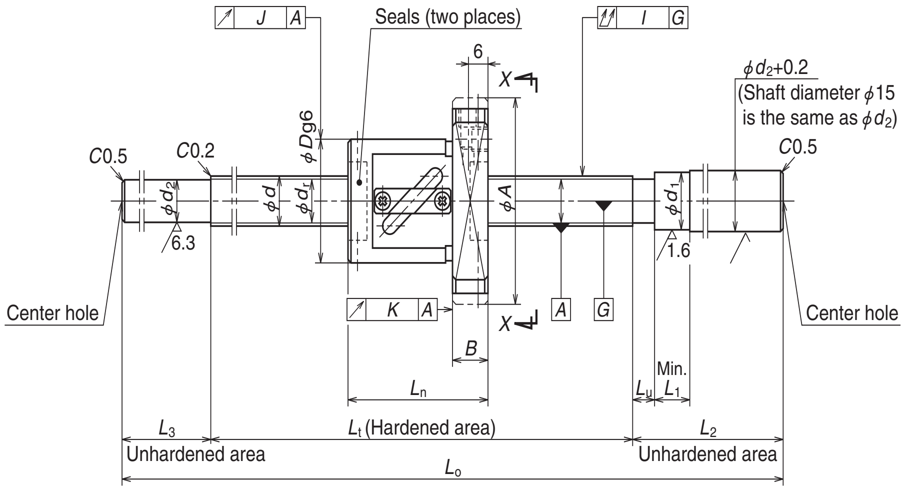
Unit: mm

Model No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial play Max.	Nut									
							Turns × Circuits	Dynamic	Static		Outside dia.	Flange				Overall length	Bolt hole			
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	H	K	B	L_n	W	X	Y	Z
W1001FS-1-C3T4	126	10	4	2.000	10.3	8.2	2.5×1	3 210	4 420	0.005	26	46	28	42	10	34	36	4.5	8	4.5
W1002FS-1-C3T4	226																			
W1003FS-1-C3T4	326																			
W1201FS-1-C3T5	110	12	5	2.381	12.3	9.8	2.5×1	4 390	6 260	0.005	30	50	32	45	10	40	40	4.5	8	4.5
W1202FS-1-C3T5	210																			
W1204FS-1-C3T5	410																			
W1202FS-2-C5T10	200	12	10	2.381	12.5	10.0	2.5×1	4 430	6 430	0.005	30	50	32	45	10	50	40	4.5	8	4.5
W1204FS-2-C5T10	400																			

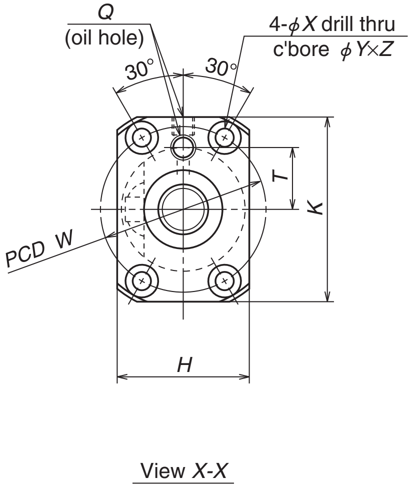
Model No.	dimensions		Screw shaft dimensions								Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min⁻¹)	Nut internal space (cm³)	Standard grease replenishment (cm³)
	Oil hole		Threaded length	Shaft end, right				Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Radial run-out					
	Q	T	L_t	d_1	L_u	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K				
W1001FS-1-C3T4	M6×1	14	160	14	5	40	70	8.2	35	265	0	0.010	0.008	0.030	0.010	0.008	0.34	3 000	0.86	0.43
W1002FS-1-C3T4			260							365		0.012	0.008	0.040			0.39			
W1003FS-1-C3T4			360							465		0.013	0.010	0.050			0.45			
W1201FS-1-C3T5	M6×1	15	150	14	5	40	70	9.8	35	255	0	0.010	0.008	0.030	0.010	0.008	0.44	3 000	1.2	0.6
W1202FS-1-C3T5			250							355		0.012	0.008	0.040			0.52			
W1204FS-1-C3T5			450							555		0.015	0.010	0.065			0.67			
W1202FS-2-C5T10	M6×1	15	250	14	8	40	70	10.0	35	355	0	0.023	0.018	0.050	0.012	0.010	0.57	3 000	1.4	0.7
W1204FS-2-C5T10			450							555		0.027	0.020	0.075			0.74			

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the *d·n* value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Screw shaft ø14
Lead 5, 8
Screw shaft ø15
Lead 10



Nut: SFT, LSFT



View X-X

Unit: mm

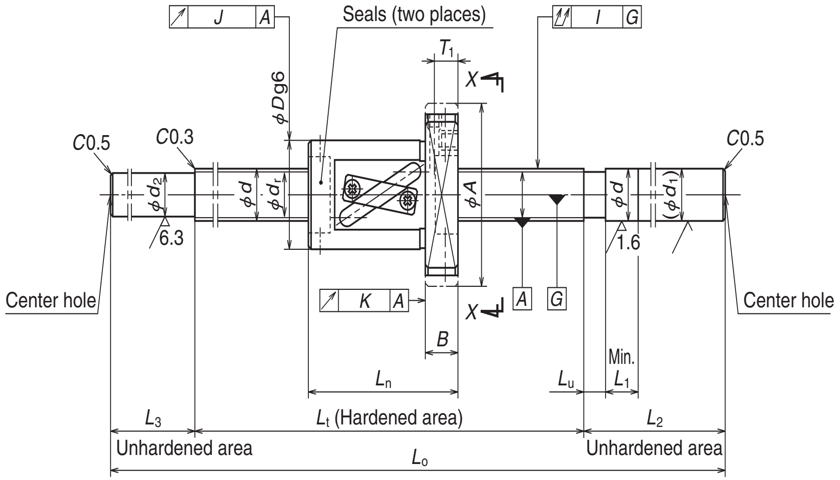
Model No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial play Max.	Nut										Nut dimensions		Screw shaft dimensions								Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min⁻¹)	Nut internal space (cm³)	Standard grease replenishment (cm³)
							Turns x Circuits	Dynamic	Static		Outside dia.	Flange				Overall length	Bolt hole				Oil hole		Threaded length	Shaft end, right				Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Radial run-out					
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	H	K	B	L_n	W	X	Y	Z	Q	T	L_t	d_1	L_u	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K				
W1403FS-1-C3T5	310	14	5	3.175	14.5	11.2	2.5×1	7 970	11 900	0.005	34	57	34	50	11	40	45	5.5	9.5	5.5	M6×1	17	350	15	5	40	100	11.2	40	490	0	0.013	0.010	0.035	0.012	0.008	0.78	3 000	2.0	1.0
W1406FS-1-C3T5	560																						600							740		0.016	0.012	0.055			1.0			
W1405FS-1-C5T8	454	14	8	3.175	14.5	11.2	2.5×1	7 880	11 800	0.005	34	57	34	50	11	46	45	5.5	9.5	5.5	M6×1	17	500	15	8	40	100	11.2	40	640	0	0.027	0.020	0.065	0.015	0.011	1.0	3 000	2.0	1.0
W1408FS-1-C5T8	754																						800							940		0.035	0.025	0.085			1.3			
W1504FS-1-C5T10	349	15	10	3.175	15.5	12.2	2.5×1	8 140	12 800	0.005	34	57	34	50	11	51	45	5.5	9.5	5.5	M6×1	17	400	15	8	40	120	12.2	50	570	0	0.025	0.020	0.050	0.015	0.011	1.0	3 000	2.3	1.2
W1506FS-1-C5T10	549																						600							770		0.030	0.023	0.065			1.3			
W1509FS-1-C5T10	849																						900							1 070		0.040	0.027	0.110			1.7			
W1511FS-1-C5T10	1 049																						1 100							1 270		0.046	0.030	0.150			1.9			

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the $d{\cdot}n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

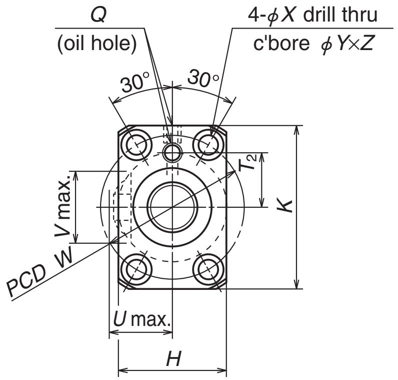
Blank Shaft End FS Model (Fine, Medium, High helix lead: Tube Recirculation)

Nut: SFT, LSFT

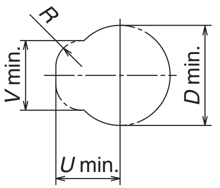
Screw shaft ø16
Lead 5, 16
Screw shaft ø20
Lead 10, 20



Nut: SFT, LSFT



View X-X



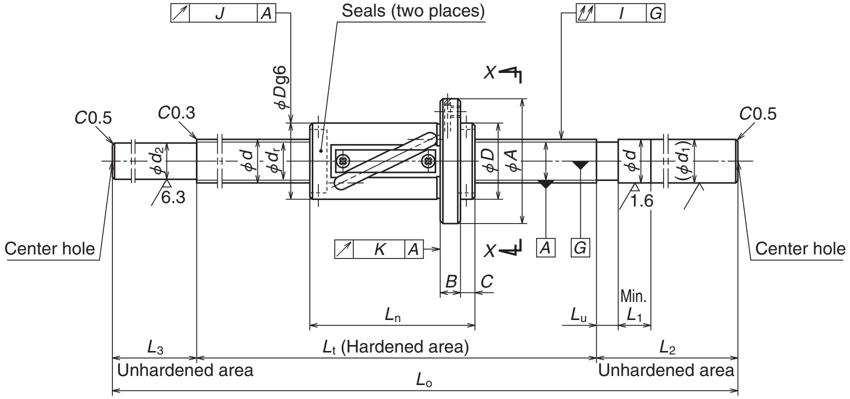
Housing hole and its clearance
(only applicable to shaft dia. ϕ16, lead 16)

Unit: mm

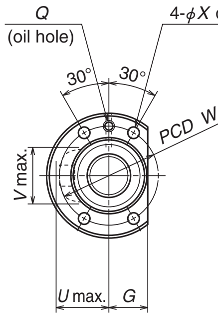
Model No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial play Max.	Nut dimensions																Screw shaft dimensions								Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min^{-1})	Nut internal space (cm³)	Standard grease replenishment (cm³)
							Turns × Circuits	Dynamic	Static		Outside dia.	Flange				Overall length	Bolt hole				Projecting tube			Oil hole			Threaded length	Shaft end, right				Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Radial run-out					
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	H	K	B	L_n	W	X	Y	Z	U	V	R	Q	T_1	T_2	L_t	d_1	L_u	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K				
W1605FS-1-C3T5	458	16	5	3.175	16.5	13.2	2.5×1	8 620	13 800	0.005	40	63	40	55	11	42	51	5.5	9.5	5.5	—	—	—	M6×1	6	17	500	16	5	40	150	13.2	60	710	0	0.015	0.010	0.055	0.012	0.008	1.4	3 000	2.6	1.3
W1609FS-1-C3T5	858																										900							1 110		0.021	0.015	0.095			1.9			
W1606FS-1-C5T16	544	16	16	3.175	16.75	13.4	1.5×1	5 480	8 080	0.005	34	57	34	50	12	56	45	5.5	9.5	5.5	19	20	8	M6×1	8	17	600	16	10	40	150	13.4	60	810	0	0.030	0.023	0.085	0.015	0.011	1.5	3 000	2.1	1.1
W1611FS-1-C5T16	1 044																										1 100							1 310		0.046	0.030	0.150			2.3	2 480		
W2009FS-1-C5T10	846	20	10	3.969	21	16.9	2.5×1	13 300	21 900	0.005	46	74	46	66	13	54	59	6.6	11	6.5	—	—	—	M6×1	6	24	900	20	10	60	150	16.9	80	1 130	0	0.040	0.027	0.110	0.015	0.011	3.2	3 000	4.7	2.4
W2013FS-1-C5T10	1 246																										1 300							1 530		0.054	0.035	0.150			4.1	2 190		
W2010FS-1-C5T20	937	20	20	3.969	21	16.9	1.5×1	8 190	13 100	0.005	46	74	46	66	13	63	59	6.6	11	6.5	—	—	—	M6×1	8	24	1 000	20	13	60	150	16.9	80	1 230	0	0.040	0.027	0.110	0.015	0.011	3.6	3 000	4.2	2.1
W2015FS-1-C5T20	1 437																										1 500							1 730		0.054	0.035	0.200			4.8	1 610		

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the $d \cdot n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

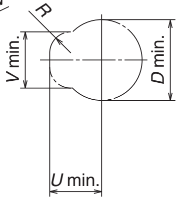
Screw shaft ø25
Lead 20, 25



Nut: LSFT



View X-X



Housing hole and its clearance

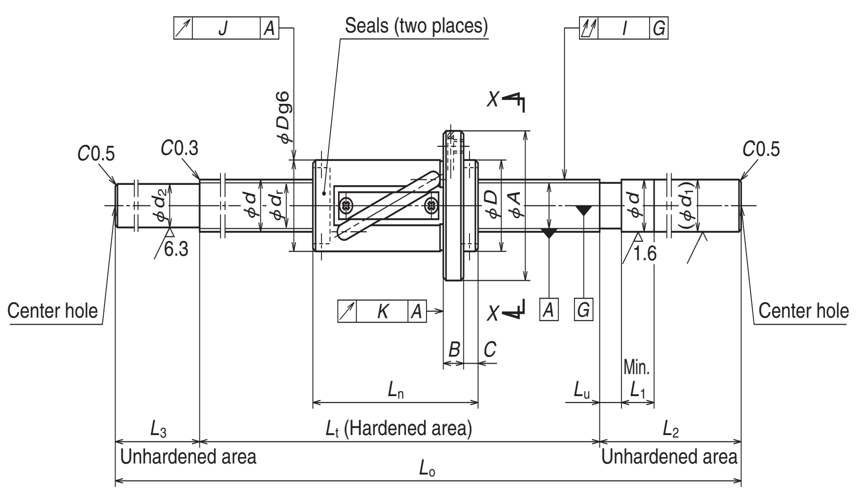
Unit: mm

Model No.	Stroke Max. L_t-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns x Circuits	Basic load ratings (N) Dynamic C_a	Basic load ratings (N) Static C_{0a}	Axial play Max.	Nut	Nut Outside dia. D	Flange A	Flange G	Flange H	Flange K	Flange B	Flange C	Overall length L_n	Bolt hole W	Bolt hole X
W2513FS-1-C5T20	1 254	25	20	4.762	26.25	21.3	2.5x1	18 600	32 600	0.005	LSFT	44	71	23	—	—	12	8	96	57	6.6
W2521FS-1-C5T20	2 054																				
W2513FS-2-C5T25	1 260	25	25	4.762	26.25	21.3	1.5x1	11 700	19 700	0.005	LSFT	44	71	23	—	—	12	10	90	57	6.6
W2521FS-2-C5T25	2 060																				

Model No.	dimensions Projecting tube U	Projecting tube V	Projecting tube R	Oil hole Q	Oil hole T	Screw shaft dimensions Threaded length L_t	Shaft end, right d_1	Shaft end, right L_u	Shaft end, right L_1	Shaft end, right L_2	Shaft end, left d_2	Shaft end, left L_3	Overall length L_o	Lead accuracy T	Deviation e_p	Variation υ_u	Run-out Shaft straightness I	Radial run-out J	Radial run-out K	Mass (kg)	Permissible rotational speed N (min^{-1})	Nut internal space (cm^3)	Standard grease replenishment (cm^3)
W2513FS-1-C5T20	31	35	12	M6x1	—	1 350	25	13	70	200	21.3	100	1 650	0	0.054	0.035	0.120	0.015	0.011	6.8	2 550	12	6.0
W2521FS-1-C5T20						2 150							2 450		0.077	0.046	0.160			9.8	1 000		
W2513FS-2-C5T25	32	34	12	M6x1	—	1 350	25	15	70	200	21.3	100	1 650	0	0.054	0.035	0.120	0.015	0.011	6.8	2 540	10	5.0
W2521FS-2-C5T25						2 150							2 450		0.077	0.046	0.160			9.8	1 000		

Notes:
1. We recommend using NSK support units. See Page B389 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the *d·n* value, critical speed, and maximum rotational speed. See Pages B47 and B299 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Blank Shaft End FS Model (Medium, High helix lead: Tube Recirculation)



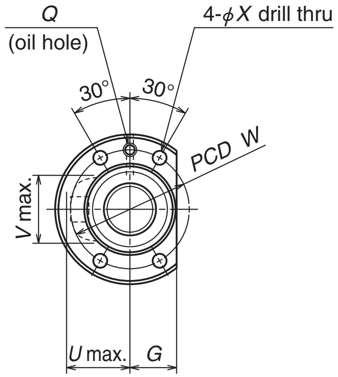
Nut: LSFT

Nut: LSFT

NSK

Screw shaft ø32

Lead 25, 32



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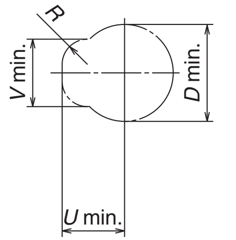


Housing hole and its clearance

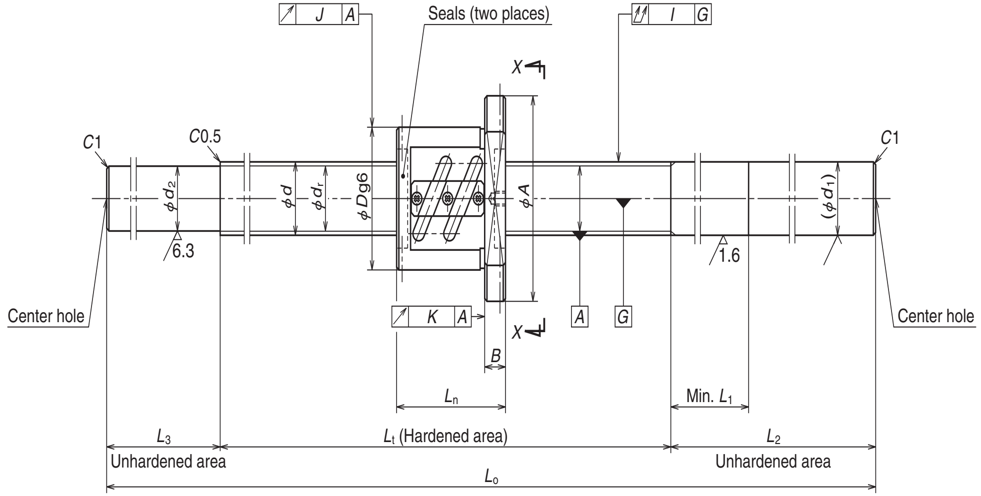
Model No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial play Max.	Nut							
							Turns x Circuits	Dynamic	Static		Outside dia.	Flange				Overall length	Bolt hole	
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	G	B	C	L_n	W	X
W3217FS-1-C5T25	1 583	32	25	4.762	33.25	28.3	2.5×1	20 400	42 200	0.005	51	85	26	15	10	117	67	9
W3227FS-1-C5T25	2 583																	
W3217FS-2-C5T32	1 591	32	32	4.762	33.25	28.3	1.5×1	13 300	25 200	0.005	51	85	26	15	12	109	67	9
W3227FS-2-C5T32	2 591																	

Unit: mm

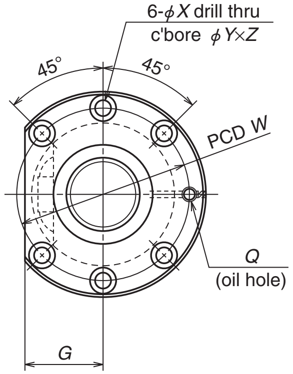
Model No.	dimensions				Screw shaft dimensions								Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed	Nut internal space	Standard grease replenishment
	Projecting tube			Oil hole	Threaded length	Shaft end, right				Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out					
	U	V	R	Q	L_t	d_1	L_u	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K		N (min⁻¹)	(cm³)	(cm³)
W3217FS-1-C5T25	34	42	12	M6×1	1 700	32	15	70	250	28.3	120	2 070	0	0.065	0.040	0.160	0.019	0.013	13.8	2 180	17	8.5
W3227FS-1-C5T25					2 700							3 070		0.093	0.054	0.210			20.0	800		
W3217FS-2-C5T32	34	42	12	M6×1	1 700	32	19	70	250	28.3	120	2 070	0	0.065	0.040	0.160	0.019	0.013	13.9	2 180	15	7.5
W3227FS-2-C5T32					2 700							3 070		0.093	0.054	0.210			20.0	790		

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the *d·n* value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Screw shaft ø20
Lead 4, 5



Nut: PFT



View X-X

Unit: mm

Model No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Preload	Dynamic friction torque, median	Nut dimensions										Screw shaft dimensions							Lead accuracy			Run-out			Mass	Permissible rotational speed	Nut internal space	Standard grease replenishment
							Turns × Circuits	Dynamic	Static	(N)	(N·cm)	Outside dia.	Flange				Overall length	Bolt hole				Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out		(kg)	N (min^{-1})	(cm^3)	(cm^3)
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n	W	X	Y	Z	Q	L_t	d_1	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K				
W2003SS-1P-C5Z4	251	20	4	2.381	20.3	17.8	2.5×2	6 550	10 900	290	3.9	40	63	24	11	49	51	5.5	9.5	5.5	M6×1	300	20	40	150	17.8	—	450	-0.007	0.023	0.018	0.055	0.015	0.011	1.5	3 000	2.7	1.4
W2005SS-1P-C5Z4	451																					500			150		50	700	-0.012	0.027	0.020	0.085			2.0			
W2008SS-1P-C5Z4	751																					800			200		100	1 100	-0.019	0.035	0.025	0.140			2.9			
W2003SS-2P-C5Z5	244	20	5	3.175	20.5	17.2	2.5×2	11 100	17 100	490	7.8	44	67	26	11	56	55	5.5	9.5	5.5	M6×1	300	20	40	150	17.2	—	450	-0.007	0.023	0.018	0.055	0.015	0.011	1.6	3 000	4.3	2.2
W2005SS-2P-C5Z5	444																					500			150		50	700	-0.012	0.027	0.020	0.085			2.2			
W2007SS-1P-C5Z5	644																					700			200		100	1 000	-0.017	0.035	0.025	0.110			2.8			
W2010SS-1P-C5Z5	944																					1 000			200		100	1 300	-0.024	0.040	0.027	0.180			3.5			

Notes: 1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the *d·n* value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

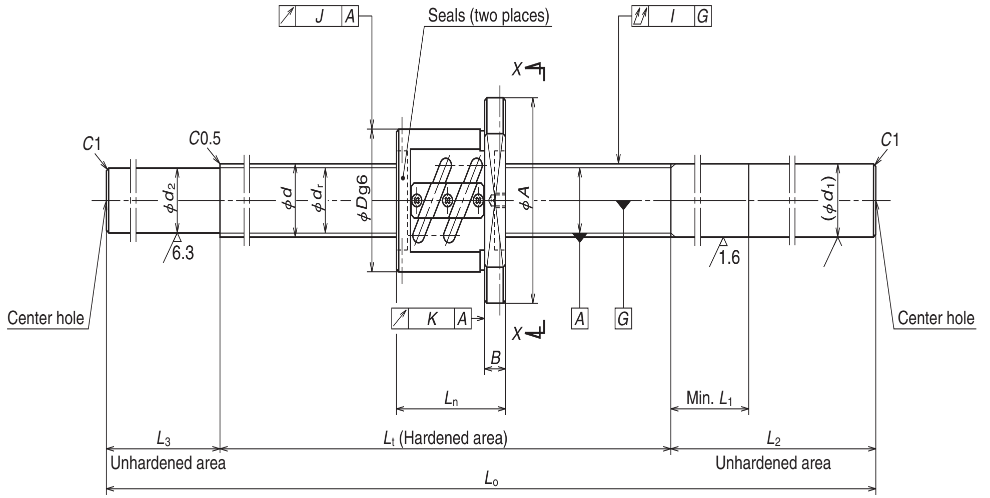
Blank Shaft End SS Model (Fine lead: Tube Recirculation)

Nut: PFT

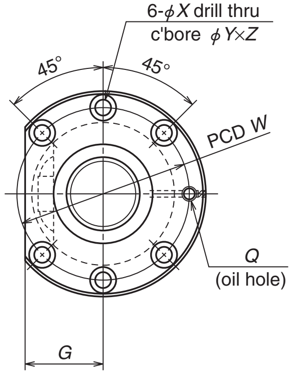
NSK

Screw shaft ø25

Lead 4, 5, 6



Nut: PFT



View X-X

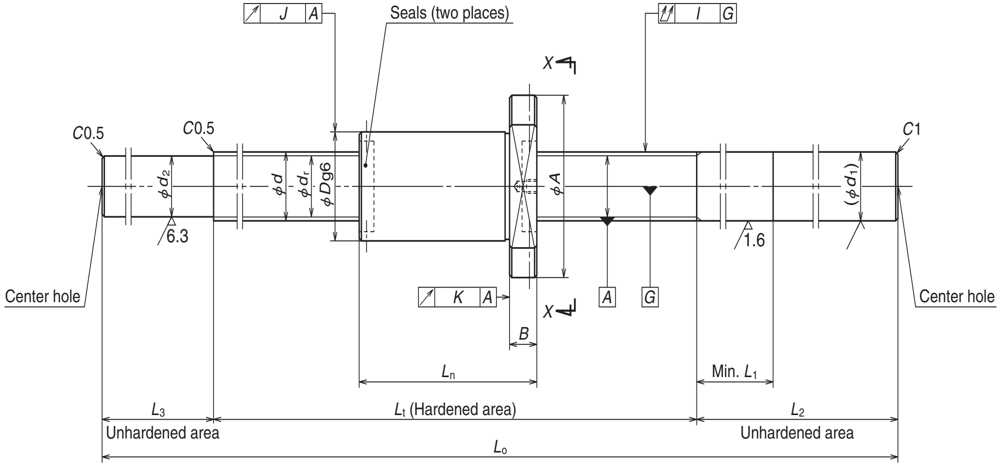
Unit: mm

Model No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Preload	Dynamic friction torque, median	Nut						
							Turns × Circuits	Dynamic	Static	(N)	(N·cm)	Outside dia.	Flange			Overall length	Bolt hole	
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n	W	X
W2503SS-1P-C5Z4	252	25	4	2.381	25.3	22.8	2.5×2	7 110	13 600	290	4.9	46	69	26	11	48	57	5.5
W2506SS-1P-C5Z4	552																	
W2510SS-1P-C5Z4	952																	
W2503SS-2P-C5Z5	245	25	5	3.175	25.5	22.2	2.5×2	12 300	21 800	540	8.8	50	73	28	11	55	61	5.5
W2505SS-1P-C5Z5	445																	
W2508SS-1P-C5Z5	745																	
W2512SS-1P-C5Z5	1 145																	
W2504SS-1P-C5Z6	338	25	6	3.969	25.5	21.4	2.5×2	16 600	26 700	690	13.8	53	76	29	11	62	64	5.5
W2508SS-2P-C5Z6	738																	
W2512SS-2P-C5Z6	1 138																	

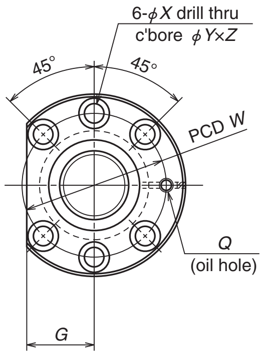
Model No.	Nut dimensions			Screw shaft dimensions							Lead accuracy			Run-out			Mass	Permissible rotational speed	Nut internal space	Standard grease replenishment
	Bolt hole		Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out		(kg)	N (min⁻¹)	(cm³)	(cm³)
	Y	Z	Q	L_t	d_1	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K				
W2503SS-1P-C5Z4	9.5	5.5	M6×1	300	25	40	150	22.8	—	450	-0.007	0.023	0.018	0.040	0.015	0.011	2.2	2 800	3.2	1.6
W2506SS-1P-C5Z4				600			200		100	900	-0.014	0.030	0.023	0.075			3.8			
W2510SS-1P-C5Z4				1 000			200		100	1 300	-0.024	0.040	0.027	0.120			5.2			
W2503SS-2P-C5Z5	9.5	5.5	M6×1	300	25	40	200	22.2	—	500	-0.007	0.023	0.018	0.040	0.015	0.011	2.5	2 800	5.2	2.6
W2505SS-1P-C5Z5				500			200		50	750	-0.012	0.027	0.020	0.060			3.4			
W2508SS-1P-C5Z5				800			250		100	1 150	-0.019	0.035	0.025	0.090			4.8			
W2512SS-1P-C5Z5				1 200			300		100	1 600	-0.029	0.046	0.030	0.120			6.3			
W2504SS-1P-C5Z6	9.5	5.5	M6×1	400	25	40	200	21.4	—	600	-0.010	0.025	0.020	0.050	0.019	0.013	3.0	2 800	7.0	3.5
W2508SS-2P-C5Z6				800			250		100	1 150	-0.019	0.035	0.025	0.090			4.8			
W2512SS-2P-C5Z6				1 200			300		100	1 600	-0.029	0.046	0.030	0.120			6.3			

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the $d{\cdot}n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Screw shaft ø25
Lead 5, 10



Nut: ZFD



View X-X

Unit: mm

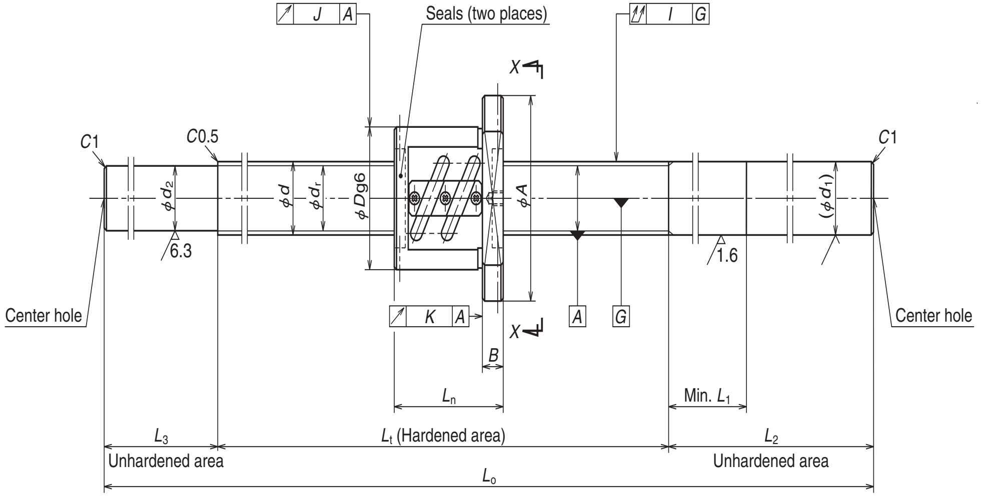
Model No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Preload	Dynamic friction torque, median	Nut dimensions										Screw shaft dimensions							Lead accuracy			Run-out			Mass	Permissible rotational speed	Nut internal space	Standard grease replenishment
							Turns × Circuits	Dynamic	Static	(N)		Outside dia.	Flange			Overall length	Bolt hole		Bolt hole		Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out		(kg)	N (min^{-1})	(cm³)	(cm³)
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}		(N·cm)	D	A	G	B	L_n	W	X	Y	Z	Q	L_t	d_1	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K				
W2502SS-1ZY-C5Z5	184	25	5	3.175	25.75	22.4	1×3	11 600	22 900	740	13.8	40	63	24	11	66	51	5.5	9.5	5.5	M6×1	250	25	40	200	22.4	—	450	-0.005	0.023	0.018	0.040	0.015	0.011	2.1	2 800	5.4	2.7
W2504SS-3ZY-C5Z5	334																					400			200		50	650	-0.009	0.025	0.020	0.060			2.8			
W2506SS-2ZY-C5Z5	534																					600			250		100	950	-0.013	0.030	0.023	0.075			3.9			
W2509SS-1ZY-C5Z5	834																					900			250		100	1 250	-0.021	0.040	0.027	0.090			4.9			
W2512SS-3ZY-C5Z5	1 134																					1 200			300		100	1 600	-0.028	0.046	0.030	0.120			6.2			
W2504SS-4ZY-C5Z10	312	25	10	4.762	26.25	21.3	1×2	13 300	21 200	880	21.5	42	69	26	15	88	55	6.6	11	6.5	M6×1	400	25	60	200	21.3	50	650	-0.008	0.025	0.020	0.060	0.015	0.011	3.0	2 800	9.0	4.5
W2506SS-3ZY-C5Z10	512																					600			250		100	950	-0.012	0.030	0.023	0.075			4.1			
W2508SS-3ZY-C5Z10	712																					800			250		100	1 150	-0.017	0.035	0.025	0.090			4.8			
W2511SS-1ZY-C5Z10	1 012																					1 100			300		100	1 500	-0.024	0.046	0.030	0.120			6.0			
W2515SS-2ZY-C5Z10	1 412																					1 500			300		100	1 900	-0.034	0.054	0.035	0.150			7.4			

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the *d·n* value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

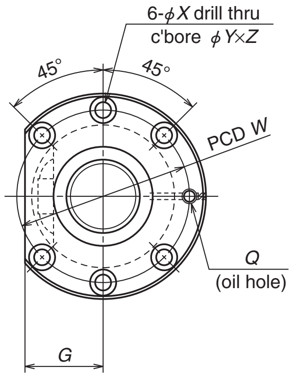
Blank Shaft End SS Model (Fine lead: Tube Recirculation)

Nut: PFT

Screw shaft ø25
Lead 10
Screw shaft ø28
Lead 5, 6



Nut: PFT



View X-X

Unit: mm

Model No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns Turns × Circuits	Basic load ratings (N)		Preload	Dynamic friction torque, median	Nut						
								Dynamic	Static	(N)	(N·cm)	Outside dia.	Flange			Overall length	Bolt hole	
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n	W	X
W2504SS-2P-C5Z10	319	25	10	4.762	25.5	20.5	1.5x2	13 600	18 900	590	13.8	58	85	32	15	81	71	6.6
W2507SS-1P-C5Z10	619																	
W2510SS-2P-C5Z10	919																	
W2515SS-1P-C5Z10	1 419																	
W2804SS-1P-C5Z5	344	28	5	3.175	28.5	25.2	2.5x2	13 000	24 400	540	9.8	55	85	31	12	56	69	6.6
W2806SS-1P-C5Z5	544																	
W2808SS-1P-C5Z5	744																	
W2812SS-1P-C5Z5	1 144																	
W2804SS-3P-C5Z6	337	28	6	3.175	28.5	25.2	2.5x2	12 900	24 300	540	10.8	55	85	31	12	63	69	6.6
W2806SS-3P-C5Z6	537																	
W2808SS-3P-C5Z6	737																	
W2812SS-3P-C5Z6	1 137																	

Model No.	dimensions			Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min^{-1})	Nut internal space (cm^3)	Standard grease replenishment (cm^3)
	Bolt hole		Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out					
	Y	Z	Q	L_t	d_1	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K				
W2504SS-2P-C5Z10	11	6.5	M6×1	400	25	60	200	20.5	50	650	–0.010	0.025	0.020	0.060	0.019	0.013	3.8	2 800	9.7	4.9
W2507SS-1P-C5Z10				700			250		100	1 050	–0.017	0.035	0.025	0.090			5.1			
W2510SS-2P-C5Z10				1 000			250		100	1 350	–0.024	0.040	0.027	0.120			6.1			
W2515SS-1P-C5Z10				1 500			300		100	1 900	–0.036	0.054	0.035	0.150			8.0	2 050		
W2804SS-1P-C5Z5	11	6.5	M6×1	400	28	40	200	25.2	—	600	–0.010	0.025	0.020	0.050	0.019	0.013	3.7	2 500	6.1	3.1
W2806SS-1P-C5Z5				600			250		100	950	–0.014	0.030	0.023	0.075			5.2			
W2808SS-1P-C5Z5				800			250		100	1 150	–0.019	0.035	0.025	0.090			6.1			
W2812SS-1P-C5Z5				1 200			300		100	1 600	–0.029	0.046	0.030	0.120			8.1			
W2804SS-3P-C5Z6	11	6.5	M6×1	400	28	40	200	25.2	—	600	–0.010	0.025	0.020	0.050	0.019	0.013	3.8	2 500	6.1	3.1
W2806SS-3P-C5Z6				600			250		100	950	–0.014	0.030	0.023	0.075			5.3			
W2808SS-3P-C5Z6				800			250		100	1 150	–0.019	0.035	0.025	0.090			6.2			
W2812SS-3P-C5Z6				1 200			300		100	1 600	–0.029	0.046	0.030	0.120			8.2			

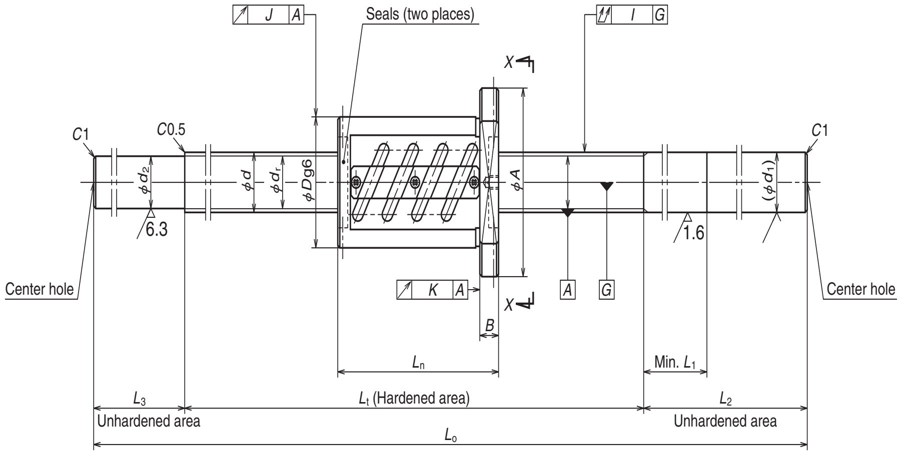
Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the $d \cdot n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Blank Shaft End SS Model (Fine lead: Tube Recirculation)

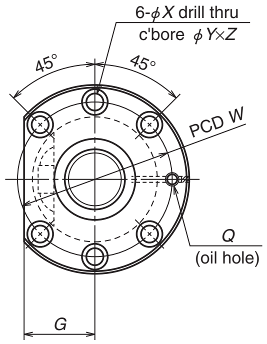
Nut: ZFT

Screw shaft ø28

Lead 5, 6



Nut: ZFT



View X-X

Unit: mm

Model No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns Turns × Circuits	Basic load ratings (N)		Preload	Dynamic friction torque, median	Nut							dimensions			Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N(min^{-1})	Nut internal space (cm^3)	Standard grease replenishment (cm^3)
								Dynamic	Static	(N)	(N·cm)	Outside dia.	Flange			Overall length	Bolt hole		Bolt hole		Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out					
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n	W	X	Y	Z	Q	L_t	d_1	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K				
W2804SS-2Z-C5Z5	314	28	5	3.175	28.5	25.2	2.5×2	20 600	48 700	1 225	21.5	55	85	31	12	86	69	6.6	11	6.5	M6×1	400	28	40	200	25.2	—	600	–0.010	0.025	0.020	0.050	0.019	0.013	4.7	2 500	9.2	4.6
W2806SS-2Z-C5Z5	514																					600			250		100	950	–0.014	0.030	0.023	0.075			5.5			
W2808SS-2Z-C5Z5	714																					800			250		100	1 150	–0.019	0.035	0.025	0.090			6.4			
W2812SS-2Z-C5Z5	1 114																					1 200			300		100	1 600	–0.029	0.046	0.030	0.120			8.4			
W2804SS-4Z-C5Z6	301	28	6	3.175	28.5	25.2	2.5×2	20 600	48 700	1 225	22.5	55	85	31	12	99	69	6.6	11	6.5	M6×1	400	28	40	200	25.2	—	600	–0.010	0.025	0.020	0.050	0.019	0.013	4.2	2 500	9.5	4.8
W2806SS-4Z-C5Z6	501																					600			250		100	950	–0.014	0.030	0.023	0.075			5.7			
W2808SS-4Z-C5Z6	701																					800			250		100	1 150	–0.019	0.035	0.025	0.090			6.6			
W2812SS-4Z-C5Z6	1 101																					1 200			300		100	1 600	–0.029	0.046	0.030	0.120			8.6			

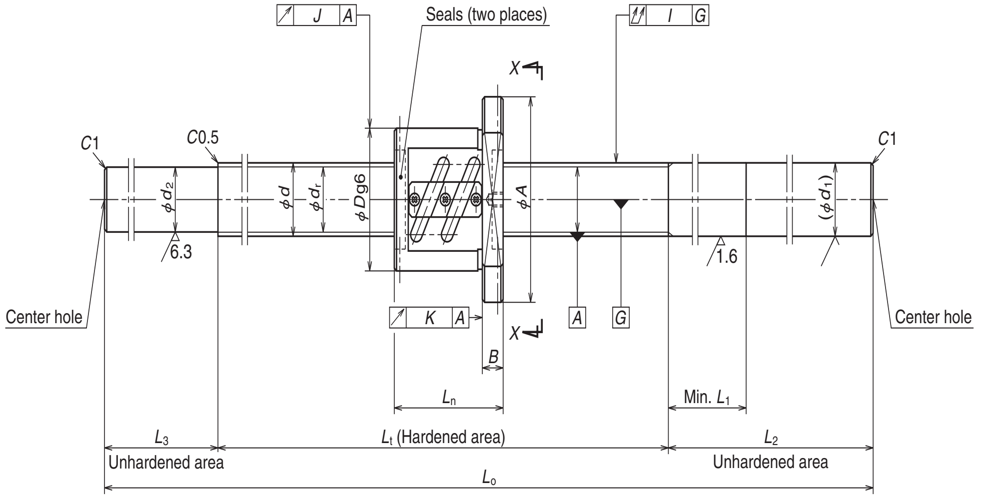
Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the *d·n* value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Blank Shaft End SS Model (Fine lead: Tube Recirculation)

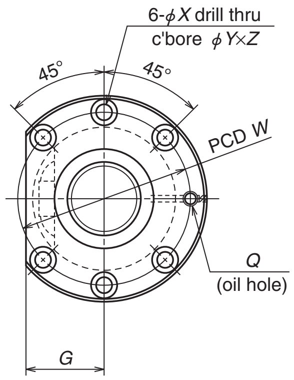
Nut: PFT

Screw shaft ø32

Lead 5, 6



Nut: PFT



View X-X

Reference No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut				
							Turns × Circuits	Dynamic	Static			Outside dia.	Flange			Overall length
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n
W3204SS-1P-C5Z5	344	32	5	3.175	32.5	29.2	2.5×2	13 700	28 000	590	10.8	58	85	32	12	56
W3206SS-1P-C5Z5	544															
W3208SS-1P-C5Z5	744															
W3212SS-1P-C5Z5	1 144															
W3215SS-1P-C5Z5	1 444															
W3206SS-3P-C5Z6	537	32	6	3.969	32.5	28.4	2.5×2	18 300	34 700	780	15.6	62	89	34	12	63
W3210SS-1P-C5Z6	937															
W3215SS-3P-C5Z6	1 437															

Unit: mm

Reference No.	dimensions					Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min-1)	Nut internal space (cm3)	Standard grease replenishment (cm3)
	Bolt hole				Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out					
	W	X	Y	Z	Q	L_t	d_1	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K				
W3204SS-1P-C5Z5	71	6.6	11	6.5	M6×1	400	32	40	200	29.2	50	650	-0.010	0.025	0.020	0.060	0.019	0.013	4.8	2 180	6.9	3.5
W3206SS-1P-C5Z5						600			250		100	950	-0.014	0.030	0.023	0.075			6.5			
W3208SS-1P-C5Z5						800			250		100	1 150	-0.019	0.035	0.025	0.090			7.7			
W3212SS-1P-C5Z5						1 200			300		100	1 600	-0.029	0.046	0.030	0.120			10.3			
W3215SS-1P-C5Z5						1 500			300		100	1 900	-0.036	0.054	0.035	0.150			12.1			
W3206SS-3P-C5Z6	75	6.6	11	6.5	M6×1	600	32	40	250	28.4	100	950	-0.014	0.030	0.023	0.075	0.019	0.013	6.7	2 180	9.4	4.7
W3210SS-1P-C5Z6						1 000			300			1 400	-0.024	0.040	0.027	0.120			9.2			
W3215SS-3P-C5Z6						1 500			300			1 900	-0.036	0.054	0.035	0.150			12.1			

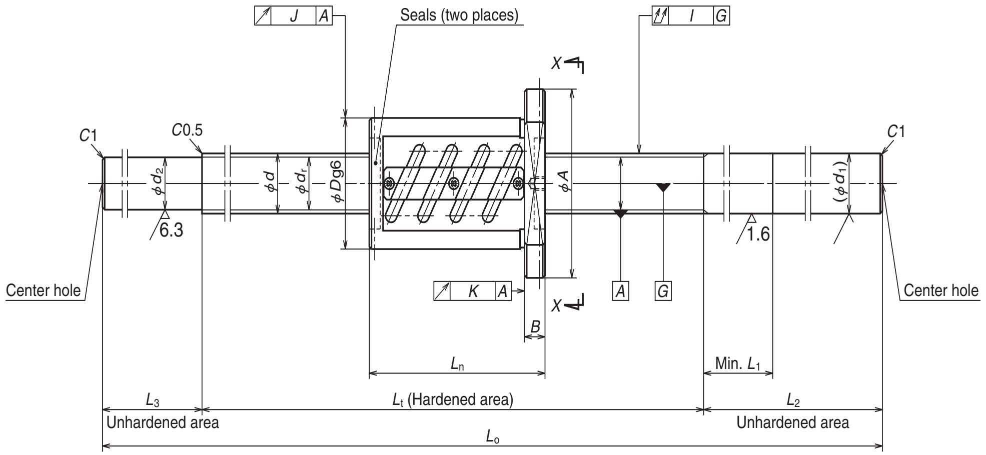
Notes: 1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the *d·n* value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Blank Shaft End SS Model (Fine lead: Tube Recirculation)

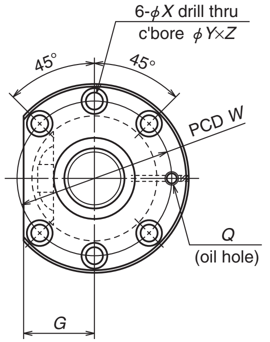
Nut: ZFT

Screw shaft ø32

Lead 5, 6, 8



Nut: ZFT



View X-X

Unit: mm

Reference No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Preload	Dynamic friction torque, median	Nut				
							Turns × Circuits	Dynamic	Static	(N)	(N·cm)	Outside dia.	Flange			Overall length
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n
W3204SS-2Z-C5Z5	314	32	5	3.175	32.5	29.2	2.5×2	21 800	56 000	1 270	22.5	58	85	32	12	86
W3206SS-2Z-C5Z5	514															
W3208SS-2Z-C5Z5	714															
W3212SS-2Z-C5Z5	1 114															
W3215SS-2Z-C5Z5	1 414															
W3206SS-4Z-C5Z6	501	32	6	3.969	32.5	28.4	2.5×2	29 100	69 300	1 720	34.5	62	89	34	12	99
W3210SS-2Z-C5Z6	901															
W3215SS-4Z-C5Z6	1 401															
W3206SS-5Z-C5Z8	518	32	8	4.762	32.5	27.5	2.5×1	20 600	40 900	1 320	30.5	66	100	38	15	82
W3210SS-3Z-C5Z8	918															
W3215SS-5Z-C5Z8	1 418															

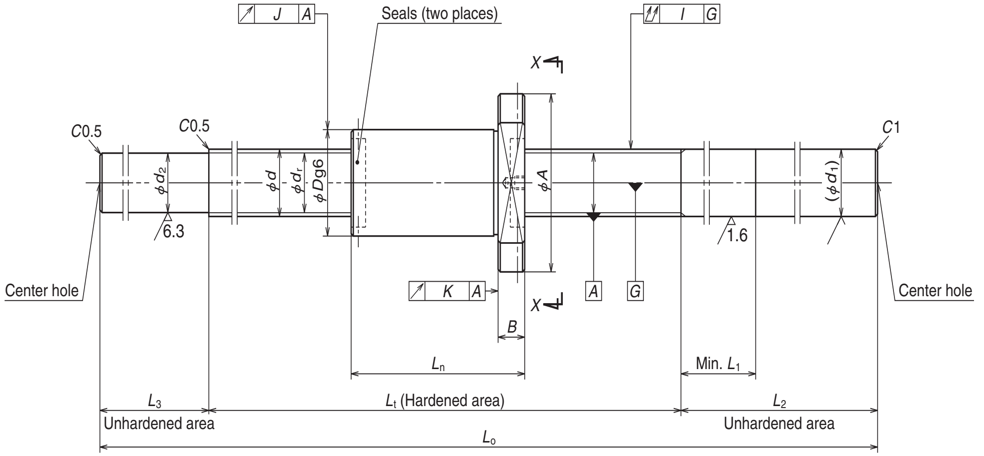
Reference No.	dimensions					Screw shaft dimensions							Lead accuracy			Run-out			Mass	Permissible rotational speed	Nut internal space	Standard grease replenishment
	Bolt hole				Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out		(kg)	N (min^{-1})	(cm^3)	(cm^3)
	W	X	Y	Z	Q	L_t	d_1	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K				
W3204SS-2Z-C5Z5	71	6.6	11	6.5	M6×1	400	32	40	200	29.2	50	650	-0.010	0.025	0.020	0.060	0.019	0.013	5.1	2 180	10	5.0
W3206SS-2Z-C5Z5						600			250		100	950	-0.014	0.030	0.023	0.075			6.9			
W3208SS-2Z-C5Z5						800			250		100	1 150	-0.019	0.035	0.025	0.090			8.0			
W3212SS-2Z-C5Z5						1 200			300		100	1 600	-0.029	0.046	0.030	0.120			10.1			
W3215SS-2Z-C5Z5						1 500			300		100	1 900	-0.036	0.054	0.035	0.150			12.4			
W3206SS-4Z-C5Z6	75	6.6	11	6.5	M6×1	600	32	40	250	28.4	100	950	-0.014	0.030	0.023	0.075	0.019	0.013	7.1	2 180	15	7.5
W3210SS-2Z-C5Z6						1 000			300		100	1 400	-0.024	0.040	0.027	0.120			9.7			
W3215SS-4Z-C5Z6						1 500			300		100	1 900	-0.036	0.054	0.035	0.150			12.6			
W3206SS-5Z-C5Z8	82	9	14	8.5	M6×1	600	32	50	250	27.5	100	950	-0.014	0.030	0.023	0.075	0.019	0.013	7.3	2 180	7.9	4.0
W3210SS-3Z-C5Z8						1 000			300		100	1 400	-0.024	0.040	0.027	0.120			9.8			
W3215SS-5Z-C5Z8						1 500			300		100	1 900	-0.036	0.054	0.035	0.150			12.6			

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the $d{\cdot}n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

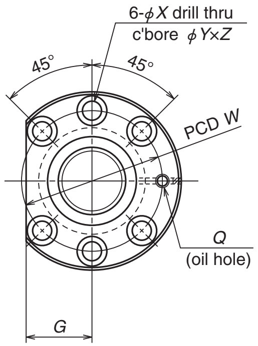
Blank Shaft End SS Model (Fine lead: Deflector (bridge) Recirculation)

Nut: ZFD

Screw shaft ø32
Lead 5, 10



Nut: ZFD



View X-X

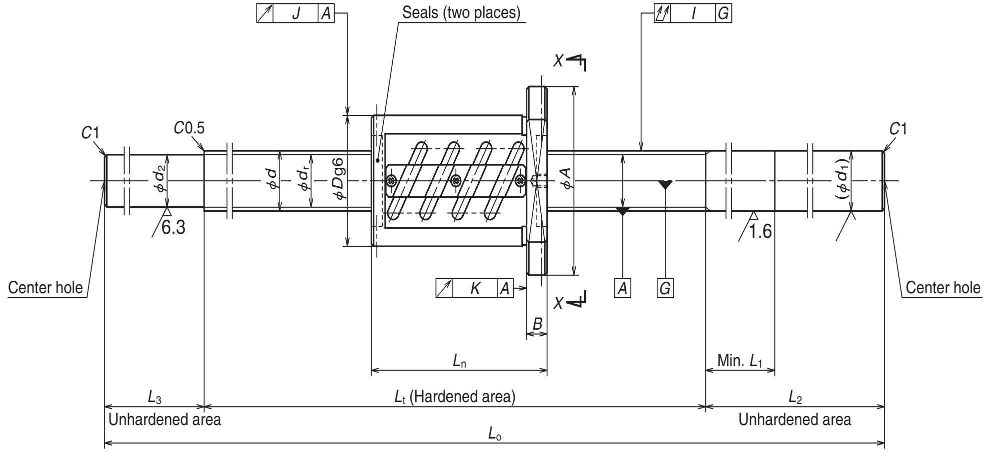
Unit: mm

Reference No.	Stroke Max. L_t-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load ratings (N) Dynamic C_a	Basic load ratings (N) Static C_{0a}	Preload (N)	Dynamic friction torque, median (N·cm)	Nut Outside dia. D	Nut Flange A	Nut Flange G	Nut Flange B	Nut Overall length L_n
W3204SS-3ZY-C5Z5	323	32	5	3.175	32.75	29.4	4	16 800	40 600	1 080	19.6	48	75	29	12	77
W3206SS-6ZY-C5Z5	523															
W3209SS-1ZY-C5Z5	823															
W3212SS-3ZY-C5Z5	1 123															
W3216SS-1ZY-C5Z5	1 523															
W3205SS-3ZY-C5Z10	380	32	10	6.35	33.75	27.1	3	30 500	52 500	1 860	49.0	54	88	34	15	120
W3207SS-3ZY-C5Z10	580															
W3210SS-6ZY-C5Z10	880															
W3214SS-3ZY-C5Z10	1 280															
W3218SS-3ZY-C5Z10	1 680															

Reference No.	Nut dimensions Bolt hole W	Bolt hole X	Bolt hole Y	Bolt hole Z	Oil hole Q	Screw shaft dimensions Threaded length L_t	Shaft end, right d_1	Shaft end, right L_1	Shaft end, right L_2	Shaft end, left d_2	Shaft end, left L_3	Overall length L_o	Lead accuracy Travel compensation T	Lead accuracy Deviation e_p	Lead accuracy Variation υ_u	Run-out Shaft straightness I	Radial run-out J	Radial run-out K	Mass (kg)	Permissible rotational speed N (min^{-1})	Nut internal space (cm^3)	Standard grease replenishment (cm^3)
W3204SS-3ZY-C5Z5	61	6.6	11	6.5	M6x1	400	32	40	200	29.4	50	650	-0.009	0.025	0.020	0.060	0.015	0.011	4.6	2 180	22	11
W3206SS-6ZY-C5Z5						600			250		100	950	-0.013	0.030	0.023	0.075			6.4			
W3209SS-1ZY-C5Z5						900			250		100	1 250	-0.021	0.040	0.027	0.090			8.1			
W3212SS-3ZY-C5Z5						1 200			300		100	1 600	-0.028	0.046	0.030	0.120			10.2			
W3216SS-1ZY-C5Z5						1 600			300		100	2 000	-0.037	0.054	0.035	0.150			12.6			
W3205SS-3ZY-C5Z10	70	9	14	8.5	M6x1	500	32	60	250	27.1	100	850	-0.010	0.027	0.020	0.075	0.019	0.013	6.2	2 180	23	12
W3207SS-3ZY-C5Z10						700			250		100	1 050	-0.015	0.035	0.025	0.090			7.3			
W3210SS-6ZY-C5Z10						1 000			300		100	1 400	-0.022	0.040	0.027	0.120			9.3			
W3214SS-3ZY-C5Z10						1 400			350		120	1 870	-0.032	0.054	0.035	0.150			11.9			
W3218SS-3ZY-C5Z10						1 800			350		120	2 270	-0.041	0.065	0.040	0.200			14.1			

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the *d·n* value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Blank Shaft End SS Model (Fine lead: Tube Recirculation)

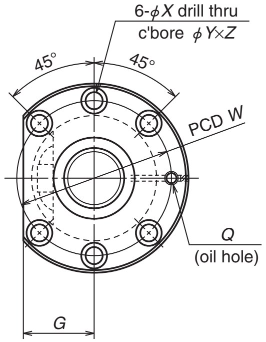


Nut: ZFT

Nut: ZFT

NSK

Screw shaft ø32, ø36
Lead 10
Screw shaft ø40
Lead 5



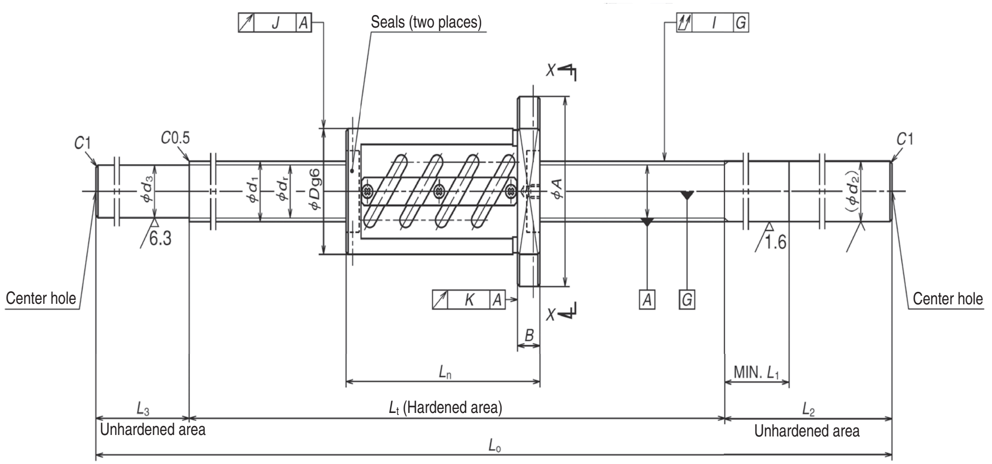
View X-X

Unit: mm

Reference No.	Stroke Max. L_t-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load ratings (N) Dynamic C_a	Basic load ratings (N) Static C_{0a}	Preload (N)	Dynamic friction torque, median (N·cm)	Nut Outside dia. D	Nut Flange A	Nut Flange G	Nut Flange B	Nut Overall length L_n
W3205SS-1Z-C5Z10	400	32	10	6.350	33	26.4	2.5×1	30 000	55 100	1 960	50	74	108	41	15	100
W3207SS-1Z-C5Z10	600															
W3210SS-4Z-C5Z10	900															
W3214SS-1Z-C5Z10	1 300															
W3218SS-1Z-C5Z10	1 700															
W3607SS-1Z-C5Z10	597	36	10	6.350	37	30.4	2.5×1	32 000	61 100	2 060	56	75	120	45	18	103
W3612SS-1Z-C5Z10	1 097															
W3620SS-1Z-C5Z10	1 897															
W4006SS-1Z-C5Z5	511	40	5	3.175	40.5	37.2	2.5×2	23 900	70 500	1 420	28.5	67	101	39	15	89
W4010SS-1Z-C5Z5	911															
W4016SS-1Z-C5Z5	1 511															

Reference No.	dimensions Bolt hole W	Bolt hole X	Bolt hole Y	Bolt hole Z	Oil hole Q	Screw shaft dimensions Threaded length L_t	Shaft end, right d_1	Shaft end, right L_1	Shaft end, right L_2	Shaft end, left d_2	Shaft end, left L_3	Overall length L_o	Lead accuracy Travel compensation T	Deviation e_p	Variation υ_u	Run-out Shaft straightness I	Radial run-out J	Radial run-out K	Mass (kg)	Permissible rotational speed N (min^{-1})	Nut internal space (cm^3)	Standard grease replenishment (cm^3)
W3205SS-1Z-C5Z10	90	9	14	8.5	M6×1	500	32	60	250	26.4	100	850	-0.012	0.027	0.020	0.075	0.019	0.013	7.5	2 180	22	11
W3207SS-1Z-C5Z10						700			250		100	1 050	-0.017	0.035	0.025	0.090			8.5			
W3210SS-4Z-C5Z10						1 000			300		100	1 400	-0.024	0.040	0.027	0.120			10.5			
W3214SS-1Z-C5Z10						1 400			350		120	1 870	-0.034	0.054	0.035	0.150			13.1			
W3218SS-1Z-C5Z10						1 800			350		120	2 270	-0.043	0.065	0.040	0.200			15.2	1 820		
W3607SS-1Z-C5Z10	98	11	17.5	11	M6×1	700	36	60	300	30.4	100	1 100	-0.017	0.035	0.025	0.065	0.019	0.013	10.9	1 940	27	14
W3612SS-1Z-C5Z10						1 200			350		120	1 670	-0.029	0.046	0.030	0.100			14.9			
W3620SS-1Z-C5Z10						2 000			350		120	2 470	-0.048	0.065	0.040	0.130			20.4			
W4006SS-1Z-C5Z5	83	9	14	8.5	Rc1/8	600	40	50	300	37.2	100	1 000	-0.014	0.030	0.023	0.050	0.019	0.013	11.1	1 750	14	7.0
W4010SS-1Z-C5Z5						1 000			300			1 400	-0.024	0.040	0.027	0.080			14.8			
W4016SS-1Z-C5Z5						1 600			350			2 050	-0.038	0.054	0.035	0.130			20.8			

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the $d{\cdot}n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

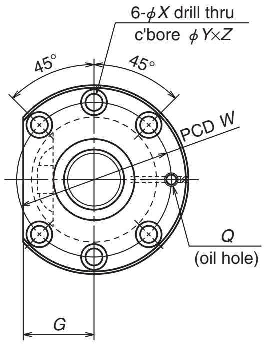


Nut: ZFT

Reference No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut				
							Turns × Circuits	Dynamic	Static			Outside dia.	Flange			Overall length
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n
W3205SS-4Z-C5Z10	310	32	10	6.350	33	26.4	2.5×2	54 500	110 000	2 320	59	74	108	41	15	160
W3207SS-4Z-C5Z10	510															
W3210SS-7Z-C5Z10	810															
W3214SS-4Z-C5Z10	1 210															
W3218SS-4Z-C5Z10	1 610															
W3607SS-3Z-C5Z10	507	36	10	6.350	37	30.4	2.5×2	58 000	122 000	2 470	67	75	120	45	18	163
W3612SS-3Z-C5Z10	1 007															
W3620SS-3Z-C5Z10	1 807															

Notes:
1. We recommend using NSK support units. See Page B389 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the *d·n* value, critical speed, and maximum rotational speed. See Pages B47 and B299 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Screw shaft ø32, ø36
Lead 10



View X-X

Unit: mm

Reference No.	dimensions					Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min⁻¹)	Nut internal space (cm³)	Standard grease replenishment (cm³)
	Bolt hole				Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out					
	W	X	Y	Z	Q	L_t	d_1	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K				
W3205SS-4Z-C5Z10	90	9	14	8.5	M6×1	500	32	60	250	26.4	100	850	-0.012	0.027	0.020	0.075	0.019	0.013	9.5	2 180	57	29
W3207SS-4Z-C5Z10						700			250		100	1 050	-0.017	0.035	0.025	0.090			10.6			
W3210SS-7Z-C5Z10						1 000			300		100	1 400	-0.024	0.040	0.027	0.120			12.5			
W3214SS-4Z-C5Z10						1 400			350		120	1 870	-0.034	0.054	0.035	0.150			15.1			
W3218SS-4Z-C5Z10						1 800			350		120	2 270	-0.043	0.065	0.040	0.200			17.2	1 910		
W3607SS-3Z-C5Z10	98	11	17.5	11	M6×1	700	36	60	300	30.4	100	1 100	-0.017	0.035	0.025	0.065	0.019	0.013	12.8	1 940	67	34
W3612SS-3Z-C5Z10						1 200			350		120	1 670	-0.029	0.046	0.030	0.100			16.8			
W3620SS-3Z-C5Z10						2 000			350		120	2 470	-0.048	0.065	0.040	0.130			22.3			

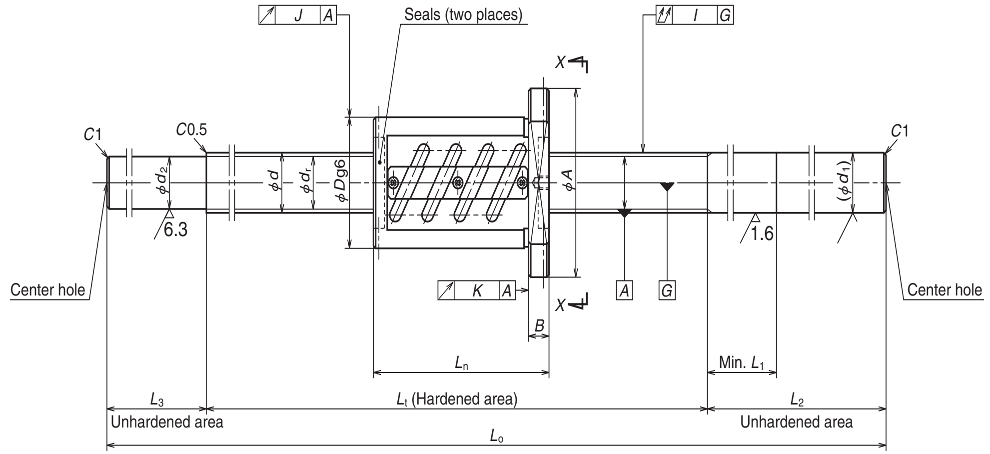
Blank Shaft End SS Model (Fine lead: Tube Recirculation)

Nut: ZFT

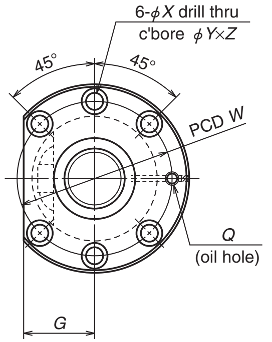
NSK

Screw shaft ø40

Lead 8, 10, 12



Nut: ZFT



View X-X

Unit: mm

Reference No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut					dimensions					Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min^{-1})	Nut internal space (cm^3)	Standard grease replenishment (cm^3)
							Turns × Circuits	Dynamic	Static			Outside dia.	Flange			Overall length	Bolt hole				Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out					
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n	W	X	Y	Z	Q	L_t	d_1	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K				
W4007SS-1Z-C5Z8	570	40	8	4.762	40.5	35.5	2.5×2	41 100	103 000	2 450	64	74	108	41	15	130	90	9	14	8.5	Rc1/8	700	40	50	300	35.5	100	1 100	−0.017	0.035	0.025	0.065	0.019	0.013	13.0	1 750	27	14
W4012SS-1Z-C5Z8	1 070																					1 200			350		100	1 650	−0.029	0.046	0.030	0.100			18.0			
W4018SS-1Z-C5Z8	1 670																					1 800			350		120	2 270	−0.043	0.065	0.040	0.130			23.5			
W4007SS-2Z-C5Z10	597	40	10	6.350	41	34.4	2.5×1	33 700	68 300	2 160	64	82	124	47	18	103	102	11	17.5	11	Rc1/8	700	40	60	300	34.4	100	1 100	−0.017	0.035	0.025	0.065	0.025	0.015	13.3	1 750	30	15
W4010SS-2Z-C5Z10	897																					1 000			300		100	1 400	−0.024	0.040	0.027	0.080			15.9			
W4014SS-1Z-C5Z10	1 297																					1 400			350		120	1 870	−0.034	0.054	0.035	0.100			20.0			
W4018SS-2Z-C5Z10	1 697																					1 800			350		120	2 270	−0.043	0.065	0.040	0.130			23.4			
W4024SS-1Z-C5Z10	2 297																					2 400			400		150	2 950	−0.058	0.077	0.046	0.170			29.4			
W4010SS-4Z-C5Z12	883	40	12	7.144	41.5	34.1	2.5×1	39 500	77 200	2 550	83	86	128	48	18	117	106	11	17.5	11	Rc1/8	1 000	40	70	300	34.1	100	1 400	−0.024	0.040	0.027	0.080	0.025	0.015	16.7	1 750	35	18
W4016SS-2Z-C5Z12	1 483																					1 600			350		150	2 100	−0.038	0.054	0.035	0.130			22.9			
W4025SS-1Z-C5Z12	2 383																					2 500			400		150	3 050	−0.060	0.077	0.046	0.170			31.1	1 220		

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the $d{\cdot}n$ value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

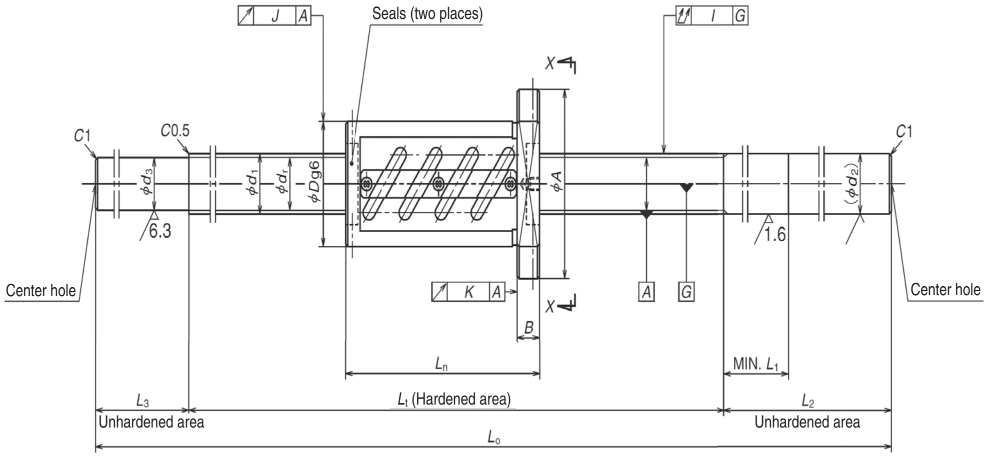
Blank Shaft End SS Model (Fine lead: Tube Recirculation)

Nut: ZFT

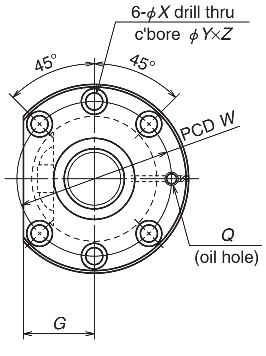
NSK

Screw shaft ø40

Lead 10, 12



Nut: ZFT



View X-X

Unit: mm

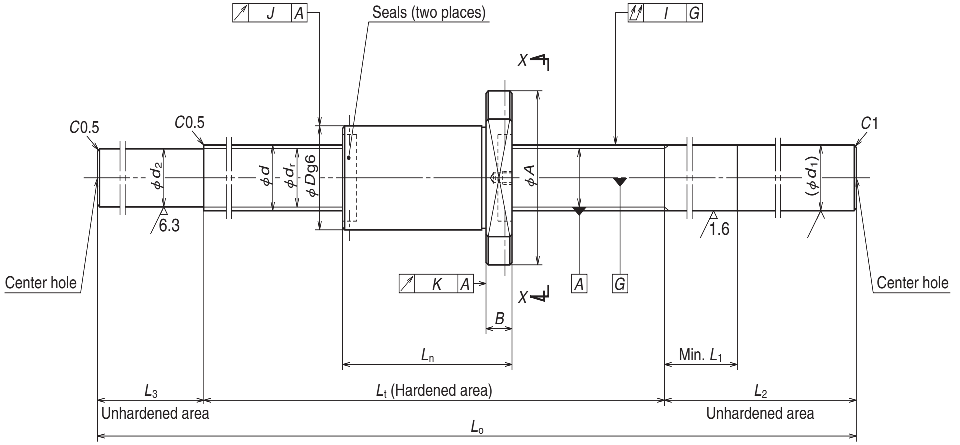
Reference No.	Stroke Max. L_t-L_n	Screw shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns: Turns × Circuits	Basic load ratings (N): Dynamic C_a	Basic load ratings (N): Static C_{0a}	Preload (N)	Dynamic friction torque, median (N·cm)	Nut: Outside dia. D	Nut: Flange A	Nut: Flange G	Nut: Flange B	Nut: Overall length L_n
W4007SS-5Z-C5Z10	507	40	10	6.350	41	34.4	2.5×2	61 200	137 000	2 600	74	82	124	47	18	163
W4010SS-7Z-C5Z10	807															
W4014SS-4Z-C5Z10	1 207															
W4018SS-5Z-C5Z10	1 607															
W4024SS-4Z-C5Z10	2 207															
W4010SS-8Z-C5Z12	775	40	12	7.144	41.5	34.1	2.5×2	71 700	154 000	3 050	96	86	128	48	18	189
W4016SS-4Z-C5Z12	1 375															
W4025SS-3Z-C5Z12	2 275															

Reference No.	Bolt hole W	Bolt hole X	Bolt hole Y	Bolt hole Z	Oil hole Q	Threaded length L_t	Shaft end, right d_1	Shaft end, right L_1	Shaft end, right L_2	Shaft end, left d_2	Shaft end, left L_3	Overall length L_o	Travel compensation T	Deviation e_p	Variation υ_u	Shaft straightness I	Radial run-out J	Radial run-out K	Mass (kg)	Permissible rotational speed N (min^{-1})	Nut internal space (cm^3)	Standard grease replenishment (cm^3)
W4007SS-5Z-C5Z10	102	11	17.5	11	Rc1/8	700	40	60	300	34.4	100	1 100	–0.017	0.035	0.025	0.065	0.025	0.015	15.5	1 750	74	37
W4010SS-7Z-C5Z10						1 000			300		100	1 400	–0.024	0.040	0.027	0.080			18.1			
W4014SS-4Z-C5Z10						1 400			350		120	1 870	–0.034	0.054	0.035	0.100			22.2			
W4018SS-5Z-C5Z10						1 800			350		120	2 270	–0.043	0.065	0.040	0.130			25.6			
W4024SS-4Z-C5Z10						2 400			400		150	2 950	–0.058	0.077	0.046	0.170			31.6	1 370		
W4010SS-8Z-C5Z12	106	11	17.5	11	Rc1/8	1 000	40	70	300	34.1	100	1 400	–0.024	0.040	0.027	0.080	0.025	0.015	19.7	1 750	93	47
W4016SS-4Z-C5Z12						1 600			350		150	2 100	–0.038	0.054	0.035	0.130			25.8			
W4025SS-3Z-C5Z12						2 500			400		150	3 050	–0.060	0.077	0.046	0.170			34.0	1 260		

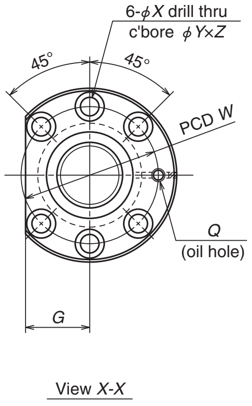
Notes:
1. We recommend using NSK support units. See Page B389 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the *d·n* value, critical speed, and maximum rotational speed. See Pages B47 and B299 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

Screw shaft ø40, ø50

Lead 10



Nut: ZFD



View X-X

Unit: mm

Reference No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut					dimensions					Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min-1)	Nut internal space (cm3)	Standard grease replenishment (cm3)
								Dynamic	Static			Outside dia.	Flange			Overall length	Bolt hole				Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out					
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n	W	X	Y	Z	Q	L_t	d_1	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K				
W4007SS-4ZY-C5Z10	557	40	10	6.350	41.75	35.1	4	45 200	93 100	2 840	83	62	104	40	18	143	82	11	17.5	11	Rc1/8	700	40	60	300	35.1	100	1 100	–0.015	0.035	0.025	0.065	0.019	0.013	12.1	1 750	32	16
W4010SS-6ZY-C5Z10	857																					1 000			300		100	1 400	–0.022	0.040	0.027	0.080			14.7			
W4014SS-3ZY-C5Z10	1 257																					1 400			350		120	1 870	–0.032	0.054	0.035	0.100			18.9			
W4018SS-4ZY-C5Z10	1 657																					1 800			350		120	2 270	–0.041	0.065	0.040	0.130			22.5			
W4024SS-3ZY-C5Z10	2 257																					2 400			400		150	2 950	–0.056	0.077	0.046	0.170			28.5	1 320		
W5007SS-1ZY-C5Z10	557	50	10	6.350	51.75	45.1	4	51 500	122 000	3 240	108	72	114	44	18	143	92	11	17.5	11	Rc1/8	700	50	60	300	45.1	100	1 100	–0.015	0.035	0.025	0.065	0.019	0.013	18.3	1 400	39	20
W5010SS-3ZY-C5Z10	857																					1 000			300		100	1 400	–0.022	0.040	0.027	0.080			22.5			
W5015SS-3ZY-C5Z10	1 357																					1 500			400		150	2 050	–0.034	0.054	0.035	0.130			31.8			
W5020SS-3ZY-C5Z10	1 857																					2 000			400		150	2 550	–0.046	0.065	0.040	0.170			38.9			
W5026SS-3ZY-C5Z10	2 457																					2 600			500		200	3 300	–0.060	0.093	0.054	0.220			49.5			

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the *d·n* value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

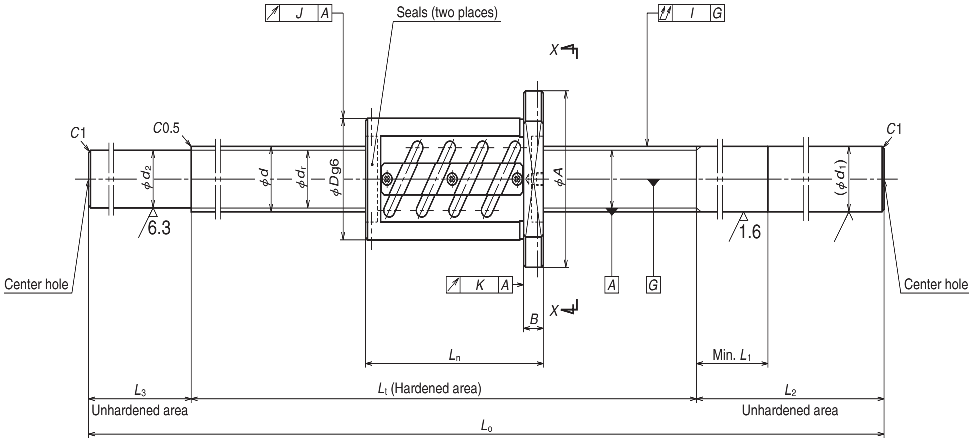
Blank Shaft End SS Model (Fine lead: Tube Recirculation)

Nut: ZFT

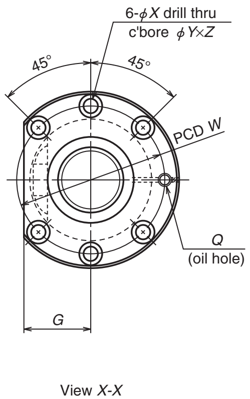
NSK

Screw shaft ø45, ø50

Lead 10



Nut: ZFT



View X-X

Unit: mm

Reference No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut				
							Turns × Circuits	Dynamic	Static			Outside dia.	Flange			Overall length
	L_t-L_n	d	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n
W4510SS-1Z-C5Z10	897	45	10	6.350	46	39.4	2.5×1	36 300	78 500	2 260	69	88	132	50	18	103
W4516SS-1Z-C5Z10	1 497															
W4525SS-1Z-C5Z10	2 397															
W5010SS-1Z-C5Z10	897	50	10	6.350	51	44.4	2.5×1	37 500	87 200	2 450	78	93	135	51	18	103
W5015SS-1Z-C5Z10	1 397															
W5020SS-1Z-C5Z10	1 897															
W5026SS-1Z-C5Z10	2 497															
W5010SS-2Z-C5Z10	837	50	10	6.350	51	44.4	2.5×2	68 100	174 000	4 020	138	93	135	51	18	163
W5015SS-2Z-C5Z10	1 337															
W5020SS-2Z-C5Z10	1 837															
W5026SS-2Z-C5Z10	2 437															

Reference No.	dimensions					Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min^{-1})	Nut internal space (cm^3)	Standard grease replenishment (cm^3)
	Bolt hole				Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Radial run-out					
	W	X	Y	Z	Q	L_t	d_1	L_1	L_2	d_2	L_3	L_o	T	e_p	υ_u	I	J	K				
W4510SS-1Z-C5Z10	110	11	17.5	11	Rc1/8	1 000	45	60	300	39.4	100	1 400	-0.024	0.040	0.027	0.080	0.025	0.015	19.7	1 550	34	17
W4516SS-1Z-C5Z10						1 600			400		150	2 150	-0.038	0.054	0.035	0.130			28.1			
W4525SS-1Z-C5Z10						2 500			450		150	3 100	-0.060	0.077	0.046	0.170			38.8	1 400		
W5010SS-1Z-C5Z10	113	11	17.5	11	Rc1/8	1 000	50	60	300	44.4	100	1 400	-0.024	0.040	0.027	0.080	0.025	0.015	23.8	1 400	37	19
W5015SS-1Z-C5Z10						1 500			400		150	2 050	-0.036	0.054	0.035	0.130			32.9			
W5020SS-1Z-C5Z10						2 000			400		150	2 550	-0.048	0.065	0.040	0.170			39.8			
W5026SS-1Z-C5Z10						2 600			450		150	3 200	-0.062	0.093	0.054	0.220			48.9			
W5010SS-2Z-C5Z10	113	11	17.5	11	Rc1/8	1 000	50	60	300	44.4	100	1 400	-0.024	0.040	0.027	0.080	0.025	0.015	25.5	1 400	59	30
W5015SS-2Z-C5Z10						1 500			400		150	2 050	-0.036	0.054	0.035	0.130			34.6			
W5020SS-2Z-C5Z10						2 000			400		150	2 550	-0.048	0.065	0.040	0.170			41.5			
W5026SS-2Z-C5Z10						2 600			450		150	3 200	-0.062	0.093	0.054	0.220			50.7			

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the *d·n* value, critical speed, and maximum rotational speed. See Pages B47 and B289 for details. The values shown for permissible rotational speed apply when the mounting configuration is Fixed-Fixed.

B-3-1.6 Ball Screws for Transfer Equipment

1. Features

- Transporting mechanism

Models with accuracy grades of Ct7 and Ct10 demonstrate high performance for transport mechanisms in Cartesian robots and single-axis actuators.

We offer a variety of models of ball screws for transfer equipment. VFA and RMA models have finished shaft ends, while RMS and R models with RNFTL, RNFBL, RNCT, RNFCL, and RNSTL ball nuts have blank shaft ends.

Table 1 Classifications of ball screws for transfer equipment

Finished shaft end	VFA model, RMA model
Blank shaft end	RMS model
	R Model
	Nut Assemblies: RNFTL, RNFBL, RNCTL, RNFCL, RNSTL

- Interchangeable screw shaft and ball nut

Screw shaft and nut assembly components are sold separately. The maximum axial play after assembly is shown in the dimension tables.

2. Specifications

(1) Ball recirculation system

Figs. 1, 2, and 3 show the structures of tube, deflector (bridge), and end cap ball recirculation systems.

Deflector (bridge) recirculation systems feature compact nut outside diameters for small leads. End cap recalculation systems suit screws with high helix leads and multiple start threads. Since the leads are up to 3 times larger than the screw shaft diameter, they are well-suited for high speeds.

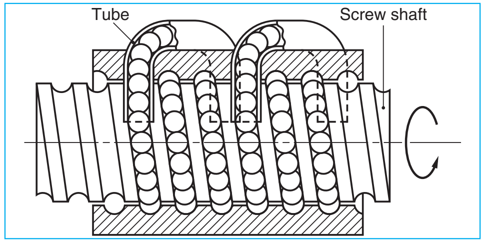


Fig. 1 Structure of tube recirculation system

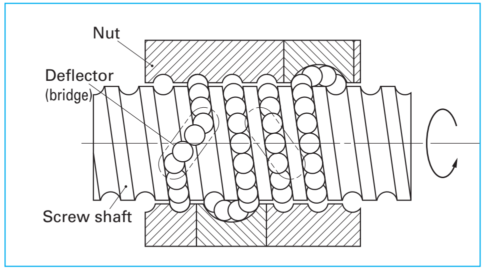


Fig. 2 Structure of deflector (bridge) recirculation system

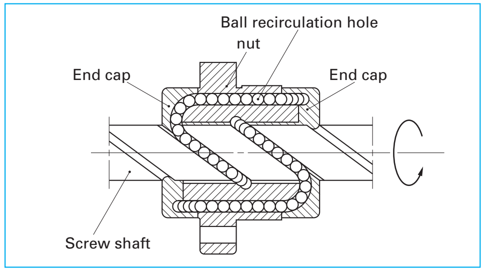


Fig. 3 Structure of end cap recirculation system

(2) Accuracy grade and axial play

Standard lead accuracy and axial play are shown on **Table 2**. Axial play varies with internal specification. Refer to the dimension tables.

Table 2 Accuracy grade and axial play

Accuracy grade	VFA model, RMA model, RMS model: Ct7 R Model: Ct10
Axial play	See dimension tables

(3) Allowable *d·n* value and the criterion of maximum rotational speed

The allowable *d·n* value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Table 3 Allowable *d·n* value and the criterion of maximum rotational speed

Allowable *d·n* value	50 000 or less
Criterion of maximum rotational speed	3 000 min^{-1}

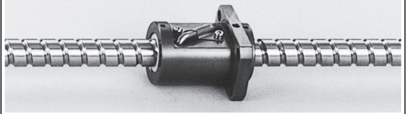
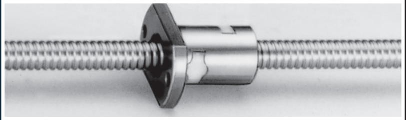
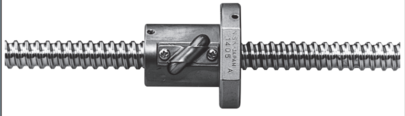
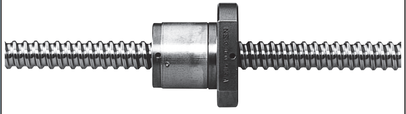
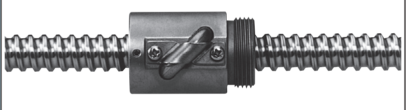
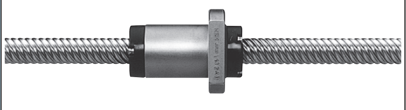
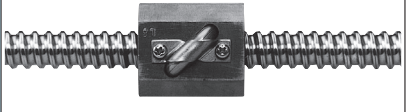
d•n value: shaft dia. d [mm] × rotational speed n [min^{-1}]

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

3. Lineup

Ball screws for transfer equipment are available in the following models:

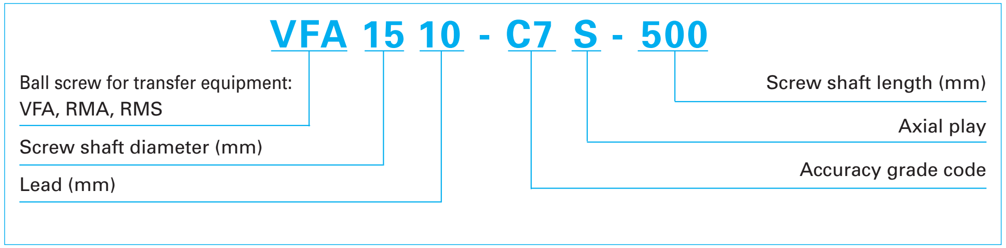
Table 4 Lineup of ball screws for transfer equipment

Nut	Shape	Flange shape	Recirculation system	Preload	Page
VFA		Flanged rectangular	Tube	No preload Slight axial play	B341 – B346
RMA RMS		Flanged Circular Ⅲ	Deflector (bridge)	No preload Slight axial play	B347 – B360
RNFTL		Flanged Circular Ⅰ Projecting tube type	Tube	No preload Slight axial play	B361 – B366
RNFBL		Flanged Circular Ⅱ	Tube	No preload Slight axial play	B367 – B368
RNCT		V-thread (no flange) Projecting tube type	Tube	No preload Slight axial play	B369 – B370
RNFCL		Flanged Circular Ⅲ	End cap	No preload Slight axial play	B371 – B374
RNSTL		Square type	Tube	No preload Slight axial play	B375 – B376

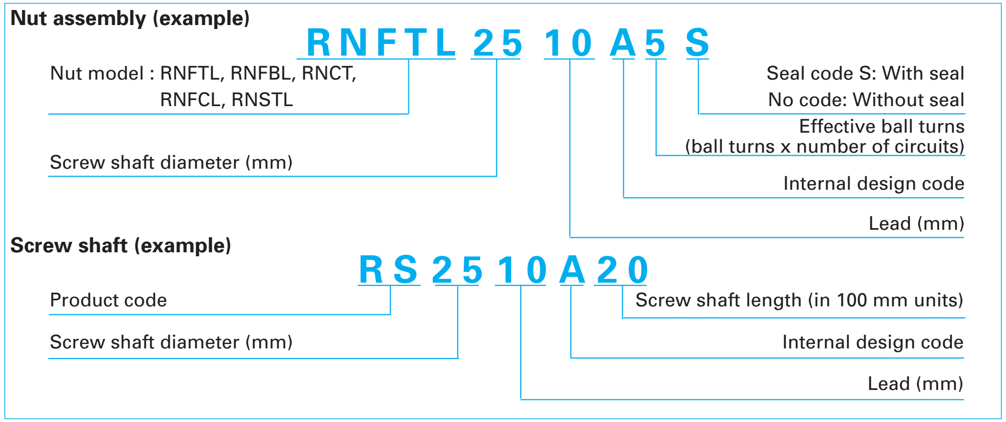
4. Structure of reference number

Ball screws for transfer equipment have the following reference number structures:

◇Reference number for VFA, RMA, and RMS models



◇Reference number for R model



5. Combinations of shaft diameter and lead

Combinations of shaft diameter and lead are shown below.
For details on standard stock products, contact NSK.

Table 5 Combinations of shaft diameter and lead for VFA, RMA, and RMS models

Lead Screw shaft diameter	1	1.5	2	10	20
6	B347, 359				
8	B349, 359	B351, 359	B353, 359		
10			B355, 359		
12			B357, 359	B341	
15				B343	B345

Table 6 Combinations of shaft diameter and lead for R model

Screw shaft diameter (mm)	Lead (mm)														
	3	4	5	6	8	10	12	16	20	25	32	40	50	64	80
10	○B361 △B369			○B361●B367											
12					○B361●B367		○B365◎B371								
14		○B361●B367 △B369□B375	○B361●B367 △B369□B375												
15									◎B371						
16						○B361		○B365 ◎B371			◎B373				
18					○B361●B367 △B369□B375										
20			○B361●B367 △B369□B375			○B361●B367 □B375			○B365 ◎B371			◎B373			
25			○B361●B367 △B369□B375			○B361●B367 △B369□B375				○B365 ◎B371			◎B373		
28				○B363●B367 △B369□B375											
32						○B363●B367 △B369□B375					○B365 ◎B371			◎B373	
36						○B363●B367 △B369□B375									
40						○B363△B369 ●B367						○B365 ◎B371			◎B373
45							○B363 △B369□B375								
50						○B363 △B369		○B363 △B369					◎B371		

○: RNFTL ●: RNFBL △: RNCT ◎: RNFCL □: RNSTL

6. Precautions for design

Please reference the general precautions on Pages B83 and B103.

(1) Nut assembly

The nut assemblies and screw shafts of R models are separate when delivered. The nut assembly comes on an arbor and must be moved onto the screw shaft during mounting.

(a) Consideration to end configuration of screw shaft

The balls may fall out from the nut when moving the assembly from the arbor to the screw shaft if dimensions or shapes are not appropriate.
If the end of the ball groove can touch the end of the arbor, connect both ends and move the assembled nut from the arbor to the screw shaft (**Fig. 4**).
If not, wrap tape around the outside of the ball screw shaft so that tape's thickness matches the outside diameter of the arbor (**Fig. 5**).
If there are gaps or nicks along the groove, fill these before moving the nut.

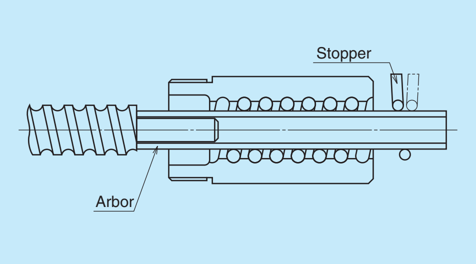


Fig. 4 Inserting nut into screwshaft

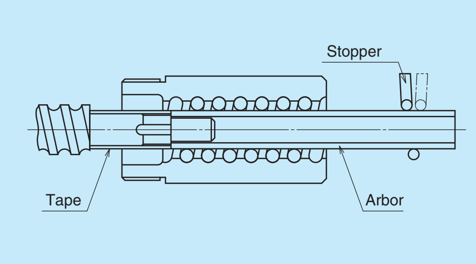


Fig. 5 Arbor and shaft end configuration

(b) Installation of arbor

Confirm the correct nut orientation for installation. Remove the stop ring on the side from where the assembled nut is to be removed. Align the centers of the screw shaft and the arbor while pressing the screw shaft end firmly against the arbor.

(c) Moving the nut

Slide the nut until it lightly touches the ball groove shoulder. With the arbor pressed against the shaft, turn the nut counter to the thread so that it moves onto the screw. Do not separate the arbor from the screw shaft shaft until the ball goove end is completey visible.

(2) Shaft end processing

RMS and R models have blank shaft ends that must be machined. See page B27 for details on shaft end configurations for NSK support units.

(a) Cutting screw shafts

Carry out the same process as that used for machining blank shaft ends for precision ball screws.

(b) Shaft end annealing

Heat the shaft end with an acetylene torch or similar and gradually cool it at room temperature. Note that non-machined areas will lose hardness if heated, which could impact the life of the ball screw. Use water cooling or other means to prevent heat conduction in these areas.

(c) Turning by lathe

Cut to length, process steps, perform triangular threading, and provide the center hole. Refer to JIS B 1192 which specifies shape accuracies.

(d) Processing by grinding

The precautions for centering, securing the nut, and providing a steady rest, etc. are the same as those for cutting. Grind the sections where bearings or Spann rings will be installed.

(e) Milling processing

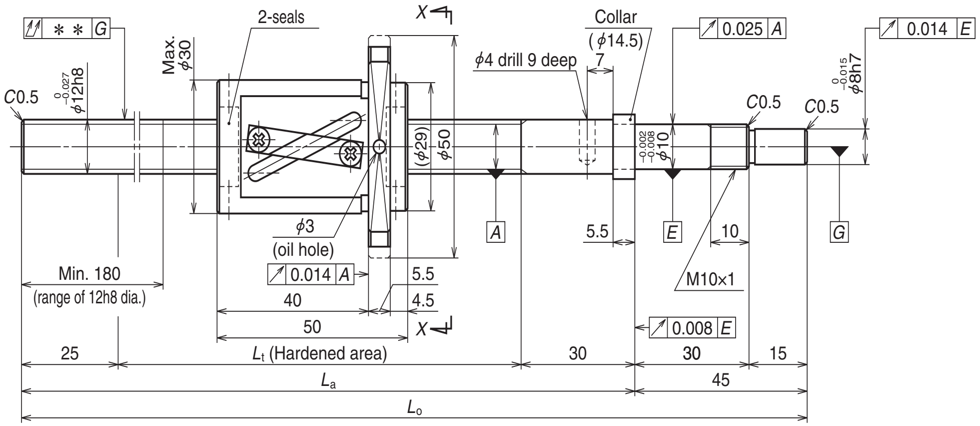
Process keyways and tooth seats for lock washers.

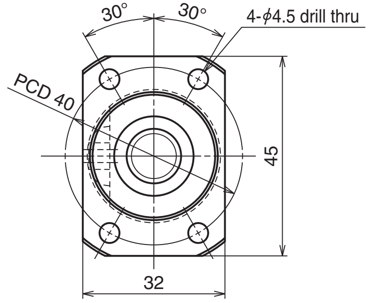
(f) Deburring, washing, and rust prevention

Wash with clean white kerosene after processing is finished. Apply lubricant if the screw will be used immediately; otherwise apply a rust preventive agent. Contact NSK if the nut is accidentally removed from the shaft.

Screw shaft ø12

Lead 10





View *X-X*

Unit: mm

Ball screw specifications		
Shaft dia.xLead / Direction of turn		12 × 10 / Right
Ball recirculation		Tube
Ball dia. / Ball circle dia.		2.381 / 12.5
Screw shaft root dia.		10.0
Effective ball turns		2.5 × 1
Accuracy grade / Axial play code		Ct7 / S
Basic load ratings (N)	Dynamic C_a	4 430
	Static C_{0a}	6 430
Axial play		0.010 or less
Dynamic friction torque (N·cm)		1.5 or less
Spacer ball		None
Factory-packed grease		NSK grease LR3
Nut internal space (cm^3)		1.4
Reference standard grease replenishment		0.7

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK10-01A (square)	WBK12SF-01 (square)
WBK10-11 (round)	

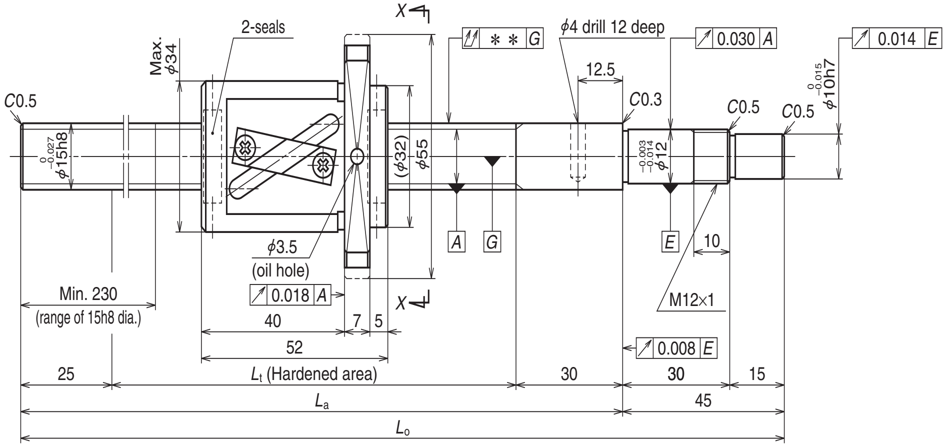
Unit: mm

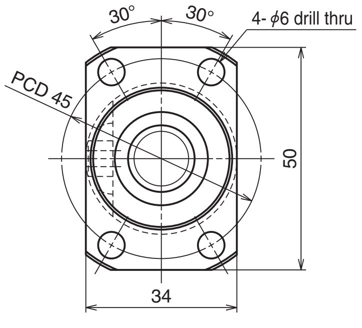
Reference No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out** ⌰	Mass (kg)	Permissible rotational speed N (min^{-1})	
	Nominal	Maximum (L_t-nut length)									Configuration	
			L_t	L_a	L_o	T	e_p	υ_{300}			Fixed - Simple	Fixed - Free
VFA1210C7S-410	250	260	310	365	410	0	0.085	0.052	0.100	0.56	3 000	3 000
VFA1210C7S-610	450	460	510	565	610	0	0.155	0.052	0.160	0.73	3 000	1 300

Notes:
1. We recommend using NSK support units. See Page B377 for details. WBK12SF-01 units (on the simple support side) support the ball screw directly on the shaft outside diameter.
2. We recommend using NSK Grease LR3 filled to about 50% of the ball nut's internal space. See Page D16 for details.
3. Permissible rotational speed is determined by the *d* · *n* value and critical speed. See Pages B47 and B337 for details.

Screw shaft ø15

Lead 10





View *X-X*

Unit: mm

Ball screw specifications		
Shaft dia.xLead / Direction of turn		15 × 10 / Right
Ball recirculation		Tube
Ball dia. / Ball circle dia.		3.175 / 15.5
Screw shaft root dia.		12.2
Effective ball turns		2.5 × 1
Accuracy grade / Axial play code		Ct7 / S
Basic load ratings (N)	Dynamic C_a	8 140
	Static C_{0a}	12 800
Axial play		0.010 or less
Dynamic friction torque (N·cm)		2.5 or less
Spacer ball		None
Factory-packed grease		NSK grease LR3
Nut internal space (cm^3)		2.3
Reference standard grease replenishment		1.2

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK12-01A (square)	WBK15SF-01 (square)
WBK12-11 (round)	

Unit: mm

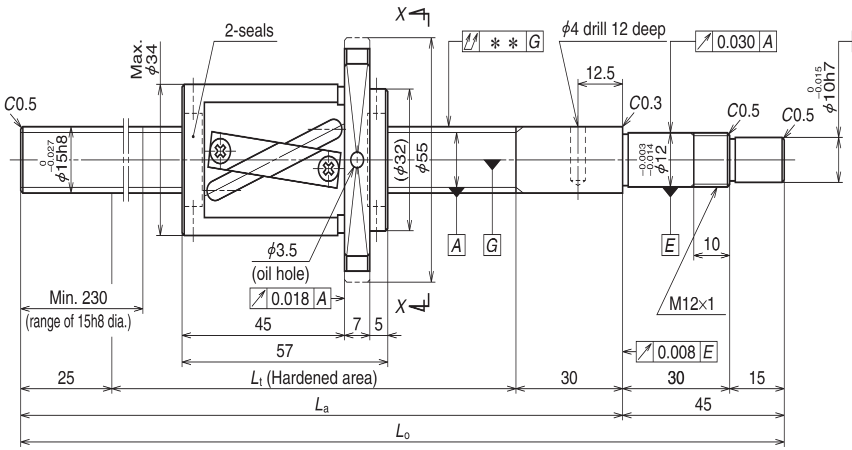
Reference No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out＊＊ ↗↗	Mass (kg)	Permissible rotational speed N (min^{-1}) Configuration	
	Nominal	Maximum (L_t-nut length)	L_t	L_a	L_o	T	e_p	υ_{300}			Fixed - Simple	Fixed - Free
VFA1510C7S-500	300	348	400	455	500	0	0.120	0.052	0.075	0.89	3 000	2 600
VFA1510C7S-700	500	548	600	655	700	0	0.195	0.052	0.110	1.1	3 000	1 150
VFA1510C7S-1000	800	848	900	955	1 000	0	0.310	0.052	0.180	1.5	2 340	510

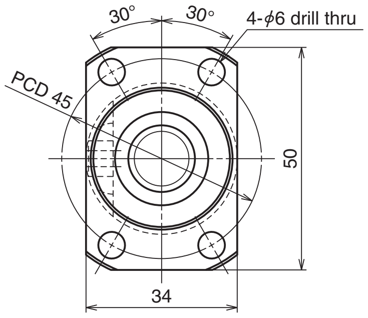
Notes: 1. We recommend using NSK support units. See Page B377 for details. WBK12SF-01 units (on the simple support side) support the ball screw directly on the shaft outside diameter.
2. We recommend using NSK Grease LR3 filled to about 50% of the ball nut's internal space. See Page D16 for details.
3. Permissible rotational speed is determined by the *d* · *n* value and critical speed. See Pages B47 and B337 for details.

Screw shaft ø15

Lead 20

Unit: mm





View X-X

Ball screw specifications		
Shaft dia.xLead / Direction of turn		15 × 20 / Right
Ball recirculation		Tube
Ball dia. / Ball circle dia.		3.175 / 15.5
Screw shaft root dia.		12.2
Effective ball turns		1.5 × 1
Accuracy grade / Axial play code		Ct7 / S
Basic load ratings (N)	Dynamic C_a	5 080
	Static C_{0a}	7 460
Axial play		0.010 or less
Dynamic friction torque (N·cm)		2.5 or less
Spacer ball		None
Factory-packed grease		NSK grease LR3
Nut internal space (cm^3)		2.3
Reference standard grease replenishment		1.4

Recommended support unit

For drive side (Fixed)	For non-drive side (Simple)
WBK12-01A (square)	WBK15SF-01 (square)
WBK12-11 (round)	

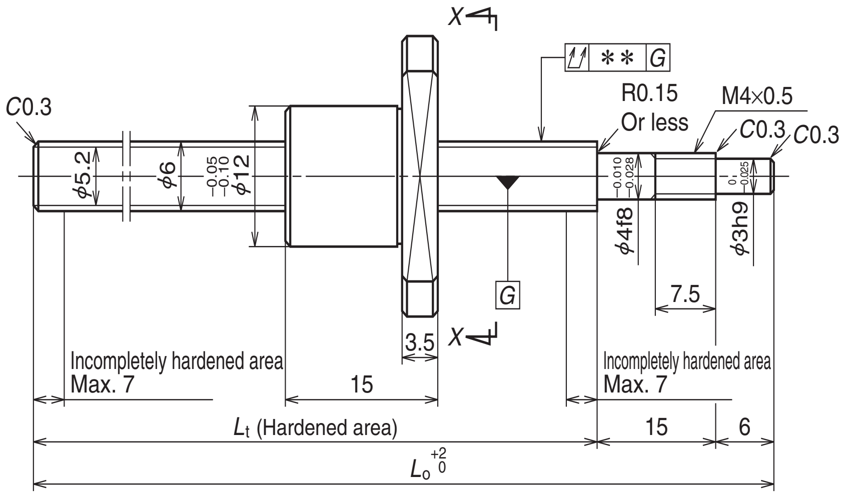
Unit: mm

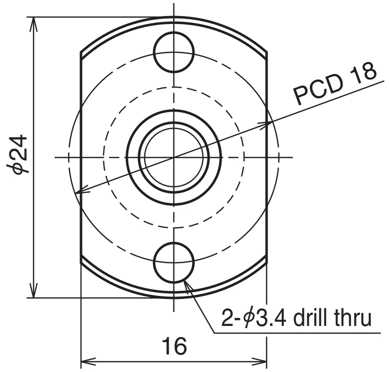
Reference No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out** ⫽	Mass (kg)	Permissible rotational speed N (min^{-1})	
	Nominal	Maximum (L_t-nut length)									Configuration	
			L_t	L_a	L_o	T	e_p	υ_{300}			Fixed - Simple	Fixed - Free
VFA1520C7S-500	300	343	400	455	500	0	0.120	0.052	0.075	0.94	3 000	2 630
VFA1520C7S-700	500	543	600	655	700	0	0.195	0.052	0.110	1.2	3 000	1 160
VFA1520C7S-1000	800	843	900	955	1 000	0	0.310	0.052	0.180	1.6	2 350	510

Notes: 1. We recommend using NSK support units. See Page B377 for details. WBK12SF-01 units (on the simple support side) support the ball screw directly on the shaft outside diameter.
2. We recommend using NSK Grease LR3 filled to about 50% of the ball nut's internal space. See Page D16 for details.
3. Permissible rotational speed is determined by the $d \cdot n$ value and critical speed. See Pages B47 and B337 for details.

Screw shaft ø6

Lead 1





View *X*-*X*

Unit: mm

Ball screw specifications	
Shaft dia.xLead / Direction of turn	6 × 1 / Right
Ball recirculation	Deflector (bridge)
Ball dia. / Ball circle dia.	0.800 / 6.2
Screw shaft root dia.	5.2
Effective ball turns	1 × 3
Accuracy grade / Axial play code	Ct7 / S
Basic load ratings (N) Dynamic C_a	610
Basic load ratings (N) Static C_{0a}	920
Axial play	0.020 or less
Dynamic friction torque (N·cm)	1.0 or less
Spacer ball	None
Factory-packed grease	**See Note 2.**

Recommended support unit

For drive side (Fixed)
WBK04R-11 (round)

Unit: mm

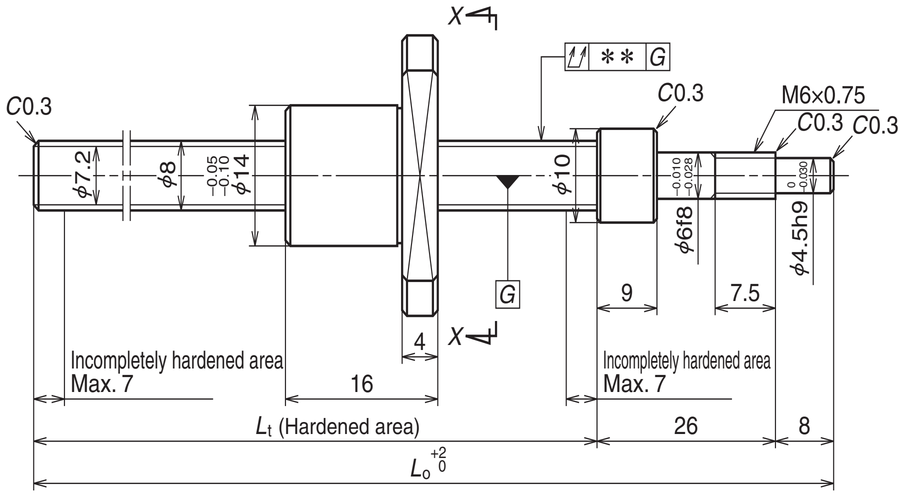
Reference No.	Stroke		Screw shaft length		Lead accuracy			Shaft run-out** ⫽	Mass (kg)	Permissible rotational speed *N* (min^{-1})
	Nominal	Maximum (L_t-Nut length)	L_t	L_o	Target compensation *T*	Deviation e_p	Variation υ_{300}			
RMA0601C7S-160	100	124	139	160	0	0.052	0.052	0.060	0.045	3 000
RMA0601C7S-260	200	224	239	260	0	0.085	0.052	0.090	0.065	3 000

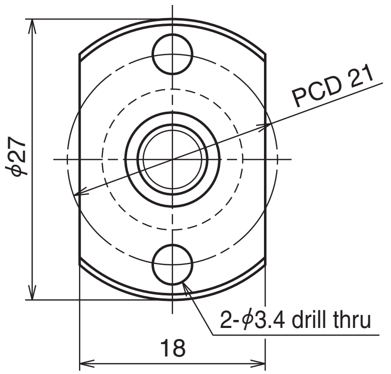
Notes:
1. We recommend using NSK support kits. See Page B389 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the *d·n* value and critical speed. See Pages B47 and B337 for details.

Screw shaft ø8

Lead 1

Unit: mm





View *X*-*X*

Ball screw specifications		
Shaft dia.xLead / Direction of turn		8 × 1 / Right
Ball recirculation		Deflector (bridge)
Ball dia. / Ball circle dia.		0.800 / 8.2
Screw shaft root dia.		7.2
Effective ball turns		1 × 3
Accuracy grade / Axial play code		Ct7 / S
Basic load ratings (N)	Dynamic C_a	710
	Static C_{0a}	1 290
Axial play		0.020 or less
Dynamic friction torque (N·cm)		1.0 or less
Spacer ball		None
Factory-packed grease		**See Note 2.**

Recommended support unit

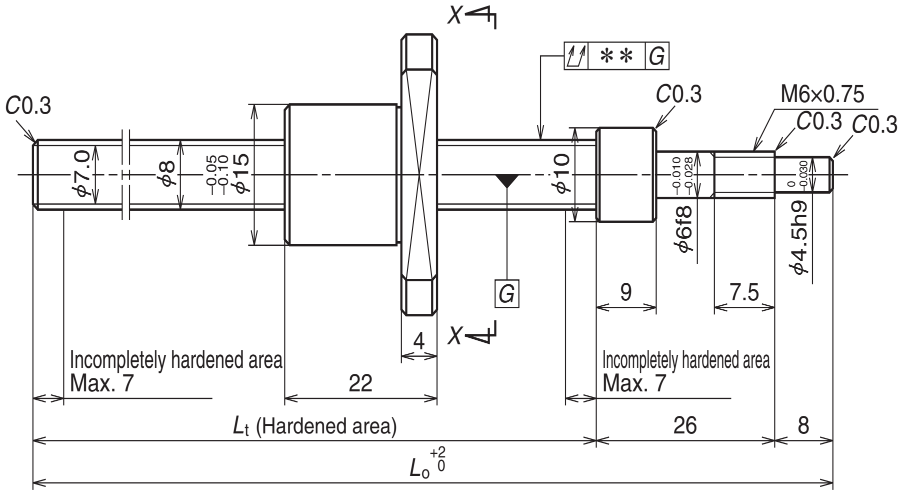
For drive side (Fixed)
WBK06R-11 (round)

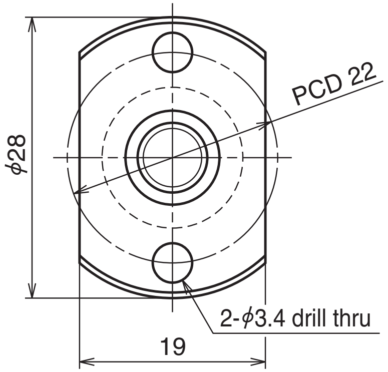
Unit: mm

Reference No.	Stroke		Screw shaft length		Lead accuracy			Shaft run-out＊＊ ⌰	Mass (kg)	Permissible rotational speed N (min^{-1})
	Nominal	Maximum (L_t-Nut length)	L_t	L_o	Target compensation T	Deviation e_p	Variation υ_{300}			
RMA0801C7S-180	100	130	146	180	0	0.052	0.052	0.060	0.085	3 000
RMA0801C7S-280	200	230	246	280	0	0.085	0.052	0.090	0.12	3 000

Notes:
1. We recommend using NSK support kits. See Page B389 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the *d·n* value and critical speed. See Pages B47 and B337 for details.

Screw shaft ø8
Lead 1.5





View X-X

Unit: mm

Ball screw specifications		
Shaft dia.xLead / Direction of turn		8 × 1.5 / Right
Ball recirculation		Deflector (bridge)
Ball dia. / Ball circle dia.		1.000 / 8.3
Screw shaft root dia.		7.0
Effective ball turns		1 × 3
Accuracy grade / Axial play code		Ct7 / S
Basic load ratings (N)	Dynamic C_a	955
	Static C_{0a}	1 580
Axial play		0.020 or less
Dynamic friction torque (N·cm)		1.0 or less
Spacer ball		None
Factory-packed grease		**See Note 2.**

Recommended support unit

For drive side (Fixed)
WBK06R-11 (round)

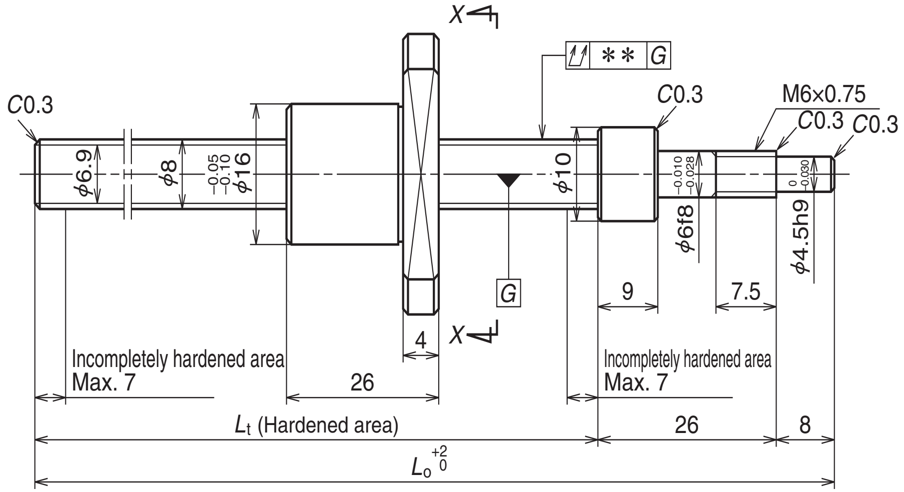
Unit: mm

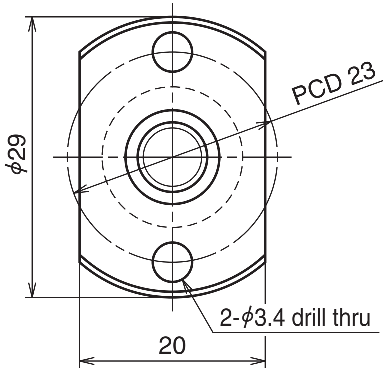
Reference No.	Stroke		Screw shaft length		Lead accuracy			Shaft run-out** ⌰	Mass (kg)	Permissible rotational speed N (min^{-1})
	Nominal	Maximum (L_t-Nut length)	L_t	L_o	Target compensation T	Deviation e_p	Variation υ_{300}			
RMA0801.5C7S-180	100	124	146	180	0	0.052	0.052	0.060	0.093	3 000
RMA0801.5C7S-280	200	224	246	280	0	0.085	0.052	0.090	0.13	3 000

Notes: 1. We recommend using NSK support kits. See Page B389 for details.
2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.
See Page D13 for details.
3. The permissible rotational speed is determined by the *d·n* value and critical speed. See Pages B47 and B337 for details.

Screw shaft ø8

Lead 2





View X-X

Unit: mm

Ball screw specifications		
Shaft dia.xLead / Direction of turn		8 × 2 / Right
Ball recirculation		Deflector (bridge)
Ball dia. / Ball circle dia.		1.200 / 8.3
Screw shaft root dia.		6.9
Effective ball turns		1 × 3
Accuracy grade / Axial play code		Ct7 / S
Basic load ratings (N)	Dynamic C_a	1 260
	Static C_{0a}	1 940
Axial play		0.020 or less
Dynamic friction torque (N·cm)		1.0 or less
Spacer ball		None
Factory-packed grease		**See Note 2.**

Recommended support unit

For drive side (Fixed)
WBK06R-11 (round)

Unit: mm

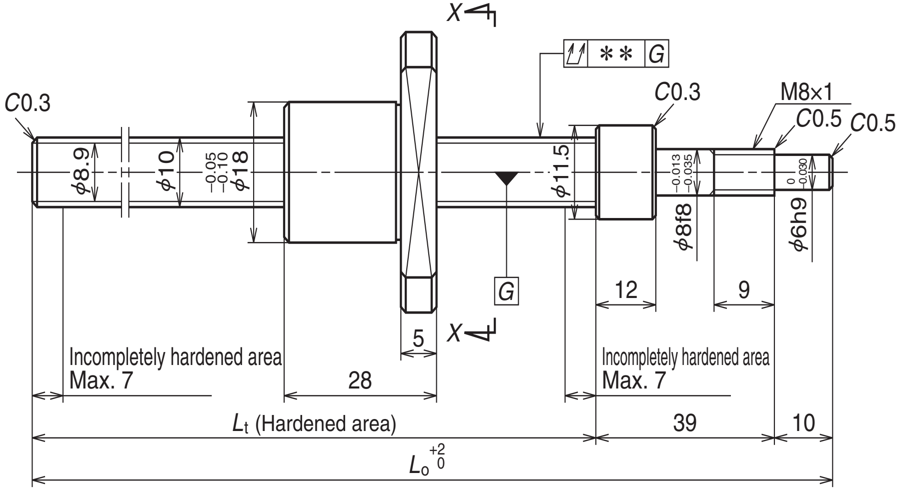
Reference No.	Stroke		Screw shaft length		Lead accuracy			Shaft run-out∗∗ ⌰	Mass (kg)	Permissible rotational speed N (min^{-1})
	Nominal	Maximum (L_t-Nut length)	L_t	L_o	Target compensation T	Deviation e_p	Variation υ_{300}			
RMA0802C7S-180	100	120	146	180	0	0.052	0.052	0.060	0.10	3 000
RMA0802C7S-280	200	220	246	280	0	0.085	0.052	0.090	0.14	3 000

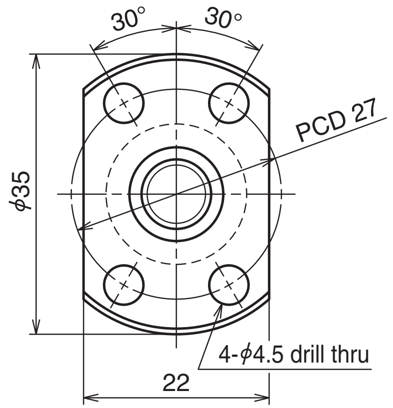
Notes:
1. We recommend using NSK support kits. See Page B389 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the $d \cdot n$ value and critical speed. See Pages B47 and B337 for details.

Screw shaft ø10

Lead 2

Unit: mm





View *X*-*X*

Ball screw specifications		
Shaft dia.xLead / Direction of turn		10 × 2 / Right
Ball recirculation		Deflector (bridge)
Ball dia. / Ball circle dia.		1.200 / 10.3
Screw shaft root dia.		8.9
Effective ball turns		1 × 3
Accuracy grade / Axial play code		Ct7 / S
Basic load ratings (N)	Dynamic C_a	1 460
	Static C_{0a}	2 620
Axial play		0.020 or less
Dynamic friction torque (N·cm)		1.0 or less
Spacer ball		None
Factory-packed grease		**See Note 2.**

Recommended support unit

For drive side (Fixed)
WBK08-01A (square)
WBK08-11 (round)

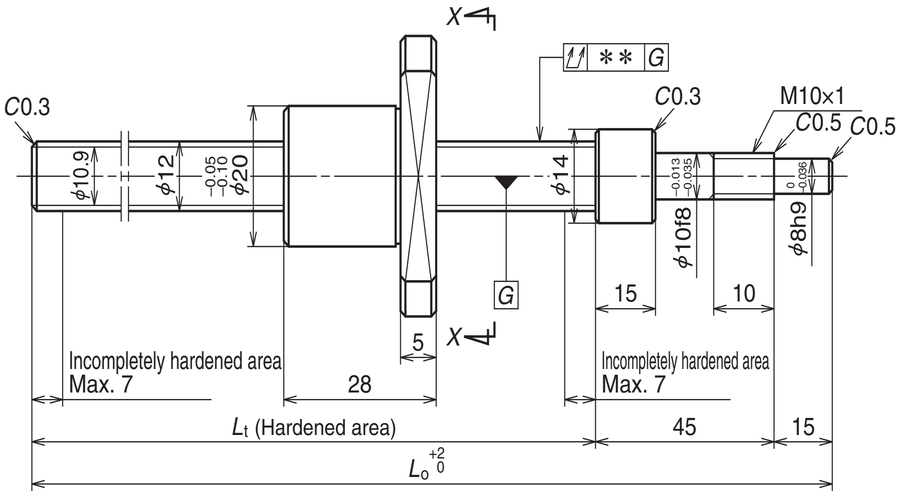
Unit: mm

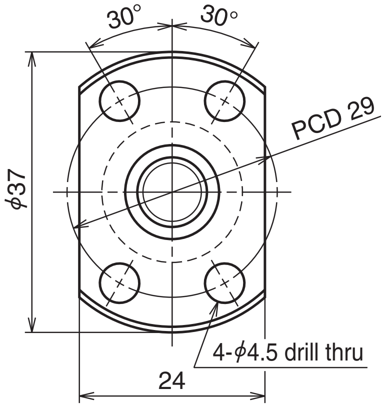
Reference No.	Stroke		Screw shaft length		Lead accuracy			Shaft run-out∗∗	Mass (kg)	Permissible rotational speed N (min^{-1})
	Nominal	Maximum (L_t-Nut length)	L_t	L_o	Target compensation T	Deviation e_p	Variation υ_{300}			
RMA1002C7S-250	150	173	201	250	0	0.085	0.052	0.070	0.19	3 000
RMA1002C7S-350	250	273	301	350	0	0.085	0.052	0.100	0.25	3 000

Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the *d·n* value and critical speed. See Pages B47 and B337 for details.

Screw shaft ø12

Lead 2





View X-X

Unit: mm

Ball screw specifications		
Shaft dia.xLead / Direction of turn		12 × 2 / Right
Ball recirculation		Deflector (bridge)
Ball dia. / Ball circle dia.		1.200 / 12.3
Screw shaft root dia.		10.9
Effective ball turns		1 × 3
Accuracy grade / Axial play code		Ct7 / S
Basic load ratings (N)	Dynamic C_a	1 590
	Static C_{0a}	3 190
Axial play		0.020 or less
Dynamic friction torque (N·cm)		1.0 or less
Spacer ball		None
Factory-packed grease		**See Note 2.**

Recommended support unit

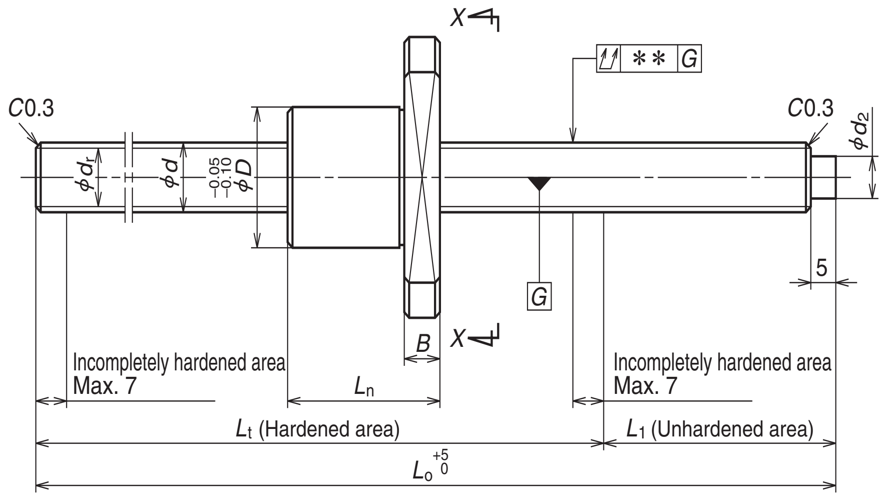
For drive side (Fixed)
WBK10-01A (square)
WBK10-11 (round)

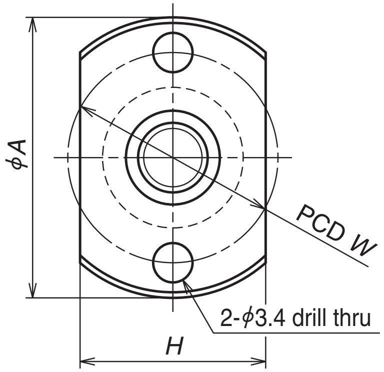
Unit: mm

Reference No.	Stroke		Screw shaft length		Lead accuracy			Shaft run-out** ↗	Mass (kg)	Permissible rotational speed N (min^{-1})
	Nominal	Maximum (L_t-Nut length)	L_t	L_o	Target compensation T	Deviation e_p	Variation υ_{300}			
RMA1202C7S-250	150	162	190	250	0	0.060	0.052	0.070	0.26	3 000
RMA1202C7S-350	250	262	290	350	0	0.085	0.052	0.100	0.34	3 000

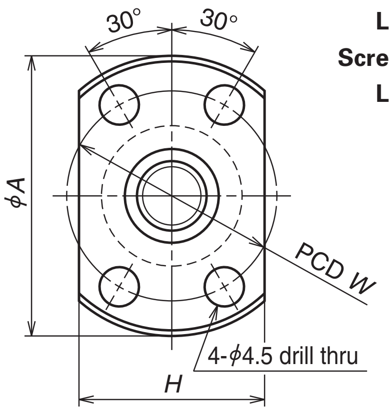
Notes:
1. We recommend using NSK support units. See Page B377 for details.
2. **Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.** See Page D13 for details.
3. The permissible rotational speed is determined by the *d·n* value and critical speed. See Pages B47 and B337 for details.

Screw shaft ø6
Lead 1
Screw shaft ø8
Lead 1, 1.5, 2
Screw shaft ø10, ø12
Lead 2





View *X-X*
(for screw shaft of 6 and 8 dia.)

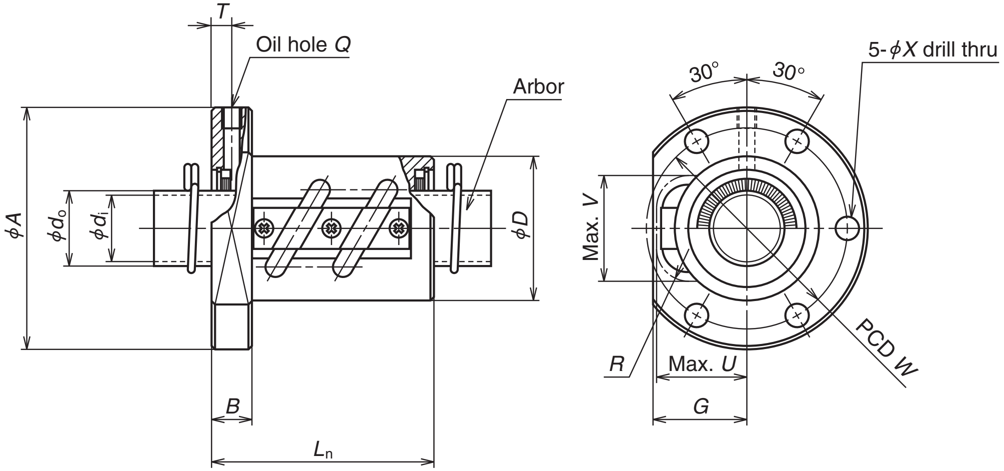


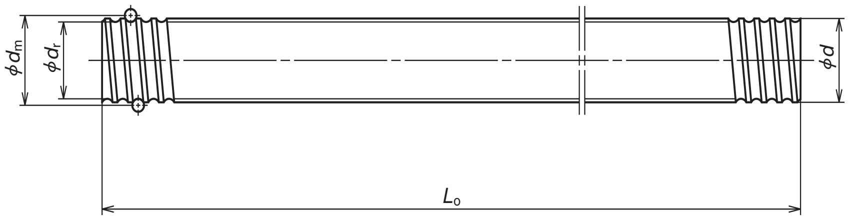
View *X-X*
(for screw shaft of 10 and 12 dia.)

Unit: mm

Reference No.	Stroke Max. L_t-L_n	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ratings	Basic load ratings (N)		Axial play Max.	Nut dimensions						Screw shaft dimensions				Lead accuracy			Shaft run-out**	Mass (Kg)	Permissible rotational speed N (min^{-1})
								Dynamic C_a	Static C_{0a}		D	A	H	B	L_n	W	Effective thread length L_t	Shaft end		Overall length L_o	Target compensation T	Deviation e_p	Variation υ_{300}			
																		L_1	d_2							
RMS0601C7S-300	235	6	1	0.800	6.2	5.3	3	610	920	0.02	12	24	16	3.5	15	18	250	50	4	300	0	0.085	0.052	0.09	0.075	3 000
RMS0801C7S-300	234	8	1	0.800	8.2	7.3	3	710	1 290	0.02	14	27	18	4	16	21	250	50	6	300	0	0.085	0.052	0.09	0.13	
RMS0801.5C7S-300	228		1.5	1.000	8.3	7.2		955	1 580		15	28	19		22	22									0.14	
RMS0802C7S-300	224		2	1.200	8.3	7.0		1 260	1 940		16	29	20		26	23									0.15	
RMS1002C7S-350	262	10	2	1.200	10.3	9.0	3	1 460	2 620	0.02	18	35	22	5	28	27	290	60	8	350	0	0.085	0.052	0.10	0.25	
RMS1202C7S-350	262	12	2	1.200	12.3	11.0	3	1 590	3 190	0.02	20	37	24	5	28	29	290	60	10	350	0	0.085	0.052	0.10	0.35	

Notes: 1. We recommend using NSK support units (Page B377) or support kits (Page B389).
2. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.
See Page D13 for details.
3. Seals are not installed.
4. The permissible rotational speed is determined by the $d \cdot n$ value and critical speed. See Pages B47 and B337 for details.



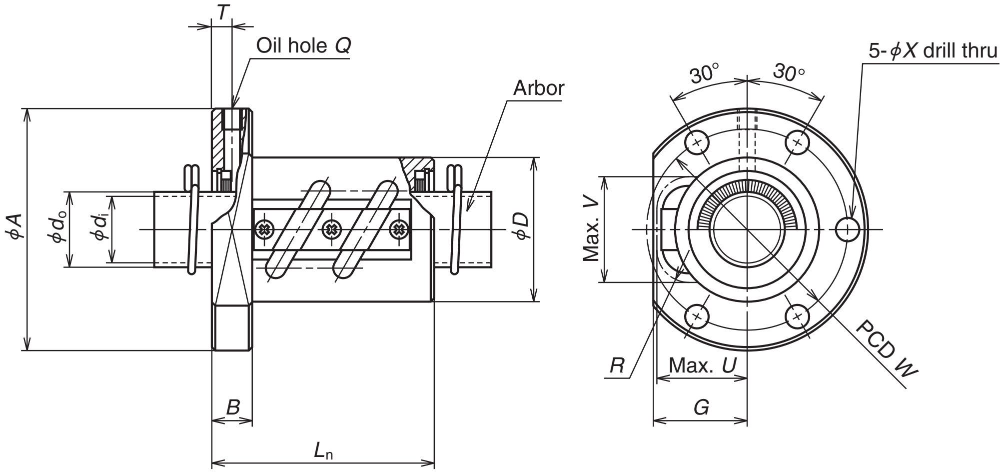


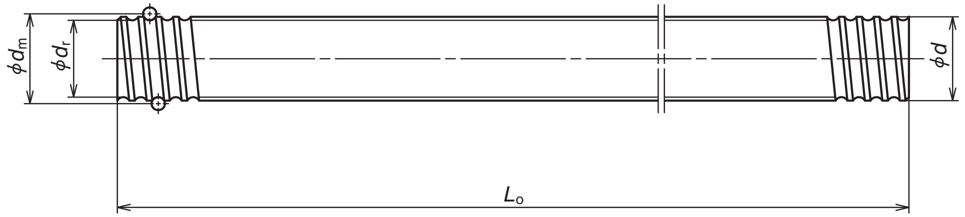
Unit: mm

Nut Ref. No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial play Max.	Ball nut dimensions
	d	l	D_w	d_m	d_r	Turns × Circuits	Dynamic C_a	Static C_{0a}		Outside dia. D
RNFTL 1003A3.5	10	3	2.381	10.65	8.1	3.5×1	4 440	6 700	0.10	20
RNFTL 1006A2.5S	10	6	2.381	10.65	8.1	2.5×1	3 280	4 730	0.10	20
RNFTL 1208A2.5S	12	8	2.778	12.65	9.6	2.5×1	4 290	6 610	0.10	25
RNFTL 1404A3.5S	14	4	2.778	14.5	11.5	3.5×1	6 310	10 800	0.10	25
RNFTL 1405A2.5S	14	5	3.175	14.5	11.0	2.5×1	6 170	9 940	0.10	30
RNFTL 1610A2.5 **RNFTL 1610A2.5S**	16	10	3.175	16.75	13.3	2.5×1	6 810	11 600	0.10	30
RNFTL 1808A3.5 **RNFTL 1808A3.5S**	18	8	4.762	18.5	13.6	3.5×1	15 500	26 200	0.15	34
RNFTL 2005A2.5 **RNFTL 2005A2.5S**	20	5	3.175	20.5	17.0	2.5×1	7 500	14 200	0.10	40
RNFTL 2010A2.5 **RNFTL 2010A2.5S**	20	10	4.762	21.25	16.2	2.5×1	12 700	21 600	0.15	40
RNFTL 2505A5 **RNFTL 2505A5S**	25	5	3.175	25.5	22.0	2.5×2	15 100	36 300	0.10	42
RNFTL 2510A2.5 **RNFTL 2510A2.5S**	25	10	6.35	26	19.0	2.5×1	20 500	34 900	0.20	44
RNFTL 2510A5 **RNFTL 2510A5S**						2.5×2	37 300	69 800		44

Nut Ref. No.	Ball nut dimensions											Nut mass (kg)	Arbor		Screw shaft				Shaft mass per meter (kg)	Nut internal space (cm³)	Standard grease replenish-ment (cm³)
	Flange			Length	Bolt hole		Oil hole		Projecting tube				Outside dia.	Bore	Standard length			Shaft Ref. No.			
	A	G	B	L_n	W	X	Q	T	U	V	R		d_0	d_i	L_o						
RNFTL 1003A3.5	40	15	6	34	30	4.5	M3×0.5	3.0	15	15	7	0.092	8.1	6.1	400	800	–	RS1003A··	0.50	–	–
RNFTL 1006A2.5S	40	15	6	36	30	4.5	M3×0.5	3.5	15	15	5	0.095	8.1	6.1	400	800	–	RS1006A··	0.56	1.1	0.6
RNFTL 1208A2.5S	45	19	8	46	35	4.5	M3×0.5	5.5	19	18	7	0.18	9.6	7.6	400	800	–	RS1208A··	0.74	1.8	0.9
RNFTL 1404A3.5S	50	19	10	43	40	4.5	M6×1	5.0	19	20	7	0.20	11.5	9.5	500	1 000	–	RS1404A··	1.02	2.0	1.0
RNFTL 1405A2.5S	50	22	10	45	40	4.5	M6×1	5.0	22	21	8	0.26	11.0	9.0	500	1 000	–	RS1405A··	1.00	2.4	1.2
RNFTL 1610A2.5 **RNFTL 1610A2.5S**	53	23	10	54	41	5.5	M6×1	5.5	23	22.5	8	0.28	13.3	11.3	500	1 000	1 500	RS1610A··	1.37	2.7	1.4
RNFTL 1808A3.5 **RNFTL 1808A3.5S**	63	27	12	58	49	6.6	M6×1	6.0	27	27	8	0.43	13.6	11.6	500	1 000	1 500	RS1808A··	1.60	5.2	2.6
RNFTL 2005A2.5 **RNFTL 2005A2.5S**	60	28	10	46	50	4.5	M6×1	5.0	28	27	10	0.42	17.0	14.6	500	1 000	2 000	RS2005A··	2.17	3.5	1.8
RNFTL 2010A2.5 **RNFTL 2010A2.5S**	67	30	12	59	53	6.6	M6×1	6.0	30	29	12	0.55	16.2	13.8	500	1 000	2 000	RS2010A··	2.18	7.1	3.6
RNFTL 2505A5 **RNFTL 2505A5S**	71	28	12	66	57	6.6	M6×1	6.0	28	31	10	0.62	22.0	19.6	1 000	2 000	2 500	RS2505A··	3.47	6.5	3.3
RNFTL 2510A2.5 **RNFTL 2510A2.5S**	80	34	15	62	62	9	M6×1	7.5	34	37	17	0.75	19.0	16.6	1 000	2 000	2 500	RS2510A··	3.13	13	6.5
RNFTL 2510A5 **RNFTL 2510A5S**	80	34	15	92	62	9	M6×1	7.5	34	37	17									18	9.0

Notes:
1. The protrusion of the tube will not cause interference if the mating section of the nut body has dimensions greater than U and V.
2. Actual screw shaft length may become slightly longer than nominal length L_0 due to manufacturing tolerances.
3. A Nut Ref. No. ending in "S" has seals. The external dimensions of these are identical to those without seals. The figure shows a seal above the center line and no seal below. Synthetic resin seals are used for shaft diameters of 14 mm or more, and brush seals for shaft diameters of 16 mm or more.
4. The nut assembly is separate from the screw shaft and comes delivered on an arbor.
5. The last digits (**) in the Shaft Ref. No. will show the value for screw shaft length in 100 mm units.
6. Standard inventory products have not undergone surface treatments.
7. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.
8. Values for nut internal space and standard grease replenishment are for ball screws with seals. The standard quantity for replenishment is about 50% of the nut's internal space. For ball screws without seals, apply grease to the screw shaft surface or move the nut by hand while filling to ensure that grease reaches all areas inside. See Page D16 for details.



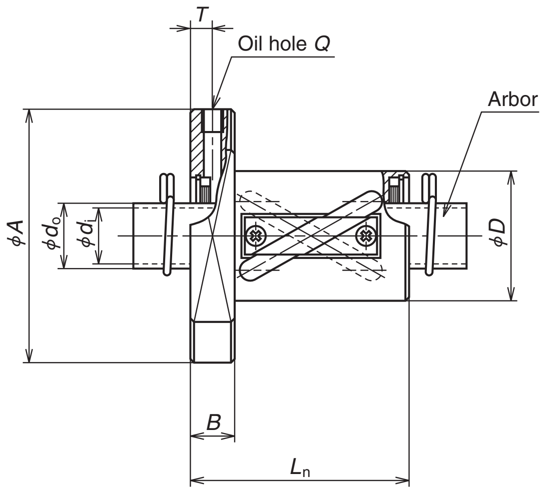


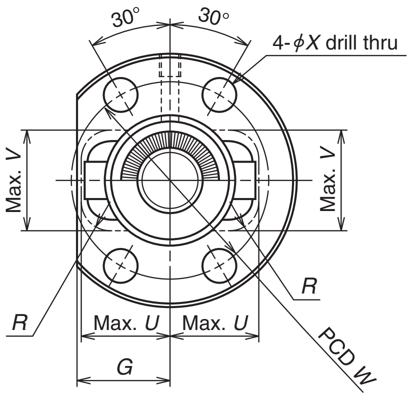
Unit: mm

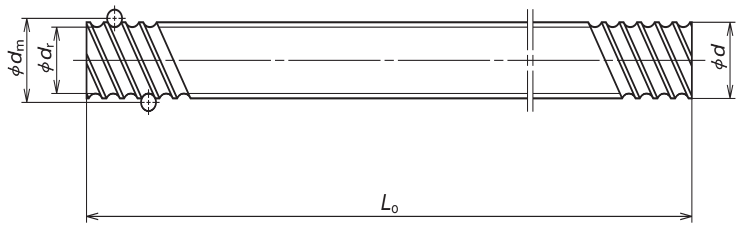
Nut Ref. No.	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load ratings (N) Dynamic C_a	Basic load ratings (N) Static C_{0a}	Axial play Max.	Ball nut dimensions Outside dia. D
RNFTL 2806A2.5 **RNFTL 2806A2.5S**	28	6	3.175	28.5	25.0	2.5×1	8 760	20 200	0.10	50
RNFTL 2806A5 **RNFTL 2806A5S**						2.5×2	15 900	40 500		50
RNFTL 3210A5 **RNFTL 3210A5S**	32	10	6.35	33.75	27.0	2.5×2	42 000	91 800	0.20	55
RNFTL 3610A2.5 **RNFTL 3610A2.5S**	36	10	6.35	37	30.0	2.5×1	24 700	50 800	0.20	60
RNFTL 3610A5 **RNFTL 3610A5S**						2.5×2	44 900	102 000		60
RNFTL 4010A7 **RNFTL 4010A7S**	40	10	6.35	41.75	35.0	3.5×2	63 100	164 000	0.20	65
RNFTL 4512A5 **RNFTL 4512A5S**	45	12	7.144	46.5	39.0	2.5×2	58 500	147 000	0.23	70
RNFTL 5010A7 **RNFTL 5010A7S**	50	10	6.35	51.75	45.0	3.5×2	70 100	205 000	0.20	80
RNFTL 5016A5 **RNFTL 5016A5S**	50	16	9.525	52	42.0	2.5×2	117 000	299 000	0.23	85

Nut Ref. No.	Ball nut dimensions											Nut mass (kg)	Arbor		Screw shaft				Shaft mass per meter (kg)	Nut internal space (cm³)	Standard grease replenishment (cm³)
	Flange			Length	Bolt hole		Oil hole		Projecting tube				Outside dia.	Bore	Standard length			Shaft Ref. No.			
	A	G	B	L_n	W	X	Q	T	U	V	R		d_0	d_i	L_0						
RNFTL 2806A2.5 **RNFTL 2806A2.5S**	79	33	15	55	65	6.6	M6×1	7.5	33	34	10	0.85	25.0	22.6	1 000	2 000	2 500	RS2806A··	4.47	5.9	3.0
RNFTL 2806A5 **RNFTL 2806A5S**	79	33	15	79	65	6.6	M6×1	7.5	33	34	10	1.07								8.4	4.2
RNFTL 3210A5 **RNFTL 3210A5S**	97	39	18	97	75	11	M6×1	9.0	39	42	17	1.55	27.0	24.6	1 000	2 000	3 000	RS3210A··	5.53	29	15
RNFTL 3610A2.5 **RNFTL 3610A2.5S**	102	42	18	68	80	11	M6×1	9.0	42	46	17	1.47	30.0	27.6	1 000	2 000	3 000	RS3610A··	6.91	21	11
RNFTL 3610A5 **RNFTL 3610A5S**	102	42	18	98	80	11	M6×1	9.0	42	46	17	1.80								33	17
RNFTL 4010A7 **RNFTL 4010A7S**	114	44	20	120	90	14	M6×1	10.0	44	50	20	2.49	35.0	31.8	2 000	3 000	4 000	RS4010A··	8.87	42	21
RNFTL 4512A5 **RNFTL 4512A5S**	130	47	22	116	100	18	M6×1	11.0	47	55	20	3.07	39.0	35.8	2 000	3 000	4 000	RS4512A··	11.16	49	25
RNFTL 5010A7 **RNFTL 5010A7S**	140	52	22	122	110	18	M6×1	11.0	52	59	20	4.06	45.0	41.8	2 000	3 000	4 000	RS5010A··	14.15	53	27
RNFTL 5016A5 **RNFTL 5016A5S**	163	57	28	146	125	22	M6×1	14.0	57	63	25	6.42	42.0	38.8	2 000	3 000	4 000	RS5016A··	13.48	94	47

Notes: 1. The protrusion of the tube will not cause interference if the mating section of the nut body has dimensions greater than *U* and *V*.
2. Actual screw shaft length may become slightly longer than nominal length L_0 due to manufacturing tolerances.
3. A Nut Ref. No. ending in "S" has seals. The external dimensions of these are identical to those without seals. The figure shows a seal above the center line and no seal below. Synthetic resin seals are used for shaft diameters of 14 mm or less and brush seals for shaft diameters of 16 mm or more.
4. The nut assembly is separate from the screw shaft and comes delivered on an arbor.
5. The last digits (**) in the Shaft Ref. No. will show the value for screw shaft length in 100 mm units.
6. Standard inventory products have not undergone surface treatments.
7. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.
8. Values for nut internal space and standard grease replenishment are for ball screws with seals. The standard quantity for replenishment is about 50% of the nut's internal space. For ball screws without seals, apply grease to the screw shaft surface or move the nut by hand while filling to ensure that grease reaches all areas inside. See Page D16 for details.







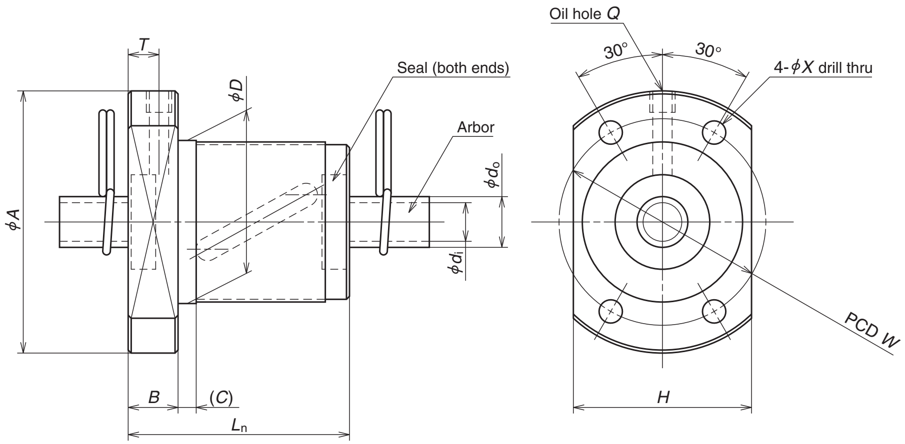
Unit: mm

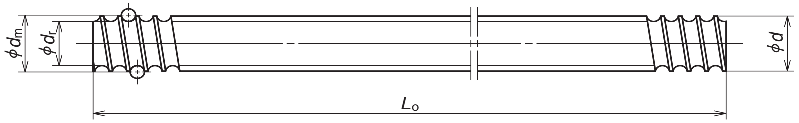
Nut Ref. No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial play Max.	Ball nut dimensions	Ball nut dimensions											Nut mass (kg)	Arbor		Screw shaft				Shaft mass per meter (kg)	Nut internal space (cm^3)	Standard grease replenish-ment (cm^3)
						Turns × Circuits	Dynamic	Static		Outside dia.	Flange			Length	Bolt hole		Oil hole		Projecting tube				Outside dia.	Bore	Standard length			Shaft Ref. No.			
	d	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	G	B	L_n	W	X	Q	T	U	V	R		d_0	d_i	L_o						
RNFTL 1212A3	12	12	2.381	12.65	10.1	1.5 × 2	3 900	6 250	0.10	24	44	17	8	44	34	4.5	M3 × 0.5	4.0	17	16	5	0.16	10.1	8.1	400	800	–	RS1212A··	0.74	1.7	0.9
RNFTL 1616A3 **RNFTL 1616A3S**	16	16	2.778	16.65	13.6	1.5 × 2	5 440	9 550	0.10	30	55	22	10	50	43	6.6	M6 × 1	5.0	22	22	7	0.29	13.6	11.6	500	1 000	1 500	RS1616A··	1.37	2.8	1.4
RNFTL 2020A3 **RNFTL 2020A3S**	20	20	3.175	20.75	17.3	1.5 × 2	8 080	15 700	0.10	35	68	25	12	59	52	9	M6 × 1	6.0	25	27	8	0.49	17.3	14.9	500	1 000	2 000	RS2020A··	2.19	4.9	2.5
RNFTL 2525A3 **RNFTL 2525A3S**	25	25	3.969	26	22.0	1.5 × 2	12 100	24 500	0.12	45	80	31	12	69	63	9	M6 × 1	6.0	31	32	10	0.80	22.0	19.6	1 000	2 000	2 500	RS2525A··	3.43	9.1	4.6
RNFTL 3232A3 **RNFTL 3232A3S**	32	32	4.762	33.25	28.0	1.5 × 2	17 600	37 700	0.15	55	100	37	15	84	80	11	M6 × 1	7.5	37	40	12	1.46	28.0	25.6	1 000	2 000	3 000	RS3232A··	5.71	19	9.5
RNFTL 4040A3 **RNFTL 4040A3S**	40	40	6.35	41.75	35.0	1.5 × 2	28 100	62 900	0.20	70	120	46	18	103	95	14	M6 × 1	9.0	46	49	15	2.69	35.0	31.8	2 000	3 000	4 000	RS4040A··	8.82	39	20

Notes: 1. The protrusion of the tube will not cause interference if the mating section of the nut body has dimensions greater than *U* and *V*.
2. Actual screw shaft length may become slightly longer than nominal length L_0 due to manufacturing tolerances.
3. A Nut Ref. No. ending in "S" has seals. The external dimensions of these are identical to those without seals. The figure shows a seal above the center line and no seal below. Synthetic resin seals are used for shaft diameters of 14 mm or less and brush seals for shaft diameters of 16 mm or more.
4. The nut assembly is separate from the screw shaft and comes delivered on an arbor.
5. The last digits (**) in the Shaft Ref. No. will show the value for screw shaft length in 100 mm units.
6. Standard inventory products have not undergone surface treatments.
7. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.
8. Values for nut internal space and standard grease replenishment are for ball screws with seals. The standard quantity for replenishment is about 50% of the nut's internal space. For ball screws without seals, apply grease to the screw shaft surface or move the nut by hand while filling to ensure that grease reaches all areas inside. See Page D16 for details.

Ball Screws for Transfer Equipment Tube Recirculation, embedded -tube, Flanged (Fine, Medium lead)

R Model, RNFBL Nut





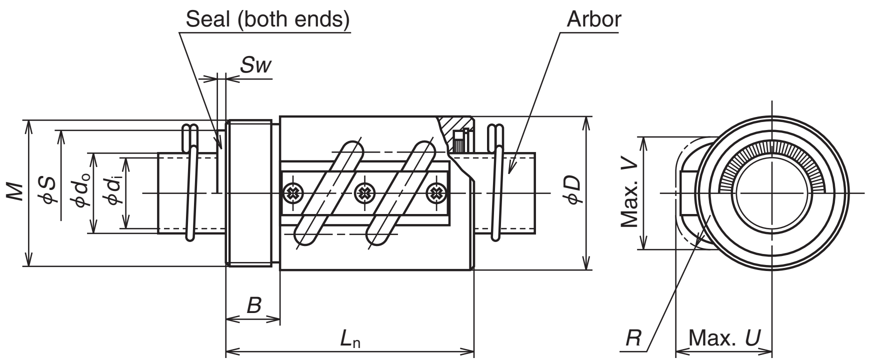
Unit: mm

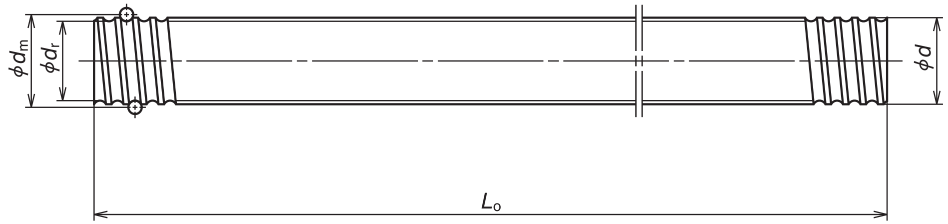
Nut Ref. No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial play Max.	Ball nut dimensions										Nut mass (kg)	Arbor		Screw shaft				Shaft mass per meter (kg)	Nut internal space (cm^3)	Standard grease replenish-ment (cm^3)
						Turns × Circuits	Dynamic	Static		Outside dia.	Flange			Length		Bolt hole		Oil hole			Outside dia.	Bore	Standard length			Shaft Ref. No.			
	d	l	D_w	d_m	d_r		C_a	C_{oa}		D	A	H	B	Overall length L_n	(C)	W	X	Q	T		d_0	d_i	L_o						
RNFBL 1006A2.5S	10	6	2.381	10.65	8.1	2.5×1	3 280	4 730	0.10	26	42	29	8	36	3	34	4.5	M3×0.5	5.0	0.16	8.1	6.1	400	800	–	RS1006A··	0.56	1.1	0.6
RNFBL 1208A2.5S	12	8	2.778	12.65	9.6	2.5×1	4 290	6 610	0.10	29	45	32	8	44	3	37	4.5	M3×0.5	5.5	0.21	9.6	7.6	400	800	–	RS1208A··	0.81	1.6	0.8
RNFBL 1404A3.5S	14	4	2.778	14.5	11.5	3.5×1	6 310	10 800	0.10	31	50	37	10	40	4	40	4.5	M6×1	5.0	0.25	11.5	9.5	500	1 000	–	RS1404A··	1.02	2.4	1.2
RNFBL 1405A2.5S	14	5	3.175	14.5	11.0	2.5×1	6 170	9 940	0.10	32	50	38	10	40	4	40	4.5	M6×1	5.0	0.26	11.0	9.0	500	1 000	–	RS1405A··	1.00	1.9	1.0
RNFBL 1808A3.5S	18	8	4.762	18.5	13.6	3.5×1	15 500	26 200	0.15	50	80	60	12	61	4	65	6.6	M6×1	6.0	1.00	13.6	11.6	500	1 000	1 500	RS1808A··	1.60	5.8	2.9
RNFBL 2005A2.5S	20	5	3.175	20.5	17.0	2.5×1	7 500	14 200	0.10	40	60	46	10	40	4	50	4.5	M6×1	5.0	0.37	17.0	14.6	500	1 000	2 000	RS2005A··	2.17	2.8	1.4
RNFBL 2010A2.5S	20	10	4.762	21.25	16.2	2.5×1	12 700	21 600	0.15	52	82	64	12	61	5	67	6.6	M6×1	6.0	1.05	16.2	13.8	500	1 000	2 000	RS2010A··	2.18	7.6	3.8
RNFBL 2505A2.5S	25	5	3.175	25.5	22.0	2.5×1	8 340	18 100	0.10	43	67	50	10	40	4	55	5.5	M6×1	5.0	0.40	22.0	19.6	1 000	2 000	2 500	RS2505A··	3.47	3.5	1.8
RNFBL 2505A5S						2.5×2	15 100	36 300						55						0.50								4.7	2.4
RNFBL 2510A2.5S	25	10	6.35	26	19.0	2.5×1	20 500	34 900	0.20	60	96	72	15	66	5	78	9.0	M6×1	7.5	1.52	19.0	16.6	1 000	2 000	2 500	RS2510A··	3.13	14	7.0
RNFBL 2510A5S						2.5×2	37 300	69 800						96						1.99								19	9.5
RNFBL 2806A2.5S	28	6	3.175	28.5	25.0	2.5×1	8 760	20 200	0.10	50	80	60	12	47	5	65	6.6	M6×1	6.0	0.70	25.0	22.6	1 000	2 000	2 500	RS2806A··	4.47	4.5	2.3
RNFBL 2806A5S						2.5×2	15 900	40 500						65						0.87								7.6	3.8
RNFBL 3210A2.5S	32	10	6.35	33.75	27.0	2.5×1	23 100	45 900	0.20	67	103	78	15	67	5	85	9.0	M6×1	7.5	1.72	27.0	24.6	1 000	2 000	3 000	RS3210A··	5.53	20	10
RNFBL 3210A5S						2.5×2	42 000	91 800						97						2.25								28	14
RNFBL 3610A2.5S	36	10	6.35	37	30.0	2.5×1	24 700	50 800	0.20	70	110	82	17	69	5	90	11.0	M6×1	8.5	1.97	30.0	27.6	1 000	2 000	3 000	RS3610A··	6.91	21	11
RNFBL 3610A5S						2.5×2	44 900	102 000						99						2.53								29	15
RNFBL 4010A5S	40	10	6.35	41.75	35.0	2.5×2	47 200	116 000	0.20	76	116	88	17	99	5	96	11.0	M6×1	8.5	2.86	35.0	31.8	2 000	3 000	4 000	RS4010A··	8.87	36	18

Notes: 1. Actual screw shaft length may become slightly longer than nominal length L_0 due to manufacturing tolerances.
2. The nut assembly is separate from the screw shaft and comes delivered on an arbor.
3. The last digits (**) in the Shaft Ref. No. will show the value for screw shaft length in 100 mm units.
4. Products in standard inventory have not had surface treatments.
5. Synthetic resin seals are used for shaft diameters of 14 mm or less and brush seals for shaft diameters of 16 mm or more.
6. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.
7. The standard quantity for grease replenishment is about 50% of the nut's internal space. See Page D16 for details.

Tube Recirculation, Nut with V-thread, (Fine lead)

R Model, RNCT Nut





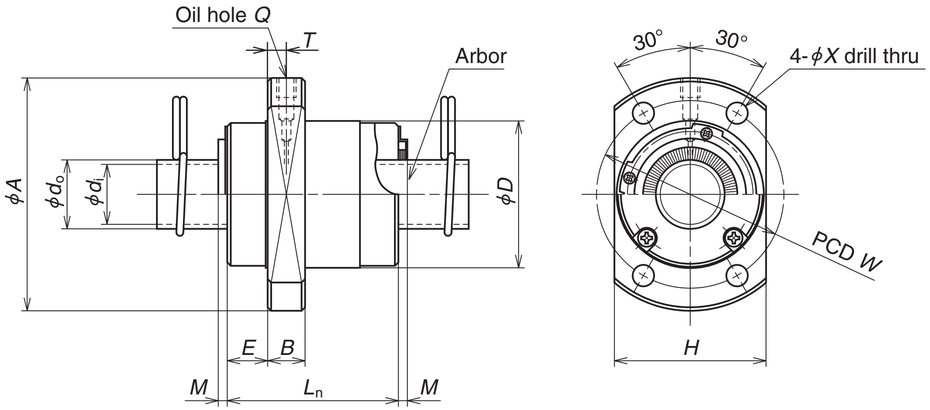
Unit: mm

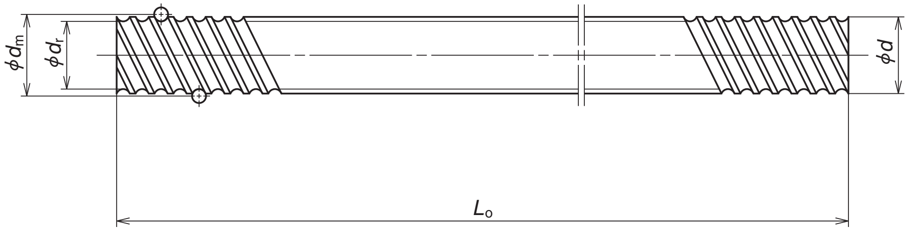
Nut Ref. No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial play Max.	Ball nut dimensions							Nut mass (kg)	Seal dimensions		Arbor		Screw shaft				Shaft mass per meter (kg)	Nut internal space (cm³)	Standard grease replenishment (cm³)
						Turns × Circuits	Dynamic	Static		Outside dia.	V-thread		Length	Projecting tube				Diameter	Thickness	Outside dia.	Bore	Standard length			Shaft Ref. No.			
	d	l	D_w	d_m	d_r		C_a	C_{oa}		D	M	B	L_n	U	V	R		S	Sw	d_0	d_i	L_o						
RNCT 1003A3.5	10	3	2.381	10.65	8.1	3.5 × 1	4 440	6 700	0.10	20	M18 × 1	10	38	15	15	7	0.049	–	–	8.1	6.1	400	800	–	RS1003A··	0.50	–	–
RNCT 1404A3.5S	14	4	2.778	14.5	11.5	3.5 × 1	6 310	10 800	0.10	25	M24 × 1	10	43	19	20	7	0.083	–	–	11.5	9.5	500	1 000	–	RS1404A··	1.02	2.7	1.4
RNCT 1405A2.5S	14	5	3.175	14.5	11.0	2.5 × 1	6 170	9 940	0.10	30	M26 × 1.5	10	45	22	21	8	0.15	–	–	11.0	9.0	500	1 000	–	RS1405A··	1.00	3.1	1.6
RNCT 1808A3.5 **RNCT 1808A3.5S**	18	8	4.762	18.5	13.6	3.5 × 1	15 500	26 200	0.15	34	M32 × 1.5	12	58	27	27	8	0.21	28.5	2.5	13.6	11.6	500	1 000	1 500	RS1808A··	1.60	6.6	3.3
RNCT 2005A2.5 **RNCT 2005A2.5S**	20	5	3.175	20.5	17.0	2.5 × 1	7 500	14 200	0.10	40	M36 × 1.5	12	48	28	27	10	0.28	29.5	2.5	17.0	14.6	500	1 000	2 000	RS2005A··	2.17	4.8	2.4
RNCT 2505A5 **RNCT 2505A5S**	25	5	3.175	25.5	22.0	2.5 × 2	15 100	36 300	0.10	42	M40 × 1.5	15	69	28	31	10	0.38	34.5	2.5	22.0	19.6	1 000	2 000	2 500	RS2505A··	3.47	8.4	4.2
RNCT 2510A5 **RNCT 2510A5S**	25	10	6.35	26	19.0	2.5 × 2	37 300	69 800	0.20	44	M42 × 1.5	15	92	34	37	17	0.49	38.5	2.5	19.0	16.6	1 000	2 000	2 500	RS2510A··	3.13	21	1
RNCT 2806A5 **RNCT 2806A5S**	28	6	3.175	28.5	25.0	2.5 × 2	15 900	40 500	0.10	50	M45 × 1.5	15	79	33	34	10	0.68	37.5	2.5	25.0	22.6	1 000	2 000	2 500	RS2806A··	4.47	9.7	4.9
RNCT 3210A5 **RNCT 3210A5S**	32	10	6.35	33.75	27.0	2.5 × 2	42 000	91 800	0.20	55	M50 × 1.5	18	97	39	42	17	0.79	45.5	2.5	27.0	24.6	1 000	2 000	3 000	RS3210A··	5.53	32	16
RNCT 3610A5 **RNCT 3610A5S**	36	10	6.35	37	30.0	2.5 × 2	44 900	102 000	0.20	60	M55 × 2	18	98	42	46	17	0.97	50.5	3.0	30.0	27.6	1 000	2 000	3 000	RS3610A··	6.91	32	16
RNCT 4010A7 **RNCT 4010A7S**	40	10	6.35	41.75	35.0	3.5 × 2	63 100	164 000	0.20	65	M60 × 2	25	125	44	50	20	1.37	54.5	3.0	35.0	31.8	2 000	3 000	4 000	RS4010A··	8.87	51	26
RNCT 4512A5 **RNCT 4512A5S**	45	12	7.144	46.5	39.0	2.5 × 2	58 500	147 000	0.23	70	M65 × 2	30	124	47	55	20	1.42	60.5	3.0	39.0	35.8	2 000	3 000	4 000	RS4512A··	11.16	60	30
RNCT 5010A7 **RNCT 5010A7S**	50	10	6.35	51.75	45.0	3.5 × 2	70 100	205 000	0.20	80	M75 × 2	40	140	52	59	20	2.41	64.5	3.0	45.0	41.8	2 000	3 000	4 000	RS5010A··	14.15	76	38
RNCT 5016A5 **RNCT 5016A5S**	50	16	9.525	52	42.0	2.5 × 2	117 000	299 000	0.23	85	M80 × 2	40	158	57	63	25	3.14	68.5	3.0	42.0	38.8	2 000	3 000	4 000	RS5016A··	13.48	114	57

Notes: 1. The protrusion of the tube will not cause interference if the mating section of the nut body has dimensions greater than *U* and *V*.
2. Actual screw shaft length may become slightly longer than nominal length L_o due to manufacturing tolerances.
3. A Nut Ref. No. ending in "S" has seals. The external dimensions of these are identical to those without seals. The figure shows a seal above the center line and no seal below. Synthetic resin seals are used for shaft diameters of 14 mm or less and brush seals for shaft diameters of 16 mm or more.
4. The nut assembly is separate from the screw shaft and comes delivered on an arbor.
5. The last digits (**) in the Shaft Ref. No. will show the value for screw shaft length in 100 mm units.
6. Standard inventory products have not undergone surface treatments.
7. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.
8. Values for nut internal space and standard grease replenishment are for ball screws with seals. The standard quantity for replenishment is about 50% of the nut's internal space. For ball screws without seals, apply grease to the screw shaft surface or move the nut by hand while filling to ensure that grease reaches all areas inside. See Page D16 for details.

Ball Screws for Transfer Equipment **End cap Recirculation, Flanged nut (Medium, Hige helix lead)**

R Model, RNFCL Nut

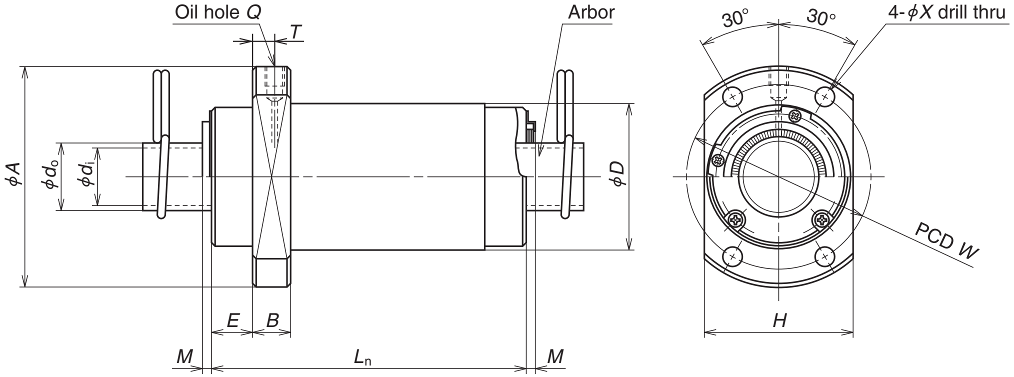


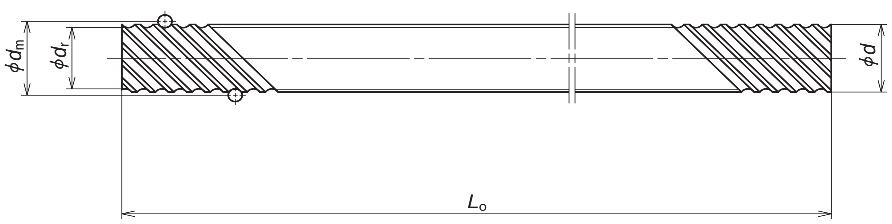


Unit: mm

Nut Ref. No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial play	Ball nut dimensions	Ball nut dimensions										Nut mass (kg)	Arbor		Screw shaft				Shaft mass per meter (kg)	Nut internal space (cm³)	Standard grease replenishment (cm³)
						Turns × Circuits	Dynamic	Static	Max.	Outside dia.	Flange			Length			Bolt hole		Oil hole			Outside dia.	Bore	Standard length			Shaft Ref. No.			
	d	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	H	B	E	L_n	M	W	X	Q	T		d_0	d_i	L_0						
RNFCL 1212A3	12	12	2.381	12.65	10.1	1.7 × 2	4 350	6 580	0.10	26	44	28	6	9	30	–	35	4.5	M3 × 0.5	3.0	0.12	10.1	8.1	400	800	–	RS1212A··	0.74	–	–
RNFCL 1212A6						1.7 × 4	7 890	13 200																						
RNFCL 1520A3	15	20	3.175	15.5	12.2	1.7 × 2	7 510	12 300	0.10	33	51	35	10	11	45	–	42	4.5	M6 × 1	5.0	0.28	12.2	10.2	500	1 000	1 500	RS1520A··	1.15	3.3	1.7
RNFCL 1520A3S																3														
RNFCL 1616A3	16	16	2.778	16.65	13.5	1.7 × 2	6 060	10 300	0.10	32	53	34	10	10	38	–	42	4.5	M6 × 1	5.0	0.23	13.5	11.5	500	1 000	1 500	RS1616A··	1.37	2.6	1.3
RNFCL 1616A3S																3														
RNFCL 1616A6						1.7 × 4	11 000	20 500								–													2.6	1.3
RNFCL 1616A6S																3														
RNFCL 2020A3	20	20	3.175	20.75	17.3	1.7 × 2	9 000	16 700	0.10	39	62	41	10	11.5	46	–	50	5.5	M6 × 1	5.0	0.37	17.3	14.9	500	1 000	2 000	RS2020A··	2.19	4.4	2.2
RNFCL 2020A3S																3														
RNFCL 2020A6						1.7 × 4	16 300	33 400								–													4.9	2.5
RNFCL 2020A6S																3														
RNFCL 2525A3	25	25	3.969	26	22.0	1.7 × 2	13 400	26 100	0.12	47	74	49	12	13	55	–	60	6.6	M6 × 1	6.0	0.62	22.0	19.6	1 000	2 000	2 500	RS2525A··	3.43	8.2	4.1
RNFCL 2525A3S																3														
RNFCL 2525A6						1.7 × 4	24 400	52 200								–													8.9	4.5
RNFCL 2525A6S																3														
RNFCL 3232A3	32	32	4.762	33.25	28.0	1.7 × 2	19 600	39 800	0.15	58	92	60	12	16	70	–	74	9	M6 × 1	5.5	1.10	28.0	25.6	1 000	2 000	3 000	RS3232A··	5.71	16	8.0
RNFCL 3232A3S																3														
RNFCL 3232A6						1.7 × 4	35 600	79 600								–													17	8.5
RNFCL 3232A6S																3														
RNFCL 4040A3	40	40	6.35	41.75	35.0	1.7 × 2	31 300	66 800	0.20	73	114	75	15	19.5	85	–	93	11	M6 × 1	6.5	2.09	35.0	31.8	2 000	3 000	4 000	RS4040A··	8.82	32	16
RNFCL 4040A3S																3.5														
RNFCL 4040A6						1.7 × 4	56 900	134 000								–													33	17
RNFCL 4040A6S																3.5														
RNFCL 5050A3	50	50	7.938	52.25	44.0	1.7 × 2	46 800	104 000	0.25	90	135	92	20	21.5	107	–	112	14	M6 × 1	7.0	3.90	44.0	40.8	2 000	3 000	4 000	RS5050A··	13.81	64	32
RNFCL 5050A3S																3.5														
RNFCL 5050A6						1.7 × 4	85 000	209 000								–													68	34
RNFCL 5050A6S																3.5														

Notes: 1. Actual screw shaft length may become slightly longer than nominal length L_0 due to manufacturing tolerances.
2. The nut assembly is separate from the screw shaft and comes delivered on an arbor.
3. The last digits (**) in the Shaft Ref. No. will show the value for screw shaft length in 100 mm units.
4. Products in standard inventory have not had surface treatments.
5. A Nut Ref. No. ending in "S" has seals. These are brush seals, and the nut total length becomes longer (by 2 x *M*) when seals are equipped.
6. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.
7. Values for nut internal space and standard grease replenishment are for ball screws with seals. The standard quantity for replenishment is about 50% of the nut's internal space. For ball screws without seals, apply grease to the screw shaft surface or move the nut by hand while filling to ensure that grease reaches all areas inside. See Page D16 for details.

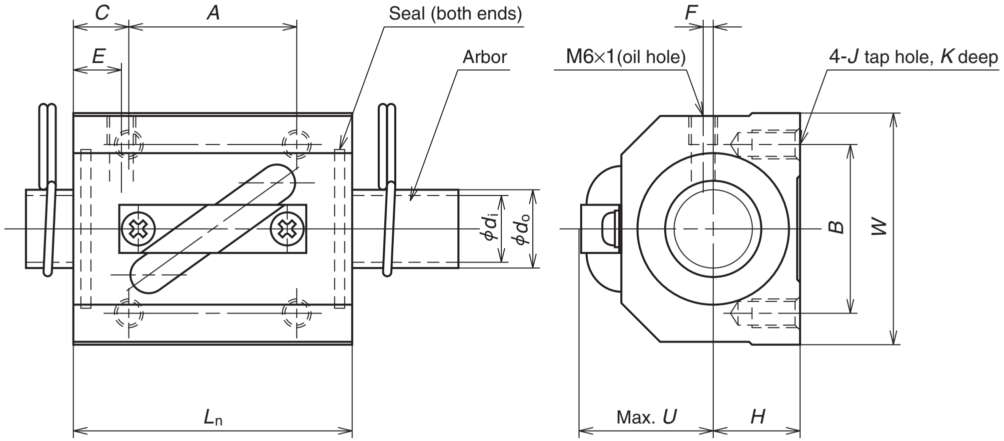


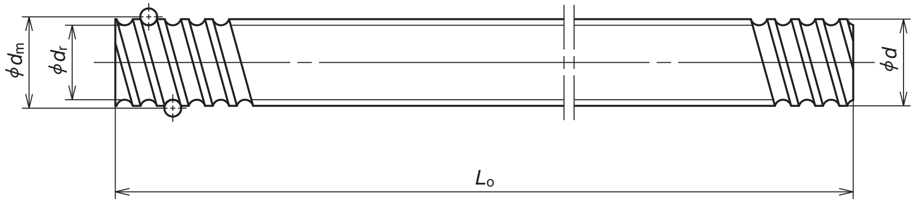


Unit: mm

Nut Ref. No.	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load ratings (N) Dynamic C_a	Basic load ratings (N) Static C_{oa}	Axial play Max.	Ball nut dimensions Outside dia. D	Ball nut dimensions Flange A	Flange H	Flange B	Length E	Length L_n	Length M	Bolt hole W	Bolt hole X	Oil hole Q	Oil hole T	Nut mass (kg)	Arbor Outside dia. d_0	Arbor Bore d_i	Screw shaft Standard length L_o				Shaft Ref. No.	Shaft mass per meter (kg)	Nut internal space (cm³)	Standard grease replenishment (cm³)
RNFCL 1632A2	16	32	2.778	16.65	13.5	0.7 × 4	4 880	8 330	0.10	32	50	34	10	10	34	–	41	4.5	M6 × 1	5.5	0.21	13.5	11.5	500	1 000	1 500	–	RS1632A··	1.34	2.4	1.2
RNFCL 1632A2S																3															
RNFCL 1632A3						1.7 × 2	5 760	10 300							66	–					0.33									3.9	2.0
RNFCL 1632A3S																3															
RNFCL 1632A6						1.7 × 4	10 500	20 500							66	–					0.33									4.1	2.1
RNFCL 1632A6S																3															
RNFCL 2040A2	20	40	3.175	20.75	17.3	0.7 × 4	7 170	13 200	0.10	38	58	40	10	11	41	–	48	5.5	M6 × 1	5.5	0.31	17.3	14.9	500	1 000	1 500	2 000	RS2040A··	2.15	4.1	2.1
RNFCL 2040A2S																3															
RNFCL 2040A3						1.7 × 2	8 480	16 500							81	–					0.53									6.3	3.2
RNFCL 2040A3S																3															
RNFCL 2040A6						1.7 × 4	15 400	33 100							81	–					0.53									7.0	3.5
RNFCL 2040A6S																3															
RNFCL 2550A2	25	50	3.969	26	22.0	0.7 × 4	10 700	20 700	0.12	46	70	48	12	13	50	–	58	6.6	M6 × 1	7.0	0.53	22.0	19.6	1 000	2 000	2 500	–	RS2550A··	3.37	8.4	4.2
RNFCL 2550A2S																3															
RNFCL 2550A3						1.7 × 2	12 700	26 500							100	–					0.91									14	7.0
RNFCL 2550A3S																3															
RNFCL 2550A6						1.7 × 4	23 000	53 000							100	–					0.91									15	7.5
RNFCL 2550A6S																3															
RNFCL 3264A3	32	64	4.762	33.25	28.0	1.7 × 2	17 900	40 200	0.15	58	92	60	12	15.5	126	–	74	9	M6 × 1	7.5	1.76	28.0	25.6	1 000	2 000	3 000	4 000	RS3264A··	5.63	24	12
RNFCL 3264A3S																3															
RNFCL 3264A6						1.7 × 4	32 400	80 300								–														26	13
RNFCL 3264A6S																3															
RNFCL 4080A3	40	80	6.350	41.75	35.0	1.7 × 2	29 500	67 900	0.20	73	114	75	15	19	158	–	93	11	M6 × 1	10.0	3.44	35.0	31.8	2 000	3 000	4 000	5 000	RS4080A··	8.69	52	26
RNFCL 4080A3S																3.5															
RNFCL 4080A6						1.7 × 4	53 600	136 000								–														55	28
RNFCL 4080A6S																3.5															

Notes:
1. Actual screw shaft length may become slightly longer than nominal length L_0 due to manufacturing tolerances.
2. The nut assembly is separate from the screw shaft and comes delivered on an arbor.
3. The last digits (**) in the Shaft Ref. No. will show the value for screw shaft length in 100 mm units.
4. Products in standard inventory have not had surface treatments.
5. A Nut Ref. No. ending in "S" has seals. These are brush seals, and the nut total length becomes longer (by 2 x M) when seals are equipped.
6. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.
7. Values for nut internal space and standard grease replenishment are for ball screws with seals. The standard quantity for replenishment is about 50% of the nut's internal space. For ball screws without seals, apply grease to the screw shaft surface or move the nut by hand while filling to ensure that grease reaches all areas inside. See Page D16 for details.





Unit: mm

Nut Ref. No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial play Max.	Ball nut dimensions
	d	l	D_w	d_m	d_r	Turns × Circuits	Dynamic C_a	Static C_{0a}		Length L_n
RNSTL 1404A3.5S	14	4	2.778	14.5	11.5	3.5 × 1	6 310	10 800	0.10	38
RNSTL 1405A2.5S	14	5	3.175	14.5	11.0	2.5 × 1	6 170	9 940	0.10	38
RNSTL 1808A3.5S	18	8	4.762	18.5	13.6	3.5 × 1	15 500	26 200	0.15	56
RNSTL 2005A2.5S	20	5	3.175	20.5	17.0	2.5 × 1	7 500	14 200	0.10	38
RNSTL 2010A2.5S	20	10	4.762	21.25	16.2	2.5 × 1	12 700	21 600	0.15	58
RNSTL 2505A2.5S	25	5	3.175	25.5	22.0	2.5 × 1	8 340	18 100	0.10	35
RNSTL 2510A5S	25	10	6.35	26	19.0	2.5 × 2	37 300	69 800	0.20	94
RNSTL 2806A2.5S	28	6	3.175	28.5	25.0	2.5 × 1	8 760	20 200	0.10	42
RNSTL 2806A5S						2.5 × 2	15 900	40 500		67
RNSTL 3210A2.5S	32	10	6.35	33.75	27.0	2.5 × 1	23 100	45 900	0.20	64
RNSTL 3210A5S						2.5 × 2	42 000	91 800		94
RNSTL 3610A2.5S	36	10	6.35	37	30.0	2.5 × 1	24 700	50 800	0.20	64
RNSTL 3610A5S						2.5 × 2	44 900	102 000		96
RNSTL 4512A5S	45	12	7.144	46.5	39.0	2.5 × 2	58 500	147 000	0.23	115

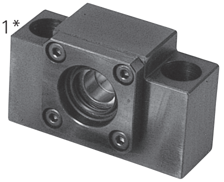
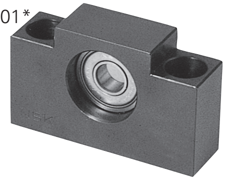
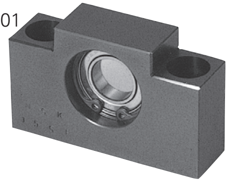
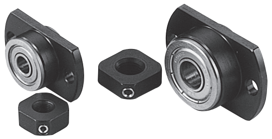
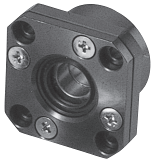
Nut Ref. No.	Ball nut dimensions										Nut mass (kg)	Arbor		Screw shaft				Shaft mass per meter (kg)	Nut internal space (cm³)	Standard grease replenishment (cm³)
	Width	Center height	Bolt hole					Oil hole				Outside dia.	Bore	Standard length			Shaft Ref. No.			
	W	H	A	B	C	J	K	E	F	U		d_0	d_i	L_0						
RNSTL 1404A3.5S	34	13	22	26	8	M4	7	7	3	20	0.20	11.5	9.5	500	1 000	–	RS1404A··	1.02	1.6	0.8
RNSTL 1405A2.5S	34	13	22	26	8	M4	7	7	3	21	0.20	11.0	9.0	500	1 000	–	RS1405A··	1.00	1.8	0.9
RNSTL 1808A3.5S	48	17	35	35	10.5	M6	10	8	3	26	0.31	13.6	11.6	500	1 000	1 500	RS1808A··	1.60	3.4	1.7
RNSTL 2005A2.5S	48	17	22	35	8	M6	9	6	2	27	0.24	17.0	14.6	500	1 000	2 000	RS2005A··	2.17	2.5	1.3
RNSTL 2010A2.5S	48	18	35	35	11.5	M6	10	10	2	28	0.35	16.2	13.8	500	1 000	2 000	RS2010A··	2.18	6.3	3.2
RNSTL 2505A2.5S	60	20	22	40	6.5	M8	10	6	0	27	0.31	22.0	19.6	1 000	2 000	2 500	RS2505A··	3.47	2.6	1.3
RNSTL 2510A5S	60	23	60	40	17	M8	12	10	0	32	1.32	19.0	16.6	1 000	2 000	2 500	RS2510A··	3.13	18	9.0
RNSTL 2806A2.5S	60	22	18	40	12	M8	12	8	0	32	0.65	25.0	22.6	1 000	2 000	2 500	RS2806A··	4.47	3.5	1.8
RNSTL 2806A5S	60	22	40	40	13.5						1.04								7.0	3.5
RNSTL 3210A2.5S	70	26	45	50	9.5	M8	12	10	0	38	1.12	27.0	24.6	1 000	2 000	3 000	RS3210A··	5.53	18	9.0
RNSTL 3210A5S	70	26	60	50	17						1.75								27	14
RNSTL 3610A2.5S	86	29	45	60	9.5	M10	16	11	0	41	1.76	30.0	27.6	1 000	2 000	3 000	RS3610A··	6.91	18	9.0
RNSTL 3610A5S	86	29	60	60	18						2.64								27	14
RNSTL 4512A5S	100	36	75	75	20	M12	20	13	0	46	1.22	39.0	35.8	2 000	3 000	4 000	RS4512A··	11.16	47	24

Notes: 1. Actual screw shaft length may become slightly longer than nominal length L_0 due to manufacturing tolerances.
2. The nut assembly is separate from the screw shaft and comes delivered on an arbor.
3. The last digits (**) in the Shaft Ref. No. will show the value for screw shaft length in 100 mm units.
4. Products in standard inventory have not had surface treatments.
5. Synthetic resin seals are used for shaft diameters of 14 mm or less and brush seals for shaft diameters of 16 mm or more.
6. Only a rust preventive agent is applied before delivery. Apply lubricant (grease or oil) before use.
7. The standard quantity for grease replenishment is about 50% of the nut's internal space. See Page D16 for details.

B-3-1.7 Accessories

Accessories to use with NSK ball screws are available.

Table 1 Support unit lineup

Application		Shape	Support side	Bearing in use	Bearing bore, Bearing seat diameter	Page
Small equipment, light load	Square	WBK**-01* 	Fixed support side	Angular contact ball bearing	ϕ4 – ϕ25	B383 –
		WBK**S-01* 	Simple support side	Deep groove ball bearing	ϕ6 – ϕ25	B387 –
		WBK**SF-01 		Deep groove ball bearing	ϕ12, ϕ15 (exclusively for VFA model)	B387
Small equipment, light load	Round	WBK**R-11 (Support kit) 	Fixed support side	Deep groove ball bearing (arranged to have angular contact)	ϕ4, ϕ6 (exclusively for RMA and RMS models)	B389
		WBK**-11* 		Angular contact ball bearing	ϕ4 – ϕ25	B385 –
Machine tools, high speed, heavy load	Round	WBK**DF*-31H 	Fixed support side	Thrust angular contact ball bearing	ϕ17 – ϕ40	B395 –

1. Classification

Ball screw support units are classified by their shape (**Table 1**). Select the type that best suits your particular needs.

2. Features

● Bearings and seals

On the fixed support side, an angular contact ball bearing is used. It has great rigidity and low friction torque, which match the rigidity of the ball screw. A thrust angular contact ball bearing with high precision and great rigidity is another choice for the fixed support side.

The dynamic load ratings of the bearing were revised in 2024.

The target is a part of Support Units with locating bearing the fixing side bearings (High-Precision Angular Contact Ball Bearing) and supporting bearings (Deep Groove Ball Bearing).

This revision is due to the introduction of NSK's original material evaluation technology (Micro-UT™).

(For more information on Micro-UT™ technology, please refer to our catalog "CAT.No 1103e Rolling Bearings").

An oil seal is installed to the fixed support side with an angular contact ball bearing. Fine clearance may occur with this seal.

A deep-groove ball bearing with a shield on both sides is used on the simple support side.

● Lock nut provided

A lock nut with fine grade finish is provided to fix the bearing with high precision.

The lock nuts are designed to be difficult to loosen, but they can still loosen if subjected to strong mechanical vibration. If necessary, this should be prevented by applying threadlocking adhesive or similar precautions.

3. Reference number coding

(For light load)

Example: **WBK 08 S - 01 A**

Product code for support unit

Nominal size code*

Mounting code

No code: Fixed side
S: Simple side
SF: Simple side (for FSS and VFA)
R: Fixed side (support kit for miniature ball screws)

01: Square type
11: Round type

No code or A: For general use
B: Low-profile type (only for square type)
C: For cleanroom use
M: Miniature general-purpose use
W: Lost-wax product

∗) Nominal size codes of 12 or less for support units mounted on the simple side do not strictly represent internal bore of bearing in millimeters. Please refer to the dimensional tables for details.

(For high speed and heavy load)

Example: **WBK 25 DF - 31H**

Product code for support unit

Nominal size code (internal bore of bearing)

H: High speed type

Bearing combination code
DF: Face to face two-row arrangement (paired mounting)
DFD: Face to face three-row arrangement
DFF: Face to face four-row arrangement

(1) Support Units for Light Loads and Small Equipment

Support units for light load and small equipment provide both fixed and support side bearing assemblies to support screw shafts. They provide all required parts such as bearing locknuts so that you can mount them directly to standard NSK machined ball screws.

Please refer to the dimensions listed on the dimension tables for the configuration of standard screw shaft ends for NSK standard ball screws with blank shaft ends. Ball screws for transfer equipment require spacers (sold separately) to use support units.

(a) Features

●Prompt delivery

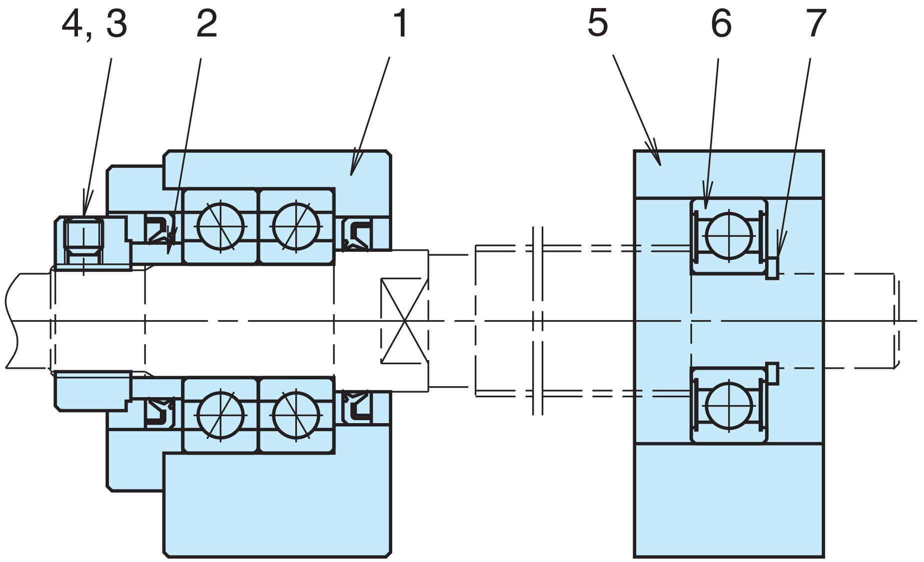
Support units are standard products.

●Best selection of bearings for your application

General use support units for fixed support are equipped with highly rigid angular contact ball bearings that have been assembled with proper preload and packed with the appropriate volume of grease. On the other hand, clean support units for fixed support low dust emission grease and low torque special bearings. Sealed deep groove ball bearings are used for simple support side units for both general and cleanroom use.

- **Accessories**
  Support units provide everything necessary for mounting ball screws to machines.
  (Please refer to the table below.)

* Do not disassemble fixed-side support units as they are equipped with bearings and oil seals.



- **Antirust treatment**
  The table on the right shows details on parts, the surface treatment, and materials.

Fixed side		Simple side	
Part No.	Name of part	Part No.	Name of part
1	Bearing housing	5	Bearing housing
2	Spacer	6	Bearing
3	Locknut	7	Snap ring
4	Set screw with brass pad		

Details for General Support Units	
Bearings and grease	Angular contact ball bearings, PS2
Surface treatment	Black oxide
Screws and snap rings	Standard material

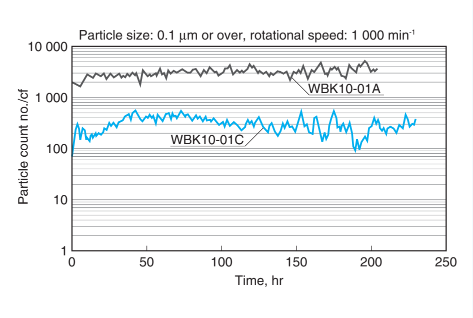
(b) Features of Clean Support Units

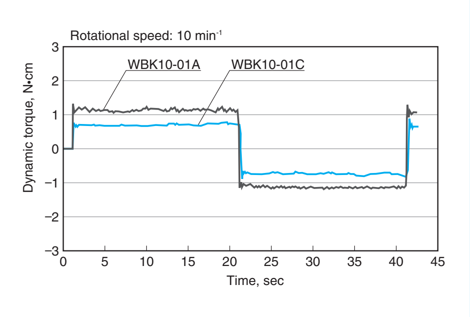
- **Outstanding low dust emissions**
  Clean support units use NSK Cleanroom Grease LG2 with proven low dust emissions. These units reduce dust emissions to 1/10th that of general support units.

- **Low torque**
  Specialized bearings provide significantly lower torque than standard units (50% lower than general support units.)

- **High antirust specifications**
  Low temperature chrome plating is applied to bearing housings, retaining plates, locknuts and spacers to improve antirust properties. Moreover, bolts and snap rings are made of stainless steel.
  The table below shows details on parts, the surface treatment, and materials.

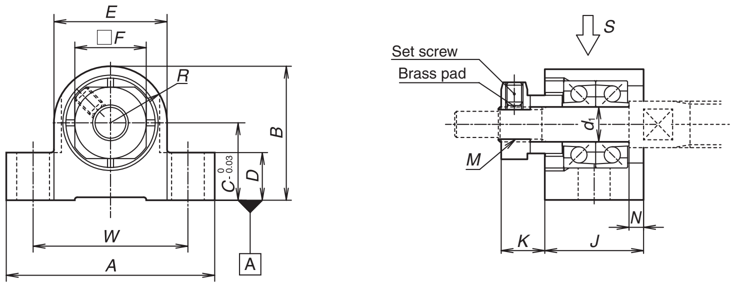
Details for Cleanroom Support Units	
Bearings and grease	Specialized angular contact ball bearings LG2
Surface treatment	Low temperature chrome plating
Set screw and snap ring material	Stainless steel



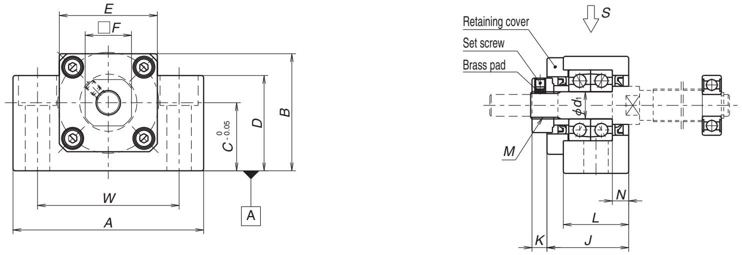


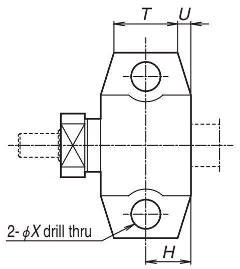
Support Units for Light Load and Small Equipment

WBK**-01M

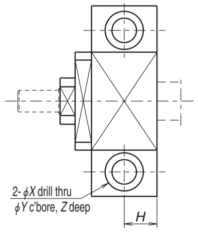


WBK**-01*

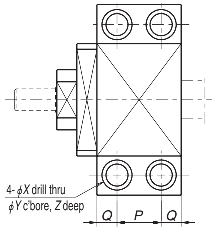




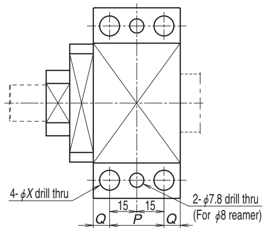
Reference No.	Tightening torque (reference) [N·cm]	
	Locknut	Set screw
WBK04-**	100	69 (M3)
WBK06-**	190	69 (M3)
WBK08-**	230	69 (M3)
WBK10-**	280	147 (M4)
WBK12-**	630	147 (M4)
WBK15-**	790	147 (M4)
WBK17-**	910	147 (M4)
WBK20-**	1670	147 (M4)
WBK25-**	2060	490 (M6)



View S (WBK06 – 15)



View S (WBK17 – 20)



View S (WBK25)

Fixed-side support units (square type)

Units: mm

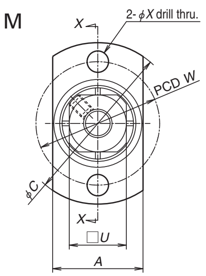
Reference No.	Use	d_1	*A*	*B*	*C*	*D*	*E*	*F*	*L*	*J*	*K*	*R*	*T*	*U*	*N*	Counterbore dimensions							Mass (kg)	Locknut screw *M*	Attached bearing for support side
																H	*P*	*Q*	*W*	*X*	*Y*	*Z*			
WBK04-01M	General	4	27	17	10	6	14	10	—	14	5.5	7	9	2.5	2	7	—	—	21	3.5	—	—	0.03	M4×0.5	—
WBK06-01M	General	6	35	22.5	13	8	19	12	—	17	7.5	9.5	12	2.5	2.5	8.5	—	—	26	5.5	—	—	0.05	M6×0.75	—
WBK06-01A[*1]	General	6	42	25	13	20	18	12	20	20	5.5	—	—	—	3.5	10	—	—	30	5.5	9.5	11	0.15	M6×0.75	—
WBK08-01A[*1]	General	8	52	32	17	26	25	14	23	23	7	—	—	—	4	11.5	—	—	38	6.6	11	12	0.25	M8×1	606ZZ
WBK08-01B	Low type		62	31	15.5	31	—		21.5	25.5	4.5				3.5	11			46	9	14	18	0.3		606ZZ
WBK08-01C[*1]	Cleanroom		52	32	17	26	25		23	23	7				4	11.5			38	6.6	11	12	0.25		606VV
WBK10-01A	General	10	70	43	25	35	36	17	24	30	5.5	—	—	—	6	12	—	—	52	9	14	11	0.5	M10×1	608ZZ
WBK10-01B	Low type			38	20	38	—															19	0.45		608ZZ
WBK10-01C	Cleanroom			43	25	35	36															11	0.5		608VV
WBK12-01A	General	12	70	43	25	35	36	19	24	30	5.5	—	—	—	6	12	—	—	52	9	14	11	0.5	M12×1	6000ZZ
WBK12-01B	Low type			38	20	38	—															19	0.4		6000ZZ
WBK12-01C	Cleanroom			43	25	35	36															11	0.5		6000VV
WBK15-01A	General	15	80	50	30	40	41	22	25	31	12	—	—	—	5	12.5	—	—	60	11	17	15	0.7	M15×1	6002ZZ
WBK15-01B	Low type			42	22	42	—															23	0.6		6002ZZ
WBK15-01C	Cleanroom			50	30	40	41															15	0.7		6002VV
WBK17-01A	General	17	86	64	39	55	50	24	35	44	7	—	—	—	7	—	19	8	68	9	14	x11	1.3	M17×1	6203ZZ
WBK20-01	General	20	95	58	30	45	56	30	42	52	10	—	—	—	10	—	22	10	75	11	17	15	1.4	M20×1	6204ZZ
WBK25-01W	General	25	105	68	35	25	66	36	48	61	13	—	—	—	14	—	30	9	85	11	—	—	1.9	M25×1.5	6205ZZ

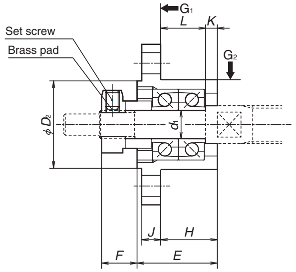
Notes:
1. Use datum surface A for mounting to the machine base.
2. After the locknut has been adjusted and tightened, insert the provided brass pad and set screw, then tighten the set screw.
3. Insert the provided set piece (brass pad) before tightening the set screw.
4. Single-row deep groove ball bearings and C-shaped snap rings are provided (excluding WBK04-01M, WBK06-01M, and WBK06-01A.
5. Bearings for WBK04-01M and WBK06-01M have non-contact metal shields on both sides.

∗1. WBK06-01A, WBK08-01A, and WBK08-01C do not have seals on the retaining cover side.

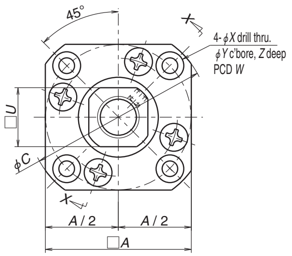
6. Contact NSK if the rotational speed will be 50 min^{-1} or less.

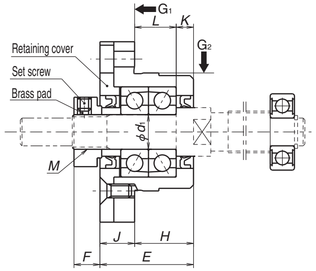
WBK**-11M



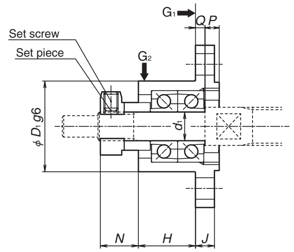


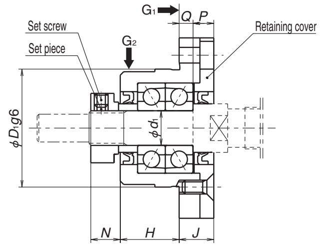
WBK**-11*





View X-X (example 1)





(example 2)

Reference No.	Tightening torque (reference) [N·cm]	
	Locknut	Set screw
WBK04-**	100	69 (M3)
WBK06-**	190	69 (M3)
WBK08-**	230	69 (M3)
WBK10-**	280	147 (M4)
WBK12-**	630	147 (M4)
WBK15-**	790	147 (M4)
WBK17-**	910	147 (M4)
WBK20-**	1670	147 (M4)
WBK25-**	2060	490 (M6)

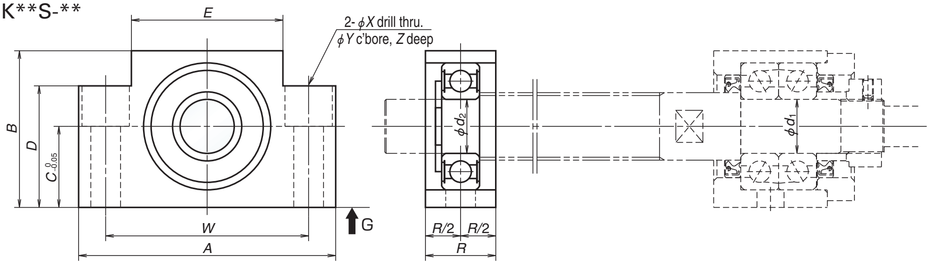
Fixed-side support units (round type)

Units: mm

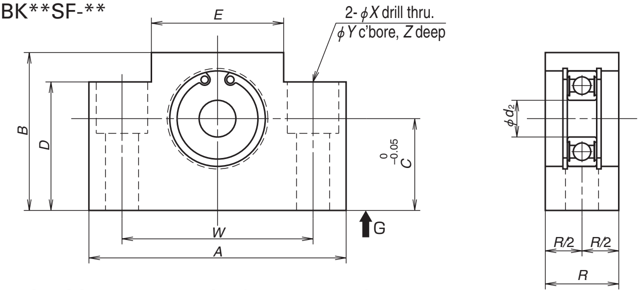
Reference No.	Use	d_1	A	C	D_1	D_2	E	H	L	K	F	N	U	P	Q	Counterbore dimensions					Mass (kg)	Locknut screw M	Attached bearing for support side
																J	W	X	Y	Z			
WBK04-11M	General	4	14	26	14	14	13.5	8.5	7	1.5	5.5	6.6	10	2.6	2.4	3	20	3.5	—	—	0.02	M4×0.5	—
WBK06-11M	General	6	19	34	19	18.5	17	12	9.5	2.5	7.5	8	12	3	2	4	26	4.5	—	—	0.04	M6×0.75	—
WBK06-11*	General	6	28	35	22	—	20	13	9.5	3.5	5.5	6.5	12	4.5	2.5	7	28	2.9	5.5	3.5	0.1	M6×0.75	—
WBK08-11B	High-load type	8	42	52	34	—	25.5	15.5	12	3.5	4.5	7	14	6	4	10	42	4.5	8	4	0.2	M8×1	606ZZ
WBK08-11*	General		35	43	28		23	14	10	4	7	8		5		9	35	3.4	6.5		0.15		606ZZ
WBK08-11C*	Cleanroom																						606VV
WBK10-11	General	10	42	52	34	—	27	17	12	5	7.5	8.5	17	6	4	10	42	4.5	8	4	0.2	M10×1	608ZZ
WBK10-11C	Cleanroom																						608VV
WBK12-11	General	12	44	54	36	—	27	17	12	5	7.5	8.5	19	6	4	10	44	4.5	8	4	0.25	M12×1	6000ZZ
WBK12-11C	Cleanroom																						6000VV
WBK15-11	General	15	52	63	40	—	32	17	11	6	12	14	22	8	7	15	50	5.5	9.5	6	0.4	M15×1	6002ZZ
WBK15-11C	Cleanroom																						6002VV
WBK20-11	General	20	68	85	57	—	52	30	20	10	10	14	30	14	8	22	70	6.6	11	10	1.1	M20×1	6204ZZ
WBK25-11	General	25	79	98	63	—	57	30	20	10	13	20	36	17	10	27	80	9	15	13	1.5	M25×1.5	6205ZZ

Notes: 1. Tighten the set screw after the locknut has been adjusted and tightened.
2. Insert the provided set piece (brass pad) before tightening the set screw.
3. Single-row deep groove ball bearings and C-shaped snap rings are provided (excluding WBK04-11M, WBK06-11M, and WBK06-11.
4. Bearings for WBK04-11M and WBK06-11M have non-contact metal shields on both sides.
∗1. WBK06-11, WBK08-11, and WBK08-11C do not have seals on the retaining cover side.
5. Contact NSK if the rotational speed will be 50 min^{-1} or less.
6. Use datum surface G_1 and G_2 for mounting to the machine base.

WBK**S-**



WBK**SF-**



Simple-side support units (square type)

Units: mm

Reference No.	Use	d_2	*A*	*B*	*C*	*D*	*E*	*R*	Counterbore dimensions				Mass
									W	*X*	*Y*	*Z*	(kg)
WBK08S-01	General	6	52	32	17	26	25	15	38	6.6	11	12	0.15
WBK08S-01B	Low type		62	31	15.5	31	—	16	46	9	14	18	0.2
WBK08S-01C	Cleanroom		52	32	17	26	25	15	38	6.6	11	12	0.15
WBK10S-01	General	8	70	43	25	35	36	20	52	9	14	11	0.4
WBK10S-01C	Cleanroom												
WBK12S-01	General	10	70	43	25	35	36	20	52	9	14	11	0.35
WBK12S-01B	Low type			38	20	38	—					19	0.4
WBK12S-01C	Cleanroom			43	25	35	36					11	0.35
WBK12SF-01[*2]	General	12											0.3
WBK12SF-01B[*1]	Low type		62	31	15.5	31	—	18	46			18	0.2
WBK15S-01	General	15	80	50	30	40	41	20	60	9	14	11	0.45
WBK15S-01B	Low type			42	22	42	—					23	0.4
WBK15S-01C	Cleanroom			50	30	40	41					11	0.45
WBK15SF-01[*2]	General		70	43	25	35	36		52				0.3
WBK15SF-01B[*1]	Low type			38	20	38	—	18				19	
WBK17S-01	General	17	86	64	39	55	50	23	68	9	14	11	0.8
WBK20S-01	General	20	95	58	30	45	56	26	75	11	17	15	0.8
WBK20SF-01B	Low type		80	42	22	42	—	22	60			23	0.4
WBK25S-01W	General	25	105	68	35	25	66	30	85	11	—	—	0.9
WBK25SF-01[*1]			95	58	30	45	56	22	75	11	17	15	0.55

Notes: 1. Use datum surface G for mounting to the machine base.
2. Note that the inner dimensions of the bearing differ for products with nominal size codes of 12 or less.
3. WBK**SF supports the ball screw outside diameter.
4. See page B400 for bearing designations and basic dynamic load ratings in the radial direction.
∗1 Exclusively for FSS models.
∗2 Exclusively for VFA models.

Specifications of support units

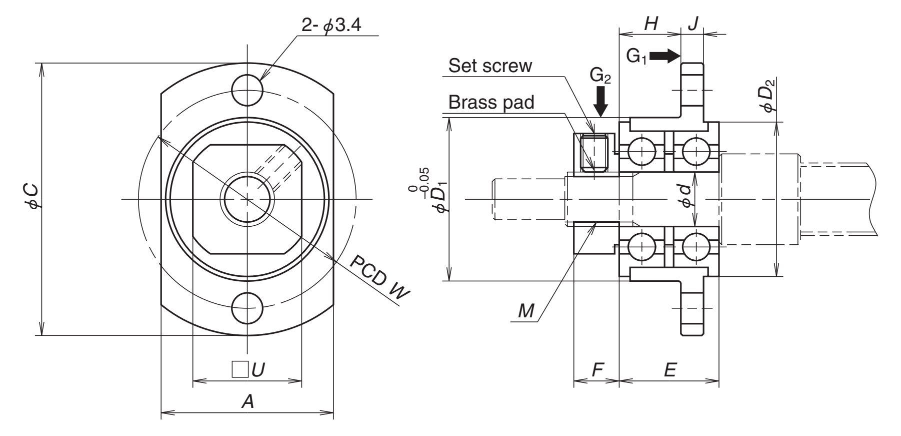
Fixed-side support units						Simple-side support units		
Reference No.	Use	Axial direction			Maximum starting torque [N·cm]	Reference No.	Bearing reference No.	Radial direction Basic dynamic load rating *C* [N]
		Basic dynamic load rating *Ca* [N]	Allowable load [N]	Rigidity [N/μm]				
WBK04-01M	General	1 470	320	39	0.2	—	—	—
WBK04-11M	General	1 470	320	39	0.2	—	—	—
WBK06-01A	General	3 350	725	28	0.49	—	—	—
WBK06-01M	General	2 760	595	60	0.35	—	—	—
WBK06-11	General	3 350	725	28	0.49	—	—	—
WBK06-11M	General	2 760	595	60	0.35	—	—	—
WBK08-01A	General	5 550	1 020	49	0.88	**WBK08S-01**	606ZZ	2 490
WBK08-01B	Low type	8 300	1 890	94	1.9	**WBK08S-01B**	606ZZ	2 490
						WBK12SF-01B[*1]	6801ZZ	2 110
WBK08-01C	Cleanroom	3 900	770	36	0.52	**WBK08S-01C**	606VV	2 490
WBK08-11	General	5 550	1 020	49	0.88	**WBK08S-01**	606ZZ	2 490
WBK08-11B	High load	8 300	1 890	94	1.9	—	606ZZ	2 490
WBK08-11C	Cleanroom	3 900	770	36	0.52	**WBK08S-01C**	606VV	2 490
WBK10-01A	General	8 300	1 910	94	1.9	**WBK10S-01**	608ZZ	3 650
						WBK12SF-01[*2]	6001ZZ	5 600
WBK10-01B	Low type	8 300	1 910	94	1.9	—	608ZZ	3 650
WBK10-01C	Cleanroom	5 400	950	50	1.1	**WBK10S-01C**	608VV	3 650
WBK10-11	General	8 300	1 910	94	1.9	**WBK10S-01**	608ZZ	3 650
WBK10-11C	Cleanroom	5 400	950	50	1.1	**WBK10S-01C**	608VV	3 650
WBK12-01A	General	9 000	2 130	104	2.1	**WBK12S-01**	6000ZZ	5 050
						WBK15SF-01[*2]	6902ZZ	4 750
WBK12-01B	Low type	9 000	2 130	104	2.1	**WBK12S-01B**	6000ZZ	5 050
						WBK15SF-01B[*1]	6902ZZ	4 750
WBK12-01C	Cleanroom	5 950	1 710	57	1.2	**WBK12S-01C**	6000VV	5 050
WBK12-11	General	9 000	2 130	104	2.1	**WBK12S-01**	6000ZZ	5 050
WBK12-11C	Cleanroom	5 950	1 710	57	1.2	**WBK12S-01C**	6000VV	5 050
WBK15-01A	General	9 600	2 360	113	2.4	**WBK15S-01**	6002ZZ	6 150
WBK15-01B	Low type	9 600	2 360	113	2.4	**WBK15S-01B**	6002ZZ	6 150
						WBK20SF-01B[*1]	6804ZZ	4 400
WBK15-01C	Cleanroom	6 450	1 925	63	1.3	**WBK15S-01C**	6002VV	6 150
WBK15-11	General	9 600	2 360	113	2.4	**WBK15S-01**	6002ZZ	6 150
WBK15-11C	Cleanroom	6 450	1 925	63	1.3	**WBK15S-01C**	6002VV	6 150
WBK17-01A	General	16 800	4 050	120	3.5	**WBK17S-01**	6203ZZ	10 500
WBK20-01	General	22 500	5 750	155	6.2	**WBK20S-01**	6204ZZ	14 100
						WBK25SF-01[*1]	6005ZZ	11 100
WBK20-11	General	22 500	5 750	155	6.2	**WBK20S-01**	6204ZZ	14 100
WBK25-01W	General	25 500	6 950	192	7.2	**WBK25S-01W**	6205ZZ	15 400
WBK25-11	General	25 500	6 950	192	7.2	**WBK25S-01W**	6205ZZ	15 400
WBK04R-11	General	615	340	6.5	0.59	—	—	—
WBK06R-11	General	1 280	650	9	0.59	—	—	—

Notes: ∗1 Exclusively for FSS models.
∗2 Exclusively for VFA models.

Support kits for ball screws for transfer equipment

Support kits are for RMA model ball screws.

In case of RMA1002 or larger rolled ball screws, please use support units for general use.



Units: mm

Reference No.	*A*	*C*	*d*	*D*₁	*D*₂	*E*	*F*	*J*	*H*	*W*	*U*	*M*	Mass (kg)
WBK04R-11	14	25	4	13	12.5	9	5	2.5	5	19	10	M4×0.5	0.13
WBK06R-11	19	30	6	18	17	11	5	2.5	6.8	24	12	M6×0.75	0.23

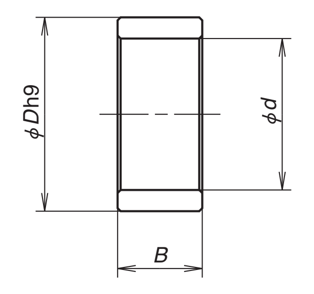
Reference No.	Applicable ball screw	Locknut tightening torque (reference) [N·cm]	Set screw tightening torque (reference) [N·cm]
WBK04R-11	RMA0601	100	38 (M2.5)
WBK06R-11	RMA0801 RMA0801.5 RMA0802	190	69 (M3)

Notes:

1. When mounting, adjust the bearing and and locknut phase to minimize the runout of the flange mounting surface. Use datum surface G_1 and G_2 for mounting to the machine base.
2. Support kits are delivered on a temporary shaft (bolt).
3. Insert the provided set piece (brass pad) before tightening the set screw.

Spacers

When using a fixed-side support unit, a spacer may be required to have an effective shoulder surface when the ball thread is threaded to the end of the shoulder, as common in R models for transfer equipment.

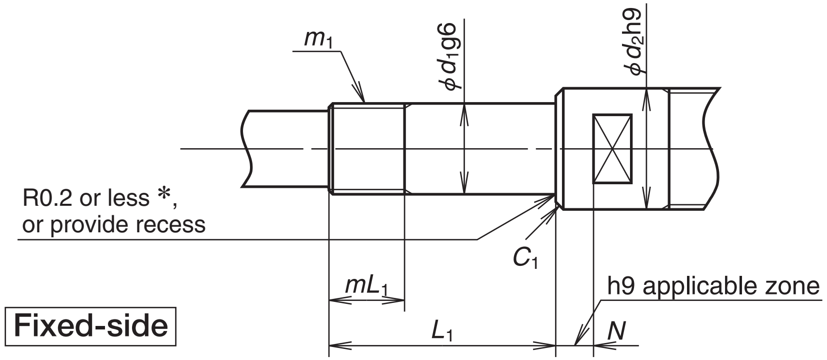


Units: mm

Reference No.	Internal diameter, *d*	Outside diameter, *D*	Width *B*	Mass (g)	Applicable support unit
WBK06K	6	9.5	5.0	2	WBK06-＊＊
WBK08K	8	11.5	5.5	2	WBK08-＊＊
WBK10K	10	14.5	5.5	4	WBK10-＊＊
WBK12K	12	15.0	5.6	3	WBK12-＊＊
WBK15K	15	19.5	10.0	10	WBK15-＊＊
WBK17K	17	24.4	7.0	13	WBK17-＊＊
WBK20K	20	25.5	11.0	17	WBK20-＊＊
WBK25K	25	32.0	14.0	34	WBK25-＊＊

Screw shaft end configuration

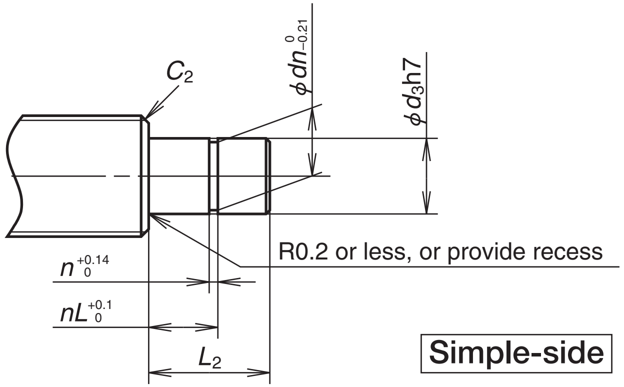
Dimensions of shaft end configurations for light load and small equipment support units are shown in the table below. When using a spacer with a ball screw for transfer equipment, add the width of the spacer (B from spacer dimensions on page B402) to the L_1 dimension below.



Radius marked with ∗ above is 0.15 or less for WBK04R-11 and WBK06R-11.

Units: mm

Reference No.	Fixed-side support units						
	Bearing journal		Locknut thread		Sealing part		Chamfer
	d_1	L_1	m_1	mL_1	d_2	N	C_1
WBK06-∗∗	6	22.5	M6×0.75	7	9.5	3.5	0.2
WBK08-∗∗	8	27	M8×1	9	11.5	4	0.2
WBK10-∗∗	10	30	M10×1	10	14	6	0.2
WBK12-∗∗	12	30	M12×1	10	15	6	0.2
WBK15-∗∗	15	40	M15×1	15	19.5	5	0.3
WBK17-∗∗	17	46	M17×1	17	24	7	0.3
WBK20-∗∗	20	53	M20×1	16	25	10	0.3
WBK25-∗∗	25	62	M25×1.5	20	32	14	0.5
WBK04R-11	4	15	M4×0.5	7.5	—	—	0.3
WBK06R-11	6	17	M6×0.75	7.5	—	—	0.3

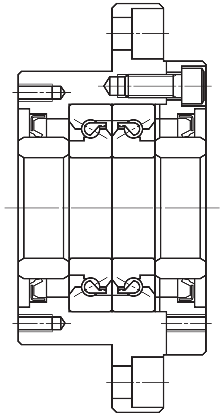


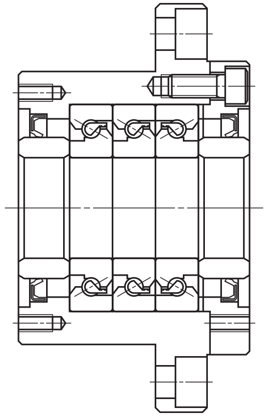
Units: mm

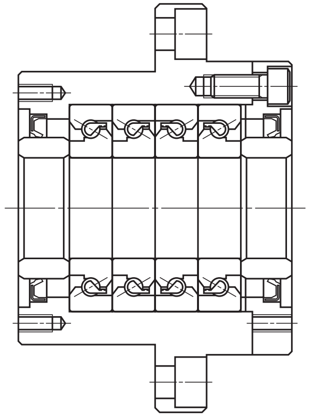
Reference No.	Simple-side support units					
	Bearing journal		Snap ring groove			Chamfer
	d_3	L_2	n	dn	nL	C_2
————	—	—	—	—	—	—
WBK08S-∗∗	6	9	0.8	5.7	6.8	0.2
WBK10S-∗∗	8	10	0.9	7.6	7.9	0.2
WBK12S-∗∗	10	22	1.15	9.6	9.15	0.5
WBK15S-∗∗	15	25	1.15	14.3	10.15	0.5
WBK17S-∗∗	17	16	1.15	16.2	13.15	0.5
WBK20S-∗∗	20	19	1.35	19	15.35	0.5
WBK25S-∗∗	25	20	1.35	23.9	16.35	0.5

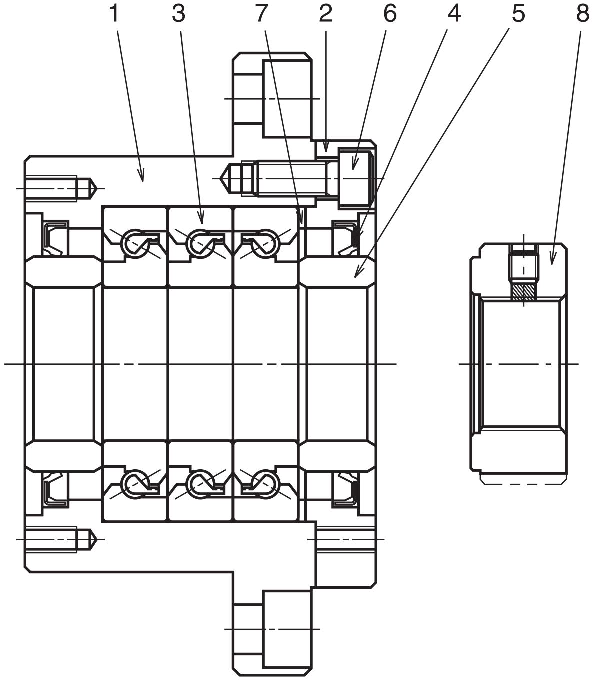
(2) Support units for ball screws for high-speed and heavy-load machine tools

Support units for high-speed and heavy-load machine tools use NSKHPS™ BSBD Series ball screw support bearings with an optimal structure and functions. Possible bearing combinations are shown below:


DF arrangement


DFD arrangement


DFF arrangement

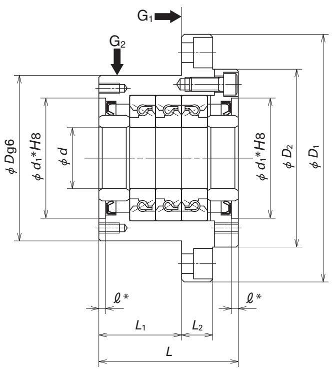


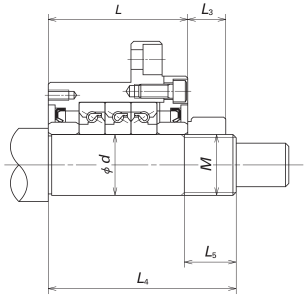
Parts list

Part No.	Part name	Quantity
1	Housing	1
2	Retaining cover	1
3	High accuracy thrust angular contact ball bearing	One set
4	Dust seal	2
5	Collar	2
6	Preload bolt	6 or 8
7	Shim	One set
8	Lock nut	1

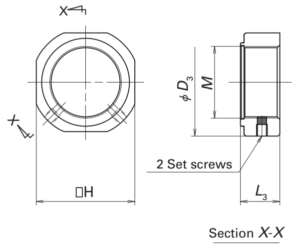
Notes:
1. NSK support units are precisely preloaded and adjusted. Parts 1–7 come as a unit and should not be disassembled.
2. Grease is pre-packed in the bearings.
3. The lock nut (Part 8) is specialized for ball screws and has an end surface that is strictly controlled to be precisely perpendicular to the V thread. Secure the lock nut using a set screw. Lock nuts are also available separately (see page B397).
4. See page B403 for details on NSKTAC C Series angular contact thrust ball bearings for ball screw support.

Support Units for High-Speed, Heavy-Load Machine Tools

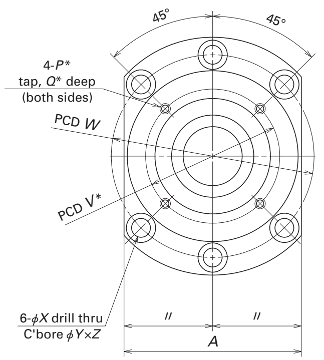




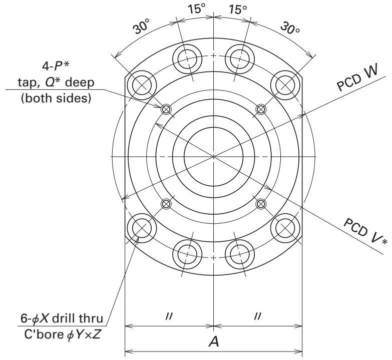
Dimensions of bearing seat



Lock nut



Bearing bore $d \leq 30$



Bearing bore $d \geqq 35$

Unit: mm

Support Unit Reference No.	Support unit																	Basic dynamic load rating	Limiting static axial load
	d	D	D_1	D_2	L	L_1	L_2	A	W	X	Y	Z	d_1*	ℓ*	V*	P*	Q*	C_a [N]	[N]
WBK17DF-31H	17	70	106	72	60	32	15	80	88	9	14	8.5	45	3	58	M5	10	27 600	26 600
WBK20DF-31H	20	70	106	72	60	32	15	80	88	9	14	8.5	45	3	58	M5	10	27 600	26 600
WBK25DF-31H	25	85	130	90	66	33	18	100	110	11	17.5	11	57	4	70	M6	12	36 000	40 500
WBK25DFD-31H					81	48												58 500 (36 000)	81 500 (40 500)
WBK30DF-31H	30	85	130	90	66	33	18	100	110	11	17.5	11	57	4	70	M6	12	37 000	43 000
WBK30DFD-31H					81	48												59 500 (37 000)	86 000 (43 000)
WBK35DF-31H	35	95	142	102	66	33	18	106	121	11	17.5	11	69	4	80	M6	12	39 000	50 000
WBK35DFD-31H					81	48												63 500 (39 000)	100 000 (50 000)
WBK35DFF-31H					96	48												63 500	100 000
WBK40DF-31H	40	95	142	102	66	33	18	106	121	11	17.5	11	69	4	80	M6	12	40 000	52 000
WBK40DFD-31H					81	48												65 000 (40 000)	104 000 (52 000)
WBK40DFF-31H					96	48												65 000	104 000

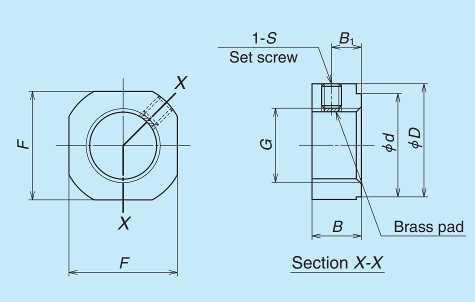
Support Unit Reference No.	Preload	Axial rigidity	Starting torque	Lock nut					Bearing seat for unit			Permissible rotational speed	Mass
				Dimension				Screwing torque (reference)					
	C_a [N]	[N/μm]	[N · cm]	M	H	D_3	L_3	[N · cm]	d	L_4	L_5	[min^{-1}]	[kg]
WBK17DF-31H	1 450	630	14	M17×1.0	32	37	18	4 100	17	81	23	6 900	1.9
WBK20DF-31H	1 450	630	14	M20×1.0	36	40	18	4 500	20	81	23	6 900	1.9
WBK25DF-31H	2 280	850	21	M25×1.5	41	45	20	8 500	25	89	26	5 200	3.1
WBK25DFD-31H	3 100	1 250	28							104			3.4
WBK30DF-31H	2 400	890	23	M30×1.5	46	50	20	10 100	30	89	26	4 900	3.0
WBK30DFD-31H	3 260	1 310	30							104			3.3
WBK35DF-31H	2 750	1 030	27	M35×1.5	50	55	22	13 800	35	92	30	4 100	3.4
WBK35DFD-31H	3 740	1 500	34							107			4.3
WBK35DFF-31H	5 490	2 060	43							122			5.0
WBK40DF-31H	2 860	1 080	28	M40×1.5	55	60	22	15 500	40	92	30	4 100	3.6
WBK40DFD-31H	3 900	1 590	36							107			4.2
WBK40DFF-31H	5 730	2 150	46							122			4.7

Notes:
1. Rigidity values in the table are theoretical values obtained from the elastic deformation between the ball groove and the balls.
2. Starting torque values indicate torque from bearing preload. Seal torque is not included.
3. We recommend h5 class tolerance for the shaft outside diameter of the bearing seats.
4. Values in parentheses for basic dynamic load ratings and permissible axial loads reflect values when axial load is applied in a line.
5. Dimensions marked with an asterisk (*) are used to install seal units for NSK hollow shaft ball screws; however, these can also be used to install dust covers and dampers.
6. Grease comes pre-packed in the bearing, allowing bearings to be used as is.
7. Permissible axial load is 0.7 times the limiting static axial load.
8. Contact NSK if the rotational speed will be 50 min^{-1} or less.
9. Use datum surface G_1 and G_2 for mounting to the machine base.

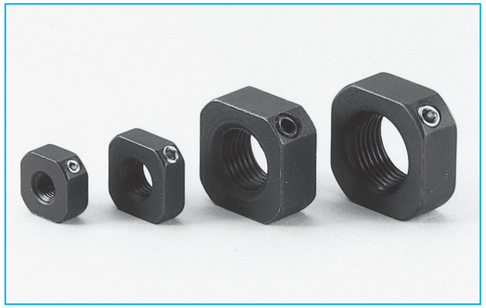
In addition to support units, NSK has other components for ball screws as shown below.

(3) Lock nuts

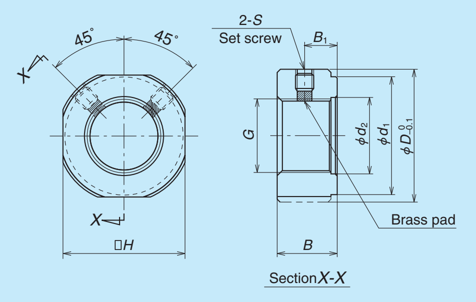
Ball screw support bearings must be installed with minimum inclination against the ball screw center. NSK lock nuts for ball screw support bearings help to reduce this inclination.



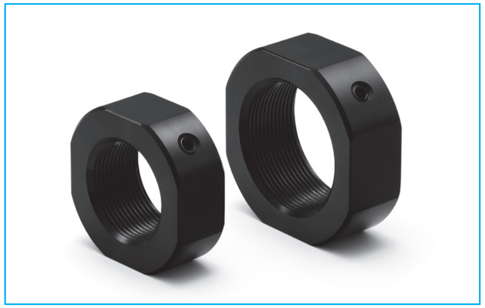
Light load Shapes and dimensions



Light load lock nuts



High speed and heavy load Shapes and dimensions



High speed and heavy load lock nuts

Light load lock nuts

Unit: mm

Lock nut Reference No.	G	D	F	B	d	B_1	S	Tightening torque (reference) [N · cm]	Set screw tightening torque (reference) [N · cm]	Mass (g)
WBK04L-01	M4×0.5	11.5	10	5	6	2.75	M3, with a brass pad	100	69 (M2.5)	3.0
WBK06L-01	M6×0.75	14.5	12	5	10	2.75	M3, with a brass pad	190	69 (M3)	3.8
WBK08L-01	M8×1	17	14	6.5	13	4	M3, with a brass pad	230	69 (M3)	6.4
WBK10L-01	M10×1	20	17	8	16	5	M4, with a brass pad	280	147 (M4)	11.2
WBK12L-01	M12×1	22	19	8	17	5	M4, with a brass pad	630	147 (M4)	12.8
WBK15L-01	M15×1	25	22	10	21	6	M4, with a brass pad	790	147 (M4)	20.0
WBK17L-01	M17×1	29	24	13	24	8	M4, with a brass pad	910	147 (M4)	33.1
WBK20L-01	M20×1	35	30	13	26	8	M4, with a brass pad	1 670	147 (M4)	50.0
WBK25L-01	M25×1.5	42	36	16	34	10	M6, with a brass pad	2 060	490 (M6)	87.0

Notes: 1. Insert brass pad and then tighten securing set screw.
2. The tightening torque is a reference value when support bearings are used in a face-to-face arrangement.

High speed and heavy load lock nuts

Unit: mm

Lock nut Reference No.	G	$D^{\ 0}_{-0.1}$	B	d_1	d_2	B_1	H	S	Tightening torque (reference) [N · cm]	Set screw tightening torque (reference) [N · cm]	Mass (g)
WBK17L-31H	M17×1	37	18	30	18	10	32	M6	4 100	490 (M6)	100.9
WBK20L-31H	M20×1	40	18	30	21	10	36	M6	4 500	490 (M6)	117.3
WBK25L-31H	M25×1.5	45	20	40	26	11	41	M6	8 500	490 (M6)	163.8
WBK30L-31H	M30×1.5	50	20	40	31	11	46	M6	10 100	490 (M6)	186.7
WBK35L-31H	M35×1.5	55	22	49	36	12	50	M6	13 800	490 (M6)	233.4
WBK40L-31H	M40×1.5	60	22	49	41	12	55	M6	15 500	490 (M6)	258.8

Note: The tightening torque is a reference value when support bearings are used in a face-to-face arrangement.

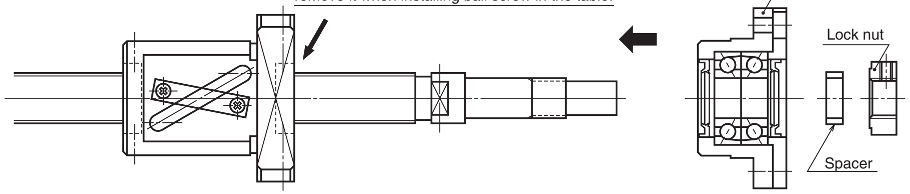
Installation of Ball Screw and Support Unit

The illustrations below show typical installation procedures for a standard ball screw and a support unit.

1) Assembly of support unit

If nut stopper is provided, remove it when installing ball screw in the table.

Do not disassemble.

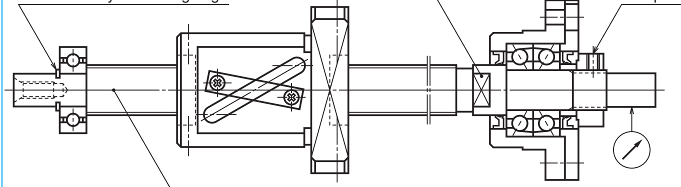


- Pay attention to turnup of seal lip.
- To prevent the seal from slipping, do not push it.
- Apply grease to the oil seal, then install in the screw shaft.

Secure the bearing after installation by a retaining ring.

For tightening the lock nut. (Flats for spanner)

Tighten the lock nut and secure it using the provided set piece (brass pad) and set screw.

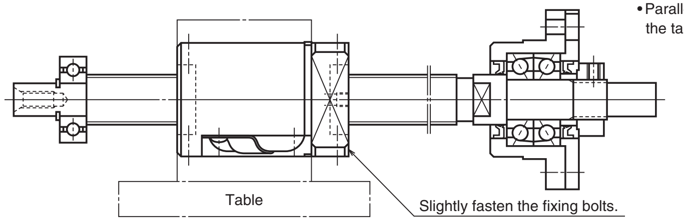


Lubrication grease is applied to the ball screw and ball nut.
(Some ball screws, such as those with SA in the Ref No., only have a rust preventive grease applied. Apply lubricant to these before use.)

Run out of the screw shaft ends must be minimal.

2) Installation of ball nut to the table

Installation example: Turn the table upside down, and install the ball screw.



Slightly fasten the fixing bolts.

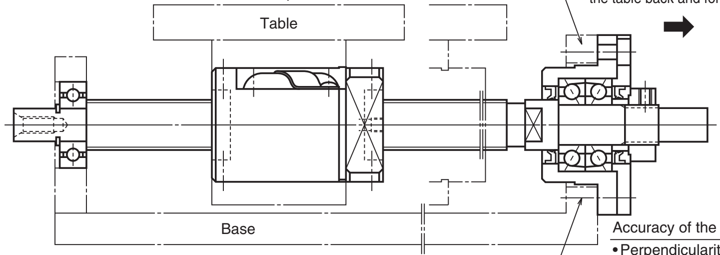
Accuracy of table
- Perpendicularity of nut housing
- Parallelism and center height deviation between the table center and the guide bearings.

3) Base and the support unit installation on the fixed support side

Provide a U-shaped opening on the mounting surface for flanged support unit.

Set the table to middle of screw shaft and put on the base.

Move the table to the fixed support unit side, then adjust the center of support unit by moving the table back and forth.

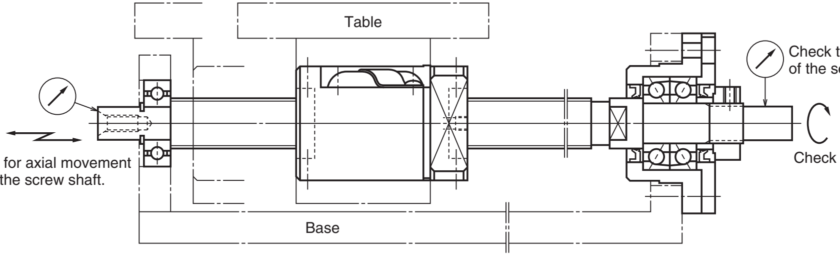


Slightly fasten the fixing bolts.

Accuracy of the base
- Perpendicularity of the mounting surface of support unit.
- Parallelism and eccentricity of center line of the base and guide bearings.

4) Base and bearing installation on simple support side, and confirming assembling accuracy.

Move the table to the simple support bearing side and adjust the center.



Check the run out of the screw shaft end.

Check the torque.

Check for axial movement of the screw shaft.

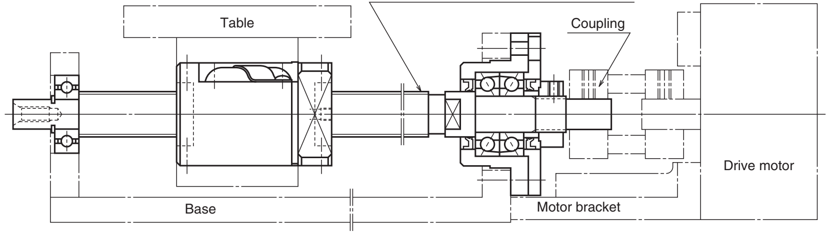
Adjust the center line by moving the table back and forth. Check for smooth operation of the table.
Repeat the same procedures described above if the table is not moving smoothly.
Tighten the fixing bolts while checking the assembly accuracy.

5) Assembly completed.

- Motor bracket / Motor / Coupling

- After assembly, execute the full run-in test.

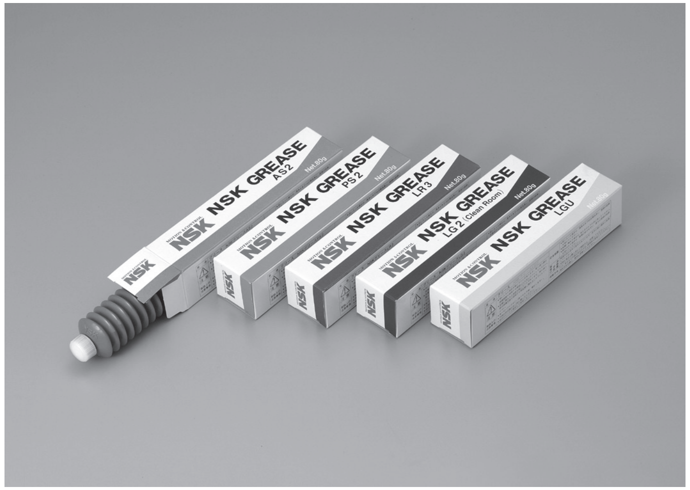
Remove overflowed grease on both sides.



Assembly accuracy of the motor bracket and coupling affects the positioning accuracy of the table.
Take the same level of care as when assembling ball screws.

(4) Grease units

NSK has numerous grease types exclusive for ball screw lubrication. They come in bellows-shaped tubes, which can be attached to a hand grease pump quickly. For details of grease types, see page D13 and for a hand grease pump and nozzles, see page D19.



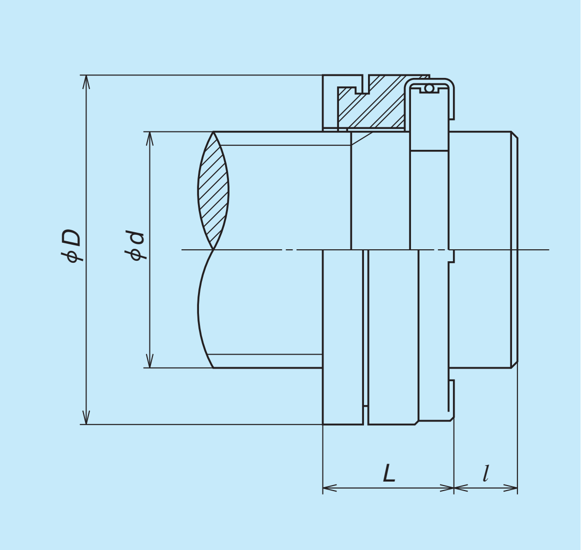
NSK grease

Lubricant greases

Name	Use	Base oil viscosity mm²/s (40°C)
NSK Grease AS2	For heavy load	130
NSK Grease PS2	High-speed, light load	15
NSK Grease LR3	High-speed, medium load	30
NSK Grease LG2	Clean environment	30
NSK Grease LGU	Clean environment	100

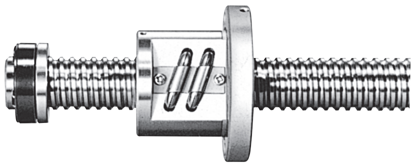
(5) Travel stoppers (made-to-order)

A travel stopper is installed in some cases to prevent the ball nut from overrunning to the end of ball thread due to a malfunction of the safety system or by human error. NSK has several series of shock-absorbing travel stoppers. The travel stopper is not sold as a standalone item since it is not for general use. Also, a travel stopper cannot be used for ball screws with end cap ball recirculation systems because the stopper would come directly into contact with components for ball recirculation. Please request NSK for the installation of travel stoppers when ordering a ball screw.



Unit: mm

Stopper Ref. No.	Applicable shaft dia. *d*	Outer dia. *D*	Length *L*	Shaft end width (Min.) *l*
BSR 20	20	32	16	5
BSR 25	25	38	16	5
BSR 32	32	46	20	6
BSR 40	40	60	22	6
BSR 50	50	72	24	7
BSR 63	63	85	25	7



Shock-absorbing travel stopper

(6) NSKHPS angular contact thrust ball bearings for ball screw support

1. Features

This is highly rigid and accurate ball screw support bearing often used for the machine tool driving mechanism.

Reliability has been improved by focusing on material cleanliness, which has the biggest impact on bearing life, by employing NSK's proprietary material evaluation technology.

The dynamic load rating has been improved by 5% compared with that of conventional bearings.

The NSKTAC C Series features high axial rigidity and is suitable for machine tool feeding mechanisms, while the NSKTAC 03 Series with its high axial load capacity is well suited for the support of large ball screws in high-load drive applications such as electric injection molding machines. With these series, users can achieve much lower torque and higher accuracy than with roller bearings.

(a) High axial rigidity

The axial rigidity is high because of a higher contact angle of 60°

(b) Low starting torque

Compared with tapered roller bearings or cylindrical roller bearings, this type has lower starting torque; so smoother rotation is possible with driving force.

(c) Easy Installation

The clearance in each individual bearing in an arrangement is adjusted to obtain the optimum preload. With universal arrangement bearings (arrangement code SU), a specific preload is obtained when used with others having the same bearing designation in any combination (DB, DF, and others).

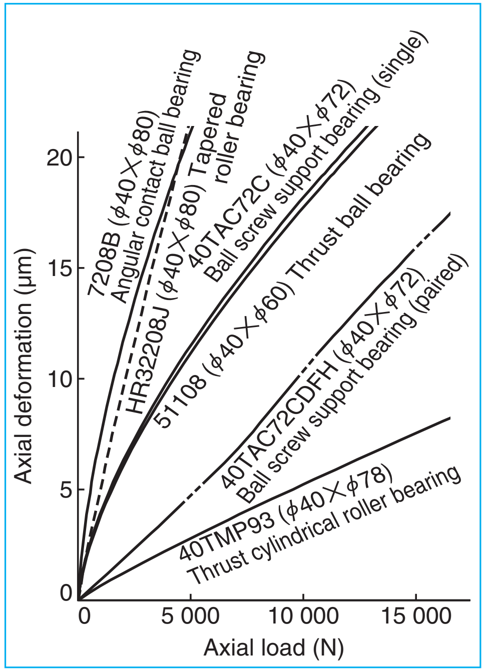


Fig. 1 Axial rigidity of various bearings

(d) Structural simplicity

Since this type can sustain both axial and radial loads, the surrounding structure is simpler and more compact than when using a combination of radial and thrust bearings.

(e) Easy handling

Since the Inner and outer rings are inseparable, handling is easy.

Table 2 Comparison with other types of bearings

Bearing type	Bearing rigidity (See Fig. 1)	Starting torque	Preload adjustment	Installation structure
Ball screw support bearings	High	Low	Not required	Simple
Combined angular contact ball bearing	Low	Low	Not required	Simple
Tapered roller bearing	Low	High	Complicated	Simple
Thrust ball bearing and radial bearing	High	Low	Complicated	Complicated
Thrust cylindrical roller bearing and radial bearing	Extremely high	Extremely high	Complicated	Complicated

Note: Consult NSK if bearings will be used for an application besides ball screw support.

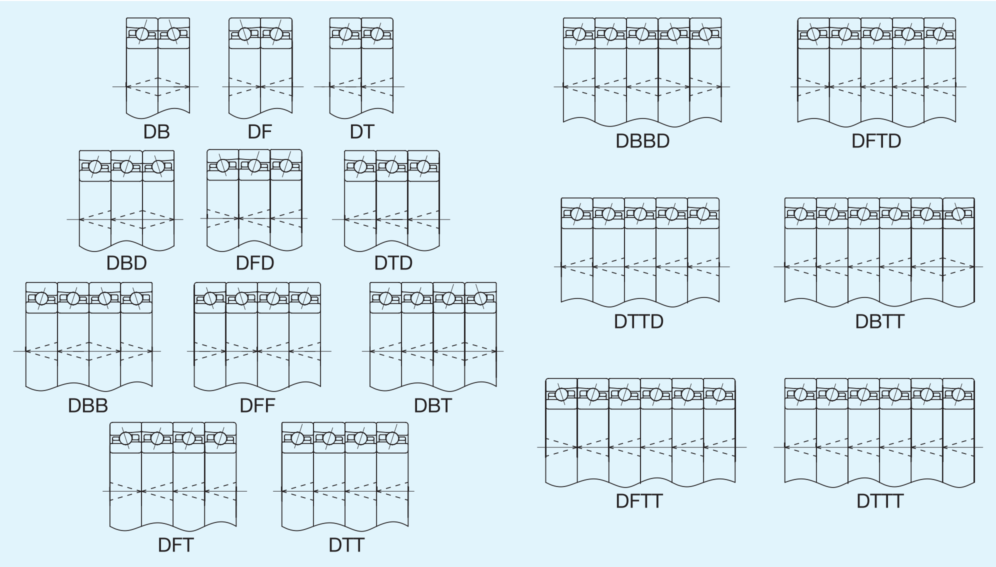
2. Bearing arrangements

Angular contact thrust ball bearings for ball screw support are generally used in two or more rows with preload applied.

Universal Arrangement Bearings

NSK manufactures universal arrangement bearings which have been controlled to have the same amount of stand-out (offset) on their front and back faces. That way, for bearings with the same bearing designation, users will achieve the specified amount for each standard preload, regardless of which combination they chose. Each universal arrangement bearing comes with a V-shaped mark on the surface of the outer ring to simplify identification of the correct direction when mounting and to ensure that the correct combination is achieved. The V-shaped mark points to the direction of the axial load that the inner ring supports (contact angle).

Arrangement Mark and Matching Method for Universal Arrangement Bearings



3. Permissible Axial Load for Angular Contact Ball Bearings

NSK has defined the limiting static axial load as the smaller of the two values listed below:

(1) Limiting axial load that produces shoulder override
The limiting load at which the contact ellipse generated between the ball and the raceway overrides the shoulder of the raceway groove (Fig. 2)

(2) Limiting axial load in terms of surface pressure
The limiting load at which the contact stress at the center of the contact area between the ball and the raceway groove reaches a level that leaves an indentation as defined in the basic static load rating (Fig. 3)

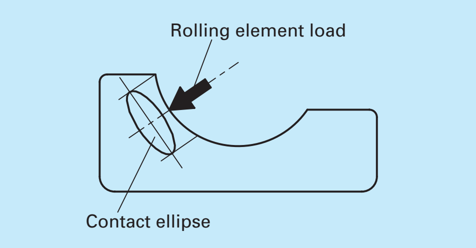


Fig. 2 Ride-over limit axial load

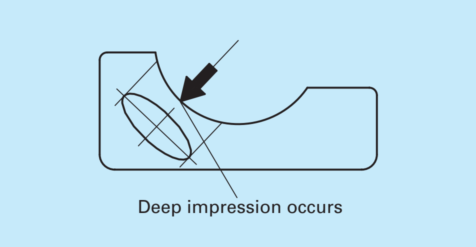


Fig. 3 Contact pressure limit axial load

To maintain optimal bearing performance, NSK has defined permissible static axial load values by applying a safety factor to the limiting axial load based on many years of experience.
The formula for calculating the basic static axial load rating C_{0a} does not take the shoulder height of the raceway groove into account. Therefore, in some cases the C_{0a}value may exceed the limiting axial load that produces shoulder override.
In such cases, the maximum load that the bearing can sustain is lower than the C_{0a} value, making the C_{0a} value unsuitable (Fig. 4). Therefore, instead of C_{0a} values, we have listed limiting axial load values in the bearing tables where necessary, particularly for angular contact thrust ball bearings as they are usually used to support heavy axial loads.

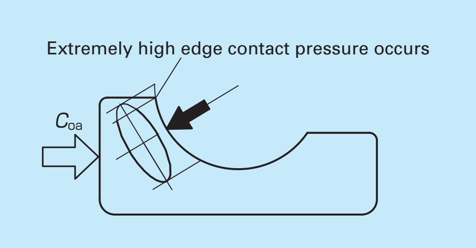


Fig. 4 C_{oa} and limit axial load

4. Rolling contact fatigue life

The relationship between basic load rating, bearing load, and basic rating life for the rolling bearing is presented in the following formula.

$$L_h = \frac{10^6}{60n}\left(\frac{C_a}{P}\right)^3$$

Where, L_h: Basic rating life (h)
C_a: Basic dynamic load rating (N)
P : Dynamic equivalent load (N)
n : Rotational speed (min^{-1})

See the table on the right for dynamic equivalnet load by arrangement.

Dynamic equivalent load $P_a = XF_r + YF_a$

Bearing configuration		Two-row		Three-row			Four-row		
Combination code		DF	DT	DFD		DTD	DFT	DFF	DFT
Number of load-sustaining rows $e = 2.17$		One	Two	One	Two	Three	One	Two	Three
$F_a/F_r \leqq e$	X	1.9	–	1.43	2.33	–	1.17	1.9	2.53
	Y	0.55	–	0.77	0.35	–	0.89	0.55	0.26
$F_a/F_r > e$	X	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
	Y	1	1	1	1	1	1	1	1

5. Fits

Recommended interference values for standard operating conditions of ball screws are listed in Table 3.
When using angular contact thrust ball bearings for high-load drive ball screw support, in cases where a single end is supported and moment loads are high, it is advisable to increase shaft interference, for example by choosing k5 etc. as required.

Table 3 Tolerances for Shaft and Housing Bore Diameters Unit: μm

Shaft Outer Diameter, Housing Bore Diameter (mm)		Tolerance of shaft outer diameter						Tolerance of housing bore diameter		
		Angular contact thrust ball bearings for high-rigidity applications			Angular contact thrust ball bearings for high-load drive applications					
Over	Incl.		Min.	Max.		Min.	Max.		Min.	Max.
10	18	h5	–8	0	js5	–4	4	H6	–	–
18	30		–9	0		–4.5	4.5		–	–
30	50		–10	0		–5.5	5.5		0	16
50	80		–13	0		–6.5	6.5		0	19
80	120		–	–		–7.5	7.5		0	22
120	180		–	–		–9.0	9.0		0	25
180	250		–	–		–	–		0	29
250	315		–	–		–	–		0	32
315	400		–	–		–	–		0	36

6. Bearing Accuracy

Table 4 to 6 shows accuracy for angular contact thrust ball bearings for ball screw support.

Tables 4 Tolerances for angular contact thrust ball bearings NSKTAC C for high-rigidity ball screw support (Class PN7C [(1)]) Unit: μm

Nominal Bore (Outside) Diameter d (D) (mm)		Single Plane Mean Bore Diameter Deviation Δ_{dmp}		Deviation of Single Bore Diameter Δ_{ds}		Single Plane Mean Outside Diameter Deviation Δ_{Dmp}		Deviation of Single Outside Diameter Δ_{Ds}		Deviation of Single Inner Ring Width Δ_{Bs}		Axial Runout of Inner (Outer) Ring of Assembled Bearing S_{ia} (S_{ea})
Over	Incl.	High	Low	High	Low	High	Low	High	Low	High	Low	Max.
10	18	0	–4	0	–4	–	–	–	–	0	–120	2.5
18	30	0	–5	0	–5	–	–	–	–	0	–120	2.5
30	50	0	–6	0	–6	0	–6	0	–6	0	–120	2.5
50	80	0	–7	0	–7	0	–7	0	–7	0	–150	2.5
80	120	–	–	–	–	0	–8	0	–8	–	–	2.5

Note: 1. NSK specification

Table 5 Tolerances for angular contact thrust ball bearings NSKTAC 03 for high-load drive applications ball screw support (Class PN5D [(2)]) Unit: μm

Nominal Bore (Outside) Diameter d (D) (mm)		Single Plane Mean Bore Diameter Deviation Δ_{dmp}		Single Plane Mean Outside Diameter Deviation Δ_{Dmp}		Deviation of Single Inner Ring Width Δ_{Bs}		Axial Runout of Inner (Outer) Ring of Assembled Bearing S_{ia} (S_{ea})
Over	Incl.	High	Low	High	Low	High	Low	Max.
10	18	0	–5	–	–	0	–80	5
18	30	0	–6	–	–	0	–120	5
30	50	0	–8	0	–7	0	–120	5
50	80	0	–9	0	–9	0	–150	8
80	120	0	–10	0	–10	0	–200	8
120	150	0	–13	0	–11	0	–250	10
150	180	0	–13	0	–13	0	–250	10
180	250	–	–	0	–15	–	–	10
250	315	–	–	0	–18	–	–	11
315	400	–	–	0	–20	–	–	13

Note: 2. NSK specification

Table 6 Tolerances for BSBD Series double-row bearings (Class P2B [(3)] BSF and BSN series) Unit: μm

Nominal Bore (Outside) Diameter d (D) (mm)		Single Plane Mean Bore Diameter Deviation Δ_{dmp}		Single Plane Mean Outside Diameter Deviation Δ_{Dmp}		Axial Runout of Inner Ring of Assembled Bearing S_{ia}	Radial Runout of Assembled Brg. Inner Ring K_{ia}	Width Tolerance	
Over	Incl.	High	Low	High	Low	Max.	Max.	High	Low
10	18	0	–5	0	–10	1.5	1.5	0	–250
18	30	0	–5	0	–10	2.5	2.5	0	–250
30	50	0	–5	0	–10	2.5	2.5	0	–250
50	80	0	–8	0	–15	2.5	2.5	0	–250

Note: 3. NSK specification

NSKTAC C Angular Contact Thrust Ball Bearings for Ball Screw Support in High-Rigidity Applications

A larger number of balls and a 60° contact angle provide high axial rigidity and make these bearings ideally suited for machine tool feeding mechanisms.

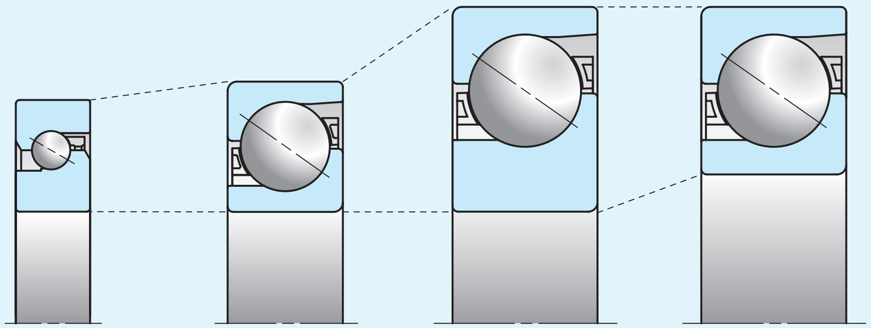
The “DDG” seals used for the sealed bearings of this series are light-contact seals for high-speed capability; a strong sealing effect is achieved by a labyrinth between the seal lip and the seal groove of the inner ring. This ensures that no foreign particles can get into the bearing and no grease can leak out, thus helping to keep the surrounding area clean. Some bearings from this series are also available as non-contact sealed bearings for even lower torque and lower heat generation.

For ease of handling and increased efficiency, NSKTAC C bearings come prepacked with “WPH” grease that resists high temperatures and is less likely to soften and leak.

NSKTAC 03 Angular Contact Thrust Ball Bearings for Ball Screw Support in High-Load Drive Applications

An optimized internal design has led to a higher limiting axial load. The number of rows may be reduced, contributing to smaller sized equipment. We also offer bearings with special bore diameters. That way, bearings with higher load capacity may be employed without any need to modify the shaft diameter, allowing for more compact screw shaft ends.

To confirm the suitability of this series for other applications, please ask NSK.



60TAC120C
(NSK TAC C)

60TAC03D
(NSK TAC 03)

TAC60-3
(NSK TAC 03 with special bore diameter)

80TAC03D
(NSK TAC 03)

For high-rigidity applications

For high-load drive applications

Designations of NSKTAC C Angular Contact Thrust Ball Bearings for Ball Screw Support in High-Rigidity Applications

Example bearing designation: 30 TAC 62 C SU H PN7C

Nominal bore diameter
Bearing type
Nominal outer diameter
Internal design
Accuracy
Preload
Arrangement
Seal

30	Nominal bore diameter	Bore diameter (mm)
TAC	Bearing type	Angular contact thrust ball bearing
62	Nominal outer diameter	Outer diameter (mm)
C	Internal design	Contact angle 60°
	Seal	No symbol: Open type DDG: Contact rubber seal V1V: Non-contact rubber seal
SU	Arrangement	SU: Universal arrangement (single-row)
H	Preload	H: Heavy preload (standard in the HPS Models)
PN7C	Accuracy	PN7C: NES Class 7C (axial runout equivalent to P2)

Designations of NSKTAC 03 Angular Contact Thrust Ball Bearings for Ball Screw Support in High-Load Drive Applications

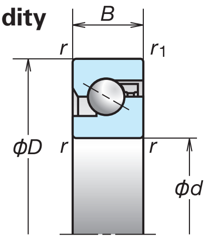
Example bearing designation: 60 TAC 03 D T85 SU M PN5D

Nominal bore diameter
Bearing type
Dimension series
Internal design
Accuracy
Preload
Arrangement
Cage

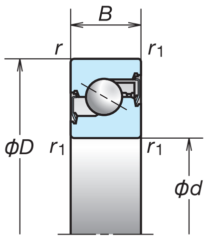
60	Nominal bore diameter	Bore diameter (mm)
TAC	Bearing type	Angular contact thrust ball bearing
03	Dimension series	02: 02 Series 03: 03 Series
D	Internal design	Contact angle 55°
T85	Cage	T85: Polyamide cage M:Brass Cage
SU	Arrangement	SU: Universal arrangement (single-row)
M	Preload	M: Medium preload EL: Extra light preload
PN5D	Accuracy	PN5D: Standard accuracy (equivalent to ISO Class 5)

NSKHPS is not applicable for TAC160-3 and 180TAC03D.

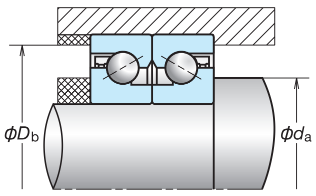
for High-Rigidity

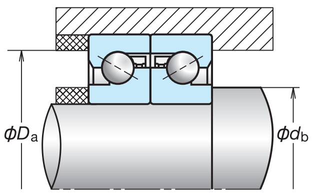


Open



Sealed DDG





Calculation of preload, axial rigidity and starting torque for bearing arrangements
Multiply by factors in table B.

Table B

	DFD ⦸ØØ	DFF ⦸⦸ØØ	DFT ⦸ØØØ
	DBD ØØ⦸	DBB ØØ⦸⦸	DBT ØØØ⦸
Preload factor	1.36	2.00	1.57
Axial rigidity	1.49	2.00	1.89
Starting torque	1.35	2.00	1.55

(Open)

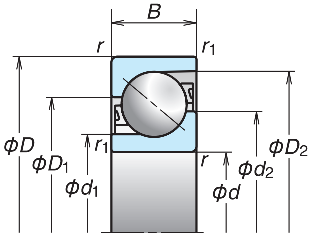
Bearing Designation	Boundary Dimensions (mm)					Abutment and Fillet Dimensions (mm)				Recommended Grease Quantity (cc)	Contact Angle (°)	Limiting Speeds[2] (min^{-1})		Mass (kg) (approx.)	Preload (DB and DF Arrangements) (N)	Axial Rigidity (DB and DF Arrangements) (N/μm)	Starting Torque (DB and DF Arrangements)[4] (N·m)(reference)	Basic Dynamic Load Rating C_a by Number of Rows Sustaining F_a			Limiting Axial Load by Number of Rows Sustaining F_a[3]		
	d	D	B	r (Min.)	r_1 (Min.)	D_b (Max.)	d_a (Min.)	D_a (Max.)	d_b (Min.)			Grease	Oil		H	H	H	1 row (kN)	2 rows (kN)	3 rows (kN)	1 row (kN)	2 rows (kN)	3 rows (kN)
15TAC47C	15	47	15	1	0.6	42	19.5	41	19.5	2.2	60	6 900	9 200	0.146	1 450	630	0.09	27.6	45.0	59.5	26.6	53.0	79.5
17TAC47C	17	47	15	1	0.6	42	23	41	23	2.2	60	6 900	9 200	0.140	1 450	630	0.09	27.6	45.0	59.5	26.6	53.0	79.5
20TAC47C	20	47	15	1	0.6	42	25	41	25	2.2	60	6 900	9 200	0.135	1 450	630	0.09	27.6	45.0	59.5	26.6	53.0	79.5
25TAC62C	25	62	15	1	0.6	57	31	56	31	3.0	60	5 200	6 900	0.252	2 280	850	0.15	36.0	58.5	77.5	40.5	81.5	122
30TAC62C	30	62	15	1	0.6	57	36	56	36	3.2	60	4 900	6 400	0.224	2 400	890	0.16	37.0	59.5	79.5	43.0	86.0	129
35TAC72C	35	72	15	1	0.6	67	42	66	42	3.8	60	4 100	5 800	0.310	2 750	1 030	0.18	39.0	63.5	84.5	50.0	100	150
40TAC72C	40	72	15	1	0.6	67	47	66	47	3.9	60	4 100	5 500	0.275	2 860	1 080	0.19	40.0	65.0	86.5	52.0	104	157
40TAC90C	40	90	20	1	0.6	85	48	84	48	8.8	60	3 500	4 600	0.674	3 450	1 150	0.29	74.5	121	160	89.5	179	269
45TAC75C	45	75	15	1	0.6	68	54	67	54	4.2	60	3 700	4 900	0.270	3 100	1 170	0.20	41.5	67.0	89.5	57.0	114	170
45TAC100C	45	100	20	1	0.6	93	55	92	55	9.7	60	3 000	4 100	0.842	4 440	1 340	0.40	77.5	126	167	99.0	198	298
50TAC100C	50	100	20	1	0.6	92	60	91	60	10.2	60	3 000	3 900	0.778	4 650	1 410	0.42	79.0	129	171	104	208	310
55TAC100C	55	100	20	1	0.6	92	63	91	63	10.2	60	3 000	3 900	0.714	4 650	1 410	0.42	79.0	129	171	104	208	310
55TAC120C	55	120	20	1	0.6	112	63	111	63	12	60	2 500	3 500	1.23	5 450	1 660	0.49	85.0	138	183	123	246	370
60TAC120C	60	120	20	1	0.6	112	70	111	70	12	60	2 500	3 500	1.16	5 450	1 660	0.49	85.0	138	183	123	246	370

(Sealed)

Bearing Designation[1]	Boundary Dimensions (mm)					Abutment and Fillet Dimensions (mm)				Contact Angle (°)	Limiting Speeds (min^{-1})	Mass (kg) (approx.)	Preload (DB and DF Arrangements) (N)	Axial Rigidity (DB and DF Arrangements) (N/μm)	Starting Torque (DB and DF Arrangements)[4] (N·m)(reference)	Basic Dynamic Load Rating C_a by Number of Rows Sustaining F_a			Limiting Axial Load by Number of Rows Sustaining F_a[3]		
	d	D	B	r (Min.)	r_1 (Min.)	D_b (Max.)	d_a (Min.)	D_a (Max.)	d_b (Min.)		Grease		H	H	H	1 row (kN)	2 rows (kN)	3 rows (kN)	1 row (kN)	2 rows (kN)	3 rows (kN)
* **15TAC47CDDG**	15	47	15	1	0.6	42	19.5	41	19.5	60	6 900	0.146	1 450	630	0.09	27.6	45.0	59.5	26.6	53.0	79.5
* **17TAC47CDDG**	17	47	15	1	0.6	42	22	41	22	60	6 900	0.140	1 450	630	0.09	27.6	45.0	59.5	26.6	53.0	79.5
* **20TAC47CDDG**	20	47	15	1	0.6	42	25	41	25	60	6 900	0.135	1 450	630	0.09	27.6	45.0	59.5	26.6	53.0	79.5
* **25TAC62CDDG**	25	62	15	1	0.6	57	30	56	30	60	5 200	0.252	2 280	850	0.15	36.0	58.5	77.5	40.5	81.5	122
30TAC62CDDG	30	62	15	1	0.6	57	36	56	36	60	4 900	0.224	2 400	890	0.16	37.0	59.5	79.5	43.0	86.0	129
35TAC72CDDG	35	72	15	1	0.6	67	41	66	41	60	4 100	0.310	2 750	1 030	0.18	39.0	63.5	84.5	50.0	100	150
40TAC72CDDG	40	72	15	1	0.6	67	46	66	46	60	4 100	0.275	2 860	1 080	0.19	40.0	65.0	86.5	52.0	104	157
40TAC90CDDG	40	90	20	1	0.6	85	47	84	47	60	3 500	0.674	3 450	1 150	0.29	74.5	121	160	89.5	179	269
45TAC100CDDG	45	100	20	1	0.6	93	54	92	54	60	3 000	0.842	4 440	1 340	0.40	77.5	126	167	99.0	198	298
50TAC100CDDG	50	100	20	1	0.6	92	59	91	59	60	3 000	0.778	4 650	1 410	0.42	79.0	129	171	104	208	310
55TAC100CDDG	55	100	20	1	0.6	92	63	91	63	60	3 000	0.714	4 650	1 410	0.42	79.0	129	171	104	208	310

Note: 1. An asterisk (*) indicates bearings that are also available as non-contact sealed bearings.
2. Limiting speeds are based on high preload (H). The values shown are valid for all types of bearing arrangements.
3. To calculate permissible axial load, multiply limiting axial load by 0.7.
4. The starting torque values in the table apply to grease lubricated bearings. Contact seal torque is not included. For oil lubricated bearings, multiply by 1.4.
5. Abutment and fillet dimensions are reccomended values for standard machine tool applications. For heavy load applications, please contact NSK.

for High-Load Drive Applications



Multi-row arrangement calculations

Calculation of preload, axial rigidity and starting torque for bearing arrangements
Multiply by factors in Table B.

Table
B

Number of load-sustaining rows	2 rows		3 rows			4 rows		5 rows
	DFD ⦸⊘⊘	DFF ⦸⦸⊘⊘	DFT ⦸⊘⊘⊘	DFFD ⦸⦸⊘⊘⊘	DFFF ⦸⦸⦸⊘⊘⊘	DFTD ⦸⊘⊘⊘⊘	DFFT ⦸⦸⊘⊘⊘⊘	DFTT ⦸⊘⊘⊘⊘⊘
	DBD ⊘⊘⦸	DBB ⊘⊘⦸⦸	DBT ⊘⊘⊘⦸	DBBD ⊘⊘⊘⦸⦸	DBBB ⊘⊘⊘⦸⦸⦸	DBTD ⊘⊘⊘⊘⦸	DBBT ⊘⊘⊘⊘⦸⦸	DBTT ⊘⊘⊘⊘⊘⦸
Preload factor	1.36	2.00	1.57	2.42	3.00	1.72	2.72	1.83
Axial rigidity	1.49	2.00	1.89	2.51	3.00	2.24	2.97	2.57
Starting torque	1.35	2.00	1.55	2.41	3.00	1.68	2.71	1.77

Bearing Designation[1]	Boundary Dimensions (mm)					Reference Dimensions (mm)				Recommended Grease Quantity (cc/row)	Contact Angle (°)	Limiting Speeds[2] (min^{-1})		Mass (kg) (approx.)	Preload[3] (DB and DF Arrangements) (N)	Axial Rigidity[3] (DB and DF Arrangements) (N/μm)	Starting Torque[4] (DB and DF Arrangements) (N·m)	Basic Dynamic Load Rating C_a by Number of Rows Sustaining F_a					Limiting static axial load by Number of Rows Sustaining F_a[5]				
	d	D	B	r (Min.)	r_1 (Min.)	d_1	d_2	D_1	D_2			Grease	Oil					1 row (kN)	2 rows (kN)	3 rows (kN)	4 rows (kN)	5 rows (kN)	1 row (kN)	2 rows (kN)	3 rows (kN)	4 rows (kN)	5 rows (kN)
15TAC02D	15	35	11	0.6	0.3	19.1	24.5	26	31.9	1	55	12 000	14 800	0.047	400	290	0.017	25.1	41.0	54.0	66.5	77.5	18.6	37.5	56.0	74.5	93.0
20TAC03D	20	52	15	1.1	0.6	27.2	35.3	37.5	46.1	2.7	55	8 300	10 300	0.155	830	430	0.026	51.0	83.0	110	135	158	38.5	77.0	116	154	193
25TAC02D	25	52	15	1	0.6	30.8	38.1	39.6	47.3	3	55	7 700	9 700	0.137	690	430	0.036	44.5	72.0	95.5	117	137	36.0	72.5	109	145	181
TAC35-3	35	90	23	1.5	1	50.4	64.2	67.1	81.7	14	55	4 600	6 000	0.712	2 500	780	0.26	136	221	293	360	420	118	235	355	470	590
40TAC03D	40	90	23	1.5	1	50.4	64.2	67.1	81.7	14	55	4 600	5 700	0.659	2 500	780	0.26	136	221	293	360	420	118	235	355	470	590
TAC40-3	40	110	27	2	1	62	79.1	82.4	100.6	25	55	3 700	5 000	1.28	3 900	970	0.50	200	325	430	525	615	181	360	540	720	905
45TAC03D	45	100	25	1.5	1	56.5	71.7	74.7	90.8	18	55	4 100	5 200	0.877	2 800	830	0.31	160	259	345	420	495	142	283	425	565	710
TAC45-3	45	110	27	2	1	62	79.1	82.4	100.6	25	55	3 700	4 800	1.21	3 900	970	0.50	200	325	430	525	615	181	360	540	720	905
50TAC03D	50	110	27	2	1	62	79.1	82.4	100.6	25	55	3 700	4 700	1.14	3 900	970	0.50	200	325	430	525	615	181	360	540	720	905
TAC50-3	50	130	31	2.1	1.1	73.9	93.8	98	119	40	55	3 100	4 200	2.00	5 200	1 120	0.78	261	425	565	690	805	242	485	725	965	1 210
55TAC03D	55	120	29	2	1	68	86.4	90.2	109.7	32	55	3 400	4 300	1.44	4 280	1 060	0.68	228	370	490	600	705	210	420	630	840	1 050
60TAC03D	60	130	31	2.1	1.1	73.9	93.8	98	119	40	55	3 100	3 900	1.80	5 200	1 120	0.78	261	425	565	690	805	242	485	725	965	1 210
TAC60-3	60	170	39	2.1	1.1	98.5	123.6	128.7	157.5	85	55	2 400	3 300	4.47	8 050	1 400	1.5	365	595	790	965	1 130	390	775	1 170	1 550	1 940
70TAC03D	70	150	35	2.1	1.1	86.3	108.6	113.4	137.8	59	55	2 700	3 400	2.67	6 400	1 250	1.1	315	510	680	830	970	305	615	920	1 230	1 530
75TAC03D	75	160	37	2.1	1.1	92.4	116.2	121	146.2	67	55	2 500	3 200	3.20	7 230	1 330	1.3	340	550	735	895	1 050	345	690	1 040	1 380	1 730
80TAC03D	80	170	39	2.1	1.1	98.5	123.6	128.7	157.5	85	55	2 400	3 000	3.80	8 050	1 400	1.5	365	595	790	965	1 130	390	775	1 170	1 550	1 940
TAC80-3	80	215	47	3	1.1	124	154.9	160.4	194.5	156	55	1 900	2 600	8.66	1 240	880	0.15	505	820	1 090	1 330	1 560	510	1 020	1 530	2 040	2 550
100TAC03D	100	215	47	3	1.1	124	154.9	160.4	194.5	156	55	1 900	2 400	7.54	1 240	880	0.15	505	820	1 090	1 330	1 560	510	1 020	1 530	2 040	2 550
TAC100-3	100	260	55	3	1.1	150.5	186.9	193.4	231.7	254	55	1 500	2 100	14.8	1 620	1 050	0.21	625	1 020	1 350	1 650	1 930	680	1 360	2 040	2 720	3 400
120TAC03D	120	260	55	3	1.1	150.5	186.9	193.4	231.7	254	55	1 500	2 000	13.3	1 620	1 050	0.21	625	1 020	1 350	1 650	1 930	680	1 360	2 040	2 720	3 400
* **TAC120-3M**	120	300	62	4	1.5	170.8	215.3	224.1	265.7	336	55	1 300	1 800	24.5	1 710	1 130	0.24	765	1 240	1 650	2 020	2 360	794	1 590	2 380	3 200	3 950
* **140TAC03DM**	140	300	62	4	1.5	170.8	215.3	224.1	265.7	336	55	1 300	1 700	22.5	1 710	1 130	0.24	765	1 240	1 650	2 020	2 360	794	1 590	2 380	3 200	3 950
* **TAC140-3M**	140	340	68	4	1.5	197.5	246.2	254.3	298.8	442	55	1 200	1 600	34.5	1 850	1 240	0.27	870	1 420	1 880	2 300	2 690	1 040	2 080	3 100	4 150	5 200
* **160TAC03DM**	160	340	68	4	1.5	197.5	246.2	254.3	298.8	442	55	1 200	1 500	32.0	1 850	1 240	0.27	870	1 420	1 880	2 300	2 690	1 040	2 080	3 100	4 150	5 200
* **TAC160-3M**	160	380	75	4	1.5	221.1	275.6	284.9	334.9	624	55	1 000	1 400	46.8	1 940	1 310	0.30	1 030	1 670	2 220	2 710	3 150	1 360	2 720	4 100	5 450	6 800
* **180TAC03DM**	180	380	75	4	1.5	221.1	275.6	284.9	334.9	624	55	1 000	1 400	43.7	1 940	1 310	0.30	1 030	1 670	2 220	2 710	3 150	1 360	2 720	4 100	5 450	6 800

Note: 1. An asterisk (*) indicates bearings that are also available equipped with screw holes for mounting bolts.
2. Limiting speeds are based on the standard preload of each bearing. The values shown are valid for all types of bearing arrangements.
3. Preload values for bearings with a bore diameter of 100 mm or more as well as for TAC80-3 are based on EL preload.
4. The starting torque values in the table apply to grease lubrication.
5. To calculate permissible axial load, multiply limiting static axial load by 0.7.

B-3-2 Dimension Tables and Reference Numbers for Ball Screws With Standard Nuts

B-3-2.1 End Deflector Recirculation Ball Screws

1. Features

●Quiet operation

The average noise level is reduced by more than 6 dB(A) compared with our existing products. At low-speed rotation, the ball screws are nearly silent, while their noise is unprecedentedly low at high-speed rotation.

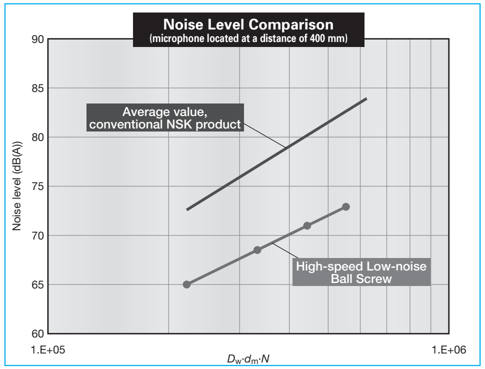


Fig. 1 Comparison of noise level

●High-speed operation

Realizes a *d·n* value of 180 000, outstanding for ball screws and far surpassing the 100 000 *d·n* performance of existing tube recirculation products. For high-lead ball screws, high-speed operation at over 200 m/min is also possible.

●Compact

The external diameter of the ball nut is 30% smaller than our existing models. Compact configurations are possible for low-profile XY tables as well as for other devices and equipment.

●Grease fitting provided as standard equipment

Ball screws with shaft diameters equal to or less than ø25 are equipped with a grease fitting (M5 × 0.8) as a standard. Lubrication ports are provided in 2 places for ease of maintenance. The ball screws can be easily connected to an integrated lubrication system.

2. Specifications

(1) Ball recirculation system

Fig. 2 shows the structure of a end-deflector recirculation system.

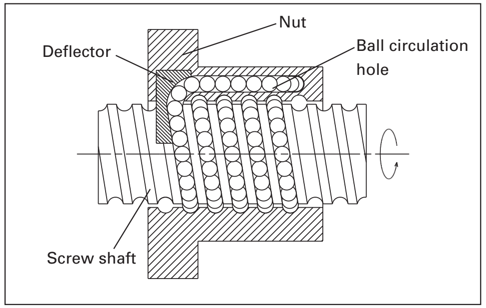


Fig. 2 Structure of end-deflector recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grades and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	C0, C1, C2, C3, C5, Ct7
Axial play	Z, 0 mm (preloaded); T, 0.005 mm or less; S, 0.020 mm or less; N, 0.050 mm or less

(3) Allowable *d·n* value and the criterion of maximum rotational speed

The allowable *d·n* value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Allowable *d·n* value : 180 000 or less
Standard of rotational speed : 5 000 min^{-1}

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Seal

A compact and thin plastic seal is used. Nut outside diameter is compact comprared with tube recirculation systems.

(5) Options

An optional NSK K1 lubrication unit, molded from resin and saturated with lubrication oil, supplies fresh oil onto ball rolling surfaces, ensuring long-term, maintenance-free operation. Please contact NSK when using NSK K1.

3. Design precaution

When designing the shaft end of a ball screw with a diameter is 25 mm or less or 32 mm or over and the lead is the same as its shaft diameter, one end of the screw must meet one of the following conditions. If not, we cannot install the ball nut on the screw shaft.

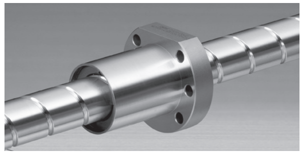
- Cut the ball groove through to the shaft end.
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove d_r specified on the dimension table.

For general precautions regarding ball screws, refer to "Design Precautions"(page B83) and "Handling Precautions"(page B103).

4. Lineup

End deflector ball screws are available in the following varieties:

Table 2 End-deflector ball screw lineup

Nut	Shape	Flange shape	Nut shape	Preload
BSS		Circular Ⅱ, Ⅲ	Circular	No preload, Slight axial play
				P-preload (light preload)

5. Structure of model number and reference number

The following explains the codes used in model numbers and ball screw reference numbers.

◇Model number

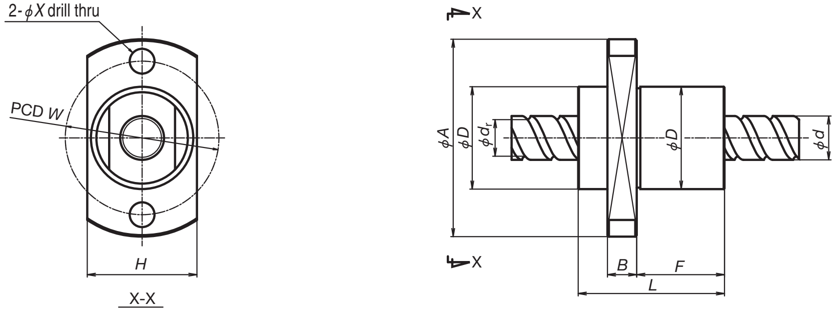
BSS 10 10 - 2E

Nut: BSS
Screw shaft diameter (mm)
Lead (mm)
Effective ball turns

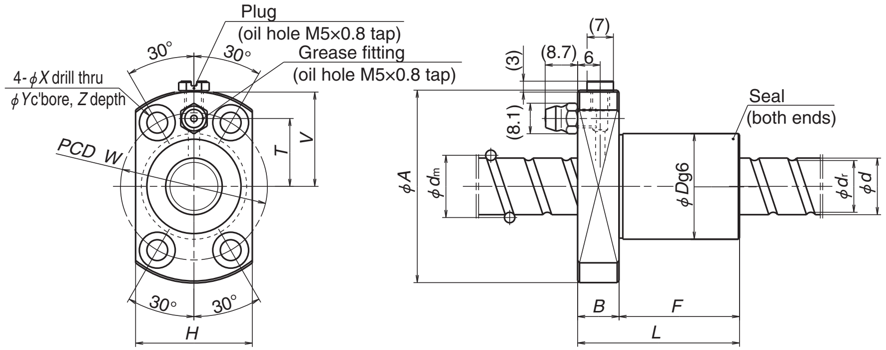
◇Reference number for ball screws

W 10 01 - ** P SS - C5 Z 10

Product code
Screw shaft diameter (mm)
Effective threaded length (in 100 mm units)
NSK design serial number
Preload code: No code, no preload; P, P-preload (page B5)
End-deflector recirculation system
Accuracy grade: C0, C1, C2, C3, C5, C7 (Ct7) (page B37 to B42)
Axial play code: Z, T, S, N (page B20)
Lead (mm)



Shape I



Shape II

Unit: mm

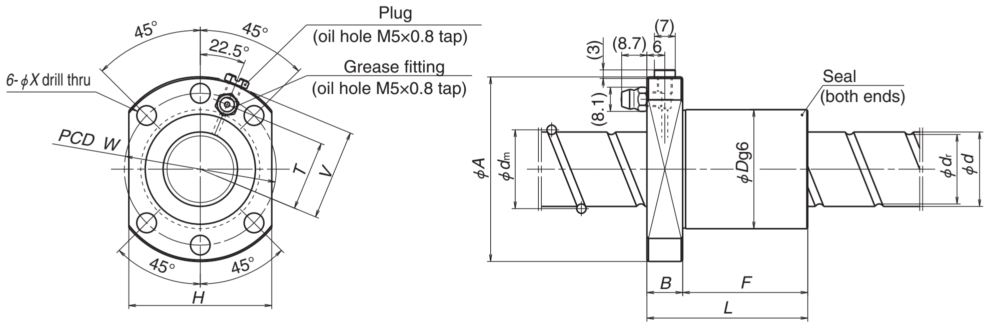
Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial rigidity	Shape	Nut total length	Nut diameter		Flange diameter	Flange width	Nut length	Flange notch	Flange dimensions		Bolt hole PCD	Bolt hole dimensions			Oil hole distance
							Dynamic	Static	K															
	d	l	D_w	d_m	d_r		C_a	C_{0a}	(N/μm)		L	D	D_1	A	B	F	G	H	V	W	X	Y	Z	T
BSS0608-2E	6	8	1.2	6.2	4.9	2	690	805	32	I	16	14	–	27	4	8	–	15 (10)	–	21	3.4	–	–	–
BSS0608-4E		8	1.2	6.2	4.9	4	1 480	1 940	75	I	24	14	–	27	4	16	–	15 (10)	–	21	3.4	–	–	–
BSS0612-2E		12	1.2	6.2	4.9	2	665	800	29	I	20	14	–	27	4	12	–	15 (10)	–	21	3.4	–	–	–
BSS0612-4E		12	1.2	6.2	4.9	4	1 430	1 790	69	I	32	14	–	27	4	24	–	15 (10)	–	21	3.4	–	–	–
BSS0810-2E	8	10	1.588	8.3	6.6	2	1 150	1 420	43	I	18	18	–	31	4	10	–	19 (13)	–	25	3.4	–	–	–
BSS0810-4E		10	1.588	8.3	6.6	4	2 470	3 430	99	I	28	18	–	31	4	20	–	19 (13)	–	25	3.4	–	–	–
BSS0815-2E		15	1.588	8.3	6.6	2	1 130	1 430	40	I	22	18	–	31	4	14	–	19 (13)	–	25	3.4	–	–	–
BSS0815-4E		15	1.588	8.3	6.6	4	2 410	3 520	93	I	37	18	–	31	4	29	–	19 (13)	–	25	3.4	–	–	–
BSS1005-3E	10	5	2.000	10.3	8.2	3	3 420	4 840	133	II	29	23	–	43	11	18	–	26	21	33	4.5	8	4.5	14
BSS1010-2E		10	2.000	10.3	8.2	2	2 290	2 980	81	II	32	23	–	43	11	21	–	26	21	33	4.5	8	4.5	14
BSS1205-3E	12	5	2.000	12.3	10.2	3	3 750	5 810	154	II	30	24	–	44	11	19	–	27	21.5	34	4.5	8	4.5	14.5
BSS1210-3E		10	2.000	12.3	10.2	3	3 760	5 780	150	II	43	24	–	44	11	32	–	27	21.5	34	4.5	8	4.5	14.5
BSS1215-2EG		15	2.381	12.3	9.8	2	3 030	4 270	93	II	40	26	–	46	11	29	–	29	22.5	36	4.5	8	4.5	15.5
BSS1220-2E		20	2.000	12.3	10.2	2	2 330	3 600	86	II	50	24	–	44	11	39	–	27	21.5	34	4.5	8	4.5	14.5
BSS1220-2EG		20	2.381	12.3	9.8	2	2 960	4 340	89	II	48	26	–	44	11	37	–	29	22.5	36	4.5	8	4.5	15.5
BSS1230-2E		30	2.000	12.3	10.2	2	2 190	3 650	75	II	70	24	–	44	11	59	–	27	21.5	34	4.5	8	4.5	14.5
BSS1505-3E	15	5	2.778	15.5	12.6	3	6 410	10 100	193	II	30	28	–	51	11	19	–	31	25	39	5.5	9.5	5.5	18
BSS1510-3E		10	2.778	15.5	12.6	3	6 530	10 200	192	II	43	28	–	51	11	32	–	31	25	39	5.5	9.5	5.5	18
BSS1510-3EG		10	3.175	15.5	12.2	3	8 700	13 800	219	II	45	32	–	55	11	34	–	33	27	43	5.5	9.5	5.5	20
BSS1520-2ES		20	2.778	15.5	12.6	2	4 220	6 400	115	II	51	28	–	51	11	51	–	31	25	39	5.5	9.5	5.5	18
BSS1520-2E		20	3.175	15.5	12.2	2	5 660	8 700	132	II	51	32	–	55	11	40	–	33	27	43	5.5	9.5	5.5	20
BSS1530-2E		30	3.175	15.5	12.2	2	5 500	8 580	119	II	71	32	–	55	11	60	–	33	27	43	5.5	9.5	5.5	20
BSS2005-3E	20	5	3.175	20.5	17.2	3	10 400	18 500	284	II	31	36	–	62	13	18	–	38	30.5	49	6.6	11	6.5	23.5
BSS2006-3E		6	3.175	20.5	17.2	3	10 300	18 800	286	II	33	40	–	66	13	20	–	42	32.5	53	6.6	11	6.5	25.5
BSS2008-3E		8	3.175	20.5	17.2	3	10 300	18 700	284	II	40	40	–	66	13	27	–	42	32.5	53	6.6	11	6.5	25.5
BSS2010-3E		10	3.175	20.5	17.2	3	10 200	18 600	281	II	45	36	–	62	13	32	–	38	30.5	49	6.6	11	6.5	23.5
BSS2010-3EG		10	3.969	21	16.9	3	14 200	23 500	296	II	65	40	–	66	13	52	–	42	32.5	53	6.6	11	6.5	25.5
BSS2012-3E		12	3.175	20.5	17.2	3	10 200	18 500	279	II	51	36	–	62	13	38	–	38	30.5	49	6.6	11	6.5	23.5
BSS2020-2E		20	3.175	20.5	17.2	2	6 790	11 800	175	II	54	36	–	62	13	41	–	38	30.5	49	6.6	11	6.5	23.5
BSS2020-2EG		20	3.969	20.5	16.4	2	9 120	14 100	176	II	53	40	–	66	13	40	–	42	32.5	53	6.6	11	6.5	25.5
BSS2030-2E		30	3.175	20.5	17.2	2	6 550	11 800	164	II	74	36	–	62	13	61	–	38	30.5	49	6.6	11	6.5	23.5
BSS2040-2E		40	3.175	20.5	17.2	2	6 380	11 600	151	II	92	36	–	62	13	79	–	38	30.5	49	6.6	11	6.5	23.5
BSS2060-2E		60	3.175	20.5	17.2	2	5 680	11 800	126	II	129	36	–	62	13	116	–	38	30.5	49	6.6	11	6.5	23.5

Note: 1) The axial rigidity K in the table above is a theoretical value derived from elastic deformation between screw grooves and balls when axial load is applied to a ball nut for which preload is set at 3% of the basic dynamic load rating (C_a).

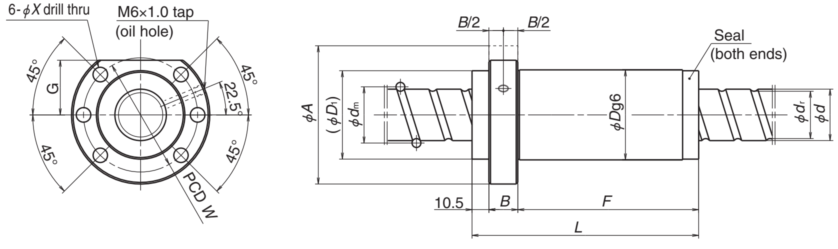
2) The standard Compact FA PSS model is available for ball screws with shaft diameters less than ø25.

3) Axial play for shaft diameters of 6 mm and 8 mm is only for T equal to or less than 0.005 mm.

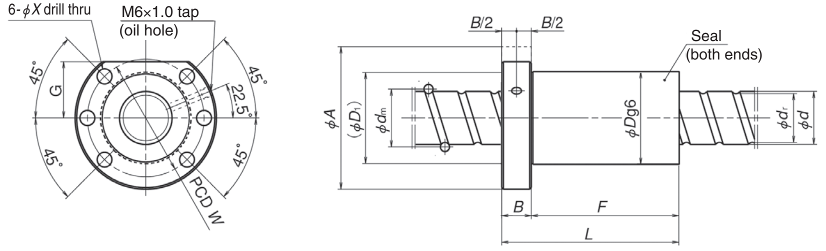
4) Dimensions in parentheses are for flat nut configurations.



Shape Ⅲ



Shape Ⅳ



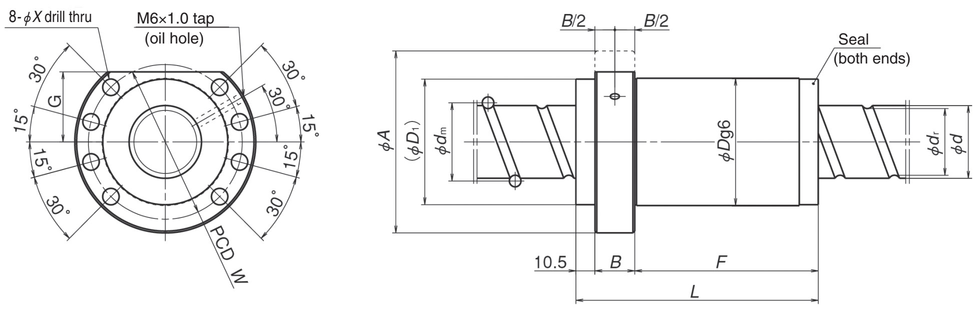
Shape Ⅳa

Unit: mm

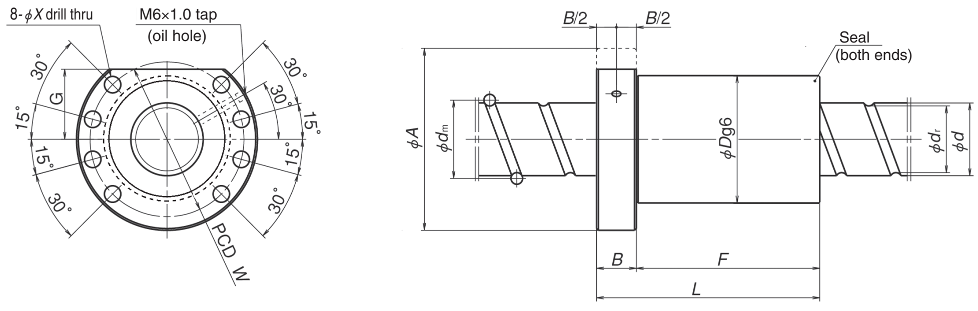
Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N) Dynamic	Basic load ratings (N) Static	Axial rigidity K	Shape	Nut total length	Nut diameter		Flange diameter	Flange width	Nut length	Flange notch	Flange dimensions		Bolt hole PCD	Bolt hole dimensions			Oil hole distance
	d	l	D_w	d_m	d_r		C_a	C_{0a}	(N/μm)		L	D	D_1	A	B	F	G	H	V	W	X	Y	Z	T
BSS2505-3E	25	5	3.175	25.5	22.2	3	11 500	23 500	343	Ⅲ	32	40	–	62	12	20	–	48	30.5	51	6.6	–	–	23.5
BSS2506-4E		6	3.969	25.5	21.4	4	20 300	39 500	471	Ⅲ	38	43	–	65	12	26	–	51	32	54	6.6	–	–	25
BSS2508-4EG		8	4.762	25.5	20.5	4	26 000	47 000	482	Ⅲ	47	46	–	68	12	35	–	54	33.5	57	6.6	–	–	26.5
BSS2510-4E		10	3.175	25.5	22.2	4	15 000	32 400	460	Ⅲ	56	40	–	62	12	44	–	48	30.5	51	6.6	–	–	23.5
BSS2510-4EG		10	4.762	25.5	20.5	4	25 900	46 800	479	Ⅲ	55	46	–	68	12	43	–	54	35.5	58	6.6	–	–	29
BSS2512-4E		12	3.175	25.5	22.2	4	14 900	32 200	457	Ⅲ	63	40	–	62	12	51	–	48	30.5	51	6.6	–	–	23.5
BSS2512-4EG		12	4.762	25.5	20.5	4	25 800	46 700	475	Ⅲ	63	46	–	68	12	51	–	54	33.5	57	6.6	–	–	26.5
BSS2516-4E		16	3.969	25.5	21.4	4	19 900	39 900	464	Ⅲ	80	44	–	66	12	68	–	52	32.5	55	6.6	–	–	25.5
BSS2520-2E		20	3.175	25.5	22.2	2	7 650	14 800	214	Ⅲ	54	40	–	62	12	42	–	48	30.5	51	6.6	–	–	23.5
BSS2525-2E		25	3.175	25.5	22.2	2	7 490	14 600	206	Ⅲ	63	40	–	62	12	51	–	48	30.5	51	6.6	–	–	23.5
BSS2530-2E		30	3.175	25.5	22.2	2	7 490	14 600	203	Ⅲ	74	40	–	62	12	62	–	48	30.5	51	6.6	–	–	23.5
BSS2550-2E		50	3.175	25.5	22.2	2	6 910	14 700	180	Ⅲ	114	40	–	62	12	102	–	48	30.5	51	6.6	–	–	23.5
BSS2812-4E	28	12	4.762	28.5	23.5	4	27 400	53 200	528	Ⅲ	70	60	–	88	18	52	–	66	–	74	6.5	11	6.5	35
BSS2816-4E		16	4.762	28.5	23.5	4	27 100	52 900	520	Ⅲ	85	60	–	88	18	67	–	66	–	74	6.5	11	6.5	35
BSS3205-4E	32	5	3.175	32.5	29.2	4	16 800	41 700	566	Ⅳ	55	56	(55)	86	12	32.5	34	–	–	71	9	–	–	–
BSS3208-4E		8	4.762	32.5	27.5	4	28 800	60 900	588	Ⅳ	78	57	(55)	86	18	49.5	34	–	–	71	9	–	–	–
BSS3210-4ES		10	3.969	32.5	28.4	4	23 000	51 300	579	Ⅳa	59	50	–	80	12	47	31	–	–	65	9	–	–	–
BSS3210-6E		10	5.556	33	27.2	6	50 900	110 000	907	Ⅳ	104	56	(55)	86	18	75.5	34	–	–	71	9	–	–	–
BSS3210-6EG		10	6.35	33	26.4	6	60 900	125 000	923	Ⅳa	78	61	–	93	18	60	34	–	–	76	9	–	–	–
BSS3212-5E		12	5.556	33	27.2	5	43 000	91 300	755	Ⅳ	103	56	(55)	86	18	74.5	34	–	–	71	9	–	–	–
BSS3212-5EG		12	6.35	33	26.4	5	51 500	103 000	767	Ⅳa	77	61	–	90	18	59	34	–	–	76	9	–	–	–
BSS3216-5E		16	5.556	33	27.2	5	44 300	90 800	756	Ⅳ	122	56	(55)	86	18	93.5	34	–	–	71	9	–	–	–
BSS3220-4ES		20	3.969	32.5	28.4	4	22 600	51 100	566	Ⅳa	98	50	–	80	12	86	31	–	–	65	9	–	–	–
BSS3220-5E		20	5.556	33	27.2	5	43 900	91 200	752	Ⅳ	141	56	(55)	86	18	112.5	34	–	–	71	9	–	–	–
BSS3232-2ES		32	3.966	32.5	28.4	2	11 400	23 300	259	Ⅳa	79	50	–	80	12	67	31	–	–	65	9	–	–	–
BSS3232-2E		32	5.556	33	27.2	2	17 700	32 900	274	Ⅳ	94	56	(55)	86	18	65.5	34	–	–	71	9	–	–	–
BSS3232-2EG		32	7.144	33.5	26.1	2	24 500	42 200	284	Ⅳ	98	62	(55)	97	18	69.5	37	–	–	82	9	–	–	–
BSS3264-2E		64	5.556	33	27.2	2	16 800	32 900	240	Ⅳ	153	56	(55)	86	18	124.5	34	–	–	71	9	–	–	–

Note: 1) The axial rigidity K in the table above is a theoretical value derived from elastic deformation between screw grooves and balls when axial load is applied to a ball nut for which preload is set at 3% of the basic dynamic load rating (C_a).

2) The standard Compact FA PSS model is available for ball screws with shaft diameters less than ø25.



Shape V



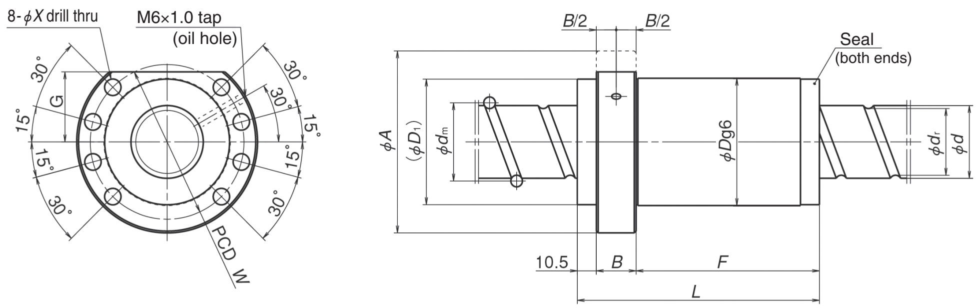
Shape Va

Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial rigidity K	Shape
	d	l	D_w	d_m	d_r		Dynamic C_a	Static C_{0a}	(N/μm)	
BSS3605-3E	36	5	3.175	36.5	33.2	3	13 500	34 100	459	V
BSS3608-4E		8	4.762	36.5	31.5	4	30 800	69 100	651	V
BSS3610-6E		10	6.35	37	30.4	6	65 000	141 000	1 018	V
BSS3612-6E		12	6.35	37	30.4	6	64 800	141 000	1 014	V
BSS3616-6E		16	6.35	37	30.4	6	64 500	142 000	1 012	V
BSS3620-6E		20	6.35	37	30.4	6	64 000	141 000	1 001	V
BSS4010-5ES	40	10	5.556	41	35.2	5	48 800	115 000	914	Va
BSS4010-5E		10	6.35	41	34.4	5	58 100	130 000	924	V
BSS4012-5E		12	6.35	41	34.4	5	58 000	130 000	922	V
BSS4016-4ES		16	5.556	41	35.2	4	39 500	90 300	722	V
BSS4016-5E		16	6.35	41	34.4	5	57 700	131 000	921	V
BSS4016-5EG		16	7.144	41.5	34.1	5	67 700	147 000	939	Va
BSS4020-4ES		20	5.556	41	35.2	4	39 300	89 900	716	V
BSS4020-5E		20	6.35	41	34.4	5	57 400	130 000	913	V
BSS4020-5EG		20	7.144	41.5	34.1	5	67 400	146 000	932	Va
BSS4025-4ES		25	5.556	41	35.2	4	39 000	90 300	711	V
BSS4025-4E		25	6.35	41	34.4	4	46 300	102 000	720	V
BSS4025-4EG		25	7.144	41.5	34.1	4	54 400	115 000	734	Va
BSS4030-3ES		30	5.556	41	35.2	3	30 300	65 900	526	V
BSS4030-3E		30	6.35	41	34.4	3	36 100	74 800	533	V
BSS4030-3EG		30	7.144	41.5	34.1	3	41 100	84 000	538	Va
BSS4040-2ES		40	5.556	41	35.2	2	19 800	41 400	328	Va
BSS4040-2E		40	6.35	41	34.4	2	23 700	47 100	334	V
BSS4080-2E		80	6.35	41	34.4	2	22 200	46 600	289	V

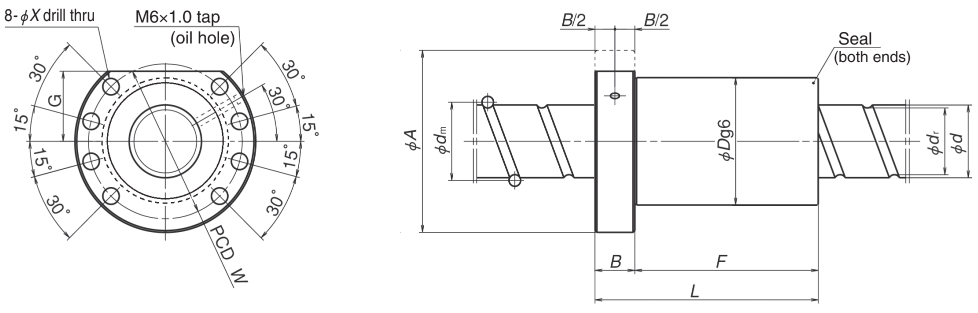
Unit: mm

Model No.	Nut total length	Nut diameter		Flange diameter	Flange width	Nut length	Flange notch	Flange dimensions		Bolt hole PCD	Bolt hole dimensions			Oil hole distance
	L	D	D_1	A	B	F	G	H	V	W	X	Y	Z	T
BSS3605-3E	50	65	(64)	95	12	27.5	36	–	–	80	9	–	–	–
BSS3608-4E	73	65	(64)	95	15	47.5	36	–	–	80	9	–	–	–
BSS3610-6E	109	65	(64)	95	22	76.5	36	–	–	80	9	–	–	–
BSS3612-6E	120	65	(64)	95	22	87.5	36	–	–	80	9	–	–	–
BSS3616-6E	143	65	(64)	95	22	110.5	36	–	–	80	9	–	–	–
BSS3620-6E	166	65	(64)	95	22	133.5	36	–	–	80	9	–	–	–
BSS4010-5ES	70	63	–	93	22	48	35	–	–	78	9	–	–	–
BSS4010-5E	99	70	(69)	100	22	66.5	38.5	–	–	85	9	–	–	–
BSS4012-5E	108	70	(69)	100	22	75.5	38.5	–	–	85	9	–	–	–
BSS4016-4ES	87	63	(62)	93	22	60	35	–	–	78	9	–	–	–
BSS4016-5E	127	70	(69)	100	22	94.5	38.5	–	–	85	9	–	–	–
BSS4016-5EG	109	80	–	110	22	87	43.5	–	–	95	9	–	–	–
BSS4020-4ES	102	63	(62)	93	22	75	35	–	–	78	9	–	–	–
BSS4020-5E	146	70	(69)	100	22	113.5	38.5	–	–	85	9	–	–	–
BSS4020-5EG	128	80	–	110	22	106	43.5	–	–	95	9	–	–	–
BSS4025-4ES	122	63	(62)	93	22	95	35	–	–	95	9	–	–	–
BSS4025-4E	145	70	(69)	100	22	112.5	38.5	–	–	85	9	–	–	–
BSS4025-4EG	127	80	–	110	22	105	43.5	–	–	95	9	–	–	–
BSS4030-3ES	111	63	(62)	93	22	84	35	–	–	95	9	–	–	–
BSS4030-3E	134	70	(69)	100	22	101.5	38.5	–	–	85	9	–	–	–
BSS4030-3EG	117	80	–	110	22	95	43.5	–	–	95	9	–	–	–
BSS4040-2ES	94	63	–	93	22	72	35	–	–	78	9	–	–	–
BSS4040-2E	110	70	(69)	100	22	77.5	38.5	–	–	85	9	–	–	–
BSS4080-2E	184	70	(69)	100	22	151.5	38.5	–	–	85	9	–	–	–

Note: The axial rigidity K in the table above is a theoretical value derived from elastic deformation between screw grooves and balls when axial load is applied to a ball nut for which preload is set at 3% of the basic dynamic load rating (C_a).



Shape V



Shape Va

Unit: mm

Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial rigidity K	Shape	Nut total length	Nut diameter		Flange diameter	Flange width	Nut length	Flange notch	Flange dimensions		Bolt hole PCD	Bolt hole dimensions			Oil hole distance
							Dynamic	Static																
	d	l	D_w	d_m	d_r		C_a	C_{0a}	(N/μm)		L	D	D_1	A	B	F	G	H	V	W	X	Y	Z	T
BSS4510-5E	45	10	6.35	46	39.4	5	62 400	147 000	1 026	V	99	75	(74)	110	22	66.5	43	–	–	93	11	–	–	–
BSS4512-5E		12	6.35	46	39.4	5	62 300	147 000	1 023	V	108	75	(74)	110	22	75.5	43	–	–	93	11	–	–	–
BSS4516-5E		16	6.35	46	39.4	5	62 100	147 000	1 018	V	127	75	(74)	110	22	94.5	43	–	–	93	11	–	–	–
BSS4516-5EG		16	7.144	46.5	39.1	5	71 400	166 000	1 032	Va	109	87	–	122	22	87	49	–	–	105	11	–	–	–
BSS4520-5E		20	6.35	46	39.4	5	61 800	146 000	1 011	V	146	75	(74)	110	22	113.5	43	–	–	93	11	–	–	–
BSS4525-5E		25	6.35	46	39.4	5	61 400	147 000	1 006	V	170	75	(74)	110	22	137.5	43	–	–	93	11	–	–	–
BSS4525-5EG		25	7.144	46.5	39.1	5	70 600	166 000	1 021	Va	152	87	–	122	22	130	49	–	–	105	11	–	–	–
BSS4530-4E		30	6.35	46	39.4	4	49 600	115 000	790	V	164	75	(74)	110	22	131.5	43	–	–	93	11	–	–	–
BSS4530-4EG		30	7.144	46.5	39.1	4	58 900	131 000	815	V	164	83	(82)	118	22	135.5	47	–	–	101	11	–	–	–
BSS5010-4E	50	10	6.35	51	44.4	4	52 600	129 000	883	V	89	82	(81)	118	22	56.5	46	–	–	100	11	–	–	–
BSS5012-4E		12	6.35	51	44.4	4	52 500	129 000	881	V	96	82	(81)	118	22	63.5	46	–	–	100	11	–	–	–
BSS5016-4E		16	6.35	51	44.4	4	52 400	128 000	878	V	111	82	(81)	118	22	78.5	46	–	–	100	11	–	–	–
BSS5016-4EG		16	7.144	51.5	44.1	4	60 800	146 000	896	Va	93	94	–	130	22	71	52	–	–	112	11	–	–	–
BSS5020-4E		20	6.35	51	44.4	4	52 200	129 000	879	V	126	82	(81)	118	22	93.5	46	–	–	100	11	–	–	–
BSS5025-4E		25	6.35	51	44.4	4	51 900	129 000	871	V	145	82	(81)	118	22	112.5	46	–	–	100	11	–	–	–
BSS5025-4EG		25	7.144	51.5	44.1	4	62 100	145 000	892	Va	127	94	–	130	22	105	52	–	–	112	11	–	–	–
BSS5030-4E		30	6.35	51	44.4	4	51 500	128 000	861	V	164	82	(81)	118	22	131.5	46	–	–	100	11	–	–	–
BSS5030-4EG		30	7.144	51.5	44.1	4	61 700	146 000	890	Va	146	94	–	130	22	124	52	–	–	112	11	–	–	–
BSS5036-4EG		36	7.938	51.5	43.2	4	70 900	161 000	893	V	189	90	(86)	126	22	156.5	50	–	–	108	11	–	–	–
BSS5040-3E		40	6.35	51	44.4	3	39 700	94 200	635	V	163	82	(81)	118	22	130.5	46	–	–	100	11	–	–	–
BSS5040-3EG		40	7.144	51.5	44.1	3	46 300	105 000	642	V	146	85	–	121	22	124	47.5	–	–	103	11	–	–	–
BSS5050-2E		50	6.35	51	44.4	2	26 100	58 300	394	V	130	82	(81)	118	22	97.5	46	–	–	100	11	–	–	–
BSS5050-2EG		50	7.938	51.5	43.2	2	35 300	73 700	411	V	118	90	–	149	20	98	54	–	–	126	11	–	–	–
BSS50100-2E		100	6.35	51	44.4	2	24 100	58 900	343	V	224	82	(81)	118	22	191.5	46	–	–	100	11	–	–	–
BSS50100-2EG		100	7.938	52.25	44	2	33 300	75 100	365	V	220	90	–	126	22	198	50	–	–	108	11	–	–	–
BSS5510-3E	55	10	6.35	56	49.4	3	41 300	103 000	700	V	79	90	(89)	126	22	46.5	50	–	–	108	11	–	–	–
BSS5520-3E		20	6.35	56	49.4	3	42 100	104 000	705	Va	88	94	–	130	22	66	52	–	–	112	11	–	–	–
BSS5525-3E		25	6.35	56	49.4	3	41 900	103 000	700	V	116	90	(89)	126	22	83.5	50	–	–	108	11	–	–	–
BSS6316-4E	63	16	9.525	65	55.2	4	131 000	338 000	1 430	Va	102	122	–	183	28	74	70	–	–	150	18	–	–	–
BSS6340-3E		40	7.144	64.5	57.1	3	52 100	135 000	792	Va	145	100	–	140	28	117	65	–	–	128	18	–	–	–

Note: The axial rigidity K in the table above is a theoretical value derived from elastic deformation between screw grooves and balls when axial load is applied to a ball nut for which preload is set at 3% of the basic dynamic load rating (C_a).

B-3-2.2 SRC Recirculation Ball Screws

1. Features

SRC Recirculation is a new generation standard method for ball recirculation in ball screws. Quiet operation is possible in all speed ranges.

2. Specifications

(1) Ball recirculation system

The structure of a SRC Recirculation system is shown below.

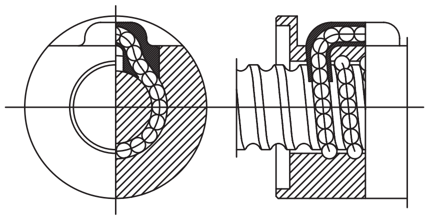


Fig.1 Structure of SRC recirculation system

Table 1 Accuracy grade and axial play

Accuracy grade	C0, C1, C2, C3, C5, Ct7
Axial play	Z, 0 mm (preloaded); T, 0.005 mm or less; S, 0.020 mm or less

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are shown in **Table 1**. Please consult NSK for other grades.

(3) Allowable *d·n* value and the criterion of maximum rotational speed

The allowable *d·n* value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Allowable *d·n* value: 160 000 or less

Criterion of maximum rotational speed

: 5 000 min^{-1}

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

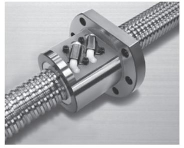
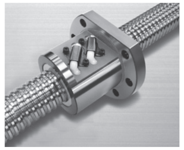
(4) Options

A type equipped with the NSK K1 lubrication unit is also available.

3. Lineup

There are three different preloads available (Table2).

Table 2 SRC recirculation ball screws lineup

Nut	Shape	Flange shape	Nut shape	Preload
SFRC		Flanged Circular Ⅱ	Circular	No preload Sligit axial play
PFRC		Flanged Circular Ⅱ	Circular	P-preload (light preload) Spacer ball 1:1
ZFRC		Flanged Circular Ⅱ	Circular	Z-preload (medium preload)

4. Structure of model number and reference number

The following explains the codes used in model numbers and ball screw reference numbers.

◇ Model number

ZFRC 40 10 - 10

Nut: SFRC, PFRC, ZFRC

Screw shaft diameter (mm)

Lead (mm)

Effective ball turns (Note)

Note: In Z-preload, the number here is twice the effective ball turns.

◇ Reference number for ball screw

W 40 07 - ＊＊ Z RC - C5 Z 10

Product code

Screw shaft diameter (mm)

Effective threaded length (in 100 mm units)

NSK design serial number

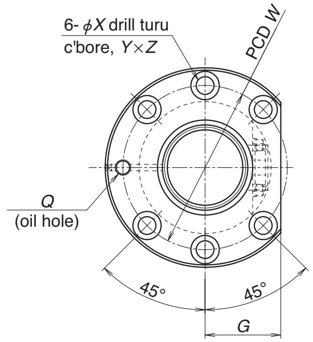
Preload code:
No code, no preload; P, P-preload
Z, Z-preload (page B5)

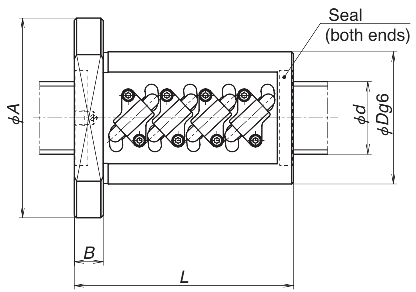
SRC recirculation system

Accuracy grade code:
C0, C1, C2, C3, C5, C7 (Ct7)
(page B37 to B42)

Axial play code:
Z, T, S (page B20)

Lead (mm)





The number of circuits (number of circulating parts) may differ from the diagram

Unit: mm

Model No.	Preload	Shaft dia.	Lead	Root dia.	Effective ball turns	Basic load ratings (N)		Axial rigidity	Ball nut dimensions					Bolt hole dimensions			Bolt hole PCD	Oil hole	Max. feed speed
		d	l	d_r	Turns × Circuits	Dynamic C_a	Static C_{0a}	K (N/μm)	Nut total length L	Nut diameter D	Flange diameter A	Flange width B	Flange notch G	X	Y	Z	W	Q	(m/min)
ZFRC 2812-7	Z	28	12	23.5	3.5×1	26100	50200	592	128	60	88	15	33	6.6	11	6.5	73	M6×1	60
PFRC 2812-3.5	P				3.5×1	16400	25100	270	80										
SFRC 2812-3.5	Clearance				3.5×1	26100	50200	381	80										
ZFRC 2816-5	Z	28	16	22.4	2.5×1	27400	47400	437	131	73	101	15	38	6.6	11	6.5	86	M6×1	80
PFRC 2816-2.5	P				2.5×1	17300	23700	199	83										
SFRC 2816-2.5	Clearance				2.5×1	27400	47400	281	83										
ZFRC 3205-10	Z	32	5	29.2	2.5×2	21800	56000	891	89	58	85	12	32	6.6	11	6.5	71	M6×1	25
PFRC 3205-5	P				2.5×2	13700	28000	406	59										
SFRC 3205-5	Clearance				2.5×2	21800	56000	573	59										
ZFRC 3210-10	Z	32	10	26.4	2.5×2	54500	110000	970	163	74	108	15	41	9	14	8.5	90	M6×1	50
PFRC 3210-5	P				2.5×2	34300	55100	434	103										
SFRC 3210-5	Clearance				2.5×2	54500	110000	623	103										
ZFRC 4005-10	Z	40	5	37.2	2.5×2	23900	70500	1067	92	67	101	15	39	9	14	8.5	83	M6×1	25
PFRC 4005-5	P				2.5×2	15100	35300	486	62										
SFRC 4005-5	Clearance				2.5×2	23900	70500	685	62										
ZFRC 4010-10	Z	40	10	34.4	2.5×2	61200	137000	1154	166	82	124	18	47	11	17.5	11	102	Rc1/8	40
PFRC 4010-5	P				2.5×2	38600	68300	526	106										
SFRC 4010-5	Clearance				2.5×2	61200	137000	740	106										
ZFRC 4012-10	Z	40	12	34.1	2.5×2	71700	154000	1177	192	86	128	18	48	11	17.5	11	106	Rc1/8	48
PFRC 4012-5	P				2.5×2	45200	77200	528	120										
SFRC 4012-5	Clearance				2.5×2	71700	154000	756	120										
ZFRC 4508-10	Z	45	8	40.5	2.5×2	44000	118000	1234	136	82	124	18	47	11	17.5	11	102	Rc1/8	28
PFRC 4508-5	P				2.5×2	27700	58900	557	88										
SFRC 4508-5	Clearance				2.5×2	44000	118000	792	88										
ZFRC 4510-10	Z	45	10	39.4	2.5×2	65800	157000	1291	166	88	132	18	50	11	17.5	11	110	Rc1/8	35
PFRC 4510-5	P				2.5×2	41500	78500	582	106										
SFRC 4510-5	Clearance				2.5×2	65800	157000	830	106										
ZFRC 4512-10	Z	45	12	39.1	2.5×2	75600	176000	1304	192	90	132	18	50	11	17.5	11	110	Rc1/8	42
PFRC 4512-5	P				2.5×2	47600	88200	586	120										
SFRC 4512-5	Clearance				2.5×2	75600	176000	838	120										
ZFRC 5010-10	Z	50	10	44.4	2.5×2	68100	174000	1397	166	93	135	18	51	11	17.5	11	113	Rc1/8	32
PFRC 5010-5	P				2.5×2	42900	87200	630	106										
SFRC 5010-5	Clearance				2.5×2	68100	174000	898	106										
ZFRC 5012-10	Z	50	12	43.2	2.5×2	91500	218000	1441	198	100	146	22	55	14	20	13	122	Rc1/8	38
PFRC 5012-5	P				2.5×2	57600	109000	647	126										
SFRC 5012-5	Clearance				2.5×2	91500	218000	926	126										
ZFRC 5508-10	Z	55	8	50.5	2.5×2	47300	144000	1439	133	94	136	18	52	11	17.5	11	114	Rc1/8	23
PFRC 5508-5	P				2.5×2	29800	72000	651	85										
SFRC 5508-5	Clearance				2.5×2	47300	144000	923	85										
ZFRC 6312-14	Z	63	12	56.2	3.5×2	136000	385000	2388	244	115	161	22	61	14	20	13	137	Rc1/8	30
PFRC 6312-7	P				3.5×2	85400	193000	1078	148										
SFRC 6312-7	Clearance				3.5×2	136000	385000	1539	148										

Notes: 1. Values for axial rigidity K above are theoretical values elastic deformation between the screw groove and ball when axial load is applied to a ball nut for which preload is set at 3% for PFRC (P-preload), and 5% for ZFRC (Z-preload) of the basic dynamic load reting (C_a).

2. Spacer balls are installed in PFRC.

B-3-2.3 Tube Recirculation Ball Screws

1. Features

Tube recirculation is a standard method for ball recirculation in ball screws. Various combinations of shaft diameter and lead are available.

2. Specifications

(1) Ball recirculation system

The structure of a tube recirculation system is shown below.

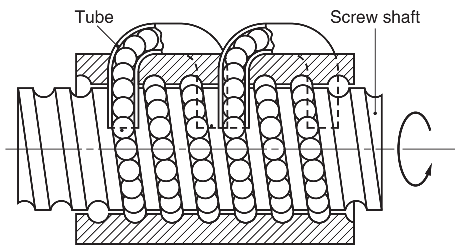


Fig.1 Structure of tube recirculation system

Table 1 Accuracy grade and axial play

Accuracy grade	SFT, PFT, ZFT, DFT: C0, C1, C2, C3, C5, Ct7 LSFT, LPFT, LDFT: C1, C2, C3, C5, Ct7 (Ct7 is not included in DFT, LDFT)
Axial play	Z, 0 mm (preloaded); T, 0.005 mm or less; S, 0.020 mm or less; N, 0.050 mm or less

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are shown in **Table 1**. Please consult NSK for other grades.

(3) Allowable $d{\cdot}n$ value and the criterion of maximum rotational speed

The allowable $d{\cdot}n$ value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below. Basic measures must be taken for high-speed ball screws.

Allowable $d{\cdot}n$ value :
Standard specification ; 70 000 or less
High-speed specification; 100 000 or less
Standard of rotational speed : 3 000 min^{-1}

Note: Please also review the critical speed. Refer to "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Options

A type equipped with the NSK K1 lubrication unit is also available.

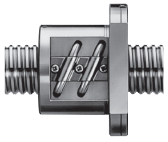
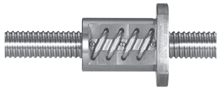
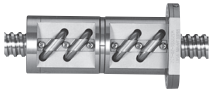
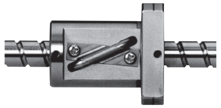
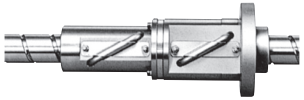
(5) Other specifications

Please consult NSK for specifications not listed in the dimension tables.

3. Lineup

There are four different preloads available with several models. Since the leads range from 1/2 to the same length of the shaft diameter (medium-high helix lead), LSFT, LPFT, and LDFT nut ball screws are suitable for high-speed operation.

Table 2 Tube recirculation ball screws lineup

Nut	Shape	Flange shape	Nut shape	Preload
SFT		Flanged d=16mm or under Rectangle d=20mm or over Circular Ⅰ, Ⅱ	Circle dia.	No preload, Slight axial play
PFT				P-preload (light preload) Spacer ball 1:1
ZFT		Flanged Circular Ⅰ, Ⅱ	Circle dia.	Z-preload (medium preload)
DFT		Flanged Circular Ⅰ, Ⅱ	Circular	D-preload (medium preload) (heavy preload)
LSFT		Flanged *d*=20mm or under Rectangle *d*=25mm or over Circular Ⅱ	*d*=20mm or under Circular *d*=25mm or over Tube-projecting type	No preload, Slight axial play
LPFT				P-preload (light preload) Spacer ball 1:1
LDFT		Flanged Circular Ⅱ	Circular	D-preload (medium preload) (heavy preload)

4. Structure of model number and reference number

The following explains the codes used in model numbers and ball screw reference numbers.

◇ Model number

SFT 14 05 - 2.5

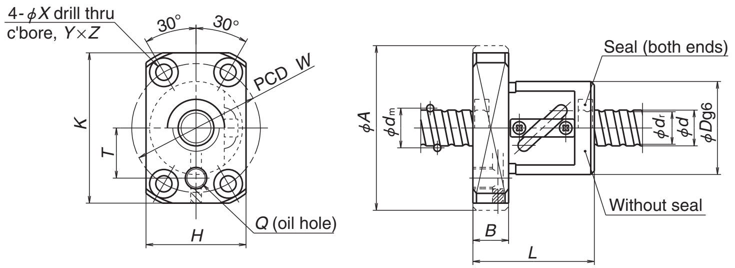
Nut:
SFT, PFT, ZFT, DFT
LSFT, LPFT, LDFT
Screw shaft diameter (mm)
Lead (mm)
Effective ball turns (Note)

Note: In Z-preload, the number here is twice the effective ball turns.

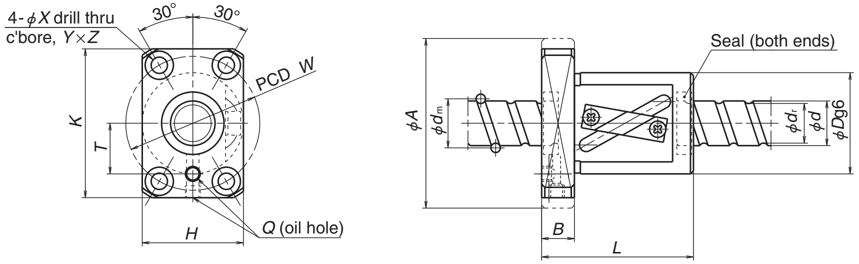
◇ Reference number for ball screw

W 14 01 - ** P - C3 Z 5

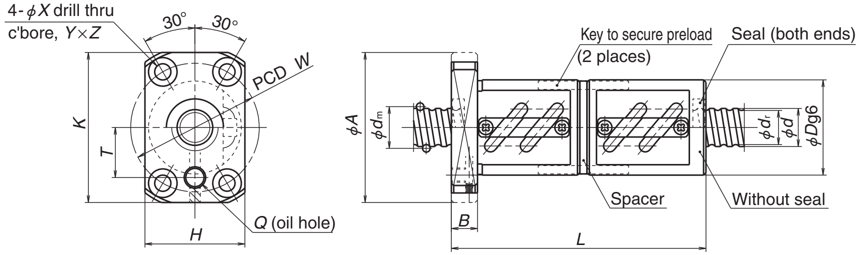
Product code
Screw shaft diameter (mm)
Effective threaded length (in 100 mm units)
NSK design serial number
Preload code:
No code, no preload; P, P-preload
Z, Z-preload; D, D-preload (page B5)
Accuracy grade code:
C0, C1, C2, C3, C5, C7 (Ct7)
(page B37 to B42)
Axial play code:
Z, T, S, N (page B20)
Lead (mm)



PFT, SFT



LPFT, LSFT

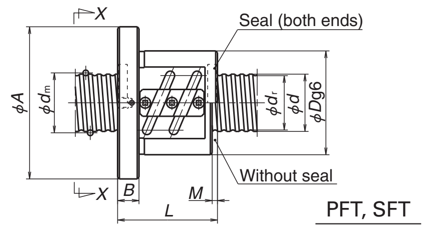


DFT

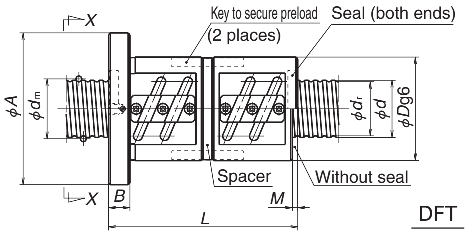
Unit: mm

Model No.	Preload	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial rigidity	Ball nut dimensions											
							Turns × Circuits	Dynamic	Static	K	Nut total length	Nut diameter	Flange diameter	Flange width	Rectangle flange dimensions		Bolt hole dimensions			Bolt hole PCD	Oil hole distance	Oil hole
		d	l	D_w	d_m	d_r		C_a	C_{0a}	(N/μm)	L	D	A	B	H	K	X	Y	Z	W	T	Q
* **PFT 1004-2.5**	P	10	4	2.000	10.3	8.2	2.5×1	2 020	2 210	79	34	26	46	10	28	42	4.5	8	4.5	36	14	M6×1
SFT 1004-2.5	Clearance							3 210	4 420	94												
PFT 1204-2.5	P	12	4	2.381	12.3	9.8	2.5×1	2 780	3 140	93	38	30	50	10	32	45	4.5	8	4.5	40	15	M6×1
PFT 1204-3	P						1.5×2	3 250	3 770	111	44											
SFT 1204-2.5	Clearance						2.5×1	4 410	6 280	111	38											
SFT 1204-3	Clearance						1.5×2	5 160	7 540	132	44											
* **PFT 1205-2.5**	P		5	2.381	12.3	9.8	2.5×1	2 770	3 130	92	40	30	50	10	32	45	4.5	8	4.5	40	15	M6×1
PFT 1205-3	P						1.5×2	3 240	3 760	110	48											
SFT 1205-2.5	Clearance						2.5×1	4 390	6 260	110	40											
SFT 1205-3	Clearance						1.5×2	5 140	7 510	131	48											
* **LPFT 1210-2.5**	P		10	2.381	12.5	10.0	2.5×1	2 790	3 220	92	50	30	50	10	32	45	4.5	8	4.5	40	15	M6×1
LSFT 1210-2.5	Clearance							4 430	6 430	110												
* **PFT 1405-2.5**	P	14	5	3.175	14.5	11.2	2.5×1	5 020	5 970	126	40	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
SFT 1405-2.5	Clearance						2.5×1	7 970	11 900	150	40											
PFT 1405-5	P						2.5×2	9 110	11 900	244	55											
SFT 1405-5	Clearance						2.5×2	14 500	23 900	291	55											
* **LPFT 1408-2.5**	P		8	3.175	14.5	11.2	2.5×1	4 960	5 920	124	46	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
LSFT 1408-2.5	Clearance							7 880	11 800	147												
* **LPFT 1510-2.5**	P	15	10	3.175	15.5	12.2	2.5×1	5 130	6 420	129	51	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
LSFT 1510-2.5	Clearance							8 140	12 800	156												
PFT 1604-3	P	16	4	2.381	16.3	13.8	1.5×2	3 740	5 130	141	45	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
SFT 1604-2.5	Clearance						2.5×1	5 070	8 500	140	38	34			34							
ZFT 1604-5	Z						2.5×1	5 070	8 500	275	50	36			36							
PFT 1604-5	P						2.5×2	5 800	8 500	226	50	34			34							
SFT 1604-3	Clearance						1.5×2	5 930	10 300	168	45	34			34							
DFT 1604-3	D						1.5×2	5 930	10 300	329	85	36			36							

Notes:
1. Rectangular flanges are used for shaft diameters of 16 mm or less.
2. Seals are equipped as standard for LSFT and LPFT nuts when shaft diameter is 20 mm or less. The outside dimensions are the same as those without seals.
3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.
4. Values for axial rigidity K above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
5. The basic load ratings with PFT and LPFT nuts are different due to the installed spacer balls.
6. Finished shaft end FA models are available for those models marked with an asterisk (*).
7. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

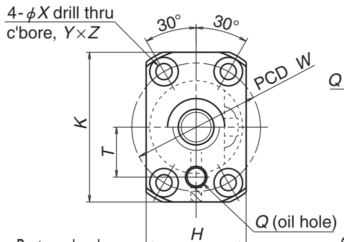


PFT, SFT

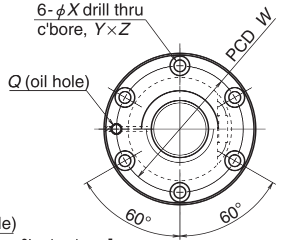


DFT

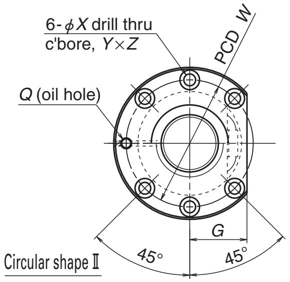
View X-X



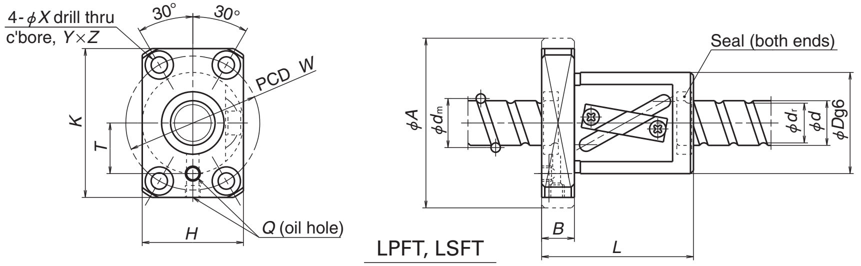
Rectangular shape



Circular shape I



Circular shape II

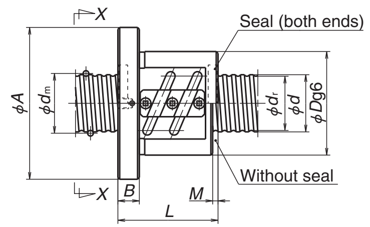


LPFT, LSFT

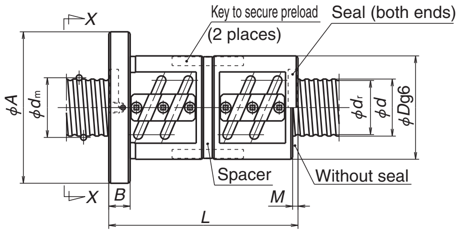
Unit: mm

Model No.	Preload	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load ratings (N) Dynamic C_a	Basic load ratings (N) Static C_{0a}	Axial rigidity K (N/μm)	Ball nut dimensions Nut total length L	Nut diameter D	Flange diameter A	Flange width B	Flange notch G	Rectangle flange dimensions H	Rectangle flange dimensions K	Seal dimension M	Bolt hole dimensions X	Bolt hole dimensions Y	Bolt hole dimensions Z	Bolt hole PCD W	Oil hole distance T	Oil hole Q
PFT 1605-3	P	16	5	3.175	16.5	13.2	1.5×2	6 350	8 070	166	52	40	63	11	—	40	55	—	5.5	9.5	5.5	51	20	M6×1
SFT 1605-2.5	Clearance						2.5×1	8 620	13 800	168	42													
ZFT 1605-5	Z						2.5×1	8 620	13 800	330	57													
PFT 1605-5	P						2.5×2	9 850	13 800	270	57													
SFT 1605-3	Clearance						1.5×2	10 100	16 100	197	52													
DFT 1605-3	D						1.5×2	10 100	16 100	387	97													
SFT 1605-5	Clearance						2.5×2	15 600	27 600	326	57													
DFT 1605-5	D						2.5×2	15 600	27 600	639	107													
PFT 1606-2.5	P		6	3.175	16.5	13.2	2.5×1	5 410	6 880	139	44	40	63	11	—	40	55	—	5.5	9.5	5.5	51	20	M6×1
SFT 1606-2.5	Clearance						2.5×1	8 590	13 800	168	44													
DFT 1606-2.5	D						2.5×1	8 590	13 800	329	86													
SFT 1606-3	Clearance						1.5×2	10 100	16 100	197	56													
DFT 1606-3	D						1.5×2	10 100	16 100	386	110													
* **LPFT 1616-1.5**	P		16	3.175	16.75	13.4	1.5×1	4 180	5 390	107	56	40	63	12	—	40	55	—	5.5	9.5	5.5	51	17	M6×1
LSFT 1616-1.5	Clearance							5 480	8 080	98														
SFT 2004-2.5	Clearance	20	4	2.381	20.3	17.8	2.5×1	5 730	10 900	171	37	40	63	11	24	—	—	3	5.5	9.5	5.5	51	—	M6×1
ZFT 2004-5	Z						2.5×1	5 730	10 900	336	49													
* **PFT 2004-5**	P						2.5×2	6 550	10 900	276	49													
SFT 2004-5	Clearance						2.5×2	10 400	21 800	332	49													
ZFT 2004-10	Z						2.5×2	10 400	21 800	651	73													
PFT 2005-3	P		5	3.175	20.5	17.2	1.5×2	7 140	10 300	201	52	44	67	11	26	—	—	3	5.5	9.5	5.5	55	—	M6×1
SFT 2005-2.5	Clearance						2.5×1	9 690	17 100	201	41													
ZFT 2005-5	Z						2.5×1	9 690	17 100	393	56													
* **PFT 2005-5**	P						2.5×2	11 100	17 100	327	56													
SFT 2005-3	Clearance						1.5×2	11 300	20 500	238	52													
ZFT 2005-6	Z						1.5×2	11 300	20 500	467	77													
SFT 2005-5	Clearance						2.5×2	17 600	34 200	388	56													
ZFT 2005-10	Z						2.5×2	17 600	34 200	762	86													

Notes: 1. Rectangular flanges are used for shaft diameters of 16 mm or less. Circular shape I and II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
2. If no seal is used with nuts PFT, SFT, or DFT, the nut length will be shortened by the amount of dimension *M*.
3. Seals are equipped as standard for LSFT and LPFT nuts when shaft diameter is 20 mm or less. The outside dimensions are the same as those without seals.
4. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.
5. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
6. The basic load ratings with PFT and LPFT nuts are different due to the installed spacer balls.
7. Finished shaft end FA models are available for those models marked with an asterisk (*).
8. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

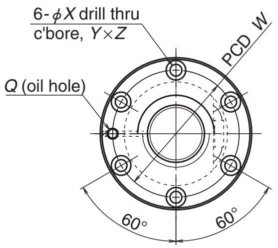


PFT, ZFT, SFT

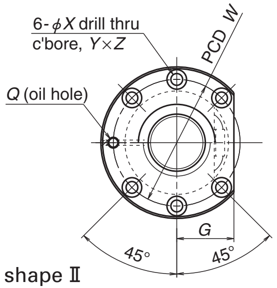


DFT

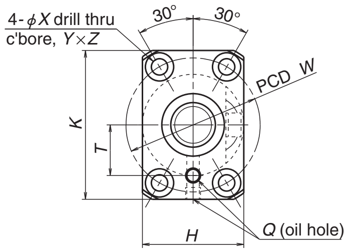
View X-X

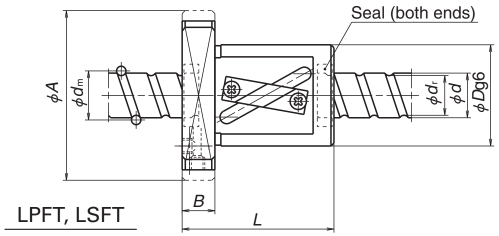


Circular shape Ⅰ



Circular shape Ⅱ





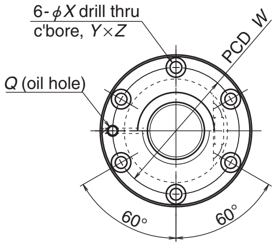
LPFT, LSFT

Unit: mm

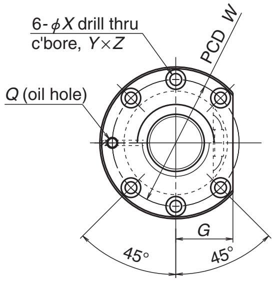
Model No.	Preload	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load ratings (N) Dynamic C_a	Basic load ratings (N) Static C_{0a}	Axial rigidity K (N/μm)	Ball nut dimensions Nut total length L	Nut diameter D	Flange diameter A	Flange width B	Flange notch G	Rectangle flange dimensions H	Rectangle flange dimensions K	Seal dimension M	Bolt hole dimensions X	Bolt hole dimensions Y	Bolt hole dimensions Z	Bolt hole PCD W	Oil hole distance T	Oil hole Q
PFT 2006-2.5	P	20	6	3.969	20.5	16.4	2.5×1	8 120	10 500	172	44	48	71	11	27	—	—	3	5.5	9.5	5.5	59	—	M6×1
PFT 2006-3	P						1.5×2	9 500	12 600	204	56													
SFT 2006-2.5	Clearance						2.5×1	12 900	21 000	204	44													
ZFT 2006-5	Z						2.5×1	12 900	21 000	401	62													
SFT 2006-3	Clearance						1.5×2	15 100	25 200	243	56													
DFT 2006-3	D						1.5×2	15 100	25 200	477	110													
PFT 2008-2.5	P		8	3.969	20.5	16.4	2.5×1	8 080	10 500	170	54	48	75	13	28	—	—	5	6.6	11	6.5	61	—	M6×1
SFT 2008-2.5	Clearance						2.5×1	12 800	20 900	203	54													
DFT 2008-2.5	D						2.5×1	12 800	20 900	397	102													
SFT 2008-3	Clearance						1.5×2	15 000	25 100	241	64													
DFT 2008-3	D						1.5×2	15 000	25 100	473	120													
∗ **LPFT 2010-2.5**	P		10	3.969	21.0	16.9	2.5×1	8 350	11 000	177	54	46	74	13	—	46	66	—	6.6	11	6.5	59	24	M6×1
LSFT 2010-2.5	Clearance							13 300	21 900	211														
LPFT 2016-2.5	P		16	3.969	21.0	16.9	2.5×1	8 170	10 800	171	72	46	74	13	—	46	66	—	6.6	11	6.5	59	24	M6×1
LSFT 2016-2.5	Clearance							13 000	21 600	203														
∗ **LPFT 2020-1.5**	P		20	3.969	21.0	16.9	1.5×1	6 250	8 760	132	63	46	74	13	—	46	66	—	6.6	11	6.5	59	24	M6×1
LSFT 2020-1.5	Clearance							8 190	13 100	123														
SFT 2504-2.5	Clearance	25	4	2.381	25.3	22.8	2.5×1	6 220	13 600	203	36	46	69	11	26	—	—	3	5.5	9.5	5.5	57	—	M6×1
ZFT 2504-5	Z						2.5×1	6 220	13 600	399	48													
∗ **PFT 2504-5**	P						2.5×2	7 110	13 600	328	48													
SFT 2504-5	Clearance						2.5×2	11 300	27 200	394	48													
ZFT 2504-10	Z						2.5×2	11 300	27 200	773	72													
PFT 2505-3	P		5	3.175	25.5	22.2	1.5×2	7 940	12 800	235	52	50	73	11	28	—	—	3	5.5	9.5	5.5	61	—	M6×1
SFT 2505-2.5	Clearance						2.5×1	10 800	21 800	243	40													
ZFT 2505-5	Z						2.5×1	10 800	21 800	477	55													
∗ **PFT 2505-5**	P						2.5×2	12 300	21 800	391	55													
SFT 2505-3	Clearance						1.5×2	12 600	25 600	285	52													
DFT 2505–3	D						1.5×2	12 600	25 600	558	102													
PFT 2505-7.5	P						2.5×3	17 500	32 700	576	70													
SFT 2505-5	Clearance						2.5×2	19 600	43 600	470	55													
ZFT 2505-10	Z						2.5×2	19 600	43 600	923	85													
SFT 2505-7.5	Clearance						2.5×3	27 700	65 400	692	70													

Notes:
1. Rectangular flanges are used for shaft diameters of 16 mm or less. Circular shape I and II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
2. If no seal is used with nuts PFT, SFT, or DFT, the nut length will be shortened by the amount of dimension *M*.
3. Seals are equipped as standard for LSFT and LPFT nuts when shaft diameter is 20 mm or less. The outside dimensions are the same as those without seals.
4. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.
5. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
6. The basic load ratings with PFT and LPFT nuts are different due to the installed spacer balls.
7. Finished shaft end FA models are available for those models marked with an asterisk (*).
8. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

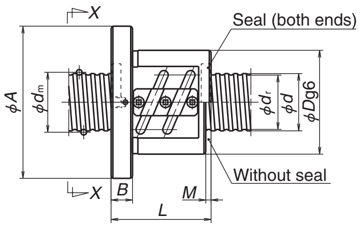
View *X-X*



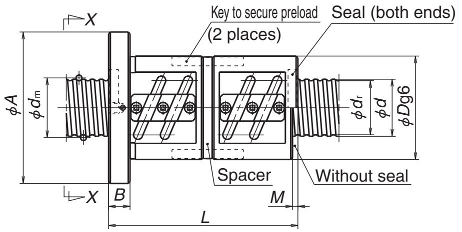
Circular shape Ⅰ



Circular shape Ⅱ



PFT, ZFT, SFT

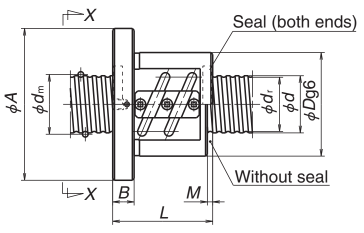


DFT

Unit: mm

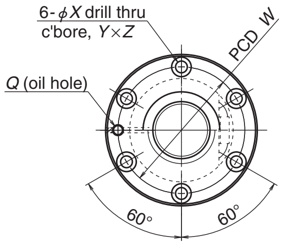
Model No.	Preload	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity	Ball nut dimensions										
		d	l	D_w	d_m	d_r		Dynamic C_a	Static C_{0a}	K (N/μm)	Nut total length L	Nut diameter D	Flange diameter A	Flange width B	Flange notch G	Seal dimension M	Bolt hole dimensions X	Y	Z	Oil hole distance W	Oil hole Q
PFT 2506-3	P	25	6	3.969	25.5	21.4	1.5×2	10 700	16 000	247	56	53	76	11	29	3	5.5	9.5	5.5	64	M6×1
SFT 2506-2.5	Clearance						2.5×1	14 500	26 700	247	44										
ZFT 2506-5	Z						2.5×1	14 500	26 700	485	62										
* **PFT 2506-5**	P						2.5×2	16 600	26 700	402	62										
SFT 2506-3	Clearance						1.5×2	17 000	32 000	294	56										
ZFT 2506-6	Z						1.5×2	17 000	32 000	577	92										
SFT 2506-5	Clearance						2.5×2	26 300	53 400	478	62										
ZFT 2506-10	Z						2.5×2	26 300	53 400	938	98										
PFT 2508-2.5	P		8	4.762	25.5	20.5	2.5×1	11 700	15 900	213	56	58	85	13	32	5	6.6	11	6.5	71	M6×1
PFT 2508-3	P						1.5×2	13 700	18 900	245	69										
SFT 2508-2.5	Clearance						2.5×1	18 500	31 800	253	56										
ZFT 2508-5	Z						2.5×1	18 500	31 800	495	80										
SFT 2508-3	Clearance						1.5×2	21 700	37 900	299	69										
DFT 2508-3	D						1.5×2	21 700	37 900	587	133										
PFT 2510-2.5	P		10	4.762	25.5	20.5	2.5×1	11 600	15 900	211	67	58	85	15	32	8	6.6	11	6.5	71	M6×1
ZFT 2510-3	Z						1.5×1	11 900	18 900	301	81										
PFT 2510-3	P						1.5×2	13 600	18 900	243	81										
SFT 2510-2.5	Clearance						2.5×1	18 500	31 700	251	67										
DFT 2510-2.5	D						2.5×1	18 500	31 700	493	127										
SFT 2510-3	Clearance						1.5×2	21 600	37 800	297	81										
DFT 2510-3	D						1.5×2	21 600	37 800	583	151										
SFT 2510-3.5	Clearance						3.5×1	24 700	44 600	347	77										
DFT 2510-3.5	D						3.5×1	24 700	44 600	681	147										

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
2. If no seal is used with nuts PFT, SFT, ZFT, or DFT, the nut length will be shortened by the amount of dimension *M*.
3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.
4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
5. The basic load ratings with PFT nuts are different due to the installed spacer balls.
6. Finished shaft end FA models are available for those models marked with an asterisk (*).
7. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

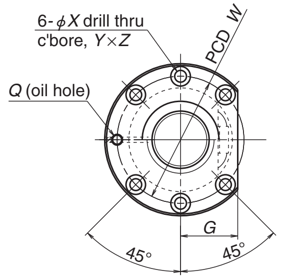


PFT, ZFT, SFT

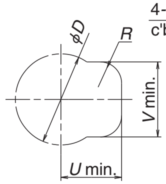
View X-X



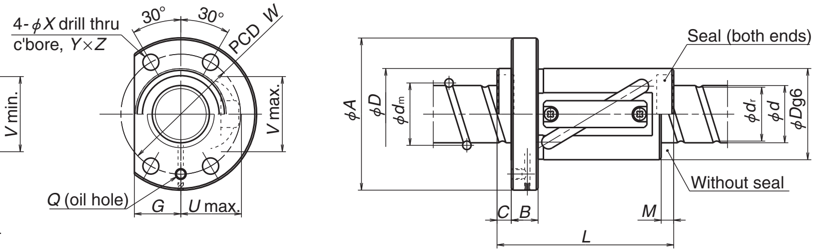
Circular shape Ⅰ



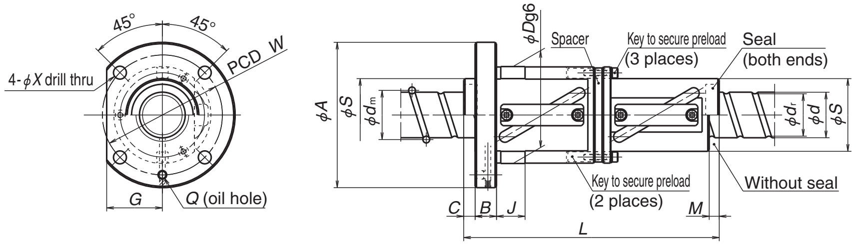
Circular shape Ⅱ



Housing hole and its clearance



LPFT, LSFT



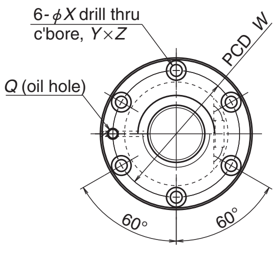
LDFT

Unit: mm

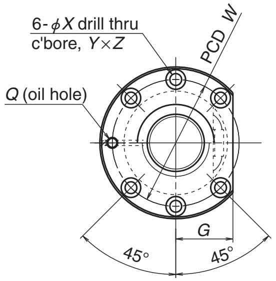
Model No.	Preload	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity K (N/μm)	Nut total length L	Ball nut dimensions															
								Dynamic C_a	Static C_{0a}			Nut diameter		Flange diameter A	Flange width B	Flange notch G	Projecting tube dimensions			Seal dimensions		Diameter g6 J	Bolt hole dimensions			Bolt hole PCD W	Oil hole Q
												D	S				U	V	R	M	C		X	Y	Z		
LPFT 2516-2.5	P	25	16	4.762	26.25	21.3	2.5×1	11 400	16 500	213	84	44	—	71	12	23	31	35	12	6	8	—	6.6	—	—	57	M6×1
LPFT 2516-3	P						1.5×2	13 400	19 500	251	100	44	—	71		23	31	35	12			—				57	
LSFT 2516-2.5	Clearance						2.5×1	18 100	33 000	253	84	44	—	71		23	31	35	12			—				57	
LDFT 2516-2.5	D						2.5×1	18 100	33 000	496	152	62	44	89		34	—	—	—			18				75	
LSFT 2516-3	Clearance						1.5×2	21 200	39 000	298	100	44	—	71		23	31	35	12			—				57	
LDFT 2516-3	D						1.5×2	21 200	39 000	584	181	62	44	89		34	—	—	—			18				75	
* **LPFT 2520-2.5**	P		20	4.762	26.25	21.3	2.5×1	11 700	16 300	211	96	44	—	71	12	23	31	35	12	7	8	—	6.6	—	—	57	M6×1
LPFT 2520-3	P						1.5×2	13 700	19 300	248	116	44	—	71		23	31	35	12			—				57	
LSFT 2520-2.5	Clearance						2.5×1	18 600	32 600	251	96	44	—	71		23	31	35	12			—				57	
LDFT 2520-2.5	D						2.5×1	18 600	32 600	492	177	62	44	89		34	—	—	—			18				75	
LSFT 2520-3	Clearance						1.5×2	21 800	38 600	296	116	44	—	71		23	31	35	12			—				57	
LDFT 2520-3	D						1.5×2	21 800	38 600	580	217	62	44	89		34	—	—	—			18				75	
* **LPFT 2525-1.5**	P		25	4.762	26.25	21.3	1.5×1	8 970	13 100	165	90	44	—	71	12	23	32	34	12	10	10	—	6.6	—	—	57	M6×1
LDFT 2525-1.5	D							11 700	19 700	297	166	62	44	89		34	—	—	—			18				75	
LSFT 2525-1.5	Clearance							11 700	19 700	151	90	44	—	71		23	32	34	12			—				57	
SFT 2805-2.5	Clearance	28	5	3.175	28.5	25.2	2.5×1	11 300	24 400	265	41	55	—	85	12	31	—	—	—	3	—	—	6.6	11	6.5	69	M6×1
ZFT 2805-5	Z						2.5×1	11 300	24 400	519	56																
* **PFT 2805-5**	P						2.5×2	13 000	24 400	432	56																
SFT 2805-5	Clearance						2.5×2	20 600	48 700	514	56																
* **ZFT 2805-10**	Z						2.5×2	20 600	48 700	1 007	86																

Notes:
1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
2. If no seal is used with nuts PFT, ZFT, or SFT, the nut length will be shortened by the amount of dimension *M*.
3. If no seal is used with nuts LSFT or LDFT, the nut length will be shortened by the amount of dimension *M* and *C*.
4. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.
5. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
6. The basic load ratings with PFT and LPFT nuts are different due to the installed spacer balls.
7. Finished shaft end FA models and standard SA models are available for those models marked with an asterisk (*).
8. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

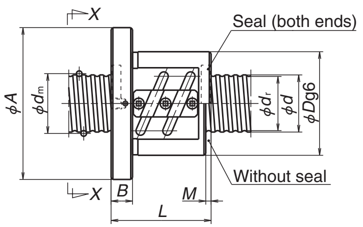
View *X-X*



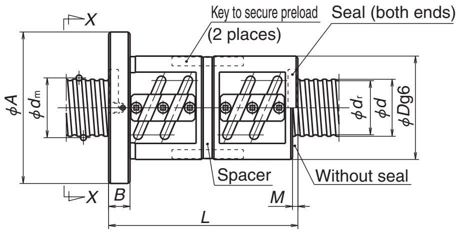
Circular shape Ⅰ



Circular shape Ⅱ



PFT, ZFT, SFT



DFT

Unit: mm

Model No.	Preload	Shaft dia. *d*	Lead *l*	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns	Basic load ratings (N)		Axial rigidity *K* (N/μm)	Ball nut dimensions										
							Turns × Circuits	Dynamic C_a	Static C_{0a}		Nut total length *L*	Nut diameter *D*	Flange diameter *A*	Flange width *B*	Flange notch *G*	Seal dimension *M*	Bolt hole dimensions			Bolt hole PCD *W*	Oil hole *Q*
																	X	*Y*	*Z*		
PFT 2806-3	P	28	6	3.175	28.5	25.2	1.5×2	8 350	14 600	265	57	55	85	12	31	3	6.6	11	6.5	69	M6×1
SFT 2806-2.5	Clearance						2.5×1	11 300	24 300	265	45										
ZFT 2806-5	Z						2.5×1	11 300	24 300	519	63										
* **PFT 2806-5**	P						2.5×2	12 900	24 300	430	63										
SFT 2806-3	Clearance						1.5×2	13 200	29 200	315	57										
ZFT 2806-6	Z						1.5×2	13 200	29 200	617	87										
SFT 2806-5	Clearance						2.5×2	20 600	48 700	513	63										
* **ZFT 2806-10**	Z						2.5×2	20 600	48 700	1 006	99										
PFT 2810-2.5	P		10	4.762	28.5	23.5	2.5×1	12 300	17 900	229	68	60	94	15	36	7	9	14	8.5	76	M6×1
ZFT 2810-3	Z						1.5×1	12 600	21 400	332	82										
PFT 2810-3	P						1.5×2	14 400	21 400	275	82										
SFT 2810-2.5	Clearance						2.5×1	19 600	35 800	277	68										
ZFT 2810-5	Z						2.5×1	19 600	35 800	543	98										
SFT 2810-3	Clearance						1.5×2	22 900	42 700	328	82										
ZFT 2810-6	Z						1.5×2	22 900	42 700	643	132										
SFT 3204-2.5	Clearance	32	4	2.381	32.3	29.8	2.5×1	6 850	17 500	247	37	54	81	12	31	3	6.6	11	6.5	67	M6×1
ZFT 3204-5	Z						2.5×1	6 850	17 500	485	49										
PFT 3204-5	P						2.5×2	7 840	17 500	403	49										
SFT 3204-5	Clearance						2.5×2	12 400	35 000	479	49										
ZFT 3204-10	Z						2.5×2	12 400	35 000	939	73										
PFT 3205-3	P		5	3.175	32.5	29.2	1.5×2	8 850	16 800	296	53	58	85	12	32	3	6.6	11	6.5	71	M6×1
SFT 3205-2.5	Clearance						2.5×1	12 000	28 000	296	41										
ZFT 3205-5	Z						2.5×1	12 000	28 000	580	56										
#* **PFT 3205-5**	P						2.5×2	13 700	28 000	481	56										
SFT 3205-3	Clearance						1.5×2	14 000	33 600	351	53										
ZFT 3205-6	Z						1.5×2	14 000	33 600	689	78										
PFT 3205-7.5	P						2.5×3	19 500	42 000	709	71										
# **SFT 3205-5**	Clearance						2.5×2	21 800	56 000	572	56										
#* **ZFT 3205-10**	Z						2.5×2	21 800	56 000	1 123	86										
SFT 3205-7.5	Clearance						2.5×3	30 900	84 000	843	71										
ZFT 3205-15	Z						2.5×3	30 900	84 000	1 652	116										

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.

2. If no seal is used with nuts PFT, SFT, ZFT, or DFT, the nut length will be shortened by the amount of dimension *M*.

3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.

4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.

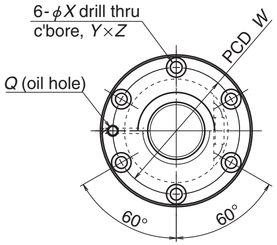
5. The basic load ratings with PFT nuts are different due to the installed spacer balls.

6. Finished shaft end FA models are available for those models marked with an asterisk (*).

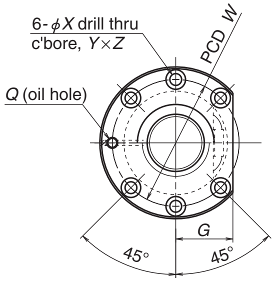
7. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

8. SRC type is recommended for markings (#).

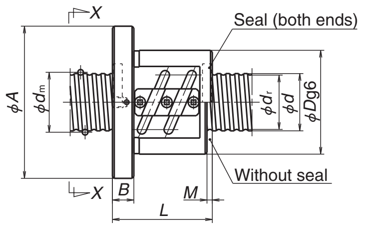
View *X-X*



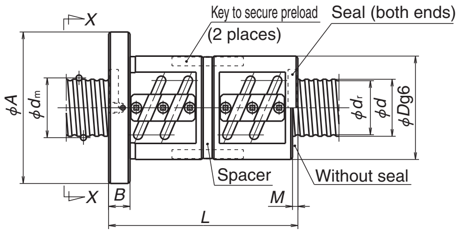
Circular shape I



Circular shape II



PFT, ZFT, SFT

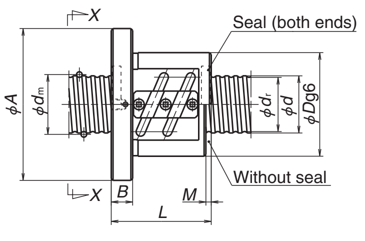


DFT

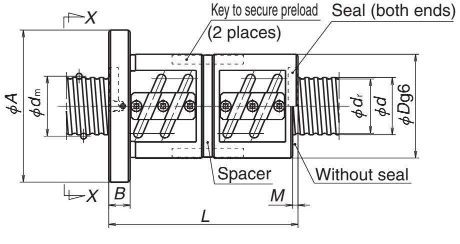
Unit: mm

Model No.	Preload	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity K (N/μm)	Ball nut dimensions										
								Dynamic C_a	Static C_{0a}		Nut total length L	Nut diameter D	Flange diameter A	Flange width B	Flange notch G	Seal dimension M	Bolt hole dimensions			Bolt hole PCD W	Oil hole Q
																	X	Y	Z		
PFT 3206-3	P	32	6	3.969	32.5	28.4	1.5×2	11 800	20 600	300	57	62	89	12	34	3	6.6	11	6.5	75	M6×1
SFT 3206-2.5	Clearance						2.5×1	16 000	34 700	302	45										
ZFT 3206-5	Z						2.5×1	16 000	34 700	592	63										
PFT 3206-5	P						2.5×2	18 300	34 700	491	63										
SFT 3206-3	Clearance						1.5×2	18 800	41 200	357	57										
ZFT 3206-6	Z						1.5×2	18 800	41 200	700	87										
SFT 3206-5	Clearance						2.5×2	29 100	69 300	585	63										
* **ZFT 3206-10**	Z						2.5×2	29 100	69 300	1 146	99										
PFT 3208-3	P		8	4.762	32.5	27.5	1.5×2	15 100	24 700	308	71	66	100	15	38	5	9	14	8.5	82	M6×1
SFT 3208-2.5	Clearance						2.5×1	20 600	40 900	307	58										
ZFT 3208-5	Z						2.5×1	20 600	40 900	602	82										
PFT 3208-5	P						2.5×2	23 500	40 900	493	82										
SFT 3208-3	Clearance						1.5×2	24 000	49 400	366	71										
ZFT 3208-6	Z						1.5×2	24 000	49 400	718	111										
SFT 3208-5	Clearance						2.5×2	37 300	81 800	594	82										
ZFT 3208-10	Z						2.5×2	37 300	81 800	1 164	130										
PFT 3210-2.5	P		10	6.35	33.0	26.4	2.5×1	18 900	27 600	266	70	74	108	15	41	7	9	14	8.5	90	M6×1
ZFT 3210-3	Z						1.5×1	19 300	32 300	381	87										
PFT 3210-3	P						1.5×2	22 100	32 300	316	87										
SFT 3210-2.5	Clearance						2.5×1	30 000	55 100	322	70										
#* **ZFT 3210-5**	Z						2.5×1	30 000	55 100	631	100										
# **PFT 3210-5**	P						2.5×2	34 300	55 100	515	100										
SFT 3210-3	Clearance						1.5×2	35 100	64 500	376	87										
ZFT 3210-6	Z						1.5×2	35 100	64 500	738	137										
SFT 3210-3.5	Clearance						3.5×1	40 100	76 600	441	80										
ZFT 3210-7	Z						3.5×1	40 100	76 600	865	120										
SFT 3210-5	Clearance						2.5×2	54 500	110 000	623	100										
#* **ZFT 3210-10**	Z						2.5×2	54 500	110 000	1 222	160										
PFT 3212-2.5	P		12	6.35	33.0	26.4	2.5×1	18 800	27 500	265	81	74	108	18	41	9	9	14	8.5	90	M6×1
ZFT 3212-3	Z						1.5×1	19 300	32 200	380	97										
PFT 3212-3	P						1.5×2	22 000	32 200	315	97										
SFT 3212-2.5	Clearance						2.5×1	29 900	55 000	320	81										
ZFT 3212-5	Z						2.5×1	29 900	55 000	628	117										
SFT 3212-3	Clearance						1.5×2	35 000	64 400	375	97										
ZFT 3212-6	Z						1.5×2	35 000	64 400	735	157										

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
2. If no seal is used with nuts PFT, SFT, ZFT, or DFT, the nut length will be shortened by the amount of dimension *M*.
3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.
4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
5. The basic load ratings with PFT nuts are different due to the installed spacer balls.
6. Finished shaft end FA models are available for those models marked with an asterisk (*).
7. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.
8. SRC type is recommended for markings (#).

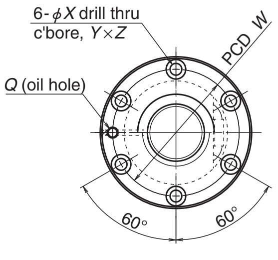


PFT, ZFT, SFT

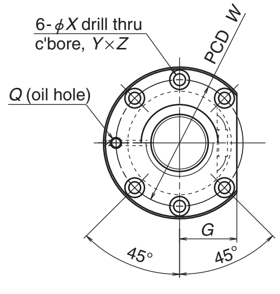


DFT

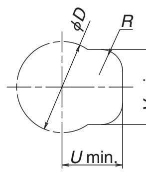
View X-X



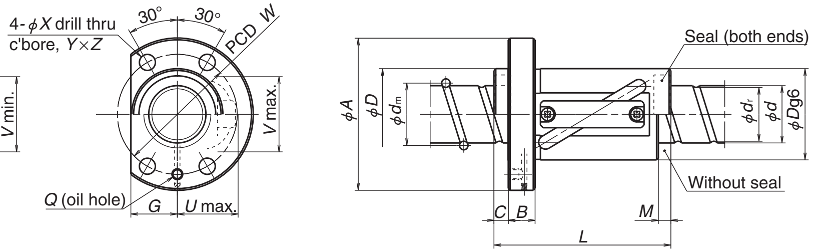
Circular shape I



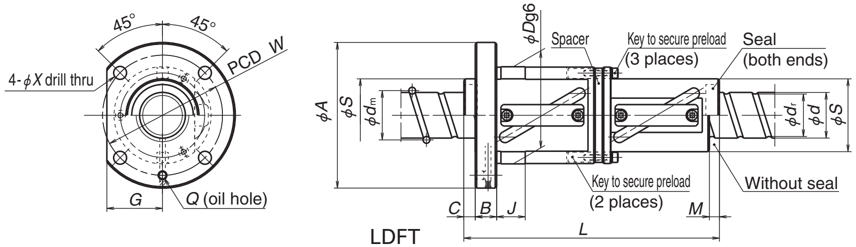
Circular shape II



Housing hole
and its clearance



LPFT, LSFT



LDFT

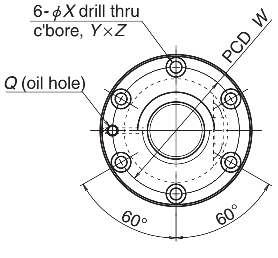
Unit: mm

Model No.	Preload	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load ratings (N) Dynamic C_a	Static C_{0a}	Axial rigidity K (N/μm)	Nut total length L
LPFT 3220-2.5	P	32	20	4.762	33.25	28.3	2.5×1	13 000	20 900	255	99
LPFT 3220-3	P						1.5×2	15 300	25 100	301	119
LSFT 3220-2.5	Clearance						2.5×1	20 700	41 900	307	99
LDFT 3220-2.5	D						2.5×1	20 700	41 900	603	179
LSFT 3220-3	Clearance						1.5×2	24 200	50 200	366	119
LDFT 3220-3	D						1.5×2	24 200	50 200	717	219
* **LPFT 3225-2.5**	P		25	4.762	33.25	28.3	2.5×1	12 900	21 100	256	117
LPFT 3225-3	P						1.5×2	15 100	24 900	295	142
LSFT 3225-2.5	Clearance						2.5×1	20 400	42 200	304	117
LDFT 3225-2.5	D						2.5×1	20 400	42 200	597	218
LSFT 3225-3	Clearance						1.5×2	23 900	49 700	358	142
LDFT 3225-3	D						1.5×2	23 900	49 700	702	268
* **LPFT 3232-1.5**	P		32	4.762	33.25	28.3	1.5×1	10 100	16 800	195	109
LSFT 3232-1.5	Clearance							13 300	25 200	184	109
LDFT 3232-1.5	D							13 300	25 200	361	205
ZFT 3605-5	Z	36	5	3.175	36.5	33.2	2.5×1	12 600	31 600	637	59
PFT 3605-5	P						2.5×2	14 400	31 600	529	59
PFT 3605-7.5	P						2.5×3	20 400	47 500	779	74
SFT 3605-5	Clearance						2.5×2	22 900	63 300	630	59
ZFT 3605-10	Z						2.5×2	22 900	63 300	1 235	89
SFT 3605-7.5	Clearance						2.5×3	32 400	94 900	926	74
ZFT 3605-15	Z						2.5×3	32 400	94 900	1 817	119

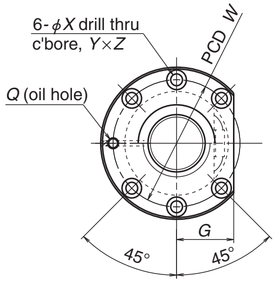
Model No.	Ball nut dimensions: Nut diameter D	S	Flange diameter A	Flange width B	Flange notch G	Projecting tube dimensions U	V	R	Seal dimensions M	C	Diameter g6 J	Bolt hole dimensions X	Y	Z	Bolt hole PCD W	Oil hole Q
LPFT 3220-2.5	51	—	85	15	26	34	42	12	7	8	—	9	—	—	67	M6×1
LPFT 3220-3	51	—	85		26	34	42	12			—				67	
LSFT 3220-2.5	51	—	85		26	34	42	12			—				67	
LDFT 3220-2.5	68	51	102		39	—	—	—			20				84	
LSFT 3220-3	51	—	85		26	34	42	12			—				67	
LDFT 3220-3	68	51	102		39	—	—	—			20				84	
* **LPFT 3225-2.5**	51	—	85	15	26	34	42	12	10	10	—	9	—	—	67	M6×1
LPFT 3225-3	51	—	85		26	34	42	12			—				67	
LSFT 3225-2.5	51	—	85		26	34	42	12			—				67	
LDFT 3225-2.5	68	51	102		39	—	—	—			20				84	
LSFT 3225-3	51	—	85		26	34	42	12			—				67	
LDFT 3225-3	68	51	102		39	—	—	—			20				84	
* **LPFT 3232-1.5**	51	—	85	15	26	34	42	12	13	12	—	9	—	—	67	M6×1
LSFT 3232-1.5	51	—	85		26	34	42	12			—				67	
LDFT 3232-1.5	68	51	102		39	—	—	—			20				84	
ZFT 3605-5	65	—	100	15	38	—	—	—	3	—	—	9	14	8.5	82	M6×1
PFT 3605-5																
PFT 3605-7.5																
SFT 3605-5																
ZFT 3605-10																
SFT 3605-7.5																
ZFT 3605-15																

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
2. If no seal is used with nuts PFT, ZFT, or SFT, the nut length will be shortened by the amount of dimension *M*.
3. If no seal is used with nuts LSFT or LDFT, the nut length will be shortened by the amount of dimension *M* and *C*.
4. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.
5. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
6. The basic load ratings with PFT and LPFT nuts are different due to the installed spacer balls.
7. Finished shaft end FA models and standard SA models are available for those models marked with an asterisk (*).
8. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

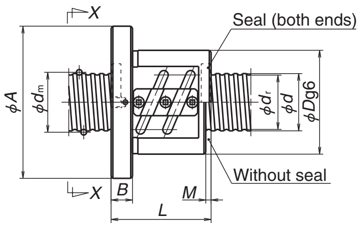
View *X-X*



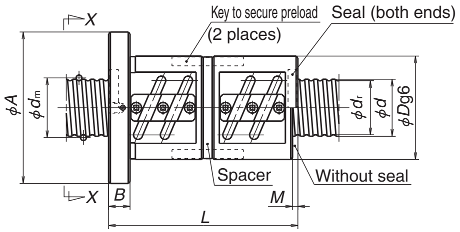
Circular shape Ⅰ



Circular shape Ⅱ



PFT, ZFT, SFT



DFT

Unit: mm

Model No.	Preload	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial rigidity	Ball nut dimensions										
							Turns × Circuits	Dynamic	Static	K	Nut total length	Nut diameter	Flange diameter	Flange width	Flange notch	Seal dimension	Bolt hole dimensions			Bolt hole PCD	Oil hole
		d	l	D_w	d_m	d_r		C_a	C_{0a}	(N/μm)	L	D	A	B	G	M	X	Y	Z	W	Q
ZFT 3606-5	Z	36	6	3.969	36.5	32.4	2.5×1	17 200	39 200	656	66	65	100	15	38	3	9	14	8.5	82	M6×1
PFT 3606-5	P						2.5×2	19 700	39 200	545	66										
PFT 3606-7.5	P						2.5×3	27 900	58 800	802	84										
SFT 3606-5	Clearance						2.5×2	31 300	78 400	648	66										
ZFT 3606-10	Z						2.5×2	31 300	78 400	1 271	102										
SFT 3606-7.5	Clearance						2.5×3	44 400	118 000	954	84										
ZFT 3606-15	Z						2.5×3	44 400	118 000	1 872	138										
PFT 3610-2.5	P		10	6.35	37.0	30.4	2.5×1	20 100	30 500	290	73	75	120	18	45	7	11	17.5	11	98	M6×1
ZFT 3610-3	Z						1.5×1	20 600	36 600	422	90										
PFT 3610-3	P						1.5×2	23 600	36 600	342	90										
SFT 3610-2.5	Clearance						2.5×1	32 000	61 100	350	73										
* **ZFT 3610-5**	Z						2.5×1	32 000	61 100	687	103										
PFT 3610-5	P						2.5×2	36 600	61 100	562	103										
SFT 3610-3	Clearance						1.5×2	37 400	73 300	417	90										
ZFT 3610-6	Z						1.5×2	37 400	73 300	817	140										
PFT 3610-7.5	P						2.5×3	51 800	91 600	826	133										
SFT 3610-5	Clearance						2.5×2	58 000	122 000	678	103										
ZFT 3610-10	Z						2.5×2	58 000	122 000	1 329	163										
SFT 3610-7.5	Clearance						2.5×3	82 200	183 000	998	133										
PFT 4005-3	P	40	5	3.175	40.5	37.2	1.5×2	9 700	21 200	354	56	67	101	15	39	3	9	14	8.5	83	Rc1/8
SFT 4005-2.5	Clearance						2.5×1	13 200	35 300	354	44										
# **ZFT 4005-5**	Z						2.5×1	13 200	35 300	695	59										
# **PFT 4005-5**	P						2.5×2	15 100	35 300	577	59										
SFT 4005-3	Clearance						1.5×2	15 400	42 300	421	56										
ZFT 4005-6	Z						1.5×2	15 400	42 300	826	81										
PFT 4005-7.5	P						2.5×3	21 300	52 900	848	74										
SFT 4005-5	Clearance						2.5×2	23 900	70 500	685	59										
#* **ZFT 4005-10**	Z						2.5×2	23 900	70 500	1 344	89										
SFT 4005-7.5	Clearance						2.5×3	33 900	106 000	1 009	74										
ZFT 4005-15	Z						2.5×3	33 900	106 000	1 979	119										
ZFT 4006-5	Z		6	3.969	40.5	36.4	2.5×1	18 000	43 800	715	66	70	104	15	40	3	9	14	8.5	86	Rc1/8
PFT 4006-5	P						2.5×2	20 500	43 800	592	66										
SFT 4006-3	Clearance						1.5×2	21 000	52 500	433	60										
ZFT 4006-6	Z						1.5×2	21 000	52 500	850	90										
PFT 4006-7.5	P						2.5×3	29 100	65 600	872	84										
SFT 4006-5	Clearance						2.5×2	32 600	87 500	705	66										
ZFT 4006-10	Z						2.5×2	32 600	87 500	1 383	102										
SFT 4006-7.5	Clearance						2.5×3	46 200	131 000	1 038	84										
ZFT 4006-15	Z						2.5×3	46 200	131 000	2 036	138										

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.

2. If no seal is used with nuts PFT, SFT, ZFT, or DFT, the nut length will be shortened by the amount of dimension *M*.

3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.

4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.

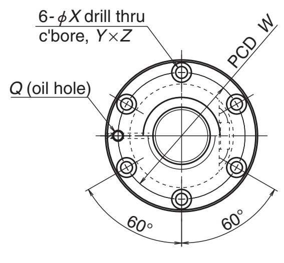
5. The basic load ratings with PFT nuts are different due to the installed spacer balls.

6. Finished shaft end FA models are available for those models marked with an asterisk (*).

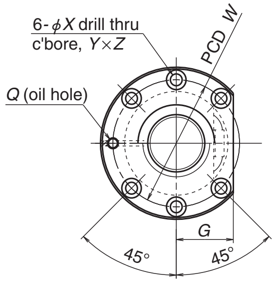
7. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

8. SRC type is recommended for markings (#).

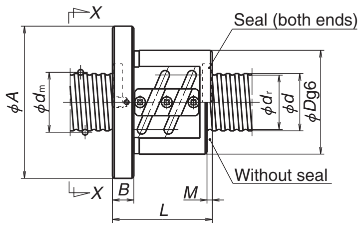
View *X-X*



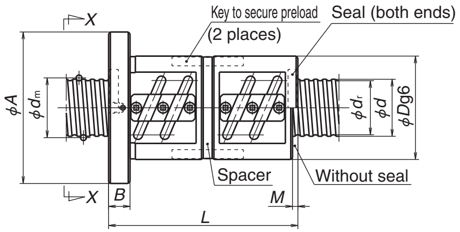
Circular shape Ⅰ



Circular shape Ⅱ



PFT, ZFT, SFT



DFT

Unit: mm

	Model No.	Preload	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity	Ball nut dimensions										
									Dynamic	Static		Nut total length	Nut diameter	Flange diameter	Flange width	Flange notch	Seal dimension	Bolt hole dimensions			Bolt hole PCD	Oil hole
			d	*l*	D_w	d_m	d_r		C_a	C_{0a}	*K* (N/μm)	*L*	*D*	*A*	*B*	*G*	*M*	*X*	*Y*	*Z*	*W*	*Q*
	PFT 4008-3	P	40	8	4.762	40.5	35.5	1.5×2	16 700	31 200	370	71	74	108	15	41	5	9	14	8.5	90	Rc1/8
	SFT 4008-2.5	Clearance						2.5×1	22 700	51 500	368	58										
	ZFT 4008-5	Z						2.5×1	22 700	51 500	721	82										
	PFT 4008-5	P						2.5×2	25 900	51 500	598	82										
	SFT 4008-3	Clearance						1.5×2	26 500	62 500	440	71										
	ZFT 4008-6	Z						1.5×2	26 500	62 500	863	111										
	SFT 4008-5	Clearance						2.5×2	41 100	103 000	711	82										
	ZFT 4008-10	Z						2.5×2	41 100	103 000	1 394	130										
	PFT 4010-2.5	P		10	6.35	41	34.4	2.5×1	21 300	34 200	322	73	82	124	18	47	7	11	17.5	11	102	Rc1/8
	PFT 4010-3	P						1.5×2	24 900	41 000	383	90										
	SFT 4010-2.5	Clearance						2.5×1	33 700	68 300	383	73										
	ZFT 4010-5	Z						2.5×1	33 700	68 300	751	103										
#	**PFT 4010-5**	P						2.5×2	38 600	68 300	623	103										
	SFT 4010-3	Clearance						1.5×2	39 500	82 000	456	90										
	ZFT 4010-6	Z						1.5×2	39 500	82 000	894	140										
	ZFT 4010-7	Z						3.5×1	45 100	97 100	1 045	123										
	SFT 4010-3.5	Clearance						3.5×1	45 100	97 100	533	83										
	PFT 4010-7	P						3.5×2	51 500	97 100	859	123										
#	**SFT 4010-5**	Clearance						2.5×2	61 200	137 000	741	103										
#*	**ZFT 4010-10**	Z						2.5×2	61 200	137 000	1 454	163										
	SFT 4010-7	Clearance						3.5×2	81 800	194 000	1 032	123										
	PFT 4012-2.5	P		12	7.144	41.5	34.1	2.5×1	24 900	38 600	323	81	86	128	18	48	9	11	17.5	11	106	Rc1/8
	SFT 4012-2.5	Clearance						2.5×1	39 500	77 200	390	81										
	ZFT 4012-5	Z						2.5×1	39 500	77 200	766	117										
#	**PFT 4012-5**	P						2.5×2	45 200	77 200	626	117										
	PFT 4012-7.5	P						2.5×3	64 000	116 000	921	153										
#	**SFT 4012-5**	Clearance						2.5×2	71 700	154 000	756	117										
#*	**ZFT 4012-10**	Z						2.5×2	71 700	154 000	1 482	189										
	SFT 4012-7.5	Clearance						2.5×3	102 000	232 000	1 114	153										
	ZFT 4016-3	Z		16	7.144	41.5	34.1	1.5×1	25 400	46 200	468	118	86	128	22	48	14	11	17.5	11	106	Rc1/8
	SFT 4016-2.5	Clearance						2.5×1	39 300	77 000	388	102										
	ZFT 4016-5	Z						2.5×1	39 300	77 000	760	150										
	SFT 4016-3	Clearance						1.5×2	46 000	92 400	461	118										
	ZFT 4016-6	Z						1.5×2	46 000	92 400	905	182										

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.

2. If no seal is used with nuts PFT, SFT, ZFT, or DFT, the nut length will be shortened by the amount of dimension *M*.

3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.

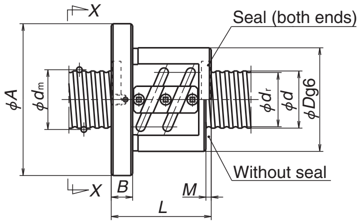
4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.

5. The basic load ratings with PFT nuts are different due to the installed spacer balls.

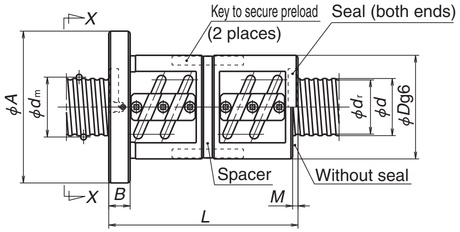
6. Finished shaft end FA models are available for those models marked with an asterisk (*).

7. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

8. SRC type is recommended for markings (#).

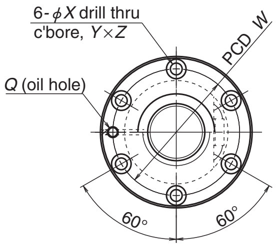


ZFT, SFT

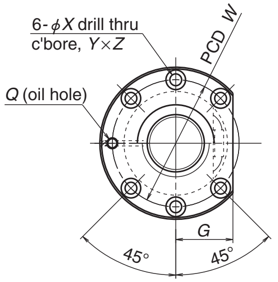


DFT

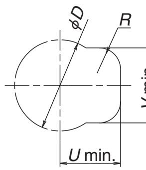
View *X*-*X*



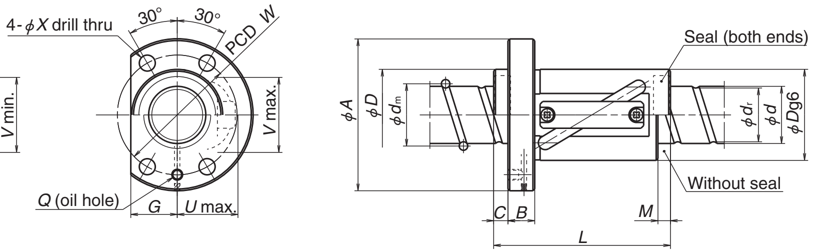
Circular shape I



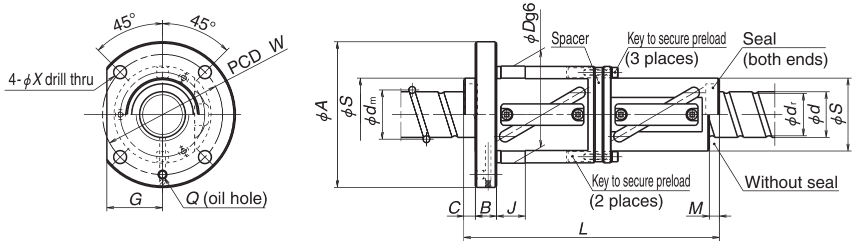
Circular shape II



Housing hole
and its clearance



LPFT, LSFT



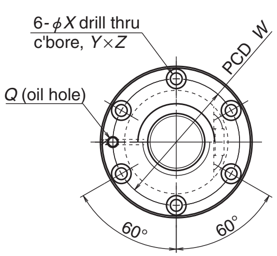
LDFT

Unit: mm

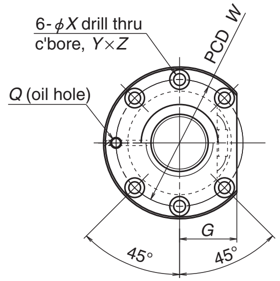
	Model No.	Preload	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial rigidity	Nut total length	Ball nut dimensions															
													Nut diameter		Flange diameter	Flange width	Flange notch	Projecting tube dimensions			Seal dimensions		Diameter g6	Bolt hole dimensions			Bolt hole PCD	Oil hole
			d	*l*	D_w	d_m	d_r	Turns × Circuits	Dynamic C_a	Static C_{0a}	*K* (N/μm)	*L*	*D*	*S*	*A*	*B*	*G*	*U*	*V*	*R*	*M*	*C*	*J*	*X*	*Y*	*Z*	*W*	*Q*
	LPFT 4025-2.5	P	40	25	6.35	41.75	35.1	2.5×1	21 500	35 100	324	123	64	—	106	18	33	42	52	15	10	10	—	11	—	—	84	Rc1/8
	LPFT 4025-3	P						1.5×2	25 100	41 800	375	148	64	—	106		33	42	52	15			—				84	
	LSFT 4025-2.5	Clearance						2.5×1	34 100	70 100	385	123	64	—	106		33	42	52	15			—				84	
	LDFT 4025-2.5	D						2.5×1	34 100	70 100	755	223	84	64	126		48	—	—	—			22				104	
	LSFT 4025-3	Clearance						1.5×2	39 900	83 600	456	148	64	—	106		33	42	52	15			—				84	
	LDFT 4025-3	D						1.5×2	39 900	83 600	894	273	84	64	126		48	—	—	—			22				104	
	LPFT 4032-2.5	P		32	6.35	41.75	35.1	2.5×1	21 200	35 300	316	146	64	—	106	18	33	42	52	15	13	12	—	11	—	—	84	Rc1/8
	LSFT 4032-2.5	Clearance							33 600	70 700	381	146	64	—	106		33	42	52	15			—				84	
	LDFT 4032-2.5	D							33 600	70 700	747	274	84	64	126		48	—	—	—			22				104	
	LPFT 4040-1.5	P		40	6.35	41.75	35.1	1.5×1	13 400	21 000	191	133	64	—	106	18	33	42	52	15	16	14	—	11	—	—	84	Rc1/8
	LSFT 4040-1.5	Clearance							21 200	42 000	227	133	64	—	106		33	42	52	15			—				84	
	LDFT 4040-1.5	D							21 200	42 000	446	253	84	64	126		48	—	—	—			22				104	
	ZFT 4510-5	Z	45	10	6.35	46.0	39.4	2.5×1	36 300	78 500	841	103	88	—	132	18	50	—	—	—	7	—	—	11	17.5	11	110	Rc1/8
	PFT 4510-7	P						3.5×2	55 400	109 000	947	123																
	PFT 4510-7.5	P						2.5×3	58 800	118 000	1 015	133																
#	**SFT 4510-5**	Clearance						2.5×2	65 800	157 000	830	103																
#	**ZFT 4510-10**	Z						2.5×2	65 800	157 000	1 627	163																
	SFT 4510-7	Clearance						3.5×2	87 900	218 000	1 136	123																
	SFT 4510-7.5	Clearance						2.5×3	93 300	235 000	1 221	133																
	DFT 4510-7.5	D						2.5×3	93 300	235 000	2 395	253																
	SFT 4512-2.5	Clearance		12	7.144	46.5	39.1	2.5×1	41 600	88 200	432	83	90	—	132	18	50	—	—	—	8	—	—	11	17.5	11	110	Rc1/8
	ZFT 4512-5	Z						2.5×1	41 600	88 200	848	119																
#	**SFT 4512-5**	Clearance						2.5×2	75 600	176 000	838	119																
#	**ZFT 4512-10**	Z						2.5×2	75 600	176 000	1 643	191																

Notes:
1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
2. If no seal is used with nuts PFT, ZFT, or SFT, the nut length will be shortened by dimension *M*.
3. If no seal is used with nuts LSFT or LDFT, the nut length will be shortened by the amount of dimension *M* and *C*.
4. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.
5. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
6. The basic load ratings with PFT and LPFT nuts are different due to the installed spacer balls.
7. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.
8. SRC type is recommended for markings (#).

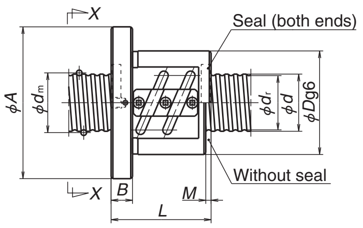
View X-X



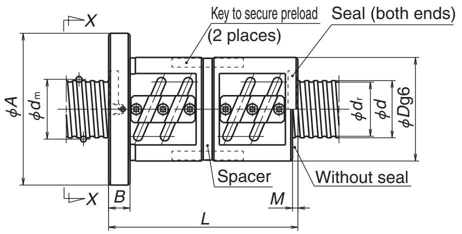
Circular shape Ⅰ



Circular shape Ⅱ



ZFT, SFT

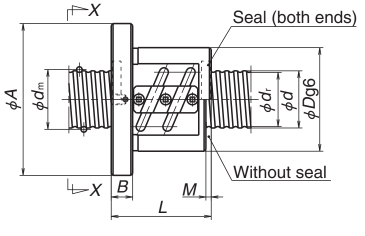


DFT

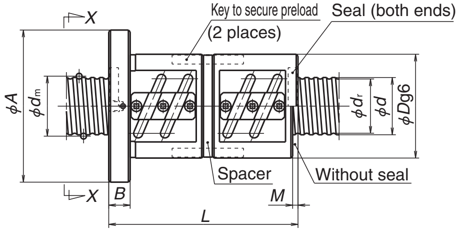
Unit: mm

Model No.	Preload	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial rigidity	Ball nut dimensions										
							Turns × Circuits	Dynamic	Static		Nut total length	Nut diameter	Flange diameter	Flange width	Flange notch	Seal dimension	Bolt hole dimensions			Bolt hole PCD	Oil hole
		d	l	D_w	d_m	d_r		C_a	C_{0a}	K (N/μm)	L	D	A	B	G	M	X	Y	Z	W	Q
SFT 5005-3	Clearance	50	5	3.175	50.5	47.2	1.5×2	16 800	52 500	499	58	80	114	15	43	3	9	14	8.5	96	Rc1/8
ZFT 5005-6	Z						1.5×2	16 800	52 500	978	83										
SFT 5005-4.5	Clearance						1.5×3	23 900	78 800	735	68										
ZFT 5005-9	Z						1.5×3	23 900	78 800	1 442	103										
SFT 5006-3	Clearance		6	3.969	50.5	46.4	1.5×2	23 000	66 100	519	62	84	118	15	45	3	9	14	8.5	100	Rc1/8
ZFT 5006-6	Z						1.5×2	23 000	66 100	1 017	92										
PFT 5006-7.5	P						2.5×3	31 900	82 700	1 045	86										
SFT 5006-5	Clearance						2.5×2	35 700	110 000	844	68										
ZFT 5006-10	Z						2.5×2	35 700	110 000	1 656	104										
SFT 5006-7.5	Clearance						2.5×3	50 700	165 000	1 243	86										
ZFT 5006-15	Z						2.5×3	50 700	165 000	2 438	140										
SFT 5008-3	Clearance		8	4.762	50.5	45.5	1.5×2	29 500	78 900	530	74	87	129	18	49	5	11	17.5	11	107	Rc1/8
ZFT 5008-6	Z						1.5×2	29 500	78 900	1 039	114										
SFT 5008-5	Clearance						2.5×2	45 700	131 000	859	85										
ZFT 5008-10	Z						2.5×2	45 700	131 000	1 685	133										
SFT 5008-7.5	Clearance						2.5×3	64 800	196 000	1 265	109										
ZFT 5008-15	Z						2.5×3	64 800	196 000	2 481	181										
SFT 5010-2.5	Clearance		10	6.35	51.0	44.4	2.5×1	37 500	87 200	464	73	93	135	18	51	7	11	17.5	11	113	Rc1/8
ZFT 5010-5	Z						2.5×1	37 500	87 200	909	103										
SFT 5010-3	Clearance						1.5×2	43 900	102 000	544	90										
ZFT 5010-6	Z						1.5×2	43 900	102 000	1 067	140										
ZFT 5010-7	Z						3.5×1	50 100	122 000	1 251	123										
PFT 5010-7.5	P						2.5×3	60 800	131 000	1 099	133										
# **SFT 5010-5**	Clearance						2.5×2	68 100	174 000	898	103										
#* **ZFT 5010-10**	Z						2.5×2	68 100	174 000	1 761	163										
SFT 5010-7.5	Clearance						2.5×3	96 500	262 000	1 321	133										
DFT 5010-7.5	D						2.5×3	96 500	262 000	2 592	253										
SFT 5012-2.5	Clearance		12	7.938	51.5	43.2	2.5×1	50 400	109 000	478	87	100	146	22	55	8	14	20	13	122	Rc1/8
ZFT 5012-5	Z						2.5×1	50 400	109 000	937	123										
# **SFT 5012-5**	Clearance						2.5×2	91 500	218 000	926	123										
# **ZFT 5012-10**	Z						2.5×2	91 500	218 000	1 815	195										
SFT 5016-2.5	Clearance		16	7.938	51.5	43.2	2.5×1	50 300	109 000	476	104	100	146	22	55	14	14	20	13	122	Rc1/8
ZFT 5016-5	Z						2.5×1	50 300	109 000	933	152										
PFT 5016-7.5	P						2.5×3	81 400	163 000	1 125	200										
SFT 5016-5	Clearance						2.5×2	91 200	218 000	921	152										
ZFT 5016-10	Z						2.5×2	91 200	218 000	1 807	248										
SFT 5016-7.5	Clearance						2.5×3	129 000	326 000	1 355	200										
ZFT 5020-3	Z		20	7.938	51.5	43.2	1.5×1	32 300	63 800	563	147	100	146	28	55	17	14	20	13	122	Rc1/8
SFT 5020-2.5	Clearance						2.5×1	50 100	108 000	473	127										
ZFT 5020-5	Z						2.5×1	50 100	108 000	928	187										
SFT 5020-3	Clearance						1.5×2	58 600	128 000	556	147										
ZFT 5020-6	Z						1.5×2	58 600	128 000	1 090	227										

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
2. If no seal is used with nuts ZFT, SFT, or DFT, the nut length will be shortened by dimension *M*.
3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.
4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
5. Standard finished shaft end SA models are available for those models marked with an asterisk (*).
6. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.
7. The basic load ratings with PFT nuts are different due to the installed spacer balls.
8. SRC type is recommended for markings (#).

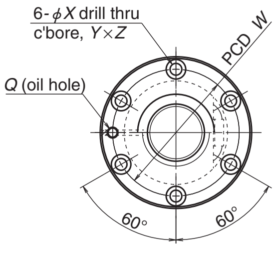


ZFT, SFT

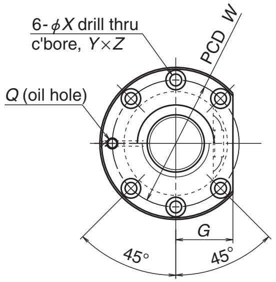


DFT

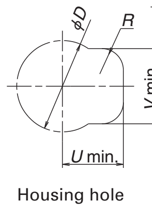
View *X*-*X*



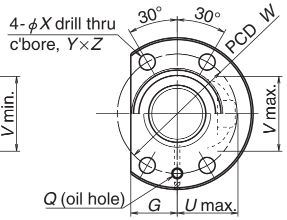
Circular shape I

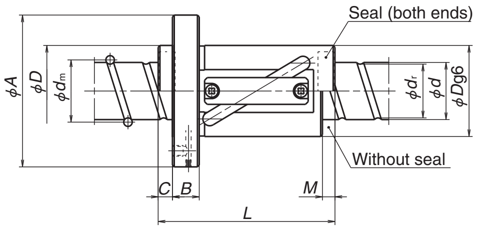


Circular shape II

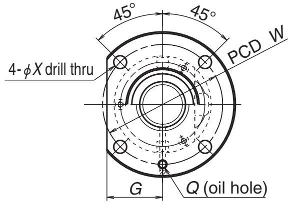


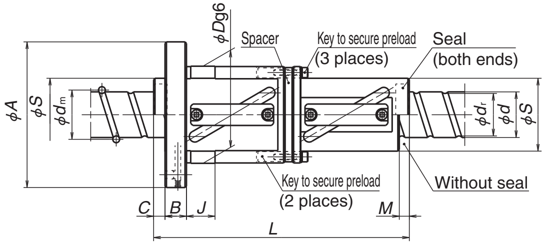
Housing hole and its clearance





LPFT, LSFT





LDFT

Unit: mm

Model No.	Preload	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial rigidity	Nut total length	Ball nut dimensions															
							Turns × Circuits	Dynamic	Static			Nut diameter		Flange diameter	Flange width	Flange notch	Projecting tube dimensions			Seal dimensions		Diameter g6	Bolt hole dimensions			Bolt hole PCD	Oil hole
		d	l	D_w	d_m	d_r		C_a	C_{0a}	K (N/μm)	L	D	S	A	B	G	U	V	R	M	C	J	X	Y	Z	W	Q
LPFT 5025-2.5	P	50	25	7.938	52.25	44	2.5×1	32 300	55 100	403	129	80	—	126	22	41	52	64	19	11	11	—	14	—	—	102	Rc1/8
LPFT 5025-3	P						1.5×2	37 800	65 700	468	154	80	—	126		41	52	64	19			—				102	
LSFT 5025-2.5	Clearance						2.5×1	51 300	110 000	480	129	80	—	126		41	52	64	19			—				102	
ZFT 5025-5	Z						2.5×1	51 300	110 000	941	204	106	80	152		56	—	—	—			25				128	
LSFT 5025-3	Clearance						1.5×2	60 100	131 000	569	154	80	—	126		41	52	64	19			—				102	
LDFT 5025-3	D						1.5×2	60 100	131 000	1 116	279	106	80	152		56	—	—	—			25				128	
LPFT 5032-2.5	P		32	7.938	52.25	44	2.5×1	32 000	54 700	397	151	80	—	126	22	41	52	64	19	14	12	—	14	—	—	102	Rc1/8
LPFT 5032-3	P						1.5×2	37 500	65 300	461	183	80	—	126		41	52	64	19			—				102	
LSFT 5032-2.5	Clearance						2.5×1	50 900	109 000	473	151	80	—	126		41	52	64	19			—				102	
LDFT 5032-2.5	D						2.5×1	50 900	109 000	928	279	106	80	152		56	—	—	—			25				128	
LSFT 5032-3	Clearance						1.5×2	59 500	131 000	560	183	80	—	126		41	52	64	19			—				102	
LDFT 5032-3	D						1.5×2	59 500	131 000	1 099	343	106	80	152		56	—	—	—			25				128	
LPFT 5040-2.5	P		40	7.938	52.25	44	2.5×1	31 600	55 200	389	178	80	—	126	22	41	52	64	19	17	14	—	14	—	—	102	Rc1/8
LSFT 5040-2.5	Clearance							50 200	110 000	469	178	80	—	126		41	52	64	19			—				102	
LDFT 5040-2.5	D							50 200	110 000	920	338	106	80	152		56	—	—	—			25				128	
LPFT 5050-1.5	P		50	7.938	52.25	44	1.5×1	20 000	32 800	236	161	80	—	126	22	41	52	64	19	21	16	—	14	—	—	102	Rc1/8
LSFT 5050-1.5	Clearance							31 700	65 700	280	161	80	—	126		41	52	64	19			—				102	
LDFT 5050-1.5	D							31 700	65 700	549	312	106	80	152		56	—	—	—			25				128	
ZFT 5510-5	Z	55	10	6.35	56.0	49.4	2.5×1	38 700	96 000	977	103	102	—	144	18	54	—	—	—	7	—	—	11	17.5	11	122	Rc1/8
SFT 5510-5	Clearance						2.5×2	70 200	192 000	964	103																
ZFT 5510-10	Z						2.5×2	70 200	192 000	1 891	163																
SFT 5510-7.5	Clearance						2.5×3	99 500	288 000	1 419	133																
ZFT 5510-15	Z						2.5×3	99 500	288 000	2 783	223																

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.

2. If no seal is used with nuts PFT, ZFT, or SFT, the nut length will be shortened by dimension *M*.

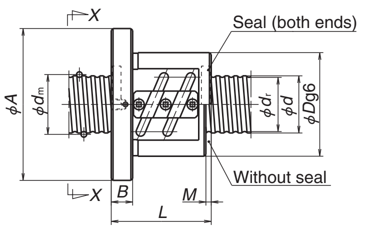
3. If no seal is used with nuts LSFT or LDFT, the nut length will be shortened by the amount of dimension *M* and *C*.

4. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.

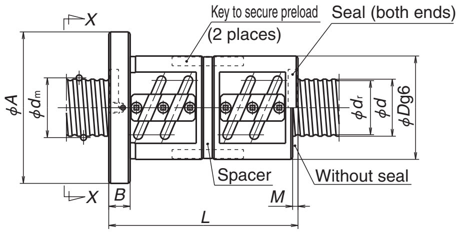
5. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.

6. The basic load ratings with LPFT nuts are different due to the installed spacer balls.

7. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

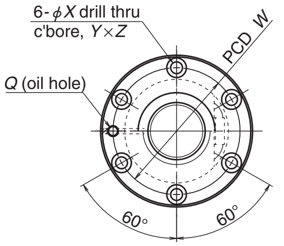


SFT, ZFT

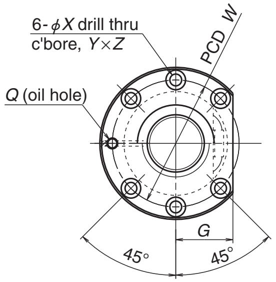


DFT

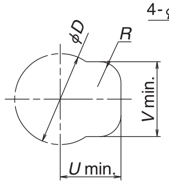
View X-X



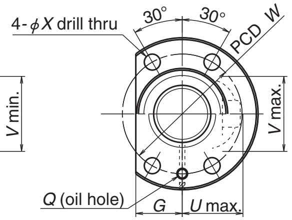
Circular shape I

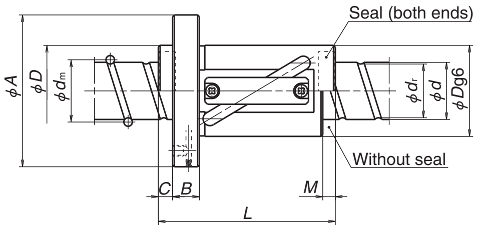


Circular shape II

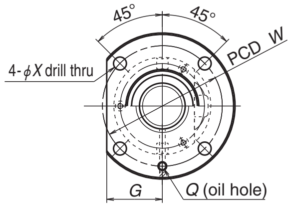


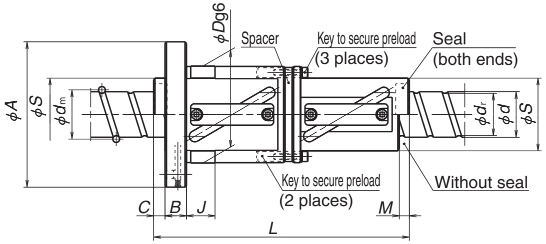
Housing hole
and its clearance





LPFT, LSFT





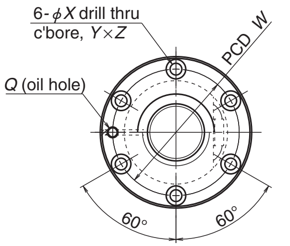
LDFT

Unit: mm

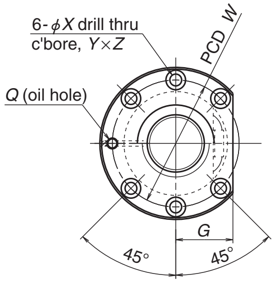
Model No.	Preload	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial rigidity	Nut total length	Ball nut dimensions															
		d	l	D_w	d_m	d_r	Turns × Circuits	Dynamic C_a	Static C_{0a}	K (N/μm)	L	Nut diameter D	S	Flange diameter A	Flange width B	Flange notch G	Projecting tube dimensions U	V	R	Seal dimensions M	C	Diameter g6 J	Bolt hole dimensions X	Y	Z	Bolt hole PCD W	Oil hole Q
SFT 6310-2.5	Clearance	63	10	6.35	64.0	57.4	2.5×1	41 100	111 000	557	77	108	—	154	22	58	—	—	—	7	—	—	14	20	13	130	Rc1/8
ZFT 6310-5	Z						2.5×1	41 100	111 000	1 091	107																
PFT 6310-7.5	P						2.5×3	66 600	166 000	1 322	137																
SFT 6310-5	Clearance						2.5×2	74 600	221 000	1 078	107																
ZFT 6310-10	Z						2.5×2	74 600	221 000	2 113	167																
SFT 6310-7.5	Clearance						2.5×3	106 000	332 000	1 588	137																
ZFT 6310-15	Z						2.5×3	106 000	332 000	3 113	227																
ZFT 6312-5	Z		12	7.938	64.5	56.2	2.5×1	55 900	136 000	1 119	123	115	—	161	22	61	—	—	—	8	—	—	14	20	13	137	Rc1/8
SFT 6312-2.5	Clearance						2.5×1	55 900	136 000	571	87																
SFT 6312-5	Clearance						2.5×2	102 000	273 000	1 107	123																
ZFT 6312-10	Z						2.5×2	102 000	273 000	2 171	195																
SFT 6316-2.5	Clearance		16	9.525	65.0	55.2	2.5×1	93 600	227 000	746	110	122	—	180	28	69	—	—	—	—	—	—	18	26	17.5	150	Rc1/8
ZFT 6316-5	Z						2.5×1	93 600	227 000	1 464	158																
PFT 6316-5	P						2.5×2	107 000	227 000	1 200	158																
SFT 6316-5	Clearance						2.5×2	170 000	454 000	1 446	158																
ZFT 6316-10	Z						2.5×2	170 000	454 000	2 835	254																
SFT 6320-2.5	Clearance		20	9.525	65.0	55.2	2.5×1	93 400	227 000	744	127	122	—	180	28	69	—	—	—	17	—	—	18	26	17.5	150	Rc1/8
ZFT 6320-5	Z						2.5×1	93 400	227 000	1 459	187																
PFT 6320-5	P						2.5×2	107 000	227 000	1 196	187																
SFT 6320-5	Clearance						2.5×2	170 000	453 000	1 442	187																
ZFT 6320-10	Z						2.5×2	170 000	453 000	2 827	307																
LPFT 6340-2.5	P		40	7.938	65.25	57	2.5×1	35 300	69 200	472	178	97	—	144	22	49	58	77	19	15	14	—	14	—	—	120	Rc1/8
LPFT 6340-3	P						1.5×2	41 300	83 100	557	218	97	—	144		49	58	77	19			—				120	
LSFT 6340-2.5	Clearance						2.5×1	56 000	138 000	567	178	97	—	144		49	58	77	19			—				120	
LDFT 6340-2.5	D						2.5×1	56 000	138 000	1 112	339	122	97	168		62	—	—	—			29				144	
LSFT 6340-3	Clearance						1.5×2	65 500	166 000	674	218	97	—	144		49	58	77	19			—				120	
LDFT 6340-3	D						1.5×2	65 500	166 000	1 323	419	122	97	168		62	—	—	—			29				144	
LPFT 6350-1.5	P		50	7.938	65.25	57	1.5×1	22 400	41 100	282	161	97	—	144	22	49	58	77	19	19	16	—	14	—	—	120	Rc1/8
LPFT 6350-2.5	P						2.5×1	34 800	69 600	471	211	97	—	144		49	58	77	19			—				120	
LSFT 6350-1.5	Clearance						1.5×1	35 600	82 200	341	161	97	—	144		49	58	77	19			—				120	
LDFT 6350-1.5	D						1.5×1	35 600	82 200	669	311	122	97	168		62	—	—	—			29				144	
LSFT 6350-2.5	Clearance						2.5×1	55 300	139 000	561	211	97	—	144		49	58	77	19			—				120	
LDFT 6350-2.5	D						2.5×1	55 300	139 000	1 099	411	122	97	168		62	—	—	—			29				144	

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
2. If no seal is used with nuts PFT, ZFT, or SFT, the nut length will be shortened by dimension *M*.
3. If no seal is used with nuts LSFT or LDFT, the nut length will be shortened by the amount of dimension *M* and *C*.
4. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.
5. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
6. The basic load ratings with LPFT nuts are different due to the installed spacer balls.
7. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

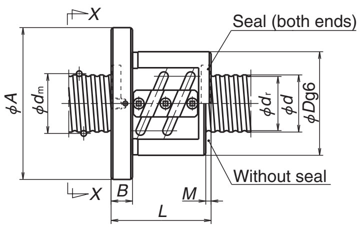
View *X*-*X*



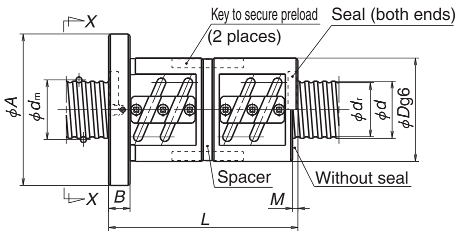
Circular shape Ⅰ



Circular shape Ⅱ



SFT



DFT

Unit: mm

Model No.	Preload	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns	Basic load ratings (N)		Axial rigidity K (N/μm)	Ball nut dimensions										
							Turns × Circuits	Dynamic C_a	Static C_{0a}		Nut total length L	Nut diameter D	Flange diameter A	Flange width B	Flange notch G	Seal dimension M	Bolt hole dimensions			Bolt hole PCD W	Oil hole Q
																	X	Y	Z		
SFT 8010-5	Clearance	80	10	6.35	81.0	74.4	2.5×2	83 200	282 000	1 309	107	130	176	22	66	7	14	20	13	152	Rc1/8
ZFT 8010-10	Z						2.5×2	83 200	282 000	2 567	167										
SFT 8010-7.5	Clearance						2.5×3	118 000	423 000	1 927	137										
ZFT 8010-15	Z						2.5×3	118 000	423 000	3 779	227										
SFT 8012-5	Clearance		12	7.938	81.5	73.2	2.5×2	113 000	350 000	1 345	123	136	182	22	68	8	14	20	13	158	Rc1/8
ZFT 8012-10	Z						2.5×2	113 000	350 000	2 637	195										
SFT 8012-7.5	Clearance						2.5×3	161 000	525 000	1 983	159										
ZFT 8012-15	Z						2.5×3	161 000	525 000	3 889	267										
SFT 8016-5	Clearance		16	9.525	82.0	72.2	2.5×2	192 000	581 000	1 764	158	143	204	28	77	10	18	26	17.5	172	Rc1/8
ZFT 8016-10	Z						2.5×2	192 000	581 000	3 459	254										
SFT 8016-7.5	Clearance						2.5×3	271 000	872 000	2 593	206										
ZFT 8016-15	Z						2.5×3	271 000	872 000	5 085	350										
SFT 8020-5	Clearance		20	9.525	82.0	72.2	2.5×2	191 000	581 000	1 758	187	143	204	28	77	17	18	26	17.5	172	Rc1/8
ZFT 8020-10	Z						2.5×2	191 000	581 000	3 447	307										
SFT 8020-7.5	Clearance						2.5×3	271 000	871 000	2 588	247										
DFT 8020-7.5	D						2.5×3	271 000	871 000	5 075	467										
SFT 10012-5	Clearance	100	12	7.938	101.5	93.2	2.5×2	124 000	441 000	1 611	129	160	220	28	82	8	18	26	17.5	188	Rc1/8
ZFT 10012-10	Z						2.5×2	124 000	441 000	3 159	201										
SFT 10012-7.5	Clearance						2.5×3	176 000	661 000	2 372	165										
ZFT 10012-15	Z						2.5×3	176 000	661 000	4 659	273										
SFT 10016-5	Clearance		16	9.525	102	92.2	2.5×2	208 000	736 000	2 109	162	170	243	32	91	10	22	32	21.5	205	Rc1/8
ZFT 10016-10	Z						2.5×2	208 000	736 000	4 136	258										
SFT 10016-7.5	Clearance						2.5×3	295 000	1 100 000	3 105	210										
ZFT 10016-15	Z						2.5×3	295 000	1 100 000	6 089	354										
SFT 10020-5	Clearance		20	9.525	102	92.2	2.5×2	208 000	735 000	2 106	191	170	243	32	91	17	22	32	21.5	205	Rc1/8
ZFT 10020-10	Z						2.5×2	208 000	735 000	4 131	311										
SFT 10020-7.5	Clearance						2.5×3	294 000	1 100 000	3 098	251										
DFT 10020-7.5	D						2.5×3	294 000	1 100 000	6 075	471										
SFT 12516-5	Clearance	125	16	9.525	127	117.2	2.5×2	231 000	918 000	2 520	170	200	290	36	109	10	26	39	25.5	243	Rc1/8
ZFT 12516-10	Z						2.5×2	231 000	918 000	4 942	266										
SFT 12516-7.5	Clearance						2.5×3	327 000	1 380 000	3 708	218										
ZFT 12516-15	Z						2.5×3	327 000	1 380 000	7 272	362										
SFT 12520-5	Clearance		20	9.525	127	117.2	2.5×2	230 000	917 000	2 515	199	200	290	36	109	12	26	39	25.5	243	Rc1/8
ZFT 12520-10	Z						2.5×2	230 000	917 000	4 931	319										
SFT 12520-7.5	Clearance						2.5×3	327 000	1 380 000	3 705	259										
DFT 12520-7.5	D						2.5×3	327 000	1 380 000	7 266	499										

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
2. If no seal is used with nuts ZFT, SFT, or DFT, the nut length will be shortened by dimension *M*.
3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.
4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
5. P-preload refers to oversize ball preload and D-preload to double-nut preload. For details, see page B5.

B-3-2.4 Deflector (Bridge) Recirculation Ball Screws

1. Features

Ball screws with deflector (bridge) recirculation systems have the smallest ball nut, making them suitable for fine lead operation.

2. Specifications

(1) Ball recirculation system

It has a small ball nut outside diameter and suits small lead ball screws. **Fig. 1** shows the structure of the deflector (bridge) recirculation system.

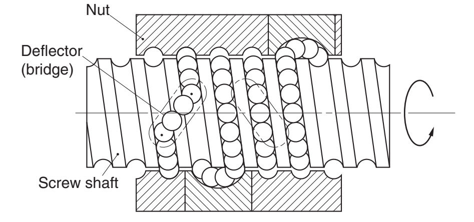


Fig. 1 Structure of deflector (bridge) recirculation system

Table 1 Accuracy grade and axial play

Accuracy grade	C0, C1, C2, C3, C5, Ct7 (Ct7 is not included in DFD)
Axial play	Z, 0 mm (preloaded); T, 0.005 mm or less S, 0.020 mm or less; N, 0.050 mm or less

(2) Accuracy grade and axial play

The available standard accuracy grades and axial play are shown in **Table 1**. Please consult NSK for other grades.

(3) Allowable *d·n* value and the criterion of maximum rotational speed

The allowable *d·n* value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below. Basic measures must be taken for the high speed ball screws.

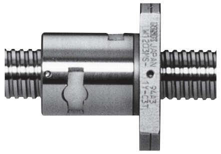
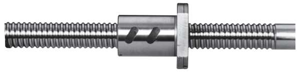
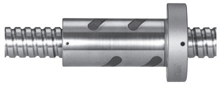
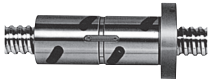
Allowable *d·n* value:
Standard specification ; 84 000 or less
High-speed specification; 100 000 or less
Standard of rotational speed : 3 000 min^{-1}

Note: Please also review the critical speed. Refer to "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Other specifications

Please consult NSK for specifications not listed in the dimension tables.

Table 2 Deflector (bridge) ball screw lineup

Nut	Shape	Flange shape	Preload
MSFD		Flanged Circular Ⅲ	Nopreload, Slight axial play
MPFD			P-preload (light preload) no spacer ball
SFD		Screw shaft diameter of 16 mm or smaller: Flanged Screw shaft diameter of 20 mm or smaller: Rectangle CircularⅠ, Ⅱ	Nopreload, Slight axial play
ZFD		Flanged Circular Ⅰ, Ⅱ	Z-preload (medium preload)
DFD		Flanged Circular Ⅰ, Ⅱ	D-preload (medium preload) (heavy preload)

3. Lineup

There are four different preloads available (Table 2). Synthetic resin that shows superb characteristics against wear is used in the recirculation deflector (bridge) for MSFD and MPFD, and has enhanced the smooth recirculation of balls.

4. Design Precautions

When designing the screw shaft end, one end of the screw must meet either one of the following conditions. If not, we cannot install the ball nut on the screw shaft.

- Cut the ball groove through to the shaft end.
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove d_r specified in the dimension tables.

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

5. Structure of model number and reference number

The following explains the codes used in model numbers and ball screw reference numbers.

◇Model number

SFD 40 08 - 4

Nut:
SFD, ZFD, DFD
MSFD, MPFD
Screw shaft diameter (mm)
Effective ball turns (Note)
Lead (mm)

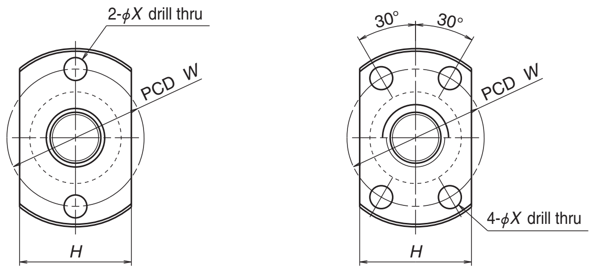
Note: In ZFD, the number here is twice the effective ball turns.

◇Reference number for ball screws

W 40 08 - Z Y - C3 Z 5**

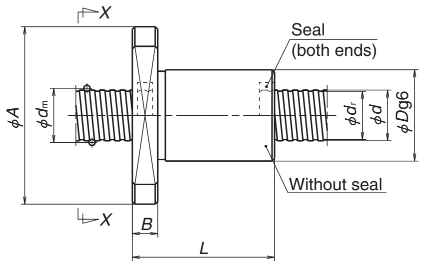
Product code
Screw shaft diameter (mm)
Effective threaded length (in 100 mm units)
NSK design serial number
Preload code:
No code, no preload;
Z, Z-preload; D, D-preload; P, P-preload (page B5)
Lead (mm)
Axial play code:
Z, T, S, N (page B20)
Accuracy grade code:
C0, C1, C2, C3, C5, C7(Ct7) (page B37 to B42)
Deflector (bridge) recirculation system

View *X*-*X*



Lead *l* = 0.5 mm

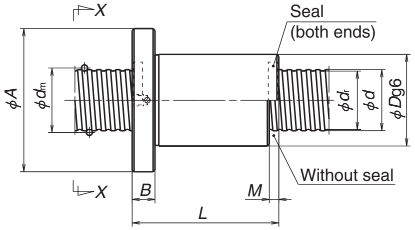
Lead *l* ≧1 mm



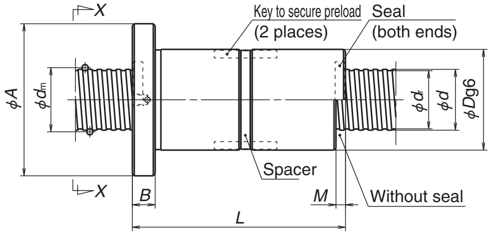
Unit: mm

Model No.	Preload	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity	Ball nut dimensions						
								Dynamic	Static		Nut total length	Nut diameter	Flange diameter	Flange width	Flange dimension	Bolt hole dimensions	Bolt hole PCD
		d	l	D_w	d_m	d_r		C_a	C_{0a}	K (N/μm)	L	D	A	B	H	X	W
MSFD 0400.5-3	Clearance	4	0.5	0.400	4.1	3.6	1×3	205	280	32	13	10	22	3	11	3.4	16
MPFD 0400.5-3	P									50							
MSFD 0401-2	Clearance		1	0.800	4.2	3.2	1×2	370	370	23	12	10	20	3	14	2.9	15
* **MPFD 0401-2**	P									36							
MSFD 0600.5-3	Clearance	6	0.5	0.400	6.1	5.6	1×3	240	430	44	13	12	24	3	13	3.4	18
MPFD 0600.5-3	P									69							
MSFD 0601-3	Clearance		1	0.800	6.2	5.2	1×3	680	920	51	15	12	24	3.5	16	3.4	18
* **MPFD 0601-3**	P									80							
MSFD 0602-3	Clearance		2	0.800	6.2	5.2	1×3	675	920	51	17	13	25	4	17	3.4	19
MPFD 0602-3	P									79							
MSFD 0800.5-3	Clearance	8	0.5	0.400	8.1	7.6	1×3	275	595	57	13	14	27	3	15	3.4	21
MPFD 0800.5-3	P									89							
MSFD 0801-3	Clearance		1	0.800	8.2	7.2	1×3	790	1 290	67	16	14	27	4	18	3.4	21
* **MPFD 0801-3**	P									104							
MSFD 0801.5-3	Clearance		1.5	1.000	8.3	7.0	1×3	1 270	1 970	79	22	15	28	4	19	3.4	22
* **MPFD 0801.5-3**	P									123							
MSFD 0802-3	Clearance		2	1.200	8.3	6.9	1×3	1 560	2 200	76	26	16	29	4	20	3.4	23
* **MPFD 0802-3**	P									119							
MSFD 1001-3	Clearance	10	1	0.800	10.2	9.2	1×3	880	1 660	81	16	16	29	4	20	3.4	23
MPFD 1001-3	P									127							
MSFD 1002-3	Clearance		2	1.200	10.3	8.9	1×3	1 800	2 970	97	28	18	35	5	22	4.5	27
* **MPFD 1002-3**	P									151							
MSFD 1002.5-3	Clearance		2.5	1.588	10.4	8.6	1×3	2 500	3 630	94	32	19	36	5	23	4.5	28
* **MPFD 1002.5-3**	P									147							
MSFD 1201-3	Clearance	12	1	0.800	12.2	11.2	1×3	940	1 980	93	16	18	31	4	22	3.4	25
MPFD 1201-3	P									145							
MSFD 1202-3	Clearance		2	1.200	12.3	10.9	1×3	1 960	3 620	114	28	20	37	5	24	4.5	29
* **MPFD 1202-3**	P									177							
MSFD 1202.5-3	Clearance		2.5	1.588	12.4	10.6	1×3	2 790	4 530	113	32	21	38	5	25	4.5	30
* **MPFD 1202.5-3**	P									176							
MSFD 1203-3	Clearance		3	2.000	12.5	10.2	1×3	3 680	5 400	111	36	22	39	5	26	4.5	31
MPFD 1203-3	P									174							
MSFD 1402-3	Clearance	14	2	1.200	14.3	12.9	1×3	2 100	4 260	129	29	22	41	6	26	5.5	32
MPFD 1402-3	P									201							
MSFD 1403-3	Clearance		3	2.000	14.5	12.2	1×3	4 010	6 480	129	37	24	43	6	28	5.5	34
MPFD 1403-3	P									201							

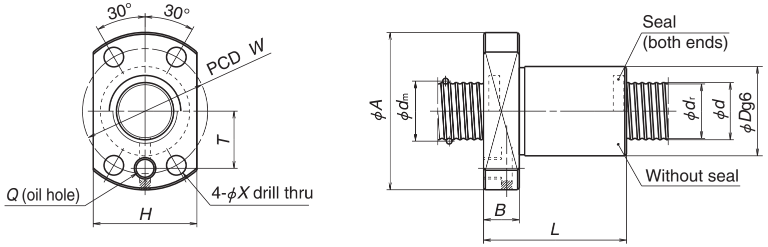
Notes: 1. If the lead is 1 mm or less and the shaft OD is 6 mm or less, seals can not be equipped (See page B68 for details on dust protection.)
2. Models with shaft OD under 14 mm do not have oil holes.
3. Right-turn screws are standard. Contact NSK for left turn screws.
4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
5. Standard finished shaft end MA models are available for those models marked with an asterisk (*).
6. P-preload refers to oversize ball preload. For details, see page B5.



SFD, ZFD

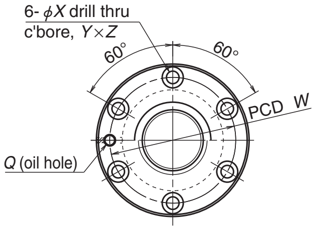


DFD

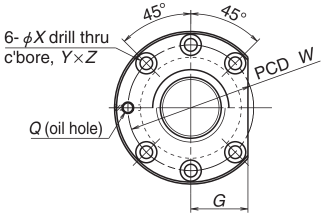


MSFD, MPFD

View X-X



Circular shape I



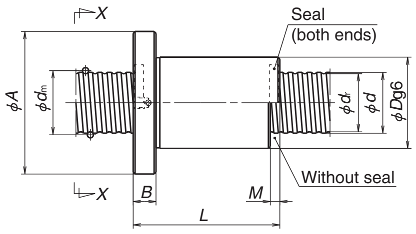
Circular shape II

Unit: mm

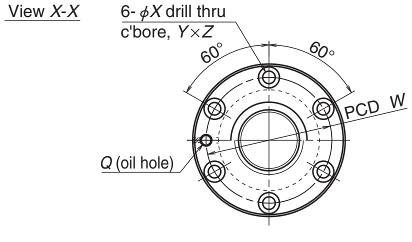
Model No.	Preload	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity K (N/μm)	Ball nut dimensions												
								Dynamic C_a	Static C_{0a}		Nut total length L	Nut diameter D	Flange diameter A	Flange width B	Flange notch		Seal dimension M	Bolt hole dimensions			Bolt hole PCD W	Oil hole position T	Oil hole Q
															G	H		X	Y	Z			
MSFD 1602-4	Clearance	16	2	1.588	16.4	14.6	1×4	4 150	8 450	194	40	25	44	10	—	29	—	5.5	—	—	35	16	M6×1
* **MPFD 1602-4**	P									302													
MSFD 1602.5-4	Clearance		2.5	1.588	16.4	14.6	1×4	4 150	8 440	194	44	25	44	10	—	29	—	5.5	—	—	35	16	M6×1
* **MPFD 1602.5-4**	P									302													
MSFD 2002-4	Clearance	20	2	1.588	20.4	18.6	1×4	4 620	10 900	237	40	30	49	10	—	34	—	5.5	—	—	40	18.5	M6×1
MPFD 2002-4	P									369													
SFD 2005-3	Clearance		5	3.175	20.75	17.4	1×3	10 100	17 400	206	46	35	58	11	22.5	—	5	5.5	9.5	5.5	46	—	M6×1
ZFD 2005-6	Z						1×3	10 100	17 400	404	66												
SFD 2005-4	Clearance						1×4	13 000	23 300	271	51												
ZFD 2005-8	Z						1×4	13 000	23 300	532	76												
SFD 2006-3	Clearance		6	3.969	21	16.9	1×3	13 100	20 500	202	52	35	58	11	22.5	—	6	5.5	9.5	5.5	46	—	M6×1
ZFD 2006-6	Z						1×3	13 100	20 500	396	76	35	58		22.5						46		
SFD 2006-4	Clearance						1×4	16 800	27 400	266	60	35	58		22.5						46		
DFD 2006-4	D						1×4	16 800	27 400	521	108	42	65		25						53		
MSFD 2502-4	Clearance	25	2	1.588	25.4	23.6	1×4	5 100	13 900	287	40	36	55	10	—	40	—	5.5	—	—	46	21.5	M6×1
MPFD 2502-4	P									447													
SFD 2505-3	Clearance		5	3.175	25.75	22.4	1×3	11 600	22 900	257	46	40	63	11	24	—	5	5.5	9.5	5.5	51	—	M6×1
* **ZFD 2505-6**	Z						1×3	11 600	22 900	503	66												
SFD 2505-4	Clearance						1×4	14 800	30 500	337	51												
ZFD 2505-8	Z						1×4	14 800	30 500	661	76												
SFD 2506-3	Clearance		6	3.969	26	21.9	1×3	15 200	27 300	254	52	40	63	11	24	—	6	5.5	9.5	5.5	51	—	M6×1
ZFD 2506-6	Z						1×3	15 200	27 300	499	76												
SFD 2506-4	Clearance						1×4	19 400	36 400	334	60												
ZFD 2506-8	Z						1×4	19 400	36 400	656	90												
ZFD 2510-4	Z		10	4.762	26.25	21.3	1×2	13 300	21 200	337	88	42	69	15	26	—	10	6.6	11	6.5	55	—	M6×1
SFD 2510-3	Clearance						1×3	18 900	31 800	253	80	42	69		26						55		
DFD 2510-3	D						1×3	18 900	31 800	497	140	47	74		28						60		

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
2. If no seal is used with nuts SFD, ZFD, or DFD, the nut length will be shortened by dimension *M*. The nut lengths of MSFD and MPFD are the same with or without seals.
3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws. Please consult NSK for MSFD and MPFD nuts.
4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for Z-preload and D-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
5. We recommend using seals if shaft diameter is 16 mm or more and an oil hole is provided.
6. Standard finished shaft end MA models are available for those models marked with an asterisk (*).
7. Z-preload refers to offset preload, P-preload to oversize ball preload, and D-preload to double-nut preload. For details, see page B5.

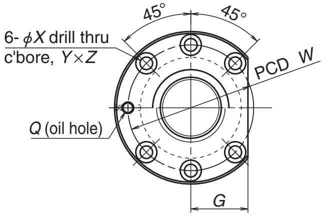
Deflector (Bridge) Recriculation



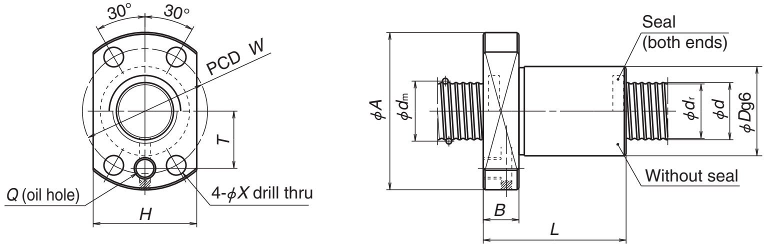
SFD, ZFD



Circular shape Ⅰ



Circular shape Ⅱ



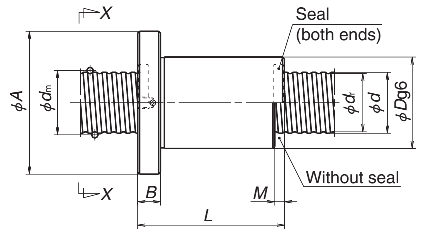
MSFD, MPFD

Unit: mm

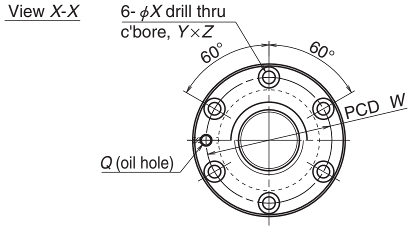
Model No.	Preload	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load ratings (N)		Axial rigidity K (N/μm)	Ball nut dimensions												
								Dynamic C_a	Static C_{0a}		Nut total length L	Nut diameter D	Flanged diameter A	Flanged width B	Flange notch		Seal dimension M	Bolt hole dimensions			Bolt hole PCD W	Oil hole position T	Oil hole Q
															G	H		X	Y	Z			
MSFD 3202-6	Clearance	32	2	1.588	32.4	30.6	1×6	8 030	27 100	521	50	42	65	10	—	46	—	6.6	—	—	54	26.5	M6×1
MPFD 3202-6	P									811													
SFD 3205-3	Clearance		5	3.175	32.75	29.4	1×3	13 100	30 500	322	47	48	75	12	29	—	5	6.6	11	6.5	61	—	M6×1
ZFD 3205-6	Z						1×3	13 100	30 500	631	67												
SFD 3205-4	Clearance						1×4	16 800	40 600	424	52												
* **ZFD 3205-8**	Z						1×4	16 800	40 600	831	77												
SFD 3205-6	Clearance						1×6	23 800	60 900	623	62												
ZFD 3205-12	Z						1×6	23 800	60 900	1 222	97												
SFD 3206-3	Clearance		6	3.969	33	28.9	1×3	17 700	37 400	328	53	48	75	12	29	—	6	6.6	11	6.5	61	—	M6×1
ZFD 3206-6	Z						1×3	17 700	37 400	643	77												
SFD 3206-4	Clearance						1×4	22 600	49 900	431	61												
ZFD 3206-8	Z						1×4	22 600	49 900	846	90												
SFD 3206-6	Clearance						1×6	32 100	74 800	635	73												
ZFD 3206-12	Z						1×6	32 100	74 800	1 245	115												
SFD 3208-3	Clearance		8	4.762	33.25	28.3	1×3	21 600	41 700	316	67	50	84	15	32	—	8	9	14	8.5	66	—	M6×1
ZFD 3208-6	Z						1×3	21 600	41 700	619	99												
SFD 3208-4	Clearance						1×4	27 700	55 600	415	76												
ZFD 3208-8	Z						1×4	27 700	55 600	815	116												
SFD 3210-3	Clearance		10	6.35	33.75	27.1	1×3	30 500	52 500	313	80	54	88	15	34	—	10	9	14	8.5	70	—	M6×1
* **ZFD 3210-6**	Z						1×3	30 500	52 500	614	120												
SFD 3210-4	Clearance						1×4	39 000	70 000	411	90												
ZFD 3210-8	Z						1×4	39 000	70 000	807	140												

Notes: 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
2. If no seal is used with nuts SFD or ZFD, the nut length will be shortened by dimension *M*. The nut lengths of MSFD and MPFD are the same with or without seals.
3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws. Please consult NSK for MSFD and MPFD nuts.
4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for Z-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
5. We recommend using seals if shaft diameter is 16 mm or more and an oil hole is provided.
6. Standard finished shaft end SS models are available for those models marked with an asterisk (*).
7. Z-preload refers to offset preload, and P-preload to oversize ball preload. For details, see page B5.

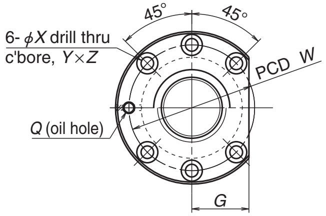
Deflector (Bridge) Recriculation



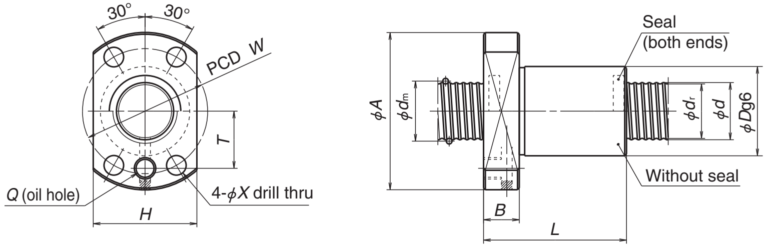
SFD, ZFD



Circular shape Ⅰ



Circular shape Ⅱ

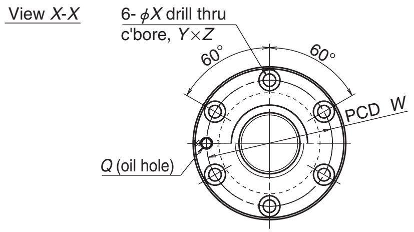


MSFD, MPFD

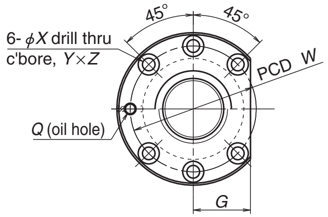
Unit: mm

Model No.	Preload	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial rigidity	Ball nut dimensions												
											Nut total length	Nut diameter	Flanged diameter	Flanged width	Flange notch		Seal dimension	Bolt hole dimensions			Bolt hole PCD	Oil hole position	Oil hole
		d	l	D_w	d_m	d_r	Turns × Circuits	Dynamic C_a	Static C_{0a}	K (N/μm)	L	D	A	B	G	H	M	X	Y	Z	W	T	Q
MSFD 4002-6	Clearance	40	2	1.588	40.4	38.6	1×6	8 720	33 900	620	50	51	74	10	—	55	—	6.6	—	—	63	31	M6×1
MPFD 4002-6	P									966													
SFD 4005-4	Clearance		5	3.175	40.75	37.4	1×4	18 700	52 200	517	55	56	90	15	34	—	5	9	14	8.5	72	—	Rc1/8
ZFD 4005-8	Z						1×4	18 700	52 200	1 013	80												
SFD 4005-6	Clearance						1×6	26 500	78 300	761	65												
ZFD 4005-12	Z						1×6	26 500	78 300	1 492	101												
SFD 4006-4	Clearance		6	3.969	41.0	36.9	1×4	25 100	63 500	522	64	56	90	15	34	—	6	9	14	8.5	72	—	Rc1/8
ZFD 4006-8	Z						1×4	25 100	63 500	1 023	93												
SFD 4006-6	Clearance						1×6	35 600	95 200	768	76												
ZFD 4006-12	Z						1×6	35 600	95 200	1 506	118												
SFD 4008-4	Clearance		8	4.762	41.25	36.3	1×4	32 000	75 000	529	76	60	94	15	36	—	8	9	14	8.5	76	—	Rc1/8
ZFD 4008-8	Z						1×4	32 000	75 000	1 038	116												
SFD 4008-6	Clearance						1×6	45 400	113 000	779	93												
ZFD 4008-12	Z						1×6	45 400	113 000	1 528	149												
SFD 4010-3	Clearance		10	6.35	41.75	35.1	1×3	35 300	69 800	394	83	62	104	18	40	—	10	11	17.5	11	82	—	Rc1/8
ZFD 4010-6	Z						1×3	35 300	69 800	773	123												
SFD 4010-4	Clearance						1×4	45 200	93 100	518	93												
ZFD 4010-8	Z						1×4	45 200	93 100	1 016	143												
SFD 5005-4	Clearance	50	5	3.175	50.75	47.4	1×4	20 700	66 700	627	55	66	100	15	38	—	5	9	14	8.5	82	—	Rc1/8
ZFD 5005-8	Z						1×4	20 700	66 700	1 230	80												
SFD 5005-6	Clearance						1×6	29 300	100 000	923	65												
ZFD 5005-12	Z						1×6	29 300	100 000	1 810	101												
SFD 5006-4	Clearance		6	3.969	51.0	46.9	1×4	27 900	81 600	636	64	66	100	15	38	—	6	9	14	8.5	82	—	Rc1/8
ZFD 5006-8	Z						1×4	27 900	81 600	1 248	93												
SFD 5006-6	Clearance						1×6	39 600	122 000	937	76												
ZFD 5006-12	Z						1×6	39 600	122 000	1 837	118												

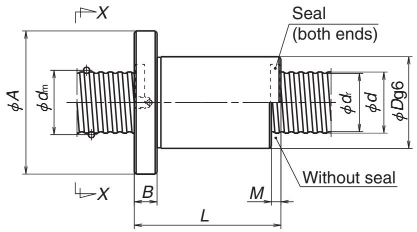
Notes:
1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
2. If no seal is used with nuts SFD or ZFD, the nut length will be shortened by dimension *M*. The nut lengths of MSFD and MPFD are the same with or without seals.
3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws. Please consult NSK for MSFD and MPFD nuts.
4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for Z-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
5. We recommend using seals if shaft diameter is 16 mm or more and an oil hole is provided.
6. Z-preload refers to offset preload, and P-preload to oversize ball preload. For details, see page B5.



Circular shape I



Circular shape II

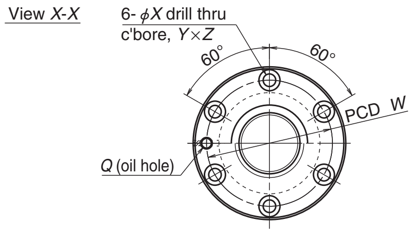


SFD, ZFD

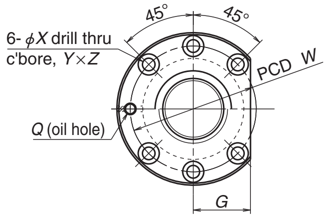
Unit: mm

Model No.	Preload	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial rigidity	Ball nut dimensions										
		d	l	D_w	d_m	d_r	Turns × Circuits	Dynamic C_a	Static C_{0a}	K (N/μm)	Nut total length L	Nut diameter D	Flanged diameter A	Flanged width B	Flange notch G	Seal dimension M	Bolt hole dimensions X	Y	Z	Bolt hole PCD W	Oil hole Q
SFD 5008-4	Clearance	50	8	4.762	51.25	46.3	1×4	35 300	94 700	635	79	70	112	18	43	8	11	17.5	11	90	Rc1/8
ZFD 5008-8	Z						1×4	35 300	94 700	1 246	119										
SFD 5008-6	Clearance						1×6	50 000	142 000	935	96										
ZFD 5008-12	Z						1×6	50 000	142 000	1 833	152										
SFD 5010-3	Clearance		10	6.35	51.75	45.1	1×3	40 200	91 500	489	83	72	114	18	44	10	11	17.5	11	92	Rc1/8
ZFD 5010-6	Z						1×3	40 200	91 500	960	123										
SFD 5010-4	Clearance						1×4	51 500	122 000	644	93										
ZFD 5010-8	Z						1×4	51 500	122 000	1 263	143										
SFD 5010-6	Clearance						1×6	72 900	183 000	947	114										
ZFD 5010-12	Z						1×6	72 900	183 000	1 858	184										
SFD 5012-3	Clearance		12	7.938	52.25	44	1×3	52 800	109 000	485	99	75	121	22	47	12	14	20	13	97	Rc1/8
ZFD 5012-6	Z						1×3	52 800	109 000	952	147										
SFD 5012-4	Clearance						1×4	67 600	145 000	639	111										
ZFD 5012-8	Z						1×4	67 600	145 000	1 252	171										
SFD 5020-3	Clearance		20	7.938	52.25	44	1×3	52 400	109 000	480	146	75	121	28	47	20	14	20	13	97	Rc1/8
ZFD 5020-6	Z							52 400	109 000	942	208										
SFD 6306-4	Clearance	63	6	3.969	64.0	59.9	1×4	30 800	104 000	772	67	80	122	18	47	6	11	17.5	11	100	Rc1/8
ZFD 6306-8	Z						1×4	30 800	104 000	1 513	96										
SFD 6306-6	Clearance						1×6	43 600	156 000	1 135	79										
ZFD 6306-12	Z						1×6	43 600	156 000	2 226	121										
SFD 6308-4	Clearance		8	4.762	64.25	59.3	1×4	39 600	124 000	787	79	82	124	18	47	8	11	17.5	11	102	Rc1/8
ZFD 6308-8	Z						1×4	39 600	124 000	1 543	119										
SFD 6308-6	Clearance						1×6	56 200	186 000	1 159	96										
ZFD 6308-12	Z						1×6	56 200	186 000	2 272	152										
SFD 6310-4	Clearance		10	6.35	64.75	58.1	1×4	58 700	162 000	810	97	85	131	22	50	10	14	20	13	107	Rc1/8
ZFD 6310-8	Z						1×4	58 700	162 000	1 588	147										
SFD 6310-6	Clearance						1×6	83 200	244 000	1 192	118										
ZFD 6310-12	Z						1×6	83 200	244 000	2 337	188										
ZFD 6312-6	Z		12	7.938	65.25	57	1×3	59 900	143 000	1 181	147	90	136	22	52	12	14	20	13	112	Rc1/8
SFD 6312-4	Clearance						1×4	76 800	191 000	793	111										
ZFD 6312-8	Z						1×4	76 800	191 000	1 555	171										
SFD 6312-6	Clearance						1×6	109 000	286 000	1 167	136										
ZFD 6312-12	Z						1×6	109 000	286 000	2 289	220										
SFD 6320-3	Clearance		20	9.525	65.75	56	1×3	98 400	231 000	766	146	95	153	28	59	20	18	26	17.5	123	Rc1/8
ZFD 6320-6	Z									1 503	228										

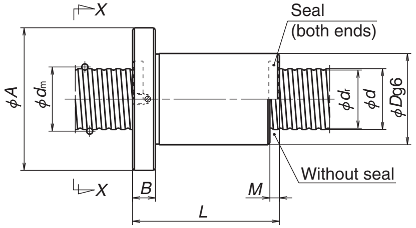
Notes:
1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
2. If no seal is used, the nut length will be shortened by dimension *M*.
3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws. Please consult NSK for MSFD and MPFD nuts.
4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for Z-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
5. We recommend using seals if shaft diameter is 16 mm or more and an oil hole is provided.
6. Z-preload refers to offset preload. For details, see page B5.



Circular shape I



Circular shape II



SFD, ZFD

Unit: mm

Model No.	Preload	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial rigidity	Ball nut dimensions										
		d	l	D_w	d_m	d_r	Turns × Circuits	Dynamic C_a	Static C_{0a}	K (N/μm)	Nut total length L	Nut diameter D	Flanged diameter A	Flanged width B	Flange notch G	Seal dimension M	Bolt hole dimensions X	Y	Z	Bolt hole PCD W	Oil hole Q
SFD 8010-4	Clearance	80	10	6.35	81.75	75.1	1×4	65 100	209 000	987	97	105	151	22	57	10	14	20	13	127	Rc1/8
ZFD 8010-8	Z						1×4	65 100	209 000	1 935	147										
SFD 8010-6	Clearance						1×6	92 200	313 000	1 452	118										
ZFD 8010-12	Z						1×6	92 200	313 000	2 848	188										
SFD 8012-4	Clearance		12	7.938	82.25	74	1×4	87 400	254 000	996	111	110	156	22	59	12	14	20	13	132	Rc1/8
ZFD 8012-8	Z						1×4	87 400	254 000	1 954	171										
SFD 8012-6	Clearance						1×6	124 000	381 000	1 467	136										
ZFD 8012-12	Z						1×6	124 000	381 000	2 877	220										
SFD 8020-3	Clearance		20	9.525	82.75	73	1×3	114 000	312 000	978	146	115	173	28	66	20	18	26	17.5	143	Rc1/8
ZFD 8020-6	Z						1×3	114 000	312 000	1 918	226										
SFD 8020-4	Clearance						1×4	146 000	416 000	1 287	168										
ZFD 8020-8	Z						1×4	146 000	416 000	2 524	268										
SFD 10010-6	Clearance	100	10	6.35	101.75	95.1	1×6	102 000	400 000	1 762	118	125	171	22	64	10	14	20	13	147	Rc1/8
ZFD 10010-12	Z									3 456	188										
SFD 10012-6	Clearance		12	7.938	102.25	94	1×6	138 000	490 000	1 789	142	130	188	28	71	12	18	26	17.5	158	Rc1/8
ZFD 10012-12	Z									3 509	226										
SFD 10020-4	Clearance		20	9.525	102.75	93	1×4	161 000	525 000	1 546	172	135	205	32	79	20	22	32	21.5	169	Rc1/8
ZFD 10020-8	Z									3 031	272										

Notes 1. Circular shape I and Circular shape II flanges are used for shaft diameters of 20 mm or more. Select a flange suitable for the space available for nut installation.
2. If no seal is used, the nut length will be shortened by dimension *M*.
3. Right-turn screws are standard. "L" is added to the end of the Model No. for left turn screws.
4. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 10% for Z-preload, and 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.
5. We recommend using seals if shaft diameter is 16 mm or more and an oil hole is provided.
6. Z-preload refers to offset preload. For details, see page B5.

B-3-2.5 High-speed Low-noise Deflector Recirculation Ball Screws

1. Features

Deflector (bridge) recirculation allows for the outer diameter of the nut to be extremely small. With optimizations to keep ball recirculation smooth, technology to reduce impact forces between balls, and specialized ball groove specifications to lower noise from ball travel by approximately 4dB(A) compared to conventional bridge deflectors, these high-speed, low-noise ball screws offer smooth and stable operating characteristics. In addition, revised internal designs provide higher load capacity for select sizes.

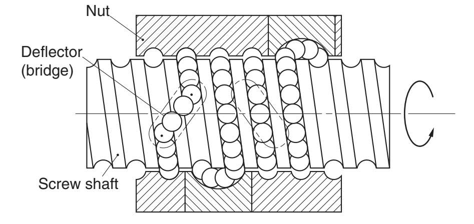


Fig. 1 Structure of deflector(bridge) recirculation system

Table 1 Accuracy grade and axial play

Accuracy grade	C0, C1, C2, C3, C5, Ct7
Axial play	Z, 0 mm (preloaded); T, 0.005 mm or less S, 0.020 mm or less; N, 0.050 mm or less

2. Specifications

(1) Ball recirculation system

Deflector (bridge) recirculation provides a compact nut outer diameter with relatively small leads. The structure of the recirculation system is shown in **Fig. 1**.

(2) Accuracy grade and axial play

The available standard accuracy grades and axial play are shown in **Table 1**. Please consult NSK for other grades.

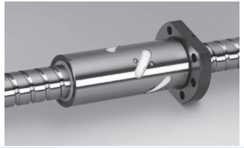
(3) Allowable *d·n* value and the criterion of maximum rotational speed

The allowable *d·n* value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Allowable *d·n* value: ≦ 160 000
(For models SFYD6320, ZFYD6320,
SFYD6330, and ZFYD6330: ≦ 150 000)
Standard of rotational speed :5 000 min^{-1}

Note: Please also review the critical speed. Refer to "Technical Description: Permissible Rotational Speed" (page B47) for details.

Table 2

Nut	Shape	Flange shape	Preload
SFYD		Compliant with DIN standards. (Other shapes are also available.)	No preload, Slight axial play
ZFYD			Z-preload (medium preload)

3. Lineup

High-speed, low-noise deflector (bridge) recirculation ball screws are available with the preload/clearance configurations shown in **Table 2**.

4. Design Precautions

When designing the screw shaft end, one end of the screw must meet either one of the following conditions. If not, we cannot install the ball nut on the screw shaft.

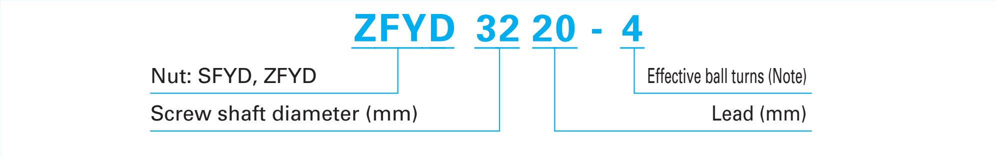
- Cut the ball groove through to the shaft end.
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove d_r specified in the dimension tables.

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

5. Structure of model number and reference number

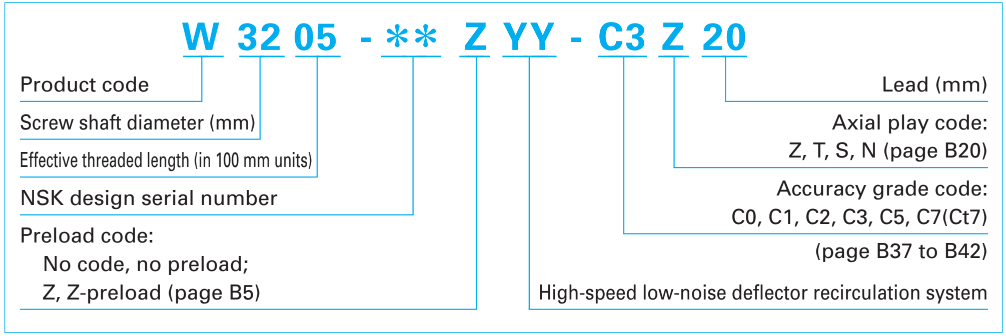
The following explains the codes used in model numbers and ball screw reference numbers.

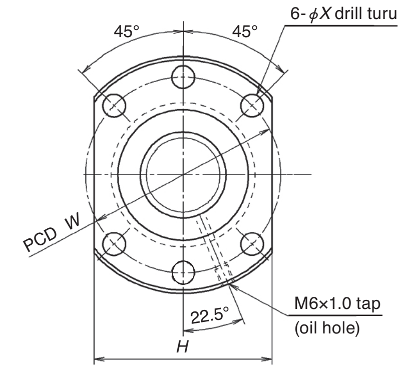
◇Model number



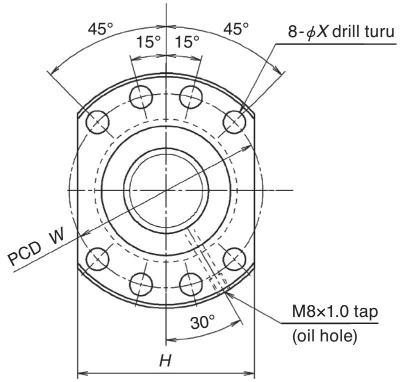
Note: In ZFYD, the number here is twice the effective ball turns.

◇Reference number for ball screws

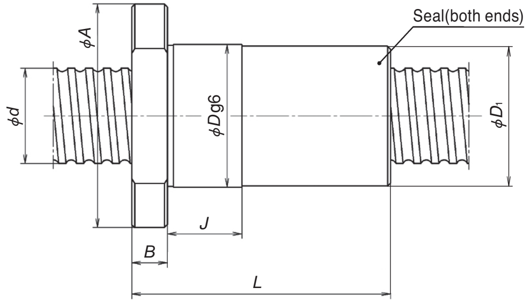




SFYD32, ZFYD32 (Screw shaft diameter d=32mm)



SFYD40, ZFYD40 (Screw shaft diameter d=40mm)
SFYD50, ZFYD50 (Screw shaft diameter d=50mm)
SFYD63, ZFYD63 (Screw shaft diameter d=63mm)



Unit: mm

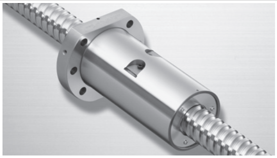
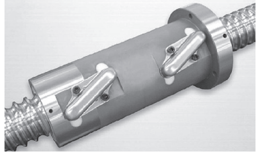
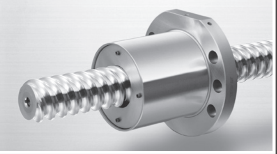
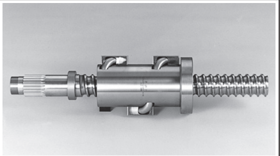
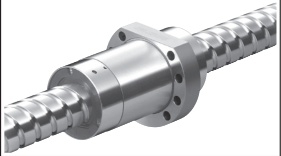
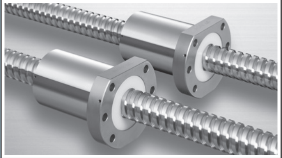
Model No.	Preload	Shaft dia.	Lead	Ball dia.	Root dia.	Effective ball turns	Basic load ratings (N)		Axial rigidity	Ball nut dimensions								
		d	l	D_w	d_r	Turns × Circuits	Dynamic C_a	Static C_{0a}	K (N/μm)	Nut total length L	Nut diameter D	Flange diameter A	Nut diameter D_1	Diameter g6 J	Flange width B	Flange dimension H	Bolt hole dimension X	Bolt hole PCD W
SFYD 3210-5	Clearance	32	10	5.556	27.7	1×5	41 900	83 200	537	94	50	80	(49)	40	12	62	9	65
ZFYD 3210-10	Z					1×5	41 900	83 200	836	156								
SFYD 3215-3	Clearance	32	15	5.556	27.7	1×3	26 800	49 700	326	88	50	80	(49)	40	12	62	9	65
ZFYD 3215-6	Z					1×3	26 800	49 700	508	148								
SFYD 3220-2	Clearance	32	20	5.556	27.7	1×2	18 700	32 900	218	81	50	80	(49)	40	12	62	9	65
ZFYD 3220-4	Z					1×2	18 700	32 900	339	132								
SFYD 4010-4	Clearance	40	10	7.144	34.6	1×4	52 400	103 000	520	87	63	93	(62)	40	14	70	9	78
ZFYD 4010-8	Z					1×4	52 400	103 000	811	137								
SFYD 4015-3	Clearance	40	15	7.144	34.6	1×3	40 700	77 100	393	95	63	93	(62)	40	14	70	9	78
ZFYD 4015-6	Z					1×3	40 700	77 100	612	155								
SFYD 5010-4	Clearance	50	10	7.144	44.6	1×4	59 100	133 000	636	90	75	110	(74)	40	16	85	11	93
ZFYD 5010-8	Z					1×4	59 100	133 000	990	140								
SFYD 5020-4	Clearance	50	20	7.938	44	1×4	67 200	145 000	633	140	75	110	(74)	40	16	85	11	93
ZFYD 5020-8	Z					1×4	67 200	145 000	984	240								
SFYD 6310-5	Clearance	63	10	7.144	57.6	1×5	81 900	220 000	989	104	90	125	(89)	40	18	95	11	108
ZFYD 6310-10	Z					1×5	81 900	220 000	1 540	164								
SFYD 6320-5	Clearance	63	20	9.525	56	1×5	153 000	385 000	1 248	166	95	135	(94)	40	20	100	13.5	115
ZFYD 6320-10	Z					1×5	153 000	385 000	1 943	286								
SFYD 6330-3	Clearance	63	30	9.525	56	1×3	97 700	230 000	757	157	95	135	(94)	40	20	100	13.5	115
ZFYD 6330-6	Z					1×3	97 700	230 000	1 179	269								

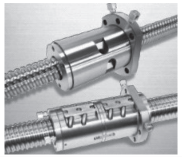
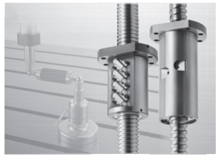
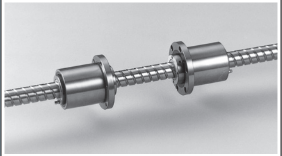
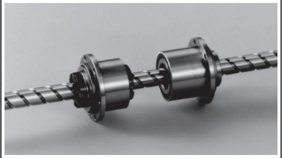
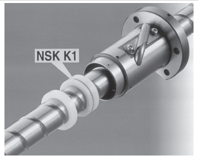
Notes: 1. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when axial load is 30% of the basic dynamic load rating C_a for clearance (no preload), 5% for P-preload. Refer to the "Technical Description" on page B56 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.

2. Mountings listed are based on dimensions specified by the German Institute for Standardization (DIN). Mounting dimensions can be adjusted to match other ball screws, etc. Please contact NSK for details.

B-3-3 Dimension Tables and Reference Numbers for Application-Oriented Ball Screws

◇Features and examples of application-oriented ball screws

Applications		Shape	Features	Equipment	Page
High-Speed Machine Tools	HMD Model		High-speed operation: 64 to 120 m/min Rigidity: 5% greater than the HMC model. High-load carrying capacity: 7% greater than the HMC model. New recirculation system reduces the noise level by 5 dB(A) or more compared with the HMC model	High-speed machining centers High-speed combined machine tools Die mold processing machine	B483
	HMS Model		Fine lead: 5 to 12 mm High-speed operation: 25 to 50 m/min Easy replacement: Dimensional interchangeability with tube recirculation ball screws. New recirculation system reduces the noise level by 5 dB(A) or more compared with tube recircualtion.	Machining centers Die mold processing machine NC lathes Combined machine tools	B487
High-Load Drives	HTF-SRC Model		High-load capacity High-speed operation by high-speed rotation: 930 mm/sec Even load distribution to balls in the ball nut for high-load drive. Improved durability by NSK S1	Injection axis of injection molding machines Servo press machines Press brake Bending machines	B491
	HTF-SRD Model		High-load capacity High-speed operation by large screw lead: 1 600 mm/sec Improved durability by NSK S1	Clamping axis of injection molding machines Die cast machines Punch presses Lifting and lowering devices	B495
	HTF Model		High-load capacity Even load distribution to the balls in a ball nut for high-load drive Improved durability by NSK S1 Provides a wide range of screw diameter and lead combinations.	Injection molding machines Press machines Press fitting machines Lifting and lowering machines	B499
Contaminated Environments	VSS Model		High dust-resistant performance: Reduces particle penetration rate to less than 1/15 (compared with standard seal). More than four times longer service life than standard seals under contaminated environments.	Woodworking machines Laser cutting machines Graphite milling machines Tire molding machines Transfer equipment	B515
Contaminated Environments and Grease Retention	Ball Screws with X1 Seals		Highly dust-resistant: Particle penetration ratio reduced to less than 1/30 of existing standard seals. Superior grease retention: Can reduce lubricant consumption, also effective at suppressing grease splattering.	Machining centers Combined machine tools NC lathes Woodworking machines Laser cutting machines Graphite milling machines Tire molding machines	B519
Twin-Drive Systems	Twin-Drive Ball Screws		Controlled screw lead accuracy and variation of preload torque for twin drive. Improved axial rigidity, expected life and controllability by the paired up two ball-screw driving systems	Machining centers Combined machine tools Large-size machine tools	B527

Applications		Shape	Features	Equipment	Page
Precision Machine Tools	Hollow Shaft Ball Screws		Suppresses thermal deformation by cooling the shaft center. Prevent the machine base from deforming due to thermal expansion. NSK special support units and seal units are available.	High-precision die processing machines High-precision combined machine tools High-precision machining centers High-precision lathes	B528
	Nut-Cooled Ball Screws		Due to the simple nut cooling setup, cooling is achieved simply by attaching piping to the thermal displacement control nut. Cooling just as effective as core cooling. Insulation to prevent heat from affecting the table.	High-precision die processing machines High-precision combined machine tools High-precision machining centers High-precision lathes Large machine tools	B533
	Ball Screws for High-Accuracy Machine Tools		Stable friction during reversals of ball screw direction. This reduces motion errors and contributes to improved surface quality.	High-precision die processing machines High-precision combined machine tools High-precision machining centers High-Prescision large-size machine tools	B537
	High-Durability Precision Ball Screws		The surface treatment technology retains the film and reduces wear. This contributes to increased precision life.	Machining centers Combined machine tools Die mold processing machine Electrical discharge machine Grinding machine	B538
Rotary Nut Ball Screws	NDT and NDD Models		Angular contact support bearings are integrated into the ball nut. Two or more ball nuts can be installed in a single ball screw shaft. NDD model ball screws can surpass the critical speed. A special vibration damper enables long-stroke-high-speed operation.	Woodworking machines Laser cutting machines Electronic component mounting devices Flat panel display manufacturing equipment Transfer equipment	B539
Robots	Σ Model		A ball screw and a ball spline are made in one shaft, combining a drive and guide system. A ball screw nut, a ball spline nut and support bearings are combined to the unit. Hollow shaft has weight saving. The shaft can be used for wiring and piping.	SCARA type robots Electronic-component mounting systems	B547
Ball Screws with the "NSK K1™" Lubrication Unit			Long-term, maintenance-free operation Maintains lubrication efficiency for a prolonged time in contaminated environments Does not pollute the environment Made of compatible material with the FDA regulations is also available.	Automotive manufacturing machines Woodworking machines Laser cutting machines Semiconductor/Flat panel display manufacturing equipment Food processing/Medical equipment	B559

B-3-3.1 HMD Model for High-Speed Machine Tools

Newly developed ball recirculation components, end deflectors, and middle deflectors contribute significantly to substantial improvements in maximum rotational speed and the level of noise as compared to the HMC model.

1. Features

- High speed

The permissible rotational speed (*d·n* value) has greatly increased to 160 000 compared with 135 000 of the HMC model.

- Low noise

Noise reduced by 5 dB(A) or more compared with HMC model ball screws for high-speed machine tools.

- Nut mounting dimensions

The ball nut diameters are the same as those of the HMC model.

2. Specifications

(1) Recirculation system

Fig.1 shows the structure of the middle-deflector recirculation system of the HMD model.

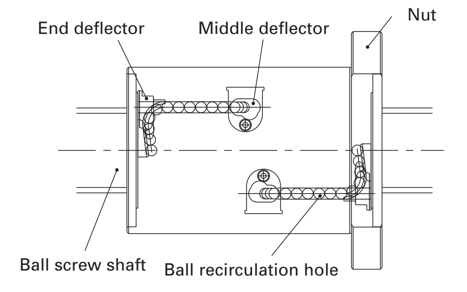


Fig. 1 Structure of middle-deflector recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grades and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	C3, C5
Axial play	0 mm (preloaded)

(3) Allowable *d·n* value and the criterion of maximum rotational speed

The allowable *d·n* value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Allowable *d·n* value: 160 000 or less

Criterion of maximum rotational speed : 4 000 min^{-1}

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Options

- For twin-drive systems (See page B527.)

Upon request, variations in lead accuracy and preload torque between paired twin-drive ball screws can be controlled for the further improvement of reliability.

- Hollow shaft ball screw (See page B528.)
- Nut-Cooled Ball Screws (See page B533.)

Temperature rise and measures to prevent thermal expansion of the ball screw drive mechanism are especially challenging for high-speed machine tools. We recommend using core forced cooling or nut cooling for the HMD model.

(5) Seal

Compact, thin plastic seals are available. Nut outside diameter is compact compared with the tube recirculation system.

3. Design precautions

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

4. Lineup

The HMD model is available in the following varieties:

Table 2 HMD model lineup

Nut	Shape	Flange shape	Nut shape	Preload
EM		Flanged Circular Ⅲ	Circular	Z-Preload (medium preload)

5. Structure of model number and reference number

The following explains the codes used in model numbers and ball screw reference numbers.

◇Model number

EM 40 20 - 6E

EM	Nut: EM
40	Screw shaft diameter (mm)
20	Lead (mm)
6E	Effective ball turns

◇Reference number for ball screw

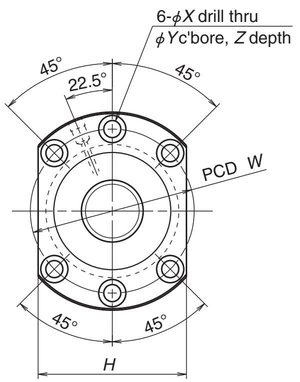
W 40 07 - ** Z M T X - C5 Z 20

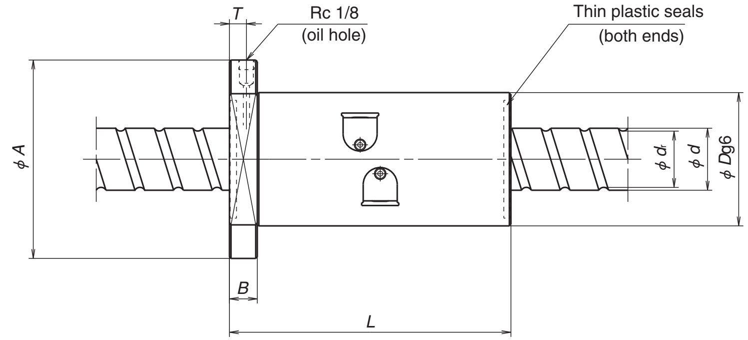
W	Product code
40	Screw shaft diameter (mm)
07	Effective threaded length (in 100 mm units)
**	NSK design serial number
Z	Preload code: Z; Z-preload
M	Middle-deflector recirculation system
T	Hollow shaft specification
X	Ball screw specification/appearance
C5	Accuracy grade: C3 or C5
Z	Axial play code: Z
20	Lead (mm)

6. Handling Precautions

Maximum operating temperature: 80°C

If using NSK K1, operating temperature should not exceed 50°C. Refer to "Design Precautions" (page B83).





Unit: mm

Model No.	Shaft dia. d	Lead l	Root dia. d_r	Basic load ratings (N)		Axial rigidity K (N/μm)	Ball nut dimensions								Bolt hole PCD W	Oil hole position T	Max. feed speed (m/min)
				Dynamic C_a	Static C_{0a}		Nut length L	Nut dia. D	Flange dia. A	Flange width B	Flange dimension H	Bolt hole dimensions X	Y	Z			
EM2812-4E	28	12	23.5	33 100	60 000	718	120	60	88	18	66	6.6	11	6.5	73	9	48
EM2816-4E		16	23.5	32 800	59 600	708	153										64
EM4016-4E	40	16	34.1	66 900	131 000	1 023	160	86	128	18	96	11	17.5	11	106	11	64
EM4020-6E		20	34.4	77 900	166 000	1 415	150										80
EM4020-4EG		20	34.1	66 500	131 000	1 013	192										80
EM4025-6E		25	34.1	91 300	191 000	1 442	182										100
EM4030-6E		30	34.1	90 400	190 000	1 419	213										120
EM4516-4E	45	16	39.1	69 900	146 000	1 121	160	92	134	18	102	11	17.5	11	112	11	56
EM4520-6E		20	39.4	83 200	187 000	1 573	150										70
EM4525-6E		25	39.1	95 700	214 000	1 589	182										88
EM5016-4E	50	16	44.1	72 700	161 000	1 216	160	98	140	18	107	11	17.5	11	118	11	51
EM5020-6E		20	44.4	85 700	205 000	1 695	150										64
EM5025-6E		25	44.1	103 000	232 000	1 731	182										80
EM5030-6E		30	44.1	102 000	235 000	1 730	213										96
EM5520-8E	55	20	49.4	118 000	309 000	2 492	192	103	145	22	108	11	17.5	11	123	12	58
EM6316-4E	63	16	55.2	131 000	338 000	1 696	170	122	180	28	138	18	26	17.5	150	14	40

Notes: 1. Right-turn screws are standard. Please contact NSK for left-turn screws.
2. Values for axial rigidity K are obtained when 5% of the basic dynamic load ratings is applied as the preload.

B-3-3.2 HMS Model for High-Speed Machine Tools

1. Features

● High speed

The permissible rotational speed (*d·n* value) has greatly increased to 160 000 compared with 100 000 for tube recirculation screws.

● Low noise

By adopting a SRC recirculation system, noise reduced by 5 dB(A) or more compared with tube recirculation screws.

● Nut mounting dimensions

The ball nut diameters are the same as those of tube recirculation screws.

2. Specifications

(1) Recirculation system

Fig.1 shows the structure of the SRC recirculation system of the HMS model.

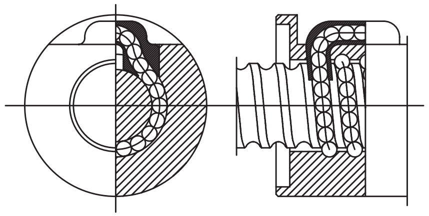


Fig. 1 Structure of SRC recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grades and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	C3, C5
Axial play	0 mm (preloaded)

(3) Allowable *d·n* value and the criterion of maximum rotational speed

The allowable *d·n* value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Allowable *d·n* value: 160 000 or less

Criterion of maximum rotational speed

: 5 000 min^{-1}

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Options

● For twin-drive systems (See page B527.)

Upon request, variations in lead accuracy and preload torque between paired twin-drive ball screws can be controlled for the further improvement of reliability.

● Hollow shaft ball screw (See page B528.)

● Nut-Cooled Ball Screws (See page B533.)

Temperature rise and measures to prevent thermal expansion of the ball screw drive mechanism are especially challenging for high-speed machine tools. We recommend using core forced cooling or nut cooling for the HMS model.

3. Design precautions

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

4. Lineup

The HMS model is available in the following varieties:

Table 2 HMS model lineup

Nut	Shape	Flange shape	Nut shape	Preload
ZFRC		Flanged Circular Ⅱ	Circular	Z-Preload (medium preload)

5. Structure of model number and reference number

The following explains the codes used in model numbers and ball screw reference numbers.

◇Model number

ZFRC 40 10 - 10

Nut: ZFRC

Screw shaft diameter (mm)

Lead (mm)

Effective ball turns*

* In the case of Z-preload, the amount shown is twice the effective ball turns.

◇Reference number for ball screws

W 40 07 - ∗∗ Z RC T - C5 Z 10

Product code

Screw shaft diameter (mm)

Effective threaded length (in 100 mm units)

NSK design serial number

Preload code: Z; Z-preload

SRC recirculation system

Hollow shaft specification

Accuracy grade: C3 or C5

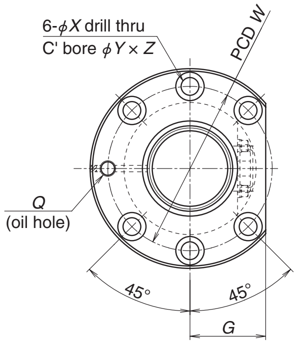
Axial play code: Z

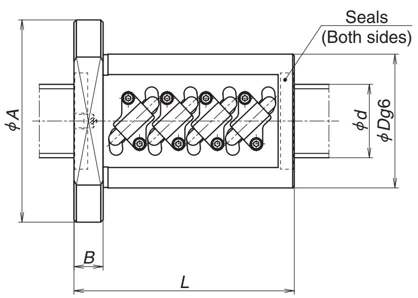
Lead (mm)

6. Handling Precautions

Maximum operating temperature: 60°C

If using NSK K1, operating temperature should not exceed 50°C. Refer to "Design Precautions" (page B83).





Unit: mm

Model No.	Shaft dia.	Lead	Root dia.	Effective turns	Basic load ratings (N)		Axial rigidity	Ball nut dimensions								Bolt hole PCD	Oil hole position	Max. feed speed
				Turns × rows	Dynamic	Static		Nut length	Nut dia.	Flange dia.	Flange width	Notch dimension	Bolt hole dimensions					
	d	l	d_r		C_a	C_{0a}	K (N/μm)	L	D	A	B	G	X	Y	Z	W	Q	(m/min)
ZFRC2812-7	28	12	23.5	3.5×1	26 100	50 200	592	128	60	88	15	33	6.6	11	6.5	73	M6×1	60
ZFRC2816-5	28	16	22.4	2.5×1	27 400	47 400	437	131	73	101	15	38	6.6	11	6.5	86	M6×1	80
ZFRC3205-10	32	5	29.2	2.5×2	21 800	56 000	891	89	58	85	12	32	6.6	11	6.5	71	M6×1	25
ZFRC3210-10	32	10	26.4	2.5×2	54 500	110 000	970	163	74	108	15	41	9	14	8.5	90	M6×1	50
ZFRC4005-10	40	5	37.2	2.5×2	23 900	70 500	1 067	92	67	101	15	39	9	14	8.5	83	M6×1	25
ZFRC4010-10	40	10	34.4	2.5×2	61 200	137 000	1 154	166	82	124	18	47	11	17.5	11	102	Rc1/8	40
ZFRC4012-10	40	12	34.1	2.5×2	71 700	154 000	1 177	192	86	128	18	48	11	17.5	11	106	Rc1/8	48
ZFRC4508-10	45	8	40.5	2.5×2	44 000	118 000	1 234	136	82	124	18	47	11	17.5	11	102	Rc1/8	28
ZFRC4510-10	45	10	39.4	2.5×2	65 800	157 000	1 291	166	88	132	18	50	11	17.5	11	110	Rc1/8	35
ZFRC4512-10	45	12	39.1	2.5×2	75 600	176 000	1 304	192	90	132	18	50	11	17.5	11	110	Rc1/8	42
ZFRC5010-10	50	10	44.4	2.5×2	68 100	174 000	1 397	166	93	135	18	51	11	17.5	11	113	Rc1/8	32
ZFRC5012-10	50	12	43.2	2.5×2	91 500	218 000	1 441	198	100	146	22	55	14	20	13	122	Rc1/8	38
ZFRC5508-10	55	12	50.5	2.5×2	47 300	144 000	1 439	133	94	136	18	52	11	17.5	11	114	Rc1/8	60
ZFRC6312-14	63	12	56.2	3.5×2	136 000	385 000	2 388	244	115	161	22	61	14	20	13	137	Rc1/8	30

Notes: 1. Right-turn screws are standard. Please contact NSK for left-turn screws.
2. Values for axial rigidity *K* are obtained when 5% of the basic dynamic load ratings is applied as the preload.

B-3-3.3.1 HTF-SRC Model for High-Load Drives

1. Features

● High-speed operation and low noise

The SRC recirculation system contributes to more than twice the feed speed (*d·n* value: 140 000 and 160 000) and 8 to 10 db(A) less noise (half to 1/3 of noise) compared with the HTF model.

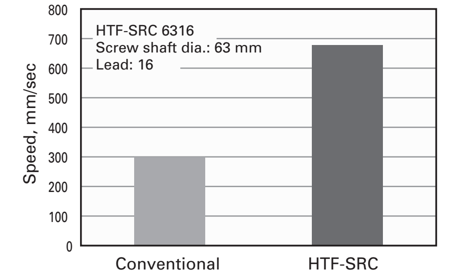


Fig. 1 Feed speed comparison

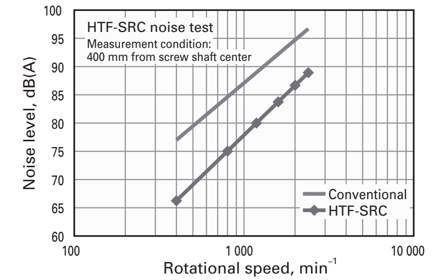


Fig. 2 Noise level comparison

2. Specifications

(1) Ball recirculation system

The SRC recirculation system picks up balls in the direction they are moving, and thus contibutes to high-speed, low-noise operation. The structure of the recirculation system is as follows.

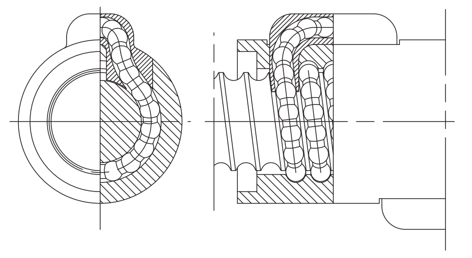


Fig. 3 Structure of SRC recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	Ct7
Axial play	S,0.020 mm or less; N,0.050 mm or less

(3) Allowable *d·n* value and the criterion of maximum rotational speed

The allowable *d·n* value and the criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Table 2 Allowable *d·n* value and the criterion of maximum rotational speed

Lead	14, 16 mm	20, 25 mm☆
Allowable *d·n* value	160 000 or less	140 000 or less
Criterion of maximum rotational speed	3 225 min^{-1}	

d·n value: shaft dia. *d* [mm] × rotational speed *n* [min^{-1}]

☆ Allowable *d · n* value for HTF-SRC5020: 160 000

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Ball retaining piece NSK S1™

NSK S1 resin retainers between balls significantly extend ball screw durability to moment load.

(5) Other

Please consult NSK for special requests, such as the addition of a recirculation circuit to increase load capacity, or the arrangement of all recirculation circuits on the same phase of the ball nut circumference.

3. Design Precautions

The HTF-SRC model is designed to distribute the load uniformly to the balls in the high-load drive mechanism. We recommend installing the ball screws in the way shown for the full use of this characteristic.

In addition, we can provide a full analysis when you use the HTF-SRC model under extreme conditions such as extremely high loads or short strokes. Contact NSK about operating conditions (See page B513).

When designing the screw shaft end, one end of the screw shaft must meet either one of the following conditions. If not, we cannot install the ball nut on the screw shaft.

- Cut the ball groove through to the shaft end.
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove d_r specified in the dimension table.

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

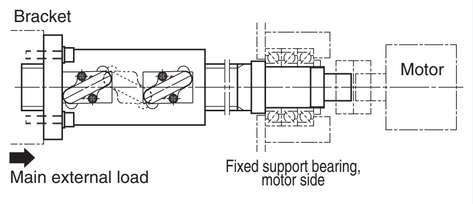
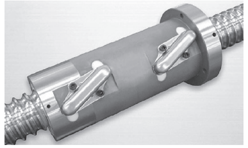


Fig. 4 Recommended installing direction of high-load drive ball screw

4. Lineup

The HTF-SRC model is available in the following varieties:

Table 3 HTF-SRC model lineup

Nut	Shape	Flange shape	Preload
HTF-SRC		Flanged Circular I	No preload Slight axial play

5. Structure of model number and reference number

The following explains the codes used in model numbers and ball screw reference numbers.

◇Model number

HTF-SRC 63 20 - 7.5

Nut: HTF-SRC
Screw shaft diameter (mm)
Lead (mm)
Effective ball turns

◇Reference number for ball screws

W 63 04 - ** RC SP - C7 S 20

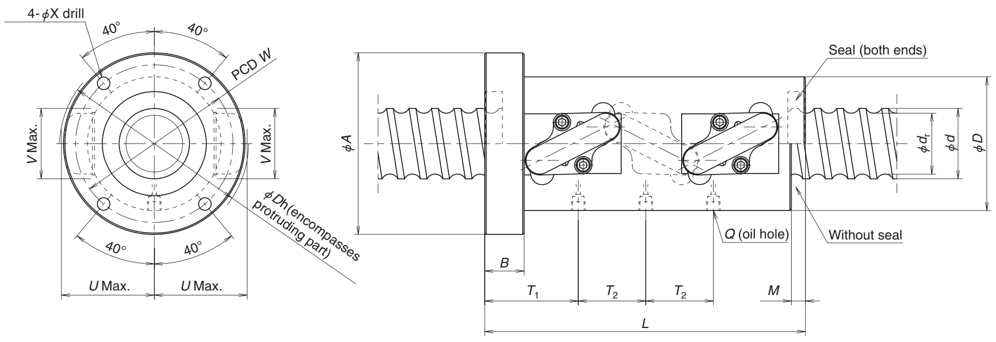
Product code
Screw shaft diameter (mm)
Effective threaded length (in 100 mm units)
NSK design serial number
SRC recirculation system
Ball retaining pieces: NSK S1 specification
Accuracy grade: C7 (Ct7) (page B37 to B42)
Axial play code: S, N (page B20)
Lead (mm)

6. Handling Precautions

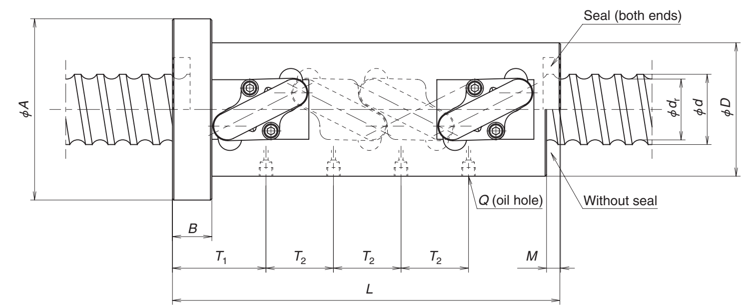
Maximum operating temperature: 70°C
(at outside diameter of ball nut)

As lubricant will deteriorate, we recommend an operating temperature of 60 °C or lower.

Please consult NSK in the case of a short stroke operation less than or equal to four times the length of the ball screw lead.



Nut model Ⅰ

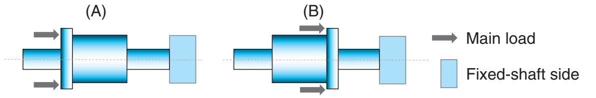


Nut model Ⅱ

Unit: mm

Model No.	Lead	Shaft dia.	Root dia.	Effective ball turns Turns × Circuits	Nut model	Basic load ratings (kN) Dynamic	Static				Ball nut dimensions										Permissible axial load (kN) Mounting *See below	
	l	d	d_r			C_a	C_{0a}	D	A	B	L	M	W	X	U	V	Dh	Q	T_1	T_2	[A] Recommended	[B]
HTF-SRC5014-7.5	14	50	41.6	2.5×3	Ⅰ	264	623	80	114	28	202	10	97	9	54.5	46	111	M6×1	69	42	104	76.8
HTF-SRC5016-7.5	16	50	39	2.5×3	Ⅰ	383	818	95	129	28	228	10	112	9	66	50	134	Rc1/8	74.5	48	129	107
HTF-SRC6316-7.5	16	63	52	2.5×3	Ⅰ	429	1 050	105	139	28	228	10	122	9	72.5	50	148	Rc1/8	74.5	48	184	142
HTF-SRC6316-10	16	63	52	2.5×4	Ⅱ	549	1 410	105	139	28	276	10	122	9	72.5	50	148	Rc1/8	74.5	48	209	152
HTF-SRC6316-10.5	16	63	52	3.5×3	Ⅰ	562	1 450	105	139	28	276	10	122	9	72.5	50	148	Rc1/8	74.5	64	217	157
HTF-SRC6316-14	16	63	52	3.5×4	Ⅱ	720	1 930	105	139	28	340	10	122	9	72.5	50	148	Rc1/8	74.5	64	236	162
HTF-SRC8016-10.5	16	80	69	3.5×3	Ⅰ	627	1 870	120	154	32	278	10	137	9	80	60	165	Rc1/8	78.5	64	321	209
HTF-SRC8016-14	16	80	69	3.5×4	Ⅱ	802	2 490	120	154	32	342	10	137	9	80	60	165	Rc1/8	78.5	64	360	217
HTF-SRC5020-7.5	20	50	39	2.5×3	Ⅰ	383	818	95	129	28	268	10	112	9	66	50	135	Rc1/8	83.5	60	121	99.4
HTF-SRC6320-7.5	20	63	49	2.5×3	Ⅰ	572	1 280	117	157	32	279	12	137	11	80	62	163	Rc1/8	90	60	211	172
HTF-SRC6320-10	20	63	49	2.5×4	Ⅱ	732	1 710	117	157	32	339	12	137	11	80	62	163	Rc1/8	90	60	232	182
HTF-SRC8020-10.5	20	80	66	3.5×3	Ⅰ	838	2 300	130	170	32	339	12	150	11	88	64	180	Rc1/8	90	80	362	254
HTF-SRC10020-10.5	20	100	86	3.5×3	Ⅰ	936	2 910	145	185	32	339	12	165	11	97	78	199	Rc1/8	90	80	524	325
HTF-SRC10020-14	20	100	86	3.5×4	Ⅱ	1 200	3 890	145	185	32	419	12	165	11	97	78	199	Rc1/8	90	80	588	335
HTF-SRC12020-7.5	20	120	106	2.5×3	Ⅰ	776	2 550	173	213	40	287	12	193	11	109.5	88	229	Rc1/8	98	60	525	376
HTF-SRC12020-10	20	120	106	2.5×4	Ⅱ	994	3 400	173	213	40	347	12	193	11	109.5	88	229	Rc1/8	98	60	628	407
HTF-SRC6325-10.5	25	63	49	3.5×3	Ⅰ	750	1 770	117	157	32	405	12	137	11	81.5	61	167	Rc1/8	101.75	100	222	172
HTF-SRC8025-7.5	25	80	63	2.5×3	Ⅰ	790	1 960	145	185	40	347	17	165	11	99.5	73	202	Rc1/8	111.75	75	334	269
HTF-SRC10025-10.5	25	100	83	3.5×3	Ⅰ	1 200	3 430	159	199	40	422	17	179	11	108	79	220	Rc1/8	111.75	100	560	383
HTF-SRC10025-14	25	100	83	3.5×4	Ⅱ	1 540	4 580	159	199	40	522	17	179	11	108	79	220	Rc1/8	111.75	100	612	395
HTF-SRC12025-10.5	25	120	103	3.5×3	Ⅰ	1 300	4 200	173	213	40	421	17	193	11	116	92	238	Rc1/8	111.25	100	750	465
HTF-SRC12025-14	25	120	103	3.5×4	Ⅱ	1 660	5 600	173	213	40	521	17	193	11	116	92	238	Rc1/8	111.25	100	836	479

Remarks: 1, If no seals are equipped, the ball nut length will be shortened by dimension *M*.
2. Contact NSK if the applied load will exceed the permissible axial load.
3. Right-turn screws are standard. Contact NSK for left-turn screws.
4. Values for permissible axial load are obtained with S clearance. If the amount of clearance or mounting conditions are different, the permissible axial load will also change.



B-3-3.3.2 HTF-SRD Model for High-Load Drives

1. Features

● High-speed operation and low noise

Used with end deflectors, HTF-SRD model ball screws achieve a maximum feed speed of 1 600 mm/s. The ball nut body surface is completely round, thus enabling well balanced ball nut rotation.

A double start thread structure which has more recirculation circuits, and large diameter balls contribute to high load carrying capacity.

● Low noise and compact design

End deflector systems using a ball scooping mechanism in the direction of the screw spiral offer smoother ball recirculation, thus contributing to less than half the noise level compared with existing ball screws equipped with a tube.

A compact, high-performance seal is available. Nut outside diameter is compact compare with the tube recirculation system.

Compact, thin plastic seals are also available. Nut outside diameter is compact compared with the tube recirculation system.

2. Specifications

(1) Ball recirculation system

End-deflector recirculation systems feature high-speed, low-noise operation and a compact ball nut. The structure of recirculation parts are as follows.

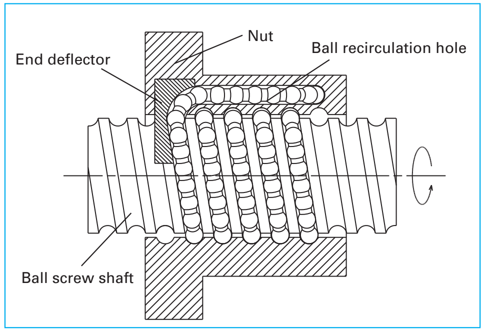


Fig. 1 Structure of End-deflector recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grades and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	Ct7
Axial play	S, 0.020 mm or less; N, 0.050 mm or less

(3) Allowable *d·n* value and the criterion of maximum rotational speed

The allowable *d·n* value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Table 2 Allowable *d·n* value and the criterion of maximum rotational speed

Allowable *d·n* value	120 000 or less
Criterion of maximum rotational speed	2 400 min^{-1}

d·n value: shaft dia. *d* [mm] × rotational speed *n* [min^{-1}]

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Ball retaining piece NSK S1™

NSK S1 resin retainers between the balls significantly extend ball screw durability to moment load.

3. Design Precautions

The HTF-SRD model is designed to distribute the load uniformly to the balls of the high-load drive mechanism. We recommend installing the ball screws in the way shown below for the full use of this characteristic.

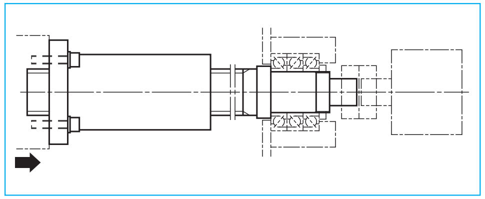


Fig. 2 Recommended installing direction of high-load drives ball screw

In addition, we will perform a full analysis when you use the HTF-SRD model under extreme conditions such as extremely high load or short strokes. Contact NSK about operating conditions (see page B513).

When designing the screw shaft end, one end of the screw shaft must meet either one of the following conditions. If not, we cannot install the ball nut on the screw shaft.

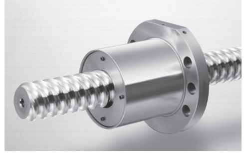
- Cut the ball groove through to the shaft end.
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove d_r specified in the dimension table.

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

4. Lineup

The HTF-SRD model is available in the following varieties:

Table 3 HTF-SRD model lineup

Nut	Shape	Flange shape	Preload
HTF-SRD		Circular Ⅲ	No preload Slight axial play

5. Structure of model number and reference number

The following explains the codes used in model numbers and ball screw reference numbers.

◇Model number

HTF-SRD 50 40 - 6E

Nut: HTF-SRD
Screw shaft diameter (mm)
Lead (mm)
Effective ball turns

◇Reference number for ball screw

W 50 18 - ＊＊ SS SP X - C7 N 40

Product code
Screw shaft diameter (mm)
Effective threaded length (in 100 mm units)
NSK design serial number
End-deflector recirculation system
Ball retaining pieces: NSK S1 specification
Ball screw specification/appearance
Accuracy grade: C7 (Ct7) (page B37 to B42)
Axial play code: S, N (page B20)
Lead (mm)

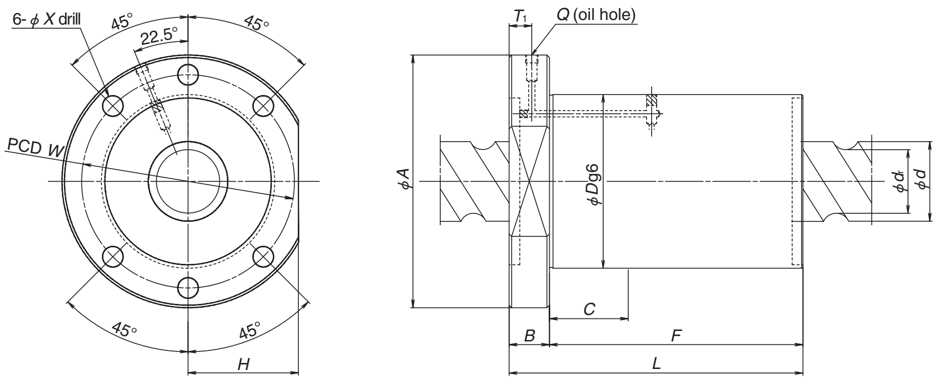
6. Handling Precautions

Maximum operating temperature: 70°C
(at outside diameter of ball nut)

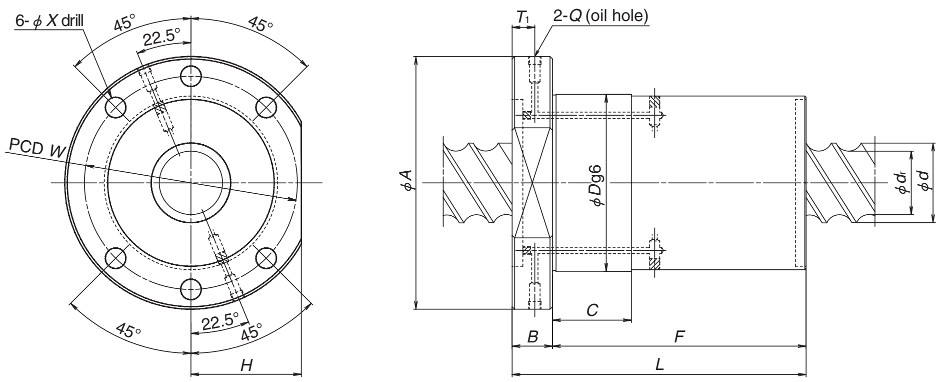
As lubricant will deteriorate, we recommend an operating temperature of 60 °C or lower.

Please consult NSK in the case of short stroke operation less than or equal to four times the length of the ball screw lead.

Ball Screws: HTF-SRD Model for High Load Drives



Nut model Ⅰ

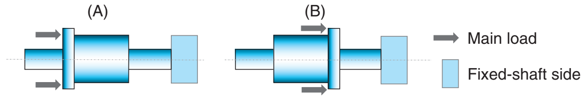


Nut model Ⅱ

Unit: mm

Model No.	Lead	Shaft dia.	Root dia.	Nut model	Basic load ratings (kN)					Ball nut dimensions								Permissible axial load (kN)	
					Dynamic	Static												Mounting	*See below
	l	d	d_r		C_a	C_{0a}	D	A	B	F	C	L	H	W	X	Q	T_1	[A] Recommended	[B]
HTF-SRD6332-4E	32	63	49	Ⅰ	292	590	140	190	32	144	—	176	85	165	14	Rc1/8	22	119	114
HTF-SRD5040-6E	40	50	39	Ⅱ	243	491	115	165	28	131	131	159	72.5	140	14	Rc1/8	18	106	99.1
HTF-SRD5040-8E	40	50	39	Ⅱ	319	679	115	165	28	171	171	199	72.5	140	14	Rc1/8	18	123	111
HTF-SRD6340-6E	40	63	49	Ⅱ	363	768	140	200	32	131	131	163	90	170	18	Rc1/8	22	181	169
HTF-SRD6340-8E	40	63	49	Ⅱ	476	1 060	140	200	32	171	171	203	90	170	18	Rc1/8	22	213	192
HTF-SRD5050-6E	50	50	39	Ⅱ	243	491	115	165	28	159	159	187	72.5	140	14	Rc1/8	18	102	94.6
HTF-SRD5050-8E	50	50	39	Ⅱ	319	679	115	165	28	209	209	237	72.5	140	14	Rc1/8	18	116	103
HTF-SRD8050-6E	50	80	63	Ⅱ	502	1 180	175	250	40	154	154	194	110	210	22	Rc1/8	30	284	263
HTF-SRD8050-8E	50	80	63	Ⅱ	658	1 630	175	250	40	204	204	244	110	210	22	Rc1/8	30	336	302
HTF-SRD6360-6E	60	63	49	Ⅱ	363	768	140	200	32	188	188	220	90	170	18	Rc1/8	22	168	153
HTF-SRD6360-8E	60	63	49	Ⅱ	476	1 060	140	200	32	248	248	280	90	170	18	Rc1/8	22	190	169
HTF-SRD10060-6E	60	100	83	Ⅱ	583	1 490	195	270	40	185	185	225	122	235	22	Rc1/8	30	366	330
HTF-SRD10060-8E	60	100	83	Ⅱ	765	2 060	195	270	40	245	245	285	122	235	22	Rc1/8	30	436	378
HTF-SRD12070-6E	70	120	103	Ⅱ	630	1 810	210	285	50	210	210	260	130	250	22	Rc1/8	40	451	393
HTF-SRD12070-8E	70	120	103	Ⅱ	826	2 520	210	285	50	280	280	330	130	250	22	Rc1/8	40	549	450
HTF-SRD8080-6E	80	80	63	Ⅱ	502	1 180	175	250	40	244	244	284	110	210	22	Rc1/8	30	258	234
HTF-SRD8080-8E	80	80	63	Ⅱ	658	1 630	175	250	40	324	100	364	110	210	22	Rc1/8	30	293	258
HTF-SRD100100-6E	100	100	83	Ⅱ	583	1 490	195	270	40	301	100	341	122	235	22	Rc1/8	30	336	294
HTF-SRD100100-8E	100	100	83	Ⅱ	765	2 060	195	270	40	401	100	441	122	235	22	Rc1/8	30	383	320
HTF-SRD80120-4E	120	80	63	Ⅱ	337	751	175	250	40	243	243	283	110	210	22	Rc1/8	30	185	172
HTF-SRD120120-6E	120	120	103	Ⅱ	630	1 810	210	285	50	356	100	406	130	250	22	Rc1/8	40	413	343
HTF-SRD120120-8E	120	120	103	Ⅱ	826	2 520	210	285	50	476	100	526	130	250	22	Rc1/8	40	480	375

Remarks: 1. Contact NSK if the applied load will exceed the permissible axial load.
2. Right-turn screws are standard. Contact NSK for left-turn screws.
3. Values for permissible axial load are obtained with S clearance. If the amount of clearance or mounting conditions are different, the permissible axial load will also change.
4. When *F* and *C* dimensions are the same, the total surface of *F* is φ **Dg6.**



B-3-3.3.3 HTF Model for High-Load Drives

1. Features

● High load carrying capacity

Has an ideal design to bear heavy load. It significantly enhances load rating as well as maximum permissible load.

● Respond to various shaft end configurations

Additional ball screw shaft machining is not required. HTF models respond to various shaft ends that convey high torque.

The HTF model can be used with: involute spline (JIS B 1603), straight sided spline (JIS B 1601), key seat, etc.

2. Specifications

(1) Ball recirculation system

The structure of the recirculation system is shown in **Fig. 1**.

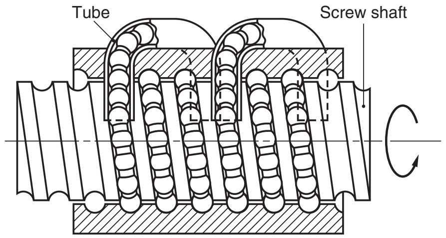


Fig. 1 Structure of tube recirculation system

(2) Accuracy grade and axial play

The allowable standard accuracy grades and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	Ct7
Axial play	S, 0.020 mm or under; N, 0.050 mm or under

(3) Allowable *d·n* value and the criterion of maximum rotational speed

The allowable *d·n* value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below. For higher-speed operation, the HTF-SRC model is recommend (See page B491).

Table 2 Allowable d•n value and the criterion of maximum rotational speed

Lead		– 20 mm	25 mm	30 – 32 mm
Allowable *d·n* value	Standard specification	70 000 or less	70 000 or less	50 000 or less
	High-speed specification	10 0000 or less	–	–
Criterion of maximum rotational speed		3 125 min^{-1}		

d•n value: shaft dia. *d* [mm] × rotational speed *n* [min^{-1}]

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Ball retaining piece NSK S1™

NSK S1 resin retainers between the balls significantly extend ball screw durability to moment load.

(5) Other

Please consult NSK for special requests, such as the addition of a recirculation circuit to increase the load capacity, or the arrangement of all recirculation circuits on the same phase of the ball nut circumference.

3. Design precautions

When designing shaft end configurations, note that HTF model ball screws are specialized for high-load drives.

The HTF model is designed to distribute load uniformly to balls in the high-load drive mechanism.

We recommend installing ball screws in the way shown in **Fig. 2** for the full use of this characteristic. In addition, we will perform a full analysis when you use the HTF model under extreme conditions such as application of extremely high load or operating in short stroke. Contact NSK about operating conditions (See page B513).

When designing the screw shaft end, the one end must be cut-through and the shaft end dimension must be less than the root diameter of the ball groove. If not, the nut cannot be assembled.

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

4. Lineup

The HTF model is available in the following varieties:

Table 3 HTF model lineup

Nut	Shape	Flange shape	Preload
HTF		Flanged Circular I	No preload Slight axial play

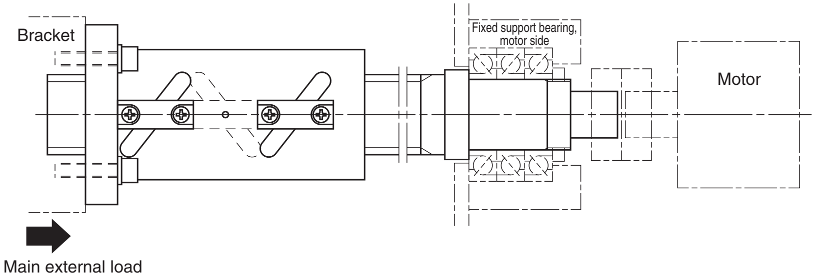
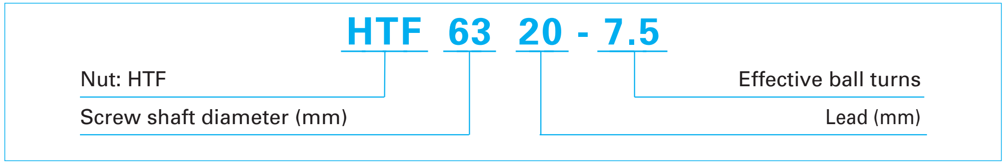


Fig. 2 Recommended installing direction of ball screws for high-load drives

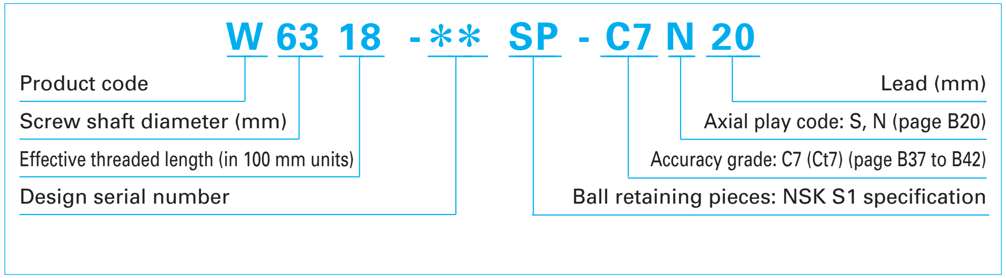
5. Structure of model number and reference number

The following explains the codes used in model numbers and ball screw reference numbers.

◇Model number

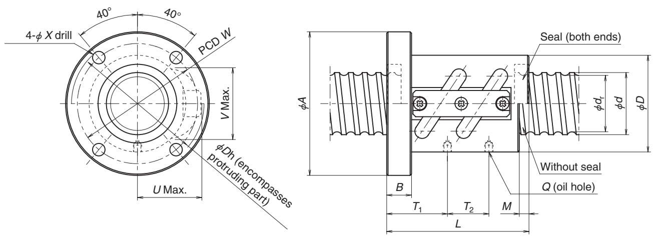


◇Reference number for ball screw

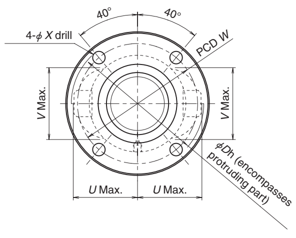


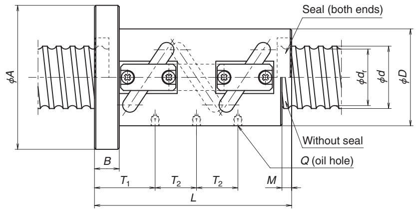
6. Handling precautions

Maximum operating temperature : 70°C
(at outside diameter of all nut)
As lubricant will deteriorate, we recommend an operating temperature of 60 °C or lower.
Please consult NSK in the case of short stroke operation less than or equal to four times the length of the ball screw lead.

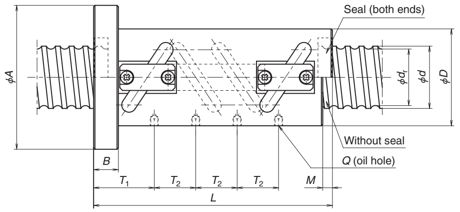


Nut model Ⅰ





Nut model Ⅱ

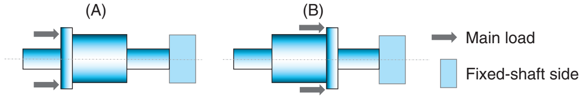


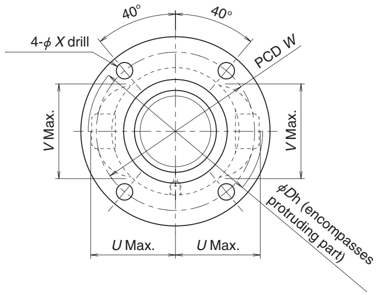
Nut model Ⅲ

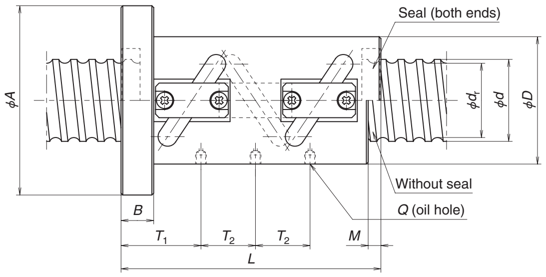
Unit: mm

Model No.	Lead	Shaft dia.	Root dia.	Effective ball turns Turns × Circuits	Nut model	Basic load ratings (kN)					Ball nut dimensions										Permissible axial load (kN) Mounting *See below	
	l	d	d_r			Dynamic C_a	Static C_{0a}	D	A	B	L	M	W	X	U	V	Dh	Q	T_1	T_2	[A] Recommended	[B]
HTF3210-5	10	32	25.6	2.5×2	Ⅰ	88.7	169	58	92	18	103	7	75	9	40.5	42	82	M6×1	36.5	30	33.0	29.5
HTF3610-5	10	36	29.6	2.5×2	Ⅰ	96.1	191	62	96	18	103	7	79	9	43	45	87	M6×1	36.5	30	37.5	33.3
HTF4010-7.5	10	40	33.6	2.5×3	Ⅱ	149	344	66	100	18	143	7	83	9	45	48	91	M6×1	46.5	30	59.5	46.1
HTF4510-7.5	10	45	38.6	2.5×3	Ⅱ	158	386	70	104	18	143	7	87	9	47	52	95	M6×1	46.5	30	70.2	52.3
HTF4510-10	10	45	38.6	2.5×4	Ⅲ	203	514	70	104	18	173	7	87	9	47	52	95	M6×1	46.5	30	81.4	56.1
HTF5010-7.5	10	50	43.6	2.5×3	Ⅱ	166	435	75	109	18	143	7	92	9	49	57	99	M6×1	46.5	30	82.0	59.6
HTF5010-10	10	50	43.6	2.5×4	Ⅲ	213	580	75	109	18	173	7	92	9	49	57	99	M6×1	46.5	30	92.4	67.1
HTF5510-7.5	10	55	48.6	2.5×3	Ⅱ	173	477	80	114	18	143	7	97	9	51.5	62	104	M6×1	46.5	30	92.8	66.2
HTF5510-10	10	55	48.6	2.5×4	Ⅲ	222	636	80	114	18	173	7	97	9	51.5	62	104	M6×1	46.5	30	110	71.5
HTF3612-5	12	36	29	2.5×2	Ⅰ	112	228	66	100	22	123	8	83	9	46.5	46	94	M6×1	44	36	42.8	38.2
HTF4012-7.5	12	40	33	2.5×3	Ⅱ	184	422	70	104	22	171	8	87	9	47.5	50	96	M6×1	56	36	62.7	49.8
HTF4512-7.5	12	45	38	2.5×3	Ⅱ	195	473	72	106	22	171	8	89	9	49.5	54	100	M6×1	56	36	75.9	56.5
HTF5012-7.5	12	50	43	2.5×3	Ⅱ	205	525	77	111	22	171	8	94	9	52	59	105	M6×1	56	36	88.5	64.2
HTF5012-10	12	50	43	2.5×4	Ⅲ	263	700	77	111	22	207	8	94	9	52	59	105	M6×1	56	36	102	68.5
HTF5512-7.5	12	55	48	2.5×3	Ⅱ	214	586	82	116	22	171	8	99	9	54.5	63	110	M6×1	56	36	101	71.9
HTF5512-10	12	55	48	2.5×4	Ⅲ	274	781	82	116	22	207	8	99	9	54.5	63	110	M6×1	56	36	118	77.0
HTF6312-7.5	12	63	56	2.5×3	Ⅱ	227	668	92	126	22	171	8	109	9	58.5	70	118	M6×1	56	36	120	85.8
HTF6312-10	12	63	56	2.5×4	Ⅲ	290	891	92	126	22	207	8	109	9	58.5	70	118	M6×1	56	36	143	92.5

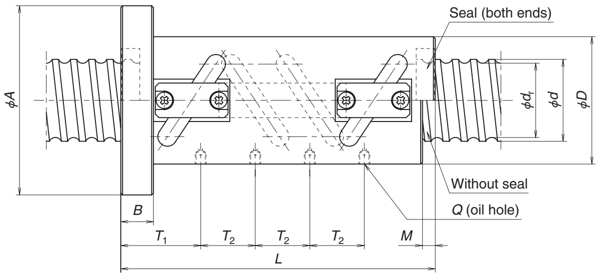
Remarks: 1. If no seals are equipped, the ball nut length will be shortened by dimension *M*.
2. Contact NSK if the applied load will exceed the permissible axial load.
3. Right-turn screws are standard. Contact NSK for left-turn screws.
4. Values for permissible axial load are obtained with S clearance. If the amount of clearance or mounting conditions are different, the permissible axial load will also change.







Nut model Ⅱ

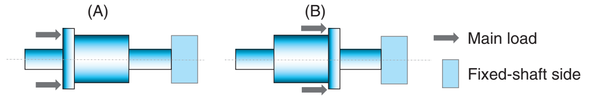


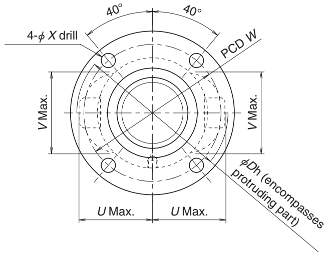
Nut model Ⅲ

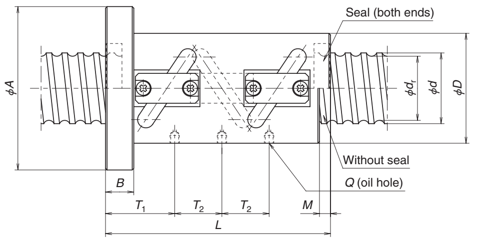
Unit: mm

	Model No.	Lead	Shaft dia.	Root dia.	Effective ball turns Turns × Circuits	Nut model	Basic load ratings (kN)		Ball nut dimensions														Permissible axial load (kN)	
							Dynamic	Static															Mounting	*See below
		l	d	d_r			C_a	C_{0a}	D	A	B	L	M	W	X	U	V	Dh	Q	T_1	T_2	[A] Recommended	[B]
#	**HTF5014-7.5**	14	50	41.7	2.5×3	Ⅱ	264	623	80	114	28	200	10	97	9	55.5	61	112	M6×1	66.5	42	104	76.8
	HTF5514-7.5	14	55	46.7	2.5×3	Ⅱ	270	696	85	119	28	200	10	102	9	57.5	65	116	M6×1	66.5	42	119	86.0
	HTF6314-7.5	14	63	54.7	2.5×3	Ⅱ	291	800	94	128	28	200	10	111	9	61.5	72	124	M6×1	66.5	42	145	102
	HTF6314-10	14	63	54.7	2.5×4	Ⅲ	373	1 070	94	128	28	242	10	111	9	61.5	72	124	M6×1	66.5	42	170	109
	HTF8014-7.5	14	80	71.7	2.5×3	Ⅱ	327	1 020	116	150	28	200	10	133	9	72	87	146	M6×1	66.5	42	195	139
	HTF8014-10	14	80	71.7	2.5×4	Ⅲ	418	1 360	116	150	28	242	10	133	9	72	87	146	M6×1	66.5	42	234	151
#	**HTF5016-7.5**	16	50	39	2.5×3	Ⅱ	383	818	95	129	28	223	10	112	9	68	66	137	Rc1/8	73	48	128	109
	HTF5516-7.5	16	55	44	2.5×3	Ⅱ	399	922	99	133	28	223	10	116	9	70	70	141	Rc1/8	73	48	150	121
#	**HTF6316-7.5**	16	63	52	2.5×3	Ⅱ	429	1 050	105	139	28	223	10	122	9	72.5	76	146	Rc1/8	73	48	184	142
#	**HTF6316-10**	16	63	52	2.5×4	Ⅲ	549	1 410	105	139	28	271	10	122	9	72.5	76	146	Rc1/8	73	48	209	152
#	**HTF6316-10.5**	16	63	52	3.5×3	Ⅱ	562	1 450	105	139	28	271	10	122	9	72.5	76	146	Rc1/8	73	64	217	157
#	**HTF6316-14**	16	63	52	3.5×4	Ⅲ	720	1 930	105	139	28	335	10	122	9	72.5	76	146	Rc1/8	73	64	236	162
	HTF8016-7.5	16	80	69	2.5×3	Ⅱ	478	1 340	120	154	32	227	10	137	9	80	92	161	Rc1/8	77	48	259	186
	HTF8016-10	16	80	69	2.5×4	Ⅲ	612	1 790	120	154	32	275	10	137	9	80	92	161	Rc1/8	77	48	305	200
#	**HTF8016-10.5**	16	80	69	3.5×3	Ⅱ	627	1 870	120	154	32	275	10	137	9	80	92	161	Rc1/8	77	64	321	209
#	**HTF8016-14**	16	80	69	3.5×4	Ⅲ	802	2 490	120	154	32	339	10	137	9	80	92	161	Rc1/8	77	64	360	217
	HTF10016-7.5	16	100	89	2.5×3	Ⅱ	529	1 710	145	185	32	227	10	165	11	91	109	184	Rc1/8	77	48	347	250
	HTF10016-10	16	100	89	2.5×4	Ⅲ	677	2 280	145	185	32	275	10	165	11	91	109	184	Rc1/8	77	48	418	272
	HTF12016-7.5	16	120	109	2.5×3	Ⅱ	572	2 050	173	213	32	227	10	193	11	104	126	210	Rc1/8	77	48	425	318
	HTF12016-10	16	120	109	2.5×4	Ⅲ	732	2 730	173	213	32	275	10	193	11	104	126	210	Rc1/8	77	48	519	351

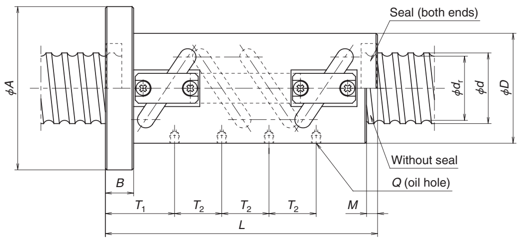
Remarks: 1. If no seals are equipped, the ball nut length will be shortened by dimension *M*.
2. Contact NSK if the applied load will exceed the permissible axial load.
3. Right-turn screws are standard. Contact NSK for left-turn screws.
4. Values for permissible axial load are obtained with S clearance. If the amount of clearance or mounting conditions are different, the permissible axial load will also change.
5. For Model No. marked with #, it is recommended to use the HTF-SRC Model.







Nut model Ⅱ

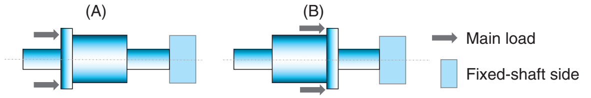


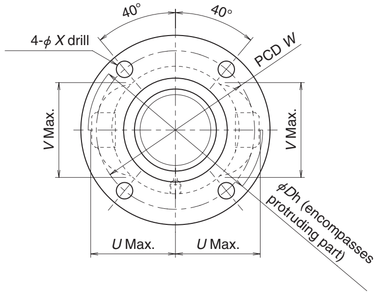
Nut model Ⅲ

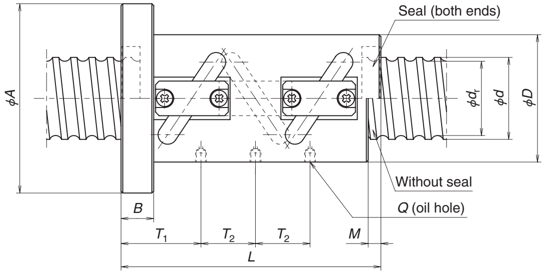
Unit: mm

	Model No.	Lead	Shaft dia.	Root dia.	Effective ball turns Turns × Circuits	Nut model	Basic load ratings (kN)		Ball nut dimensions													Permissible axial load (kN)	
							Dynamic	Static														Mounting	*See below
		l	d	d_r			C_a	C_{0a}	D	A	B	L	M	W	X	U	V	Dh	Q	T_1	T_2	[A] Recommended	[B]
#	**HTF6320-7.5**	20	63	49	2.5×3	Ⅱ	572	1 320	117	157	32	273	12	137	11	83.5	81	168	Rc1/8	88	60	212	173
#	**HTF6320-10**	20	63	49	2.5×4	Ⅲ	732	1 760	117	157	32	333	12	137	11	83.5	81	168	Rc1/8	88	60	234	183
	HTF6320-10.5	20	63	49	3.5×3	Ⅱ	749	1 810	117	157	32	333	12	137	11	83.5	81	168	Rc1/8	88	80	243	190
	HTF8020-7.5	20	80	66	2.5×3	Ⅱ	639	1 690	130	170	32	273	12	150	11	89.5	96	181	Rc1/8	88	60	310	233
	HTF8020-10	20	80	66	2.5×4	Ⅲ	818	2 250	130	170	32	333	12	150	11	89.5	96	181	Rc1/8	88	60	353	247
#	**HTF8020-10.5**	20	80	66	3.5×3	Ⅱ	838	2 300	130	170	32	333	12	150	11	89.5	96	181	Rc1/8	88	80	365	255
	HTF10020-7.5	20	100	86	2.5×3	Ⅱ	713	2 140	145	185	32	273	12	165	11	97.5	114	196	Rc1/8	88	60	427	295
	HTF10020-10	20	100	86	2.5×4	Ⅲ	914	2 850	145	185	32	333	12	165	11	97.5	114	196	Rc1/8	88	60	501	314
#	**HTF10020-10.5**	20	100	86	3.5×3	Ⅱ	935	2 920	145	185	32	333	12	165	11	97.5	114	196	Rc1/8	90	80	520	324
#	**HTF10020-14**	20	100	86	3.5×4	Ⅲ	1 200	3 890	145	185	32	413	12	165	11	97.5	114	196	Rc1/8	90	80	582	335
#	**HTF12020-7.5**	20	120	106	2.5×3	Ⅱ	775	2 550	173	213	40	281	12	193	11	111	130	223	Rc1/8	96	60	522	376
#	**HTF12020-10**	20	120	106	2.5×4	Ⅲ	993	3 400	173	213	40	341	12	193	11	111	130	223	Rc1/8	96	60	624	407
	HTF12020-10.5	20	120	106	3.5×3	Ⅱ	1 020	3 530	173	213	40	341	12	193	11	111	131	223	Rc1/8	96	80	657	424
	HTF12020-14	20	120	106	3.5×4	Ⅲ	1 300	4 710	173	213	40	421	12	193	11	111	131	223	Rc1/8	96	80	748	442
	HTF14020-7.5	20	140	126	2.5×3	Ⅱ	829	3 000	204	250	40	281	12	226	14	122.5	148	248	Rc1/8	96	60	630	468
	HTF14020-10	20	140	126	2.5×4	Ⅲ	1 060	4 000	204	250	40	341	12	226	14	122.5	148	248	Rc1/8	96	60	765	514
#	**HTF6325-10.5**	25	63	49	3.5×3	Ⅱ	749	1 810	117	157	32	398	12	137	11	83.5	83	169	Rc1/8	98.75	100	228	175
#	**HTF8025-7.5**	25	80	64	2.5×3	Ⅱ	829	2 020	145	185	40	338	17	165	11	102	100	206	Rc1/8	109.25	75	338	271
	HTF10025-7.5	25	100	84	*2.5×3*	Ⅱ	917	2 550	159	199	40	338	17	179	11	108.5	118	219	Rc1/8	109.25	75	484	354
	HTF10025-10	25	100	84	2.5×4	Ⅲ	1 170	3 400	159	199	40	413	17	179	11	108.5	118	219	Rc1/8	109.25	75	554	375
#	**HTF10025-10.5**	25	100	84	3.5×3	Ⅱ	1 200	3 490	159	199	40	413	17	179	11	108.5	118	219	Rc1/8	109.25	100	575	388
#	**HTF10025-14**	25	100	84	3.5×4	Ⅲ	1 540	4 650	159	199	40	513	17	179	11	108.5	118	219	Rc1/8	109.25	100	629	399
	HTF12025-7.5	25	120	104	2.5×3	Ⅱ	990	3 080	173	213	40	338	17	193	11	116	135	223	Rc1/8	109.25	75	612	424
	HTF12025-10	25	120	104	2.5×4	Ⅲ	1 270	4 110	173	213	40	413	17	193	11	116	135	223	Rc1/8	109.25	75	712	450
#	**HTF12025-10.5**	25	120	104	3.5×3	Ⅱ	1 300	4 200	173	213	40	413	17	193	11	116	134	233	Rc1/8	109.25	100	739	464
#	**HTF12025-14**	25	120	104	3.5×4	Ⅲ	1 660	5 600	173	213	40	513	17	193	11	116	134	233	Rc1/8	109.25	100	821	479
	HTF14025-7.5	25	140	124	2.5×3	Ⅱ	1 050	3 610	204	250	40	338	17	226	14	127.5	153	258	Rc1/8	109.25	75	752	531
	HTF14025-10	25	140	124	2.5×4	Ⅲ	1 350	4 810	204	250	40	413	17	226	14	127.5	153	258	Rc1/8	109.25	75	897	572
	HTF14025-10.5	25	140	124	3.5×3	Ⅱ	1 380	4 910	204	250	40	413	17	226	14	127.5	153	258	Rc1/8	109.25	100	939	594
	HTF14025-14	25	140	124	3.5×4	Ⅲ	1 770	6 540	204	250	40	513	17	226	14	127.5	153	258	Rc1/8	109.25	100	1 060	618
	HTF16025-7.5	25	160	144	2.5×3	Ⅱ	1 140	4 140	234	280	40	338	17	256	14	138	173	279	Rc1/8	109.25	75	874	638
	HTF16025-10	25	160	144	2.5×4	Ⅲ	1 450	5 520	234	280	40	413	17	256	14	138	173	279	Rc1/8	109.25	75	1 050	696

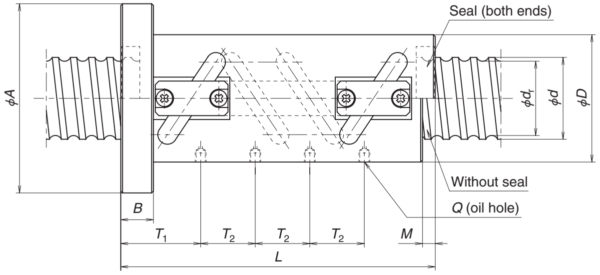
Remarks: 1. If no seals are equipped, the ball nut length will be shortened by dimension *M*.
2. Contact NSK if the applied load will exceed the permissible axial load.
3. Right-turn screws are standard. Contact NSK for left-turn screws.
4. Values for permissible axial load are obtained with S clearance. If the amount of clearance or mounting conditions are different, the permissible axial load will also change.
5. For Model No. marked with #, it is recommended to use the HTF-SRC Model.







Nut model Ⅱ

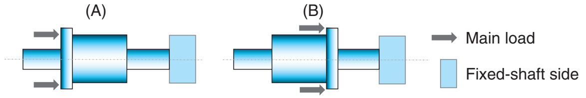


Nut model Ⅲ

Unit: mm

Model No.	Lead	Shaft dia.	Root dia.	Effective ball turns	Nut model	Basic load ratings (kN)		Ball nut dimensions													Permissible axial load (kN)	
				Turns × Circuits		Dynamic	Static														Mounting	*See below
	l	d	d_r			C_a	C_{0a}	D	A	B	L	M	W	X	U	V	Dh	Q	T_1	T_2	[A] Recommended	[B]
HTF14030-7.5	30	140	121	2.5×3	Ⅱ	1 310	4 110	222	282	50	411	22	252	18	139	160	281	Rc1/8	134.5	90	809	613
HTF14030-10	30	140	121	2.5×4	Ⅲ	1 670	5 490	222	282	50	501	22	252	18	139	160	281	Rc1/8	134.5	90	938	659
HTF14030-10.5	30	140	121	3.5×3	Ⅱ	1 710	5 710	222	282	50	501	22	252	18	139	160	281	Rc1/8	134.5	120	987	688
HTF16030-7.5	30	160	141	2.5×3	Ⅱ	1 400	4 760	234	294	50	411	22	264	18	148	177	299	Rc1/8	134.5	90	1 010	708
HTF16030-10	30	160	141	2.5×4	Ⅲ	1 790	6 340	234	294	50	501	22	264	18	148	177	299	Rc1/8	134.5	90	1 190	761
HTF16030-10.5	30	160	141	3.5×3	Ⅱ	1 830	6 520	234	294	50	501	22	264	18	148	177	299	Rc1/8	134.5	120	1 240	786
HTF20030-7.5	30	200	181	2.5×3	Ⅱ	1 550	5 960	290	350	50	411	22	320	18	178	212	359	Rc1/8	134.5	90	1 300	955
HTF20030-10	30	200	181	2.5×4	Ⅲ	1 980	7 950	290	350	50	501	22	320	18	178	212	359	Rc1/8	134.5	90	1 570	1 040
HTF14032-7.5	32	140	118	2.5×3	Ⅱ	1 590	4 740	222	296	70	465	22	259	22	148	163	299	Rc1/8	166.5	96	828	621
HTF14032-10	32	140	118	2.5×4	Ⅲ	2 040	6 320	222	296	70	561	22	259	22	148	163	299	Rc1/8	166.5	96	954	664
HTF14032-10.5	32	140	118	3.5×3	Ⅱ	2 080	6 420	222	296	70	561	22	259	22	148	163	299	Rc1/8	166.5	128	998	690
HTF16032-7.5	32	160	138	2.5×3	Ⅱ	1 660	5 370	234	308	70	465	22	271	22	152	181	307	Rc1/8	166.5	96	1 020	708
HTF16032-10	32	160	138	2.5×4	Ⅲ	2 130	7 160	234	308	70	561	22	271	22	152	181	307	Rc1/8	166.5	96	1 200	757
HTF16032-10.5	32	160	138	3.5×3	Ⅱ	2 180	7 460	234	308	70	561	22	271	22	152	181	307	Rc1/8	166.5	128	1 270	791
HTF20032-7.5	32	200	178	2.5×3	Ⅱ	1 840	6 840	290	364	70	465	22	327	22	182	215	367	Rc1/8	166.5	96	1 340	968
HTF20032-10	32	200	178	2.5×4	Ⅲ	2 360	9 120	290	364	70	561	22	327	22	182	215	367	Rc1/8	166.5	96	1 610	1 050

Remarks: 1. If no seals are equipped, the ball nut length will be shortened by dimension *M*.
2. Contact NSK if the applied load will exceed the permissible axial load.
3. Right-turn screws are standard. Contact NSK for left-turn screws.
4. Values for permissible axial load are obtained with S clearance. (For models with 32mm lead, values are obtained with N clearance, which is the basic specification.) If the amount of clearance or mounting conditions are different, the permissible axial load will also change.



NSK Technical Data Sheet for NSK High-Load Drive Ball Screws

Custom-made ball screw

Company name:	Date:	NSK sales office
Section:	Contact person:	
Address:		

Name of machine*1 : *Electric injection molding machine; 200-ton capacity* Application*2 : *Injection axis*

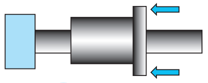
Drawing/rough sketch attached?: ☑ Yes ☐ No

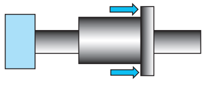
*1 Please specify the capacity of injection molding machines or presses.
*2 Please indicate the axis of injection molding machines (injection, claimping, etc.).

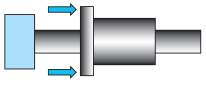
1. Use conditions

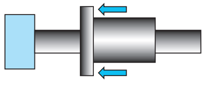
Operating conditions	☑ Shaft rotation — Moving nut ☐ Shaft rotation — Moving shaft ☐ Nut rotation — Moving nut ☐ Nut rotation — Moving shaft	☑ Normal operation ☐ Back drive operation ☐ Oscillation	Degree of vibration/impacts	☐ Smooth operation without impacts ☑ Normal operation ☐ Operation with impacts or vibration
Direction of load*3	☐ Per image below ☐ Other (*Attached*)		Mounting orientation	☑ Horizontal ☐ Vertical (Indicate direction of gravity)
Lubricant	☑ Grease ☐ Oil	(Brand name: *High-load grease with an extreme pressure additive* Maker:)	Lubricant replenishment method	☐ Manual (grease gun, etc.) ☑ Automatic (cm³/ cycles)
Oil holes	☑ Per NSK recommendations ☐ Yes ☐ No			
Seals	☑ Yes	☐ No	NSK S1 ball retaining piece	☑ Per NSK recommendations ☐ No
Environment	Temp : *40* [✓ °C]/ °F	Contaminants ☐ Yes : Particle size (a) 0.1 or less, (b) 0.1 to 0.3, (c) Over 0.3; Material: ☑ No		
Surface treatment	☑ Not required ☐ Low-temperature chrome plating	☐ Fluoride low-temperature chrome plating		☐ Other
Quantity for mass-production	/Month	/Year	/Lot	Quantity used per machine: *1* pcs./machine

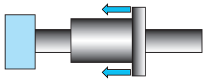
*3 Please specify load direction using the images below. (Fixed-shaft side: ▭, Main load: ←)
Load applied in the opposite direction of the main load indicated by the arrows is defined as "load in direction opposite main load."


[✓ a) C-C (NSK recommended)]


b) T-T


c) T-C


d) C-T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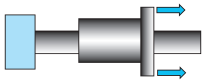
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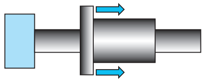
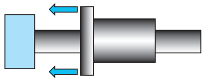

c') T-C


d') C-T

*4 Confirm the strength of the ball screw and nut sections for both load in the direction of main load and in the direction opposite the main load.

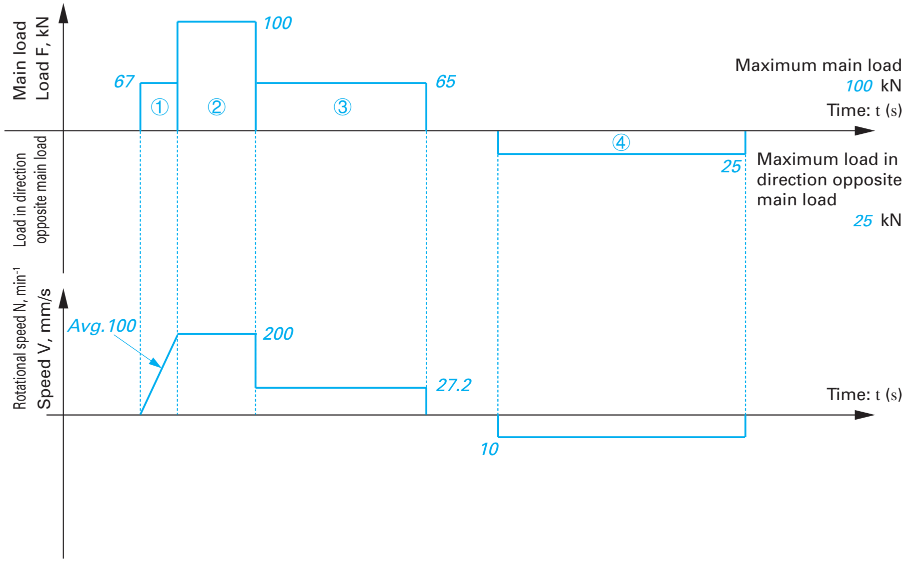
2. Specifications

Shaft diameter	ϕ *63* mm	Lead	*16* mm	Accuracy grade	*Ct7*	Axial play	*0.050 or less* mm max.
Nut Model No.	*HTF-SRC 6316-7.5-S1*	Effective ball circuits	*2.5 × 3*	Direction of turn	*right*	Thread length/ Overall shaft length	*800* / *1200*

Special Notes / Requests

NSK Technical Data Sheet for NSK High-Load Drive Ball Screws

3. Load chart (If using multiple ball screws, fill out the axial load per ball screw.)



	Axial load* F (kN)	Rotational speed or Average speed N (min⁻¹)	 V (mm/s)	Time t (s)	Stroke St (mm)	Remarks
①	*67*		*100*	*0.1*	*10*	
②	*100*		*200*	*0.5*	*100*	
③	*65*		*27.2*	*7*	*190*	
④	*25*		*10*	*30*	*300*	
⑤	*0*		*0*	*10.4*	*0*	
⑥				*Total: 48*	*Total: 600*	
⑦						
⑧						
⑨						
⑩						

Main load	Dynamic axial load (Max.)*:	*100* (kN)	Static axial load (Max.)* (at 0 mm/s):	(kN)
Load in direction opposite main load	Dynamic axial load (Max.)*:	*25* (kN)	Static axial load (Max.)* (at 0 mm/s):	(kN)
	Stroke in normal use:	*300* (mm)	Maximum stroke:	*500* (mm)
	Cycle time:	*48* (s)	Required life:	*40000* (☑ h or ☐ cycles)

*If using multiple ball screws, fill out the axial load per ball screw.

4. Durability test

Test conducted in actual machine → ☐ Yes
→ ☑ No → Test scheduled (Date: *From Mid-March 20XX*)
→ Not scheduled (Reason:)

Endurance of the ball screw

(1) Mounting accuracy, load conditions, and lubricating conditions are the main factors affecting ball screw fatigue life. Therefore, we recommend evaluating the influence of those factors on actual machines.
(2) Temperature rise caused by operational and environmental conditions may reduce the effectiveness of lubricant.
(3) Insufficient or incorrect information for the direction or size of loads may lead to premature failure.

NSK Technical Data Sheet for NSK High-Load Drive Ball Screws

Custom-made ball screw

Company name: Date:
Section: Contact person:
Address:

NSK sales office

Name of machine*1 : ______________________ Application*2 : ______________________

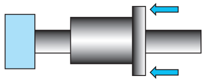
Drawing/rough sketch attached?: ☐ Yes ☐ No

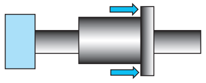
*1 Please specify the capacity of injection molding machines or presses.
*2 Please indicate the axis of injection molding machines (injection, claimping, etc.).

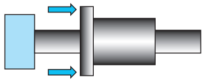
1. Use conditions

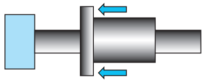
Operating conditions	☐ Shaft rotation — Moving nut ☐ Shaft rotation — Moving shaft ☐ Nut rotation — Moving nut ☐ Nut rotation — Moving shaft	☐ Normal operation ☐ Back drive operation ☐ Oscillation		Degree of vibration/impacts	☐ Smooth operation without impacts ☐ Normal operation ☐ Operation with impacts or vibration
Direction of load*3	☐ Per image below ☐ Other ( )			Mounting orientation	☐ Horizontal ☐ Vertical (Indicate direction of gravity)
Lubricant	☐ Grease (Brand name: ☐ Oil Maker:)			Lubricant replenishment method	☐ Manual (grease gun, etc.) ☐ Automatic (cm^3/ cycles)
Oil holes	☐ Per NSK recommendations ☐Yes ☐No				
Seals	☐ Yes	☐ No		NSK S1 ball retaining piece	☐ Per NSK recommendations ☐ No
Environment	Temp : °C / °F	Contaminants ☐ Yes : Particle size (a) 0.1 or less, (b) 0.1 to 0.3, (c) Over 0.3; Material: ☐ No			
Surface treatment	☐ Not required	☐ Low-temperature chrome plating	☐ Fluoride low-temperature chrome plating	☐ Other	
Quantity for mass-production	/Month	/Year	/Lot	Quantity used per machine	pcs./machine

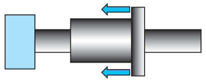
*3 Please specify load direction using the images below. (Fixed-shaft side: 🟦, Main load: ←)
Load applied in the opposite direction of the main load indicated by the arrows is defined as "load in direction opposite main load."

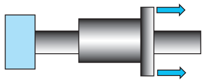

a) C-C (NSK recommended)

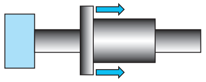

b) T-T

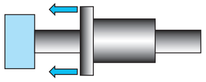

c) T-C


d) C-T


a') C-C


b') T-T


c') T-C


d') C-T

*4 Confirm the strength of the ball screw and nut sections for both load in the direction of main load and in the direction opposite the main load.

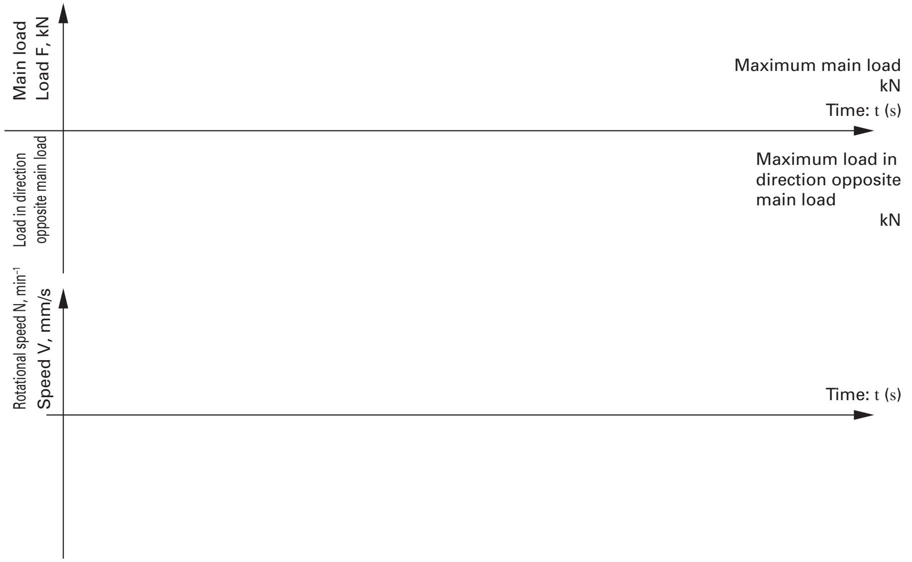
2. Specifications

Shaft diameter	ϕ mm	Lead	mm	Accuracy grade		Axial play	mm max.
Nut Model No.		Effective ball circuits		Direction of turn		Thread length/ Overall shaft length	/

Special Notes / Requests

NSK Technical Data Sheet for NSK High-Load Drive Ball Screws

3. Load chart (If using multiple ball screws, fill out the axial load per ball screw.)



	Axial load*	Rotational speed or Average speed		Time	Stroke	Remarks
	F (kN)	N (min^{-1})	V (mm/s)	t (s)	St (mm)	
①						
②						
③						
④						
⑤						
⑥						
⑦						
⑧						
⑨						
⑩						

Main load	Dynamic axial load (Max.)*:	(kN)	Static axial load (Max.)* (at 0 mm/s):	(kN)
Load in direction opposite main load	Dynamic axial load (Max.)*:	(kN)	Static axial load (Max.)* (at 0 mm/s):	(kN)
	Stroke in normal use:	(mm)	Maximum stroke:	(mm)
	Cycle time:	(s)	Required life:	(☐h or ☐cycles)

*If using multiple ball screws, fill out the axial load per ball screw.

4. Durability test

Test conducted in actual machine → ☐ Yes
→ ☐ No → Test scheduled (Date:)
→ Not scheduled (Reason:)

Endurance of the ball screw

(1) Mounting accuracy, load conditions, and lubricating conditions are the main factors affecting ball screw fatigue life. Therefore, we recommend evaluating the influence of those factors on actual machines.
(2) Temperature rise caused by operational and environmental conditions may reduce the effectiveness of lubricant.
(3) Insufficient or incorrect information for the direction or size of loads may lead to premature failure.

B-3-3.4.1 VSS Model for Contaminated Environments

1. Features

● High dust-resistance

Specially profiled screw shaft grooves and high performance seals prevent the entry of fine contaminants. Reduces particle penetration rate to less than 1/15 existing standard products.

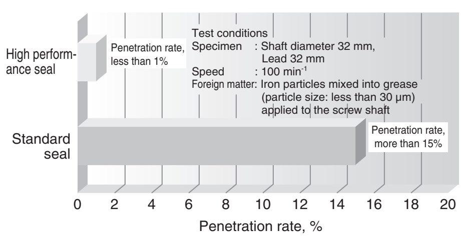
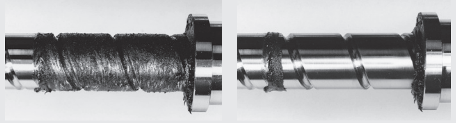


Fig. 1 Particle penetration rate



Before passage through high performance seal

After passage through high performance seal

All contaminants adhering to the screw shaft are swept away after passage through high performance seals.

Fig. 2 Contamination before and after particle penetration test

● Long life

High performance seals extend ball screw durability under severely contaminated environments with iron powder.

Extreme durability tests under contaminated environments show the durability of the VSS model extends life by more than four times that with a standard seal.

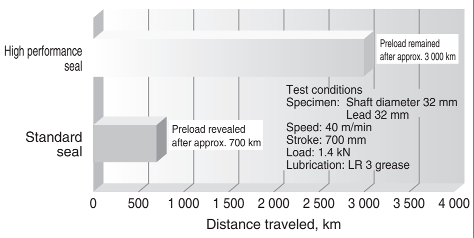


Fig. 3 Extreme durability test results using iron particles

● High speed

For ultimate smoothness of ball recirculation, the internal ball recirculation system enables high-speed operation at a maximum of $d\cdot n$ 150 000. Large lead specifications allow high-speeds of 150 m/min.

● Low-noise

Reduces noise by more than 6 dB(A) compared with our conventional tube recirculation ball screws, thereby providing low-noise and good noise tone features.

● Compact size

Ball nut external diameter is up to 25% smaller than our conventional models.

2. Specifications

(1) Ball recirculation system

End-deflector recirculation systems feature high-speed operation with low-noise, and compact ball nut. The structure of recirculation system is shown in **Fig. 4**.

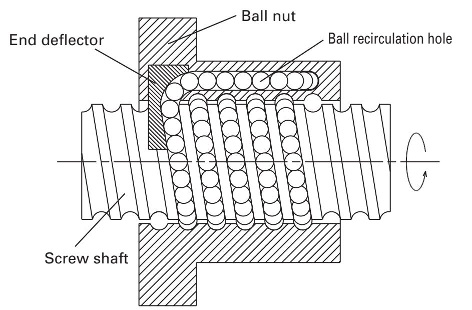


Fig. 4 Structure of end deflector recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	C5
Axial play	Z, 0 mm (preloaded) T, 0.005 mm or less; S, 0.020 mm or less

(3) Allowable *d•n* value and the criterion of maximum rotational speed

The allowable $d\cdot n$ value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Allowable $d\cdot n$ value: 150 000 or less

Criterion of maximum rotational speed: 3 000 min^{-1}

Note: Please also review critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) High performance seal

A high performance seal with special lip that contacts the screw shaft cross-section and prevents entry of fine contaminants.

(5) Lubrication unit

Incorporates NSK K1 lubrication unit to sufficiently lubricate the high performance seal lip, reduce friction, and improve durability.

(6) Options

Non-contact metal protector that traces the ball screw grooves and safeguards the seal against high-temperature foreign matter.

3. Design precautions

When designing the screw shaft end, one end of the screw must meet either one of the following conditions. If not, we cannot install the ball nut on the screw shaft.

- Cut the ball groove through to the shaft end.
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove d_r specified in the dimension tables.

High performance seals may increase torque, which may in turn increase temperature. Please inform NSK about your service conditions using the technical data sheet on page B526.

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

4. Structure of model number and reference number

The following explains the codes used in model numbers and ball screw reference numbers.

◇Model number

VSS 32 10 - 6E

Nut: VSS
Screw shaft diameter (mm)
Lead (mm)
Effective turns of balls

◇Reference number for ball screws

W 36 12 - ** P SS V1 - C5 Z 10

Product code
Screw shaft diameter (mm)
Effective threaded length (in 100 mm units)
Design serial number
Preload code: P; P-Preload (page B5)
End-deflector recirculation system
High performance seal V1
Accuracy grade: C5 (page B37 to B42)
Axial play: Z, T, S (page B20)
Lead (mm)

5. Handling Precautions

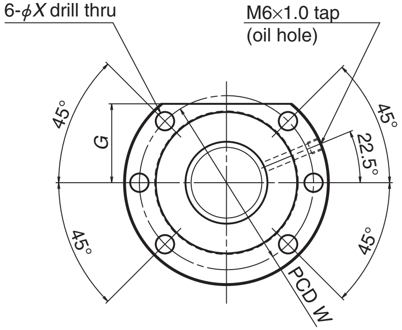
Maximum operating temperature: 50˚C

Maximum momentary operating temperature: 80˚C

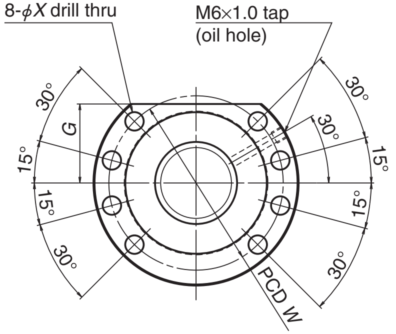
Chemical precautions: Never expose the ball screw to grease-removing organic solvents such as hexane or thinner. Never immerse the ball screw in kerosene or rust preventive oils which contain kerosene.

The data shown in the catalogs 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.

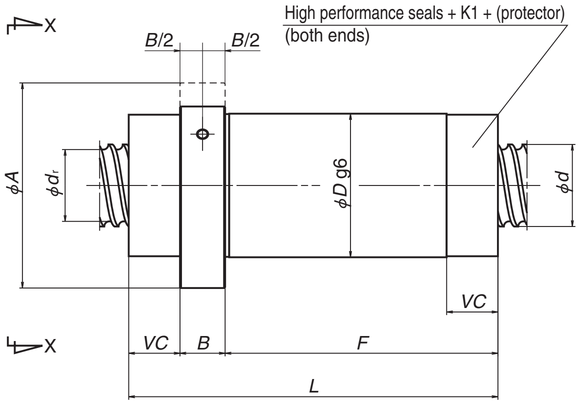
View *X*-*X*



Screw shaft diameter $d = 32$ mm



Screw shaft diameter $d \geq 40$ mm



Unit: mm

Model No.	Shaft dia.	Lead	Root dia.	Effective ball turns	Basic load ratings (N)		Axial rigidity *K* (N/μm)	Ball nut dimensions									Maximum shaft length
					Dynamic	Static		Nut total length	Nut outside diameter	Flange outside diameter	Flange width	Nut length	Notch dimensions	Seal installation dimensions	Bolt hole PCD	Bolt hole dimensions	
	d	*l*	d_r		C_a	C_{0a}		*L*	*D*	*A*	*B*	*F*	*G*	*VC*	*W*	*X*	
VSS3210-6E	32	10	27.2	6	50 900	110 000	720	132	56	86	18	89.5	34	24.5	71	9	2 800
VSS3216-5E		16		5	44 300	90 800	600	150				107.5					
VSS3220-5E		20		5	43 900	91 200	596	169				126.5					
VSS3232-4E		32		4	32 100	65 800	421	122				79.5					
VSS4040-4E	40	40	34.4	4	42 900	94 300	513	144	70	100	22	94.5	38.5	27.5	85	9	3 800
VSS5050-4E	50	50	44.4	4	47 400	117 000	606	164	82	118	22	114.5	46	27.5	100	11	5 000

Notes: 1. Right-turn screws are standard. Contact NSK for left-turn screws.

2. Values for axial rigidity *K* above are theoretical values obtained from the elastic deformation between the screw groove and ball when preload is 1.5% of the basic dynamic load rating C_a and axial load is applied. Refer to the "Technical Description" on page B37 if axial load and preload differ from the conditions above or if deformation of the ball nut body must be considered.

3. Products with clearance (axial play) may have partially negative clearance (preload) depending on the screw length. Refer to page B20 for details.

B-3-3.4.2 Ball Screws with X1 Seals for Contaminated Environments and Grease Retention

1. Features

● High dust resistance

Particle penetration ratio reduced to less than 1/30 existing standard seals, thus contributing to longer service life for machine tools.

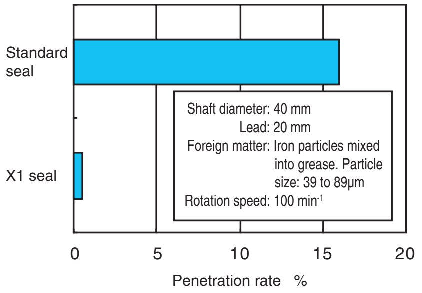


Fig. 1 Results of particle penetration rate test

● Superior grease retention

Automatically adding grease makes it possible to reduce the amount used and keep it from spattering.

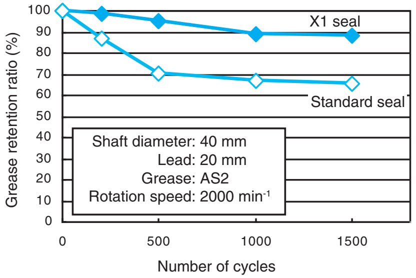


Fig. 2 Results of grease leakage test

● Contact seal with low torque

Optimizing the seal shape reduces torque and enhances seal performance.

2. Specifications

(1) Structure

The ball screw with X1 seals has a double seal structure combining a dust-resistant seal and a grease-retaining seal.

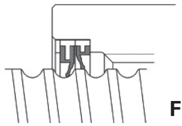


Fig. 3 Seal structure

(2) Scope of application

This model is standard for the following four types.

Ball screws for high-speed machine tools	HMS model	Nut: ZFRC
	HMD model	Nut: EM
	BSS model	Nut: BSS
	Deflector (bridge) recirculation	Nut: ZFD

For specifications other than above, please consult NSK. Table 1 shows the minimum nut outer diameter on which X1 seals can be mounted.

Table 1 The minimum nut outer diameter on which X1 seals can be mounted

Shaft diameter: 28 mm	60 mm
Shaft diameter: 32 mm	56 mm (58 mm)
Shaft diameter: 36 mm	70 mm
Shaft diameter: 40 mm	70 mm (68 mm)
Shaft diameter: 45 mm	82 mm
Shaft diameter: 50 mm	82 mm (78 mm)

Values in parentheses are applicable to the deflector (bridge) recirculation.

(3) Accuracy grade / axial play

Table 2 shows standard tolerance classes and axial clearances. Please consult NSK for tolerance classes other than those in the table.

Table 2 Accuracy grade and axial play

Accuracy grade	C3, C5
Axial play	0 mm (preloaded)

(4) Design-related precautions

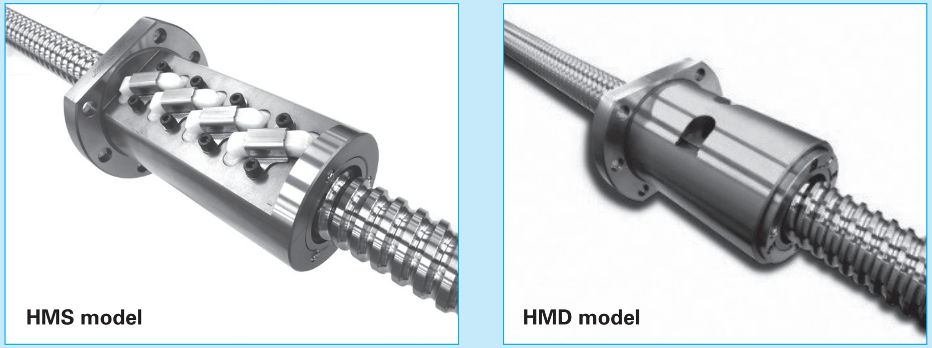
When designing the screw shaft end, assume that the end of the screw shaft is cut.

The temperature will increase somewhat when torque is applied if an X1 seal is attached. Please inform NSK about your service conditions using the technical data sheet on page B526.

Maximum overall shaft length is 2900 mm.

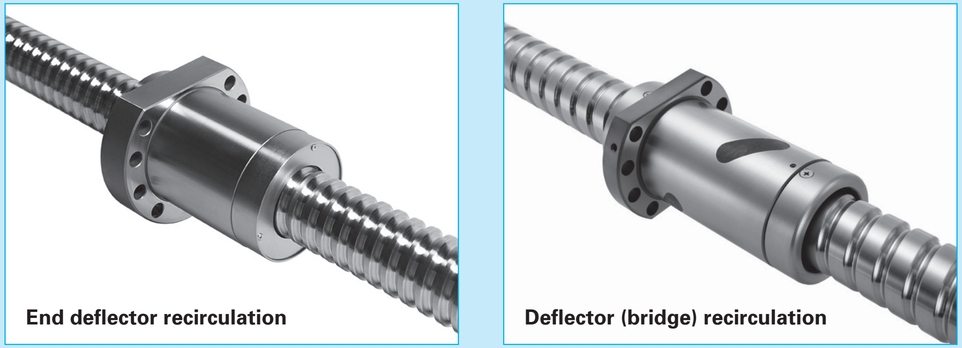
For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

Right-turn screws are the standard. For specifications on left-turn screws, contact NSK.



HMS model

HMD model



End deflector recirculation

Deflector (bridge) recirculation

Fig. 4 External appearance

3. Example reference number

The following explains the codes used in ball screw reference numbers.

Note: "X1" is added at the end of the "nut code" and Provisional Ref. No.

◇Reference number for ball screws

W4010-＊＊ZMX1-C5Z16

X1 seal equipped ball screw code

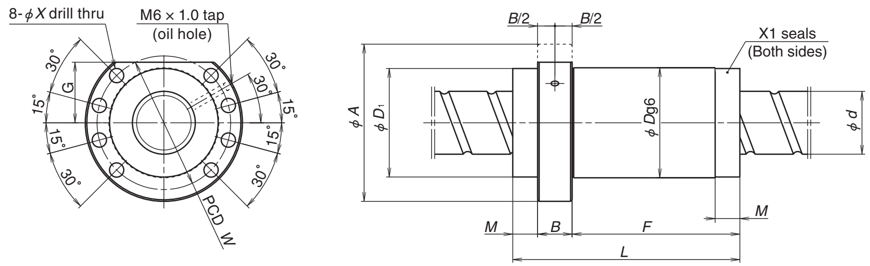
4. Precautions for use

Temperature range for use: Maximum temperature: 60˚C (at outside diameter of ball nut)

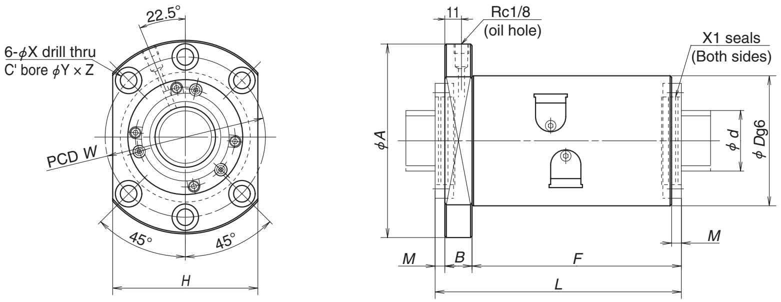
Chemicals to avoid contact with:

Do not leave ball screw in organic solvent, white kerosene such as hexane, thinner which removes oil, or rust preventive oil which contains white kerosene.

The data shown in the catalogs 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.



End deflector recirculation (Nut: BSS)



HMD model (Nut: EM)

Applicable dimensions for End deflector recirculation

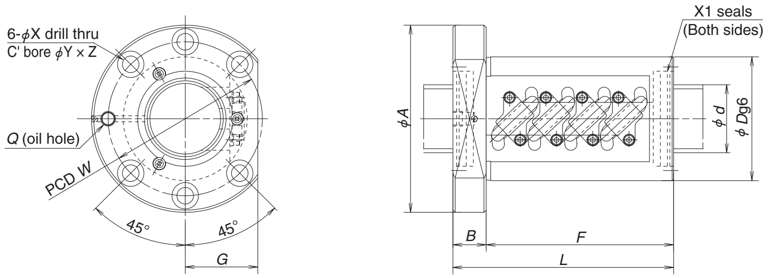
Unit: mm

Model No.	Shaft dia.	Lead	Basic load ratings (N)		Nut dimensions									
			Dynamic	Static	L	F	M	B	D	D1	A	G	Bolt holes	
	d	l	C_a	C_{0a}									X	W
BSS3205-4E	32	5	16 800	41 700	72	41	19	12	56	55	86	34	9	71
BSS3210-6E		10	50 900	110 000	114	80.5	15.5	18		55.5				
BSS3232-4E		32	32 100	65 800	106.5	73				55.4				
BSS3616-10E	36	16	99 100	232 000	140	101	17	22	70	69	100	38.5	9	85
BSS3620-12E		20	116 000	282 000	175	138	15							
BSS4010-5E	40	10	58 100	130 000	112	73	17	22	70	69	100	38.5	9	85
BSS4016-10E		16	105 000	261 000	140	101								
BSS4020-5E		20	57 400	130 000	159	120								
BSS4020-10E		20	104 000	260 000										
BSS4030-6E		30	74 500	168 000	129	101	6		80	76	110	43.5		95
BSS4040-4E		40	42 900	94 300	117	81	14		70	69	100	38.5		85
BSS5010-4E	50	10	52 600	129 000	102	63	17	22	82	81	118	46	11	100
BSS5020-8E		20	94 700	259 000	139	100								
BSS5050-4E		50	64 100	147 000	140	105	13		90	85	135	51	11	112

Applicable dimensions for HMD model

Unit: mm

Model No.	Shaft dia.	Lead	Basic load ratings (N)		Nut dimensions										
			Dynamic	Static	L	F	M	B	D	A	H	Bolt holes			
	d	l	C_a	C_{0a}								X	Y	Z	W
EM2812-3E	28	12	20 900	38 800	115	85.5	11.5	18	65	99	76	9	14	8.5	81
EM4016-4E	40	16	66 900	131 000	172	148	6	18	86	128	96	11	17.5	11	106
EM4020-6E		20	77 900	166 000	164	139	7								
EM4030-6E		30	90 400	190 000	226	201.5	6.5								
EM4516-4E	45	16	69 900	146 000	173	148.5	6.5	18	92	134	102	11	17.5	11	112
EM4520-6E		20	83 200	187 000	164	139	7								
EM5016-4E	50	16	72 700	161 000	173	148.5	6.5	18	98	140	107	11	17.5	11	118
EM5020-6E		20	85 700	205 000	164	139	7								
EM5025-6E		25	103 000	232 000	196	171									
EM5030-6E		30	102 000	235 000	227	202									

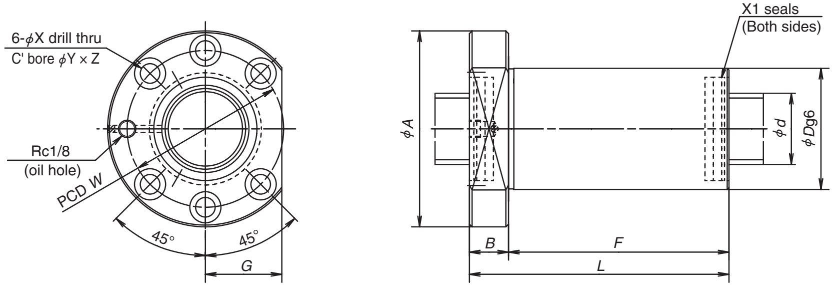


HMS model (Nut: ZFRC)

Applicable dimensions for HMS model

Unit: mm

Model No.	Shaft dia.	Lead	Basic load ratings (N)		Nut dimensions										
			Dynamic	Static							Bolt holes				Oil hole
	d	*l*	C_a	C_{0a}	*L*	*F*	*B*	*D*	*A*	*G*	*X*	*Y*	*Z*	*W*	*Q*
ZFRC2812-7	28	12	26 100	50 200	141	122	19	60	88	33	6.6	11	10.5	73	M6×1
ZFRC3205-10	32	5	21 800	56 000	107	87	20	58	85	32	6.6	11	6.5	71	M6×1
ZFRC4010-10	40	10	61 200	137 000	173	151	22	82	124	47	11	17.5	11	102	Rc1/8
ZFRC4012-10		12	71 700	154 000	197	175		86	128	48				106	Rc1/8
ZFRC4508-10	45	8	44 000	118 000	146	124	22	82	124	47	11	17.5	11	102	Rc1/8
ZFRC5010-10	50	10	68 100	174 000	174	151	23	93	135	51	11	17.5	11	113	Rc1/8
ZFRC5012-10		12	91 500	218 000	200	177		100	146	55	14	20	13	122	Rc1/8



Deflector (bridge) recirculation (Nut: ZFD)

Applicable dimensions for Deflector (bridge) recirculation

Unit: mm

Model No.	Shaft dia.	Lead	Basic load ratings (N)		Nut dimensions									
			Dynamic	Static							Bolt holes			
	d	*l*	C_a	C_{0a}	*L*	*F*	*B*	*D*	*A*	*G*	*X*	*Y*	*Z*	*W*
ZFD3210-8	32	10	28 600	58 600	150	130	20	58	92	36	9	14	8.5	74
ZFD4005-12	40	5	26 500	78 300	119	97	22	68	102	40	9	14	8.5	84
ZFD4006-12		6	35 600	95 200	135	113								
ZFD4008-8		8	32 000	75 000	131	109								
ZFD4010-8		10	45 200	93 100	153	131			110	43	11	17.5	11	88
ZFD4012-8		12	52 300	103 000	177	155		69	111	42.5				89
ZFD5010-8	50	10	51 500	122 000	154	131	23	78	120	47	11	17.5	11	98
ZFD5020-6		20	52 400	109 000	199	176								

NSK Data Sheet for Ball Screws in Contaminated Environments

[Example]

(Please copy) 1/1

Model: Washing machine

Location: Workpiece transfer axis

1. Operating Conditions

Operating Conditions	[✓ a) Shaft rotation – nut moving] b) Shaft rotation – shaft moving c) Nut rotation – nut moving d) Nut rotation – shaft moving	Stroke in Normal Use	400 [mm] (Please indicate operating pattern)
		Mounting Orientation	a) Vertical [✓ b) Horizontal]
Lubricant	[✓ a) Grease] (Brand: AS2) b) Oil (Brand:)	Lubricating Method	a) Automatic [✓ b) Grease gun] (cm^3/ min)
Operating Duration	years 6 months Axial play: 0.1 mm Seal: standard /		

2. Ball Screw Environment (Accessories & Contamination)

Contaminant	Iron particles and washing solution	Contaminant Size	Particle size 30 μm max. -
Cause of Contamination	Does not fall directly on it, but there is a possibility that it could happen. (Please reference with photographs)		
Countermeasures (For already assembled parts, complete after inspection)	[✓ a) Telescopic cover] ~~b) Bellow~~ ~~c) Dust collector~~ ~~d) Dust-resistant lubricant~~ e) Other ( ) (Please supply drawings to demonstrate dust countermeasures)		

3. Ball Screw Dimensions

Screw Shaft Diameter	Φ 32	Lead	5 mm	Accuracy Grade	C5	Axial Play	Z
Nut	ZFRC	Effective ball turns	2.5×2	Direction of Turn	Right	Screw/Overall Length	510 / 750

Remarks

Request X1 seal

4. Durability Test

Durability test → [✓ Scheduled] Scheduled to perform functional evaluation for about 2 months.

→ Not scheduled (Reason:)

Ball Screw Use in Contaminated Environments

※Please read the below and tick the relevant boxes

- ☐ The results for evaluation tests carried out by NSK for dust-resistant seals represent an example under set testing conditions (foreign matter and operating conditions). Seals may be unable to completely prevent contamination under actual conditions and life may be affected by the environment, lubrication conditions, etc.
- ☐ Dust-resistant accessories (covers, lubrication, collectors, etc.) are required in addition to the seals to improve wear life in contaminated environments.
- ☐ Ball screw wear life is greatly impacted by foreign matter entering the nut, offset load from misalignment, and lubricating conditions. The customer is responsible for evaluating and checking final durability in the actual machine.

Company Name:	Date:		NSK Ltd. Sales Representative Sign	NSK Ltd. Sales Manager Sign
Department:	Name:			
Address:	Tel:	Fax:		

NSK Ltd.

NSK Data Sheet for Ball Screws in Contaminated Environments

(Please copy) 1/1

Model:

Location:

1. Operating Conditions

Operating Conditions	a) Shaft rotation – nut moving b) Shaft rotation – shaft moving c) Nut rotation – nut moving d) Nut rotation – shaft moving	Stroke in Normal Use	[mm] (Please indicate operating pattern)
		Mounting Orientation	a) Vertical b) Horizontal
Lubricant	a) Grease (Brand:) b) Oil (Brand:)	Lubricating Method	a) Automatic b) Grease gun (cm^3/ min)
Operating Duration	years months Axial play: mm Seal: standard /		

2. Ball Screw Environment (Accessories & Contamination)

Contaminant		Contaminant Size	Particle size -
Cause of Contamination	(Please reference with photographs)		
Countermeasures (For already assembled parts, complete after inspection)	a) Telescopic cover b) Bellow c) Dust collector d) Dust-resistant lubricant e) Other ( ) (Please supply drawings to demonstrate dust countermeasures)		

3. Ball Screw Dimensions

Screw Shaft Diameter	φ	Lead	mm	Accuracy Grade		Axial Play	
Nut		Effective ball turns		Direction of Turn		Screw/Overall Length	/

Remarks

4. Durability Test

Durability test → Scheduled

→ Not scheduled (Reason:)

Ball Screw Use in Contaminated Environments

※Please read the below and tick the relevant boxes

- ☐ The results for evaluation tests carried out by NSK for dust-resistant seals represent an example under set testing conditions (foreign matter and operating conditions). Seals may be unable to completely prevent contamination under actual conditions and life may be affected by the environment, lubrication conditions, etc.
- ☐ Dust-resistant accessories (covers, lubrication, collectors, etc.) are required in addition to the seals to improve wear life in contaminated environments.
- ☐ Ball screw wear life is greatly impacted by foreign matter entering the nut, offset load from misalignment, and lubricating conditions. The customer is responsible for evaluating and checking final durability in the actual machine.

Company Name:	Date:		NSK Ltd. Sales Representative Sign	NSK Ltd. Sales Manager Sign
Department:	Name:			
Address:	Tel:	Fax:		

NSK Ltd.

B-3-3.5 Twin-Drive Ball Screws

(1) Features

Variations in the lead accuracy and preload torque between two ball screws, which make up a twin-drive unit, are controlled, improving travel accuracy and ball screw operating lifetime.

Fig. 1 shows measured variation in lead accuracy while **Fig. 2** displays an example of variation in thermal expansion between the two ball screws. **Fig. 3** is a schematic diagram comparing the travel accuracy between a twin-drive ball screw and conventional model.

● High rigidity and long lifetime

Twin-drive systems are superior to single-drive systems in system rigidity, supporting the design of the long-life feeding mechanism, even at one size smaller shaft diameter.

● High responsiveness to positioning commands

Twin-drive systems permit the use of screw shaft diameters that are one size smaller, thereby reducing screw shaft inertia by up to 50%, offering high responsiveness to positioning commands.

● Improved high-speed capability and noise level

Twin-drive systems allow the use of smaller screw diameters, resulting in no increase in the level of noise. The end-deflector recirculation system significantly improves high-speed capability and noise levels compared with existing tube recirculation systems, offering high-speed feeding of up to 1 200 mm/min (shaft dia. 40 mm, lead 30 mm, rotational speed 4 000 min^{-1}).

(2) Specifications

Table 1 Specifications of twin-drive systems

Item	End-deflector, Tube, Deflector (bridge)
Shaft dia.	32 – 63 mm
Lead	10 – 30 mm
Accuracy grade	C5
Screw shaft length	3 m or less

(3) Optional specifications

- Hollow shaft ball screw and nut-cooled ball screw
- Provides high accuracy through the use of forced cooling. Please refer to ball screws for high precision machine tools (page B528 to B538) for more details.

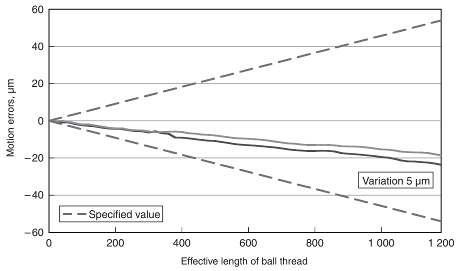
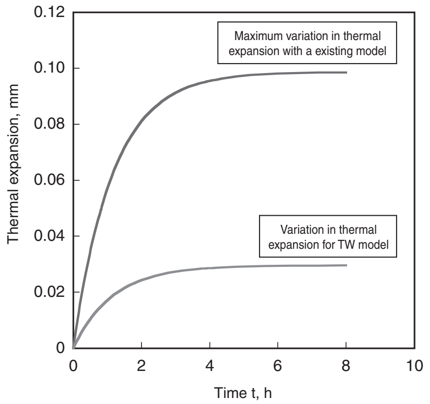


Fig. 1 Example of measured variation in lead accuracy



■Ball screw specifications and other conditions
Shaft dia.: 40 mm
Lead: 20 mm
Torque: 51–106 N·cm
Stroke: 1 000 mm
Maximum rotational speed: 3 000 min^{-1}
Average rotational speed: 230 min^{-1}

Fig. 2 Calculation example of the variation of thermal expansion

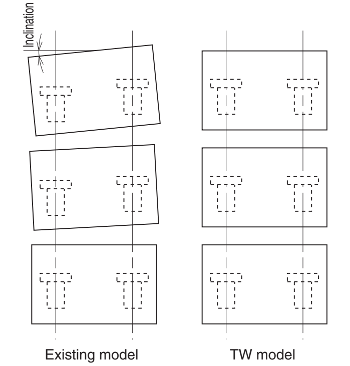


Fig. 3 Schematic diagram of travel accuracy

B-3-3.6.1 Hollow Shaft Ball Screws for High Precision Machine Tools

The increase in speed of the feeding mechanism for highly accurate positioning may require some measures against thermal expansion of the ball screw (forced cooling using hollow ball screw). NSK standardized hollowed screw shafts and shaft end configurations (sealing section and support bearing seat). NSK recommends this as the most effective measure against thermal expansion.

1. Features

●Stable positioning accuracy

Suppresses expansion of the ball screw shaft by rising temperature, and provides stable, precise positioning.

● Prevents displacement of various sections

Minimizes deformation of the ball screw support bearings as well as machine base caused by thermal expansion of the ball screw. Forced cooling keeps heat from spreading to other sections, and prevents the processing table from deforming due to heat.

● Reduces warm-up time

Temperature does not rise high, therefore shortening the machine warm-up period.

● Maintains lubricant's effect

Removes heat from the ball screw, deterring lubricant deterioration.

● Easy design for installation

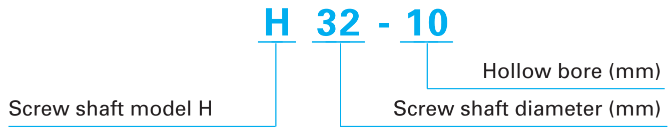
Uses a specialized bearing support unit for NSK ball screws (high speed and high load capacity support unit for machine tools, see page B393) and seal unit (page B531) on the standardized shaft end. This makes designing for mounting easy.

NSK also provides nut-cooled ball screws. The level of temperature rise for nut-cooled ball screw is equal to hollow shaft ball screw thanks to the optimized nut internal design for cooling. Please refer to nut-cooled ball screws (page B533) for more details.

3. Structure of model no.

The following explains the codes used in model numbers:

◇Example model no.



2. Design precautions

Refer to the HMC model, end-deflector recirculation system, tube recirculation system, and deflector (bridge) recirculation system for ball screw specifications. If the overall ball screw length exceeds 3 000 mm, contact NSK. For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling precautions" (page B103).

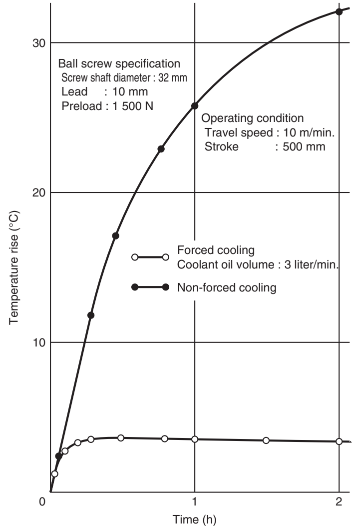
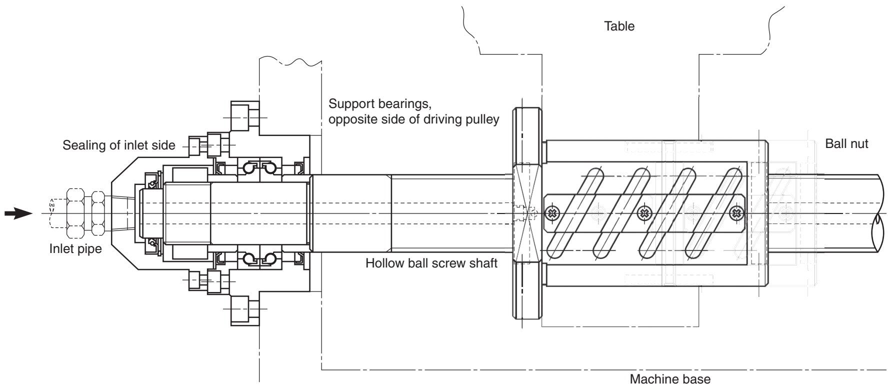
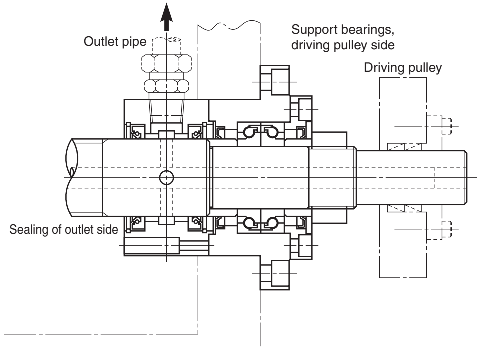
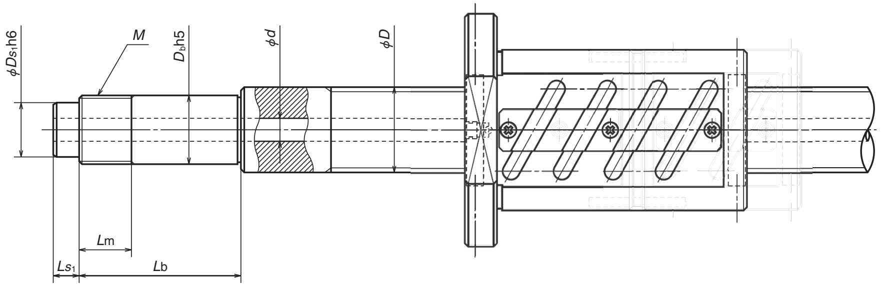


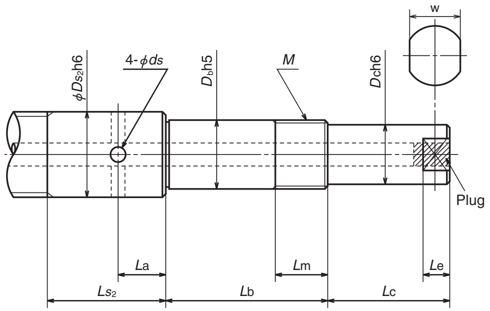
Fig. 1 Effect of forced cooling by hollow shaft ball screw

4. Installation example and standard dimensions









Unit: mm

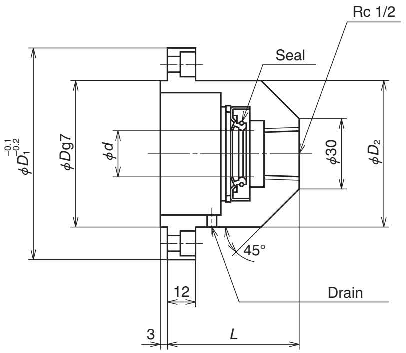
Model No.	Screw shaft		Bearing seat				Sealing						Drive side		Spanner flats		Applicable support unit	Applicable bearing	Equipped seal unit	
	Outside dia.	Bore dia.	Outside dia.	Lock nut			Inlet		Outlet										Shaft end	Shaft outer surface
	D	d	Db	M	Lm	Lb	Ds_1	Ls_1	Ds_2	Ls_2	La	ds	Dc	Lc	w	Le				
H32-10	32	10	25	M25×1.5	26	89 104 119	20	15	32	60	25	6	20	40	17	8	WBK25DF-31H WBK25DFD-31H	25TAC62CSUHPN7C DF arrangement 25TAC62CSUHPN7C DFD arrangement (25TAC62CSUHPN7C DFF arrangement)	WSK20A-01	WSK32B-01
H40-12	40	12	30	M30×1.5	26	89 104 119	25	15	40	60	25	7	25	50	22	10	WBK30DF-31H WBK30DFD-31H	30TAC62CSUHPN7C DF arrangement 30TAC62CSUHPN7C DFD arrangement (30TAC62CSUHPN7C DFF arrangement)	WSK25A-01	WSK40B-01
H50-15	50	15	40	M40×1.5	30	92 107 122	32	15	50	65	27	8	35	70	30	13	WBK40DF-31H WBK40DFD-31H WBK40DFF-31H	40TAC72CSUHPN7C DF arrangement 40TAC72CSUHPN7C DFD arrangement 40TAC72CSUHPN7C DFF arrangement	WSK32A-01	WSK50B-01

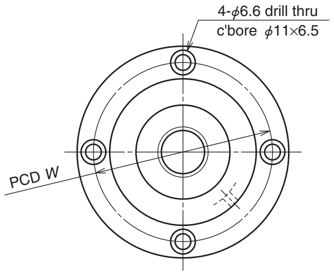
Notes: 1. Please consult NSK for other models.
2. See B404 for bearing arrangement codes.

5. Seal units for hollow ball screw shafts (available by order)

This is an exclusive joint for coolant for the hollow ball screw shaft.

A Type
(for shaft end)

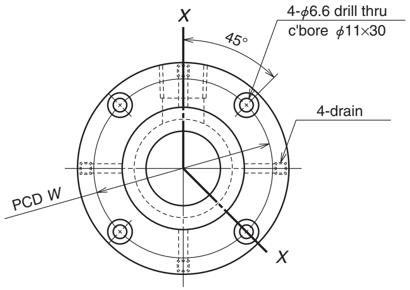


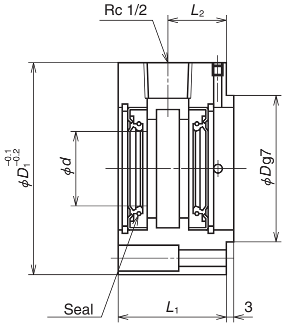


Unit: mm

Reference No.	d	D	D_1	D_2	L	W	Fixing bolt
WSK20A-01	20	57	85	57	56	70	M6
WSK25A-01	25	57	85	57	56	70	M6
WSK32A-01	32	69	95	67	61	80	M6

B Type
(for shaft outer surface)





Section X-X

Unit: mm

Reference No.	d	D	D_1	L_1	L_2	W	Fixing bolt
WSK32B-01	32	57	85	46	25	70	M6
WSK40B-01	40	57	85	46	25	70	M6
WSK50B-01	50	69	95	49	27	80	M6

◇ **Handling precautions**

- Use NSK support units (high speed and high load capacity support units for machine tools on page B393) for installation in order to maintain the eccentricity between screw shaft and seal unit.
- Apply grease to the lip section for protection at the time of installation to the ball screw.
- Make certain that the drain holes (one for A Type, four for B Type) of the seal unit directly face downward when the unit is installed.

B-3-3.6.2 Nut-Cooled Ball Screws for High Precision Machine Tools

Nut-cooled ball screws are easily cooled with a ball nut cooling system and are ideal for use in high-speed and high-precision machine tools that have nut cooling systems.

Using nut-cooled ball screws makes it possible to cool long ball screws that are difficult to cool with hollow-core cooling, and they accommodate the broad high-precision needs of machine tools both small and large.

1. Features

● Cooling effects

By optimizing the cooling structure inside the nut, cooling capacity equivalent to hollow shaft cooling has been achieved. The nut in contact with the table is cooled, so that heat conduction from the table to the ball screw is blocked. Moreover, by cooling the hollow shaft in parallel, the screw shaft and ball nut can be cooled at the same time for even more precise temperature control.

● Internal design in consideration of preload torque change

The nut-cooled ball screw has double contact-point preload in the tensile direction. This prevents an increase in preload torque when the nut is cooled, enabling effective cooling of the ball screw.

● Cooling structure

The cooling fluid goes in a balanced way through the nut.

● Improved handling

Ball screws can be cooled by simply attaching piping to the exterior flange part.* Sliding seals and rotary joints for hollow shaft cooling are not needed. Dimensions for mounting area (without nut cooling) are the same as conventional products, so the nut cooling can be implemented without changing machine designs.

● Long ball screws can be cooled at a low cost

Since these products are suitable for long ball screws for which hollow hole processing is difficult, improved precision of large machine tools can be achieved at a low cost.

2. Design precautions

If heat from the bearing is too great, separate cooling for the bearing and surrounding areas is recommended. For details, please contact NSK.

◇Reference number for nut-cooled ball screws

W4012-＊＊ZMNC-C5Z20

Nut-cooled ball screw code

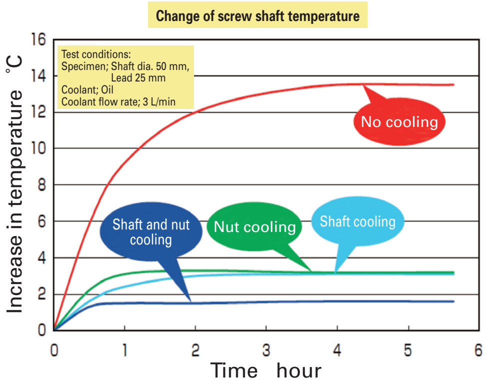
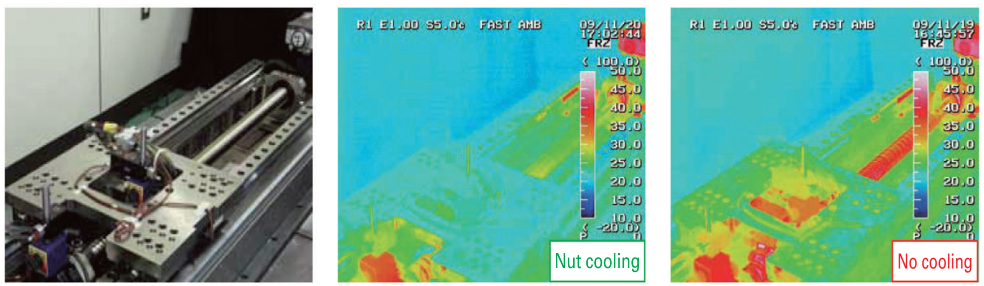


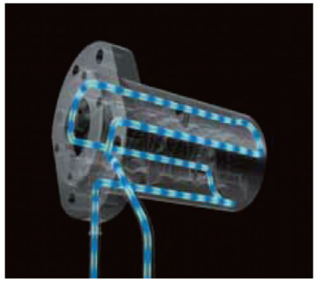
Fig. 1 Effect of forced cooling by nut-cooled ball screw



Test table appearance Temperature distribution with nut cooling Temperature distribution without cooling

Fig. 2 Effect of forced cooling by nut-cooled ball screw

Cooling structure

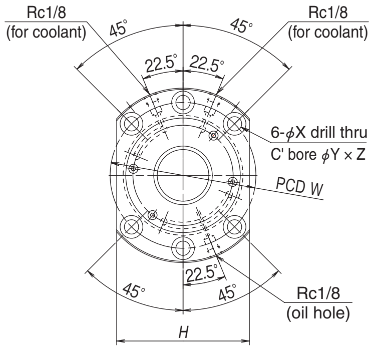


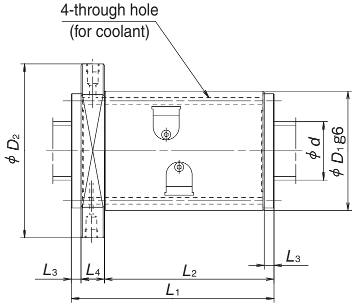
Single nut

Fig. 3 Cooling structure of a nut-cooled ball screw

Nut-Cooled Ball Screws: Dimension Tables

● Nut-cooled ball screws (for HMD model, nut: EM)



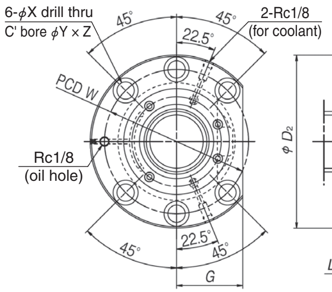


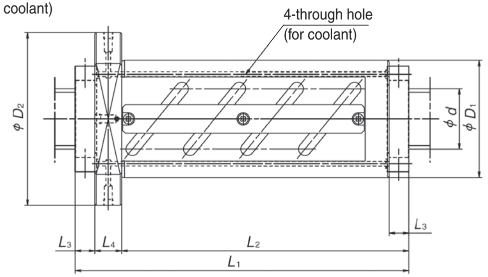
Applicable dimensions for HMD model

Unit: mm

Model No.	Shaft dia.	Lead	Nut dimensions										
	d	l	D_1	D_2	H	L_1	L_2	L_3	L_4	W	X	Y	Z
EM4016-4E	40	16	86	128	96	166	140.5	7.5	18	106	11	17.5	11
EM4020-6E		20				156	130.5						
EM4025-6E		25				188	162.5						
EM4030-6E		30				219	193.5						
EM4516-4E	45	16	92	134	102	166	140.5	7.5	18	112	11	17.5	11
EM4520-6E		20				156	130.5						
EM4525-6E		25				188	162.5						
EM5016-4E	50	16	98	140	107	166	140.5	7.5	18	118	11	17.5	11
EM5020-6E		20				156	130.5						
EM5025-6E		25				188	162.5						
EM5030-6E		30				219	193.5						
EM6316-4E	63	16	122	180	138	176	139	9	28	150	18	26	17.5

● Nut-cooled ball screws (tube recirculation, nut: ZFT)





Dimensions for tube recirculation

Unit: mm

Model No.	Shaft dia.	Lead	Nut dimensions										
	d	l	D_1	D_2	L_1	L_2	L_3	L_4	G	W	X	Y	Z
ZFT5010-15	50	10	93	135	243	205	10	18	51	113	11	17.5	11
ZFT5012-10		12	100	146	219	173	12	22	55	122	14	20	13
ZFT5016-10		16	100	146	280	226	16	22					
ZFT5020-6		20	100	146	257	189	20	28					
ZFT5510-10	55	10	102	144	183	145	10	18	54	122	11	17.5	11
ZFT6310-15	63	10	108	154	247	205	10	22	58	130	14	20	13
ZFT6312-10		12	115	161	219	173	12	22	61	137	14	20	13
ZFT6316-10		16	122	180	272	226	16	28	69	150	18	26	17.5
ZFT6320-10		20	122	180	347	279	20	28					
ZFT8010-10	80	10	130	176	187	145	10	22	66	152	14	20	13
ZFT8012-10		12	136	182	219	173	12	22	68	158	14	20	13
ZFT8016-10		16	143	204	286	226	16	28	77	172	18	26	17.5
ZFT8020-10		20	143	204	343	275	20	28					
ZFT10012-10	100	12	160	220	225	173	12	28	82	188	18	26	17.5
ZFT10016-10		16	170	243	286	226	16	32	91	205	22	32	21.5
ZFT10020-10		20	170	243	347	275	20	32					

B-3-3.6.3 Ball Screws for High-Accuracy Machine Tools

In typical ball screws, when the drive system reverses direction, the motor cannot maintain proper tracking for the resulting sudden changes in friction characteristics (driving torque). This causes motion errors called "quadrant glitches" that leave streaks on the surface of the workpiece requiring additional machining. When using ball screws with offset preload and double nut preload, quadrant glitches appear as two error peaks.

Though this problem was thought to be unavoidable, these ball screws with quadrant glitch control eliminate the "low torque area" characteristic of typical designs. This advancement completely erases the 2nd peak and improves surface finish quality through smooth motion.

1. Features

●Improve surface finish quality

Controlling the 2nd peak with the ball screw itself allows the servo controller to better correct for the 1st peak. As there's no need to correct for the 2nd peak, control parameters can be identified more easily, greatly reducing quadrant glitches overall. With simplified controller compensation, machine tools can achieve a higher quality finished surface.

●Compatible with Existing

Mountings are fully interchangeable with those of conventional products, allowing ball screws forhigh-accuracy machine tools to be used without costly equipment changes.

2. Specifications

Table 1 Specifications of Ball Screws for High-Accuracy Machine Tools

Recirculation System	All
Preload Type	• Offset preload (Z preload) • Double-nut preload (D preload) • Spring double-nut preload (J preload)
Shaft Dia.	25 - 63 mm
Lead	Lead / Shaft Dia.≦1/2
Accuracy Grade	C0 - C5

Note: Some configurations are not available.
Please contact NSK for details.

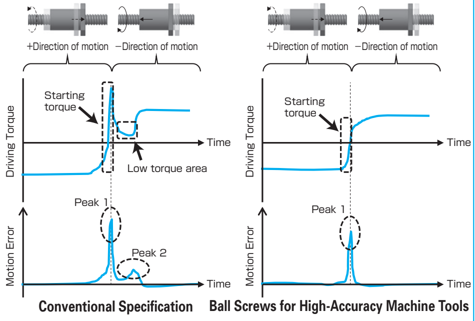


Fig. 1 Motion error and drive torque when reversing direction (schematic)

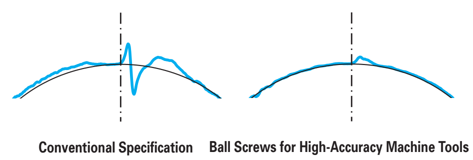


Fig. 2 Motion error during circular interpolation machining (with servo controller compensation, schematic)

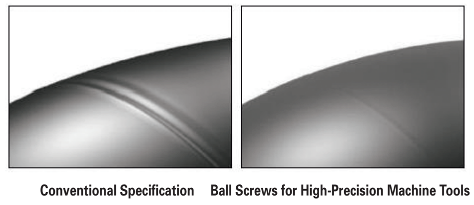


Fig. 3 Enlarged view of machined surface (representation)

3. Design Precautions

Machined surface quality is affected by various factors. This product is designed to improve surface quality by suppressing the 2nd peak of quadrant glitches that occur when using ball screws with offset preload or double-nut preload.This product may not improve the quality of machined surfaces affected by other factors.

The relationship between preload, dynamic preload torque, and nut rigidity for this product is different than that for conventional ball screws.

Please contact NSK for details.

B-3-3.6.4 High-Durability Precision Ball Screws

High-durability precision ball screws use NSK's exclusive surface-processing technology to improve the formation of the lubricating oil film on the surface of the ball screw raceway.

This helps suppress screw wear, enabling long-term stable operation of equipment and extended periods between maintenance.

1. Features

●Preserves high precision over time

Improved oil film formation helps suppress wear caused by metal-to-metal contact and maintains high precision over long periods.

This capability makes high-durability precision ball screws especially suited to low-speed and short-stroke operations where oil film formation is difficult.

●Extended maintenance cycles

Longer accuracy life allows for stable operation of equipment long-term, with extended intervals between maintenance.

●Reduced energy consumption

Improved oil film formation reduces dynamic friction torque at low speeds by up to 40% compared to conventional products, helping to save energy.

●Compatible with Existing Mountings

Mountings are fully interchangeable with those of conventional products, allowing high-durability precision ball screws to be used without costly equipment changes.

2. Specifications

Table 1 Available Specifications for High-Durability Precision Ball Screws

Recirculation System	Any
Preload Type	Any
Shaft Dia.	20 - 63 mm
Shaft Length	Up to 3000 mm
Nut Length	Up to 250 mm
Accuracy Grade	Any except C0
Seal	Any
Surface Treatment (Plating, etc.)	None

Please contact NSK for availability of other options.

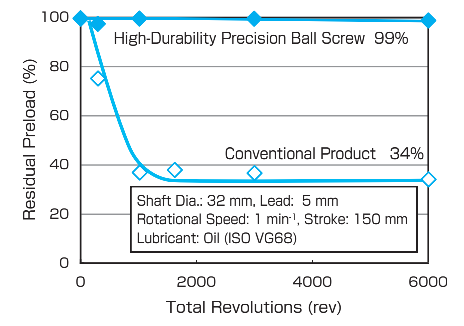


Fig. 1 Low-speed wear test results

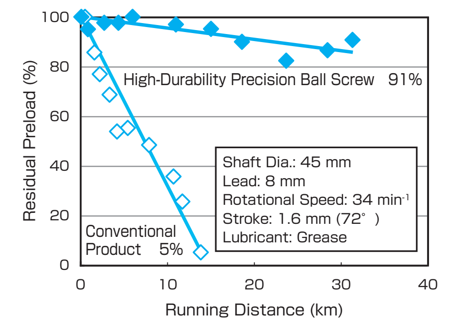


Fig. 2 Short-stroke wear test results

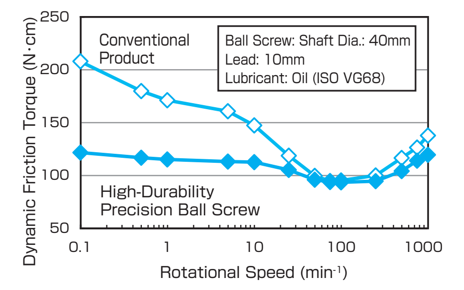


Fig. 3 Test results about rotational speed and dynamic friction torque

Note:
Data shown is based on testing and is not a guarantee of performance in actual equipment. As the accuracy life of ball screws is significantly affected by the operating environment, take measures to protect equipment from dust and contaminants using covers, seals, etc. as necessary.

B-3-3.7 Rotary Nut Ball Screws

A rotary nut ball screw is developed as a unit into which angular contact support ball bearings are integrated. It is best suited for an application that requires rotation of the ball nut while the screw shaft is fixed.

NDT model

1. Structure

Balls are installed between the assembly housing and the ball nut. The outer bearing rings are integrated into the assembly housing and thus, a compact design is attained.

A timing pulley (prepared by the user) is directly secured to the end face of the nut.

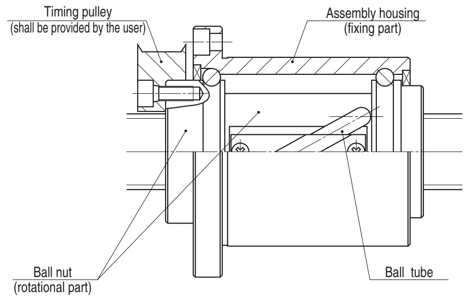


Fig. 1 Ball nut structure

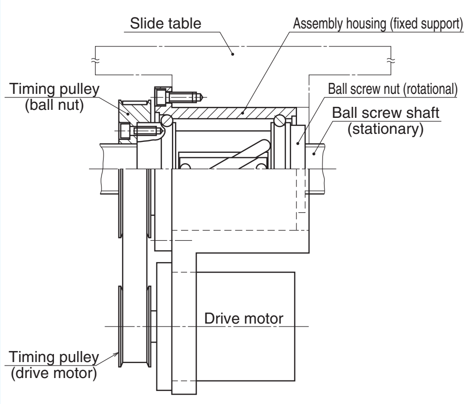


Fig. 2 Example of installation to the slide

2. Features

- Multi-nut drive

Two or more nut units can be installed in a single ball screw shaft. They can be operated by respective motors.

- High operation speed

High feeding speed operation, yet low rotational speed is feasible by medium to high-helix lead ball screws.

- Easy installation

Merely install a mount housing to the table of the machine to take advantage of this multi-nut rotation system.

- Simple shaft end configuration

Shaft end configuration is simple because this unit does not need support bearings.

- Shaft diameter/lead combination

There are 10 types of "shaft diameter/lead" combinations.

Selections are: Shaft diameters -- 32, 40, 50 mm; Leads -- 20, 25, 32, 40, 50 mm.

- Low inertia

Compared to conventional NSK products (end cap ball recirculation system), rotational inertia was reduced by up to 16%.

3. Specifications

(1) Ball recirculation system

The structure of the tube recirculation system is shown below.

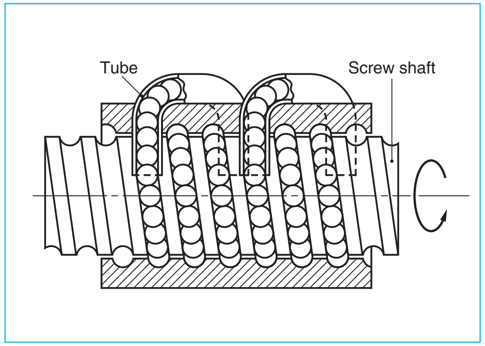


Fig. 3 Structure of ball tube recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grades and axial play are as follows. Please consult NSK for other grades.

Table 1 Axial play

Axial play code	Z	T	S
Axial play	0	0.005 mm or less	0.020 mm or less

Table 2 Combination of accuracy grades and axial play

Accuracy grade	C3	C5	Ct7
Axial play code	Z, T, S	Z, T, S	S

4. Allowable d•n value and the criterion of maximum rotational speed

The allowable *d·n* value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Note: The basic concept is the same as that of general ball screws. Refer to "Technical Description: Permissible Rotational Speed" (page B47).

Table 3 Allowable d•n value and the criterion of maximum rotational speed

Allowable *d·n* value	Standard specification	70 000 or less
	High-speed specification	100 000 or less
Criterion of maximum rotational speed	3 000 min^{-1}	

d·n value: shaft dia. d [mm] × rotational speed n [min^{-1}]

- Critical speed n_c

As shown **Fig. 4**, calculate mounting distance (mm) of L_1, L_2, and L_3 (assume that the nut section is a fixed support.) **Table 4** shows coefficient "*f*" of each shaft end mounting condition.

$$n_c = f \cdot \frac{d_r}{L_i^2} \times 10^7 \ (\mathrm{min}^{-1}) \qquad (\text{Ⅲ-1})$$

d_r: Screw shaft root diameter (See the dimension table.)

L_i: Distance between support positions (mm) (See **Fig. 4**)

f : Factor determined by the ball screw shaft end mounting condition

Table 4

Shaft end mounting condition	*f*
Fixed -- Fixed	21.9
Fixed -- Simple	15.1
Fixed — Free	3.4

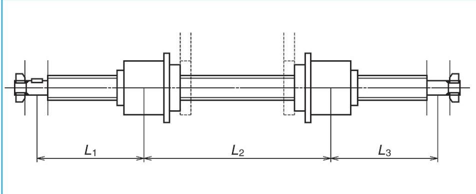


Fig. 4 Installation example

5. Design precautions

One end of the screw thread should be cut-through to the end. Also, if the nut must be removed from the screw shaft, the user should have an arbor to prevent the balls from falling out during this process. (NSK manufactures arbors on request.)

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

NDD model: (Incorporating vibration damper)

An increase in stroke length may restrict required rotational speed of a ball screw due to critical speed even if there is no *d·n* limitation.

In such a case, we recommend using NDD model rotary nut ball screws equipped with vibration dampers.

This makes it possible to operate a ball screw exceeding the critical speed, which is conventionally considered impossible.

Notes: 1) However, the NDD model cannot be used exceeding the *d·n* limitation. Please consult with NSK in such a case.

2) You cannot rotate the screw shaft of the NDD model.

1. Structure

Hollow ball screw shafts have a mechanism to absorb vibration energy (vibration damper). This increases dynamic rigidity of the screw shaft and lowers vibration when exceeding the critical speed.

Construction of the ball nuts are the same as those of the NDT model.

2. Features

- No need for measures against critical speed.

Conventionally, an increase in screw shaft diameter or use of intermediate support is the measure against critical speed. NDD model ball screw will make these measures needless.

- Dimensional interchageability with NDT model ball screws

The vibration damper is set inside the ball screw shaft, and therefore, there is no difference with the existing model in regards to external dimensions. The ball nuts of NDD models are interchangeable with those of NDT models.

- Others

Benefits include multiple ball nuts on a screw shaft, high feeding speed for long stroke, easy installation, and low inertia of ball nuts identical to the NDT model.

3. Specifications

Recirculation system, accuracy grade, axial play and preload are the same as the NDT model.

4. Design precautions

Design precautions are identical to those of the NDT model.

5. Permissible rotational speed

The d•n value is the same as the NDT model.
You don't need to consider the critical speed.

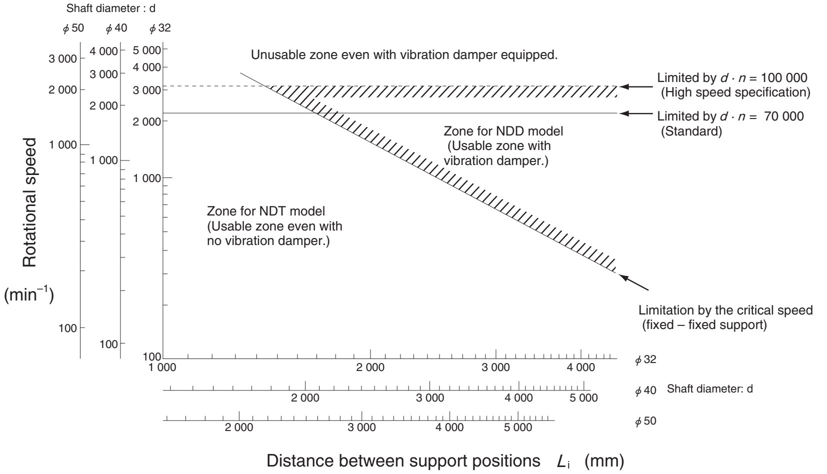
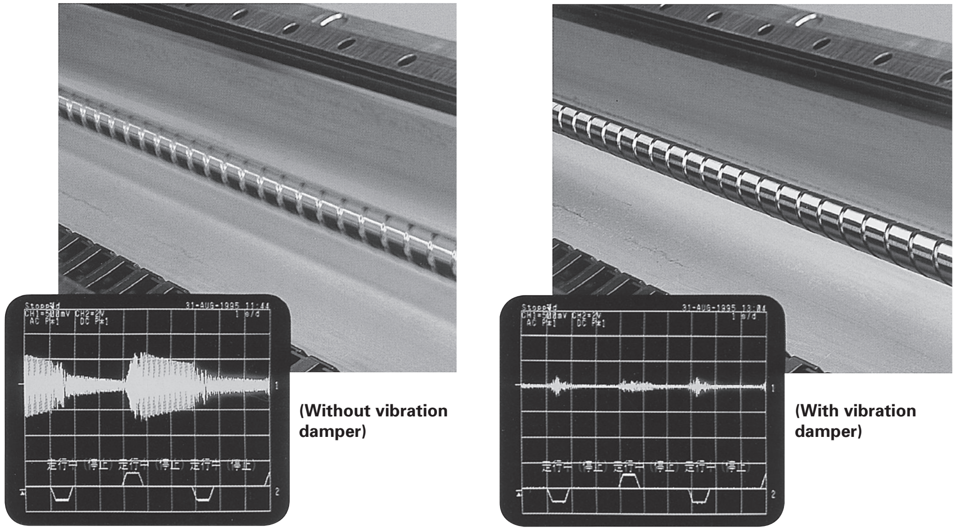


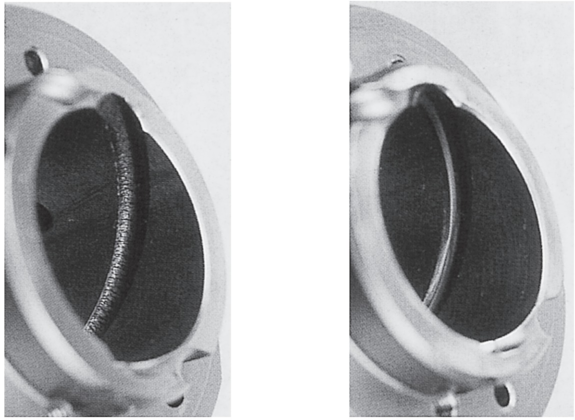
Fig. 5 Rotational speed and distance between support positions for NDT and NDD models



(Without vibration damper)

(With vibration damper)

Fig. 6 Vibration of screw shaft when nut is rotating



(Without vibration damper)

(With vibration damper)

Fig. 7 Effect of vibration damper (results of endurance test)

Example calculation of permissible rotational speed

[Example calculation]
Assume a system which moves two nuts on a shaft as shown below.
Does this system operate appropriately if: both ends of the ball screw (shaft diameter 40 mm/lead 40 mm) are fixed, and the travel speed is at 60 m/min?

[Answer]
The rotational speed n (min^{-1}) when the lead of the ball screw is 40 mm, and the travel speed is at 60 m/min is:

$$n = \frac{60 \times 10^3}{40} = 1\,500 \ (\text{min}^{-1})$$

● Calculate $d \cdot n$ value

As the $d \cdot n$ value of standard specification is 7 000, therefore, permissible rotational speed is:

$$n \leq \frac{70\,000}{40} = 1\,750 \ (\text{min}^{-1})$$

● Calculate critical speed

The maximum distance between support positions comes between Nut A and B.

$L_2 = 3\,300$ (mm)
$f = 21.9$ (Fixed-Fixed)
Root diameter: $d_r = 35.1$ (mm)

Therefore, the permissible rotational speed is;

$$n \leq \frac{21.9 \times 35.1}{3\,300^2} \times 10^7 = 706 \ (\text{min}^{-1})$$

The calculation indicates that the $d \cdot n$ value is at the safe level. But critical speed exceeds the limitation. However, with a vibration damper, the system can be operated at 1 500 min^{-1}.

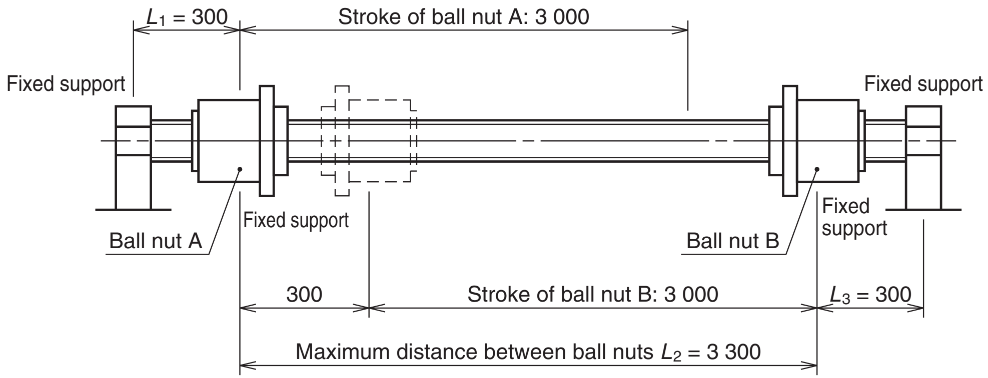
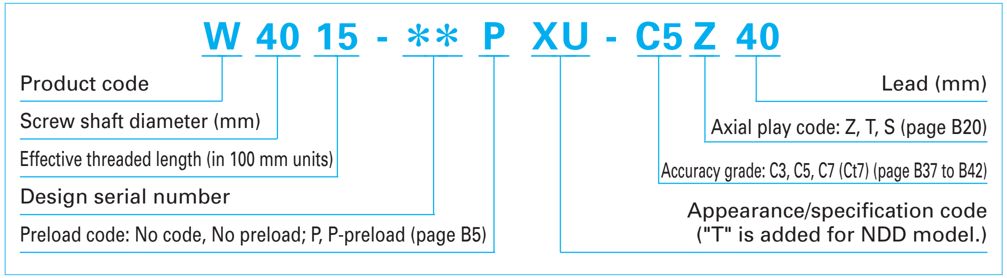


Fig. 8 Example calculation of permissible rotational speed

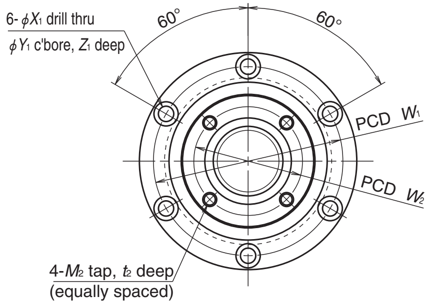
Structure of reference number

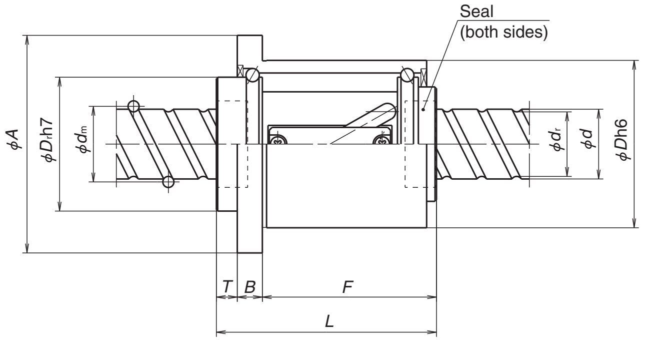
The following explains the codes used in reference numbers:

◇Reference number for ball screws



ND Model for Rotary Nut Drives





Unit: mm

Model No.	Shaft dia. d	Lead ℓ	Ball dia. D_w	Ball pitch circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load ratings (N)		Moment of inertia, ball nut J (kg·cm^2)	Ball nut mass W (kg)	Ball nut dimensions													Tap hole PCD W_2
							Dynamic C_a	Static C_{0a}			Nut total length L	Nut outside diameter D	Flange outside diameter A	Flange width B	Nut length F	Projection tube dimensions D_r	T	Bolt hole dimensions X_1	Y_1	Z_1	Bolt hole PCD W_1	Tap hole dimensions M_2	t_2	
NDT **NDD** **3220-2.5**	32	20	4.762	33.25	28.3	2.5×1	20 700	41 900	6.2	2.9	107	78	105	12	83	60	12	6.6	11	6.5	91	M6	12	50
NDT **NDD** **3225-2.5**		25	4.762	33.25	28.3	2.5×1	20 400	42 200	6.7	3.2	120	78	105	12	96	60	12	6.6	11	6.5	91	M6	12	50
NDT **NDD** **3232-1.5**		32	4.762	33.25	28.3	1.5×1	13 300	25 200	6.2	2.9	107	78	105	12	83	60	12	6.6	11	6.5	91	M6	12	50
NDT **NDD** **3232-3**						1.5×2	24 100	50 400																
NDT **NDD** **4025-2.5**	40	25	6.35	41.75	35.1	2.5×1	34 100	70 100	19.3	6.0	136	100	133	15	106	76	15	9	14	8.5	116	M8	16	62
NDT **NDD** **4032-1.5**		32	6.35	41.75	35.1	1.5×1	21 600	41 300	18.0	5.5	122	100	133	15	92	76	15	9	14	8.5	116	M8	16	62
NDT **NDD** **4032-3**						1.5×2	39 300	82 700																
NDT **NDD** **4040-1.5**		40	6.35	41.75	35.1	1.5×1	21 200	42 000	19.2	6.0	136	100	133	15	106	76	15	9	14	8.5	116	M8	16	62
NDT **NDD** **4040-3**						1.5×2	38 500	84 000																
NDT **NDD** **5025-2.5**	50	25	7.938	52.25	44.0	2.5×1	51 300	110 000	45.7	8.5	140	120	156	18	107	96	15	11	17.5	11	136	M10	18	78
NDT **NDD** **5032-2.5**		32	7.938	52.25	44.0	2.5×1	50 900	109 000	48.9	9.4	158	120	156	18	125	96	15	11	17.5	11	136	M10	18	78
NDT **NDD** **5040-1.5**		40	7.938	52.25	44.0	1.5×1	32 300	64 600	45.5	8.5	140	120	156	18	107	96	15	11	17.5	11	136	M10	18	78
NDT **NDD** **5040-3**						1.5×2	58 700	129 000																
NDT **NDD** **5050-1.5**		50	7.938	52.25	44.0	1.5×1	31 700	65 700	48.7	9.4	158	120	156	18	125	96	15	11	17.5	11	136	M10	18	78
NDT **NDD** **5050-3**						1.5×2	57 500	131 000																

Notes:
1. Right-turn screws are standard. Contact NSK for left-turn screws.
2. Seals are standard equipment.

B-3-3.8 Σ (Sigma) Model for Robots

1. Features

Σ model (NSK's Robotte) is a ball screw with a high-performance spline. It is ideal for various actuators such as the vertical axis of SCARA robots.

A ball screw groove and a ball spline groove are made in one shaft, combining the ball screw and the ball spline.

Mount housing, nuts, and support bearings are combined into a single unit.

Timing pulley (prepared by the user) is directly secured at the end face of the nut.

● High functions

A single shaft has both feeding mechanism and guide functions. This allows the shaft ends to move back and forth (linear motion), as well as to rotate.

● Compact and lightweight

A ball screw nut and a spline nut are placed on one shaft, and support bearings are combined to the unit. This allows for a compact and high-precision design. Hollow shafts are standard to reduce weight. The hollow shaft can be used for wiring and piping. Other components are also designed to be light in weight.

● Low intertia

Tube recirculation decreases the outside diameter of the nut, allowing for a low intertia design.

It reduces the inertia by 19% of conventional products.

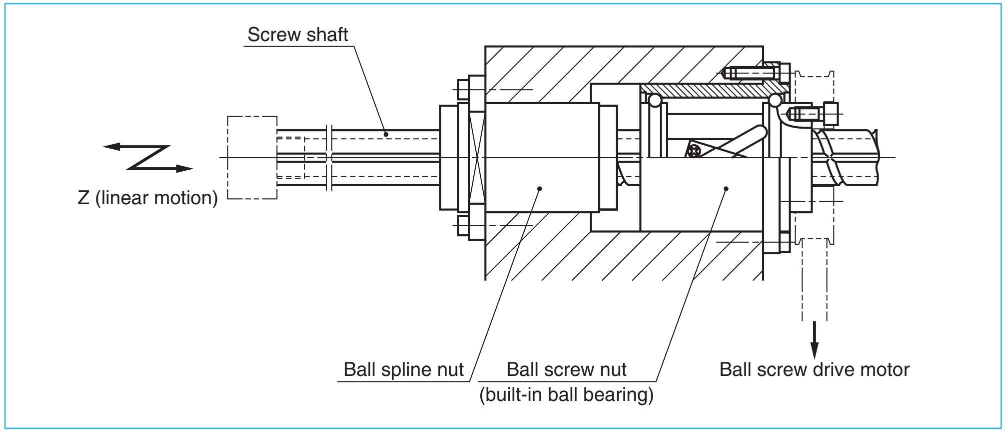


Fig. 2 Example structure of single Z axis unit

2. Functions

As shown in **Fig. 1**, the ball screw nut and a spline nut are rotated independently to control rotation. Thereby the shaft can move in any direction -- linear and rotational. **Table 1** shows the relationship between power input and output.

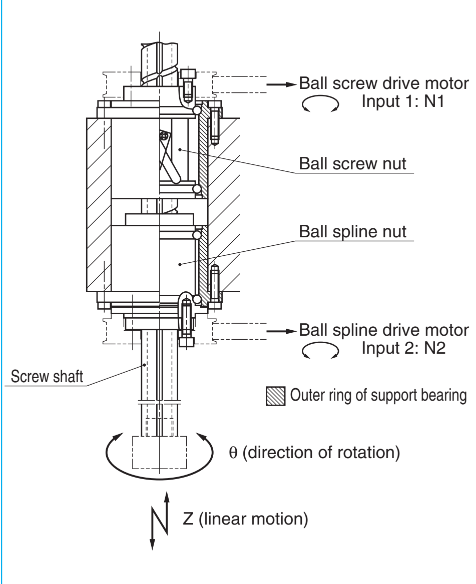


Fig. 1 Example structure of Z axis plus θ axis actuator

Table 1 Power input and output of Σ model

Shaft movement (output)		Input		
Z (vertical movement) (mm/min)	θ (rotational movement) (min^{-1})	① Ball screw (min^{-1})	② Spline (min^{-1})	Notes
Up, down N1× l	Stop 0	Rotate N1	Stop 0	–
Stop 0	Rotate N2	Rotate N1	Rotate N2	N1 = N2
Up, down N2× l	Rotate N2	Stop 0	Rotate N2	–
Up, down $\vert$N1–N2$\vert$× l	Rotate N2	Rotate N1	Rotate N2	N1≠N2

3. Specifications

(1) Ball recirculation system

The structure of the tube recirculation system is shown below.

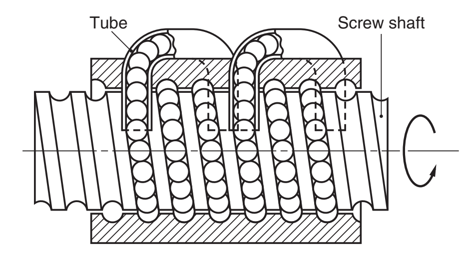


Fig. 3 Structure of tube recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grades and axial play for ball screw are as follows. The axial play for the spline is 0 mm (preloaded product). Please consult NSK for other grades.

Table 2 Accuracy grade and axial play

Accuracy grade	C3, C5, Ct7
Axial play	Z, 0 mm (preloaded) T, 0.005 mm or less; S, 0.020 mm or less

(3) Allowable d•n value, the criterion of maximum rotational speed and maximum speed

The allowable *d·n* value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Permissible d•n value: 70 000 or less

Criterion of maximum rotational speed: 3 000 min^{-1}

Maximum speed: 100 m/min

Note: Please also review the critical speed.

For details, see "Technical Description: Permissible Rotational Speed" (page B47).

(4) Applications

SCARA and Cartesian industrial robots, semiconductor manufacturing machines, machines for automobile production facilities, material handling systems, other Z (vertical) axis and Z axis plus θ (rotation) axis actuators.

4. Design precautions

The overall length L can be extended to 25 times the shaft diameter.

To remove the spline nut from the shaft for assembling, use an arbor as shown in **Fig. 4.** (page B573). Avoid removing ball screw nuts as much as possible. Refer to root diameter in the dimension tables for arbor diameters. (NSK manufactures arbors on request.)

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

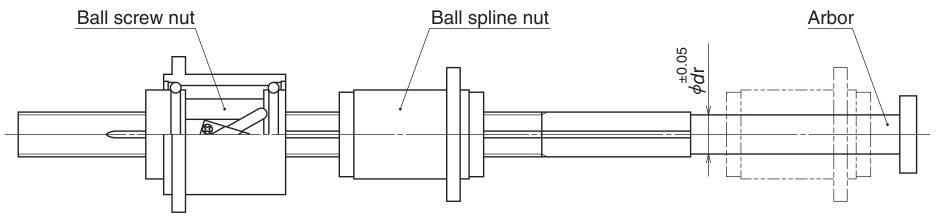
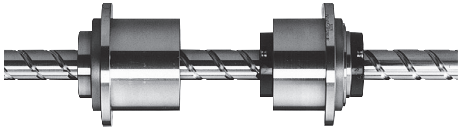
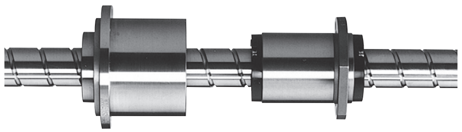
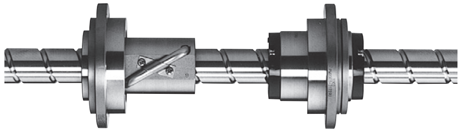
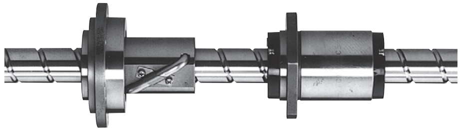


Fig. 4 Removing spline nut

5. Lineup

The Σ model (NSK's Robotte) comes in four varieties with different functions and performance. Select a standard model if rigidity is important. A compact system is recommended for reducing weight.

Table 3 Σ Model lineup

Model	Appearance	Size	Structure (Movement)
Σ		Standard	Z+θ Unit
ΣZ		Standard	Z Unit
ΣC		Compact	Z+θ Unit
ΣCZ		Compact	Z Unit

6. Load rating and life

The relationship between load rating of the ball spline section and life is the same as other NSK linear motion products. However, various loads that apply to Robotte must be taken into account. For example, the following factors must be considered in calculating life when the product is used as shown in **Fig. 5**.

Fa : Load that is generated when the shaft moves vertically. (Load is applied to the ball screw nut.)

T : Torque that is generated to the shaft by F_a.

Fr : Load that is generated by moment of inertia of the shaft and the work attached to Robotte as well as by centrifugal force when the arm rotates.

θ : Direction of F_r load that changes by shaft rotation.

NSK has life calculation programs which take these factors into account. Please ask NSK for more details.

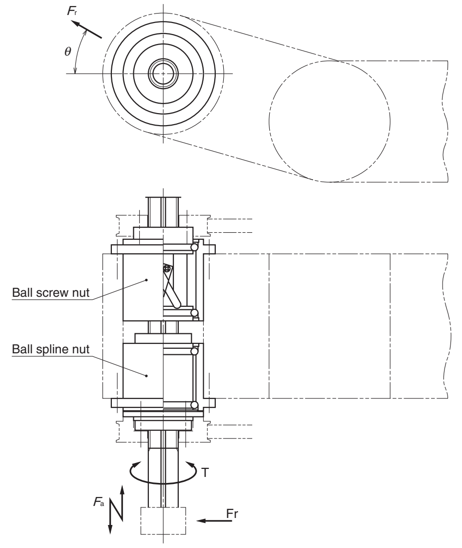
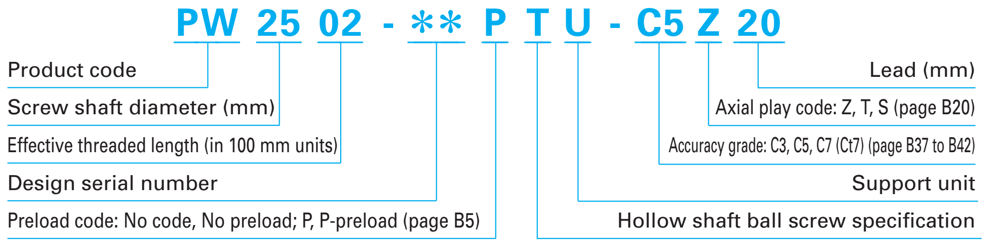


Fig. 5 Example structure of Z axis plus θ axis actuator

7. Structure of reference number

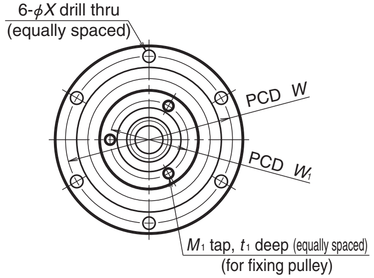
The following explains the codes used in reference numbers:

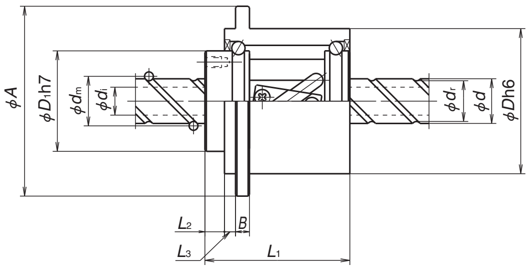
◇Reference number for ball screws

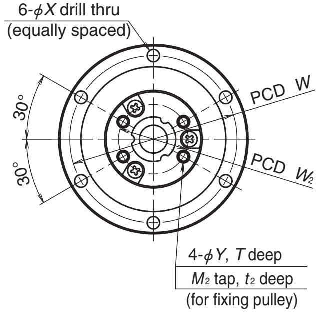


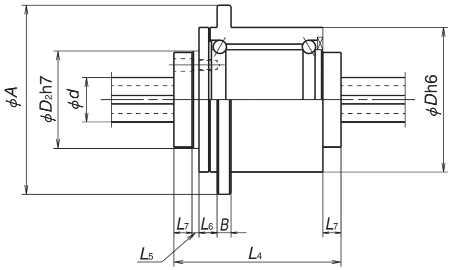
PW 25 02 - ＊＊ P T U - C5 Z 20

PW: Product code
25: Screw shaft diameter (mm)
02: Effective threaded length (in 100 mm units)
＊＊: Design serial number
P: Preload code: No code, No preload; P, P-preload (page B5)
T: Hollow shaft ball screw specification
U: Support unit
C5: Accuracy grade: C3, C5, C7 (Ct7) (page B37 to B42)
Z: Axial play code: Z, T, S (page B20)
20: Lead (mm)









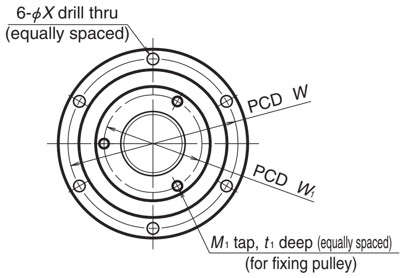
Unit: mm

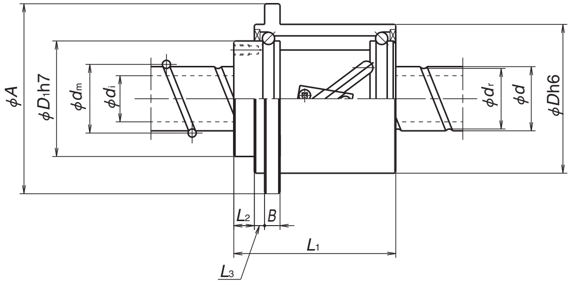
Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Screw shaft bore dia.	Ball screw nut															
							Basic load ratings (N)		Dimensions												Moment of inertia (kg·cm²)	Mass (kg)
	d	l	D_w	d_m	d_r	d_i	Dynamic C_a	Static C_{0a}	D	A	B	L_1	L_2	L_3	M_1	t_1	W_1	D_1	W	X		
∑1610	16	10	3.175	16.75	13.4	(8)	5 610	8 300	48	64	5	47	7	4	3-M4	6	28	35	56	4.5	0.41	0.50
∑1632		32					3 600	5 200				52									0.44	0.55
∑2010	20	10	3.175	20.75	17.4	(14)	9 560	17 300	54	70	6	57	8	4	3-M4	6	32	40	62	4.5	0.64	0.74
∑2020		20					6 100	10 500				63									0.65	0.81
∑2040		40					4 050	7 020				57									0.64	0.74
∑2510	25	10	3.175	25.75	22.4	(18)	10 700	22 000	58	74	6	57	8	4	3-M4	6	38	45	66	4.5	1.10	0.81
∑2520		20					6 860	13 100				63									1.18	0.88
∑2525		25					6 720	13 300				72									1.30	1.00
∑2550		50					4 490	8 270				64									1.20	0.91
∑3220	32	20	3.175	32.75	29.4	(25)	7 710	16 900	70	95	8	70	10	6	3-M5	10	44	53	82	6.6	2.60	1.46
∑3232		32					7 590	16 700				91									3.15	1.83
∑4020	40	20	3.969	41.0	36.9	(30)	11 600	26 500	85	110	8	73	10	6	4-M5	10	58	67	96	6.6	5.96	2.02
∑4040		40					11 300	26 200				107									7.85	2.85
∑4520	45	20	3.969	46.0	41.9	(35)	12 000	30 000	90	115	8	73	10	6	4-M5	10	63	72	101	6.6	7.73	2.17
∑4540		40					11 800	29 700				107									10.3	3.06

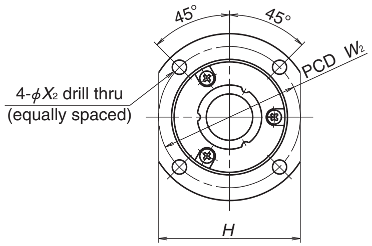
Model No.	Ball spline nut																				
	Basic load ratings (N)		Basic torque (N·m)		Dimensions															Moment of inertia (kg·cm²)	Mass (kg)
	Dynamic C_r	Static C_{0r}	Dynamic C_t	Static C_{0t}	D	A	B	L_4	L_5	L_6	L_7	Y	T	M_2	t_2	W_2	D_2	W	X		
∑1610	5 530	7 270	61.5	91.3	48	64	5	60	2.5	6.5	6.5	4.5	6.5	M4	7	25	35	56	4.5	0.71	0.63
∑1632	5 890	8 000	65.5	100																	
∑2010	6 260	8 720	86.3	135	54	70	6	65	2.5	6.5	6.5	5.5	6.5	M5	8	30.5	40	62	4.5	1.15	0.87
∑2020	6 610	9 450	91.1	145																	
∑2040	6 610	9 450	91.1	145																	
∑2510	6 630	9 450	115	185	58	74	6	70	2.5	6.5	6.5	5.5	6.5	M5	8	35.5	45	66	4.5	1.88	1.03
∑2520	7 290	10 900	125	210																	
∑2525	7 290	10 900	125	210																	
∑2550	7 290	10 900	125	210																	
∑3220	7 630	11 600	165	285	70	95	8	75	2.5	7.5	6.5	5.5	6.5	M5	8	42	50	82	6.6	3.80	1.62
∑3232	7 950	12 400	175	305																	
∑4020	10 600	14 800	290	455	85	110	8	80	4	7.5	8	5.5	8	M5	8	55	65	96	6.6	9.74	2.38
∑4040	11 200	15 900	305	490																	
∑4520	11 200	15 900	340	550	90	115	8	85	4	7.5	8	5.5	8	M5	8	60	70	101	6.6	12.5	2.56
∑4540	11 700	17 000	360	590																	

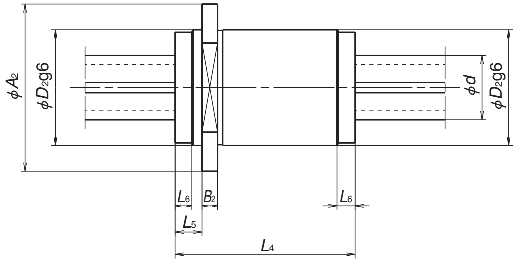
Σ Model for Robots

Σ Z Model







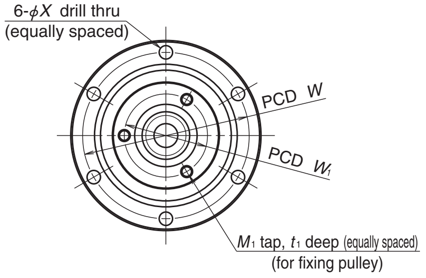


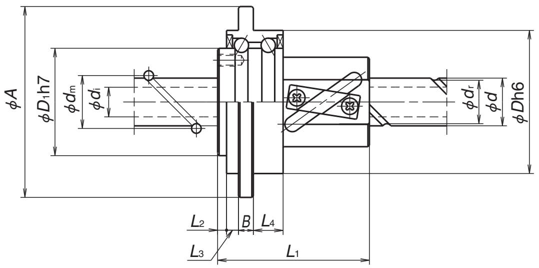
Unit: mm

Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Screw shaft bore dia.	Ball screw nut														
							Basic load ratings (N)		Dimensions												
	d	l	D_w	d_m	d_r	d_i	Dynamic C_a	Static C_{0a}	D	A	B	L_1	L_2	L_3	M_1	t_1	W_1	D_1	W	X
ΣZ1610	16	10	3.175	16.75	13.4	(8)	5 610	8 300	48	64	5	47	7	4	3-M4	6	28	35	56	4.5
ΣZ1632		32					3 600	5 200				52								
ΣZ2010	20	10	3.175	20.75	17.4	(14)	9 560	17 300	54	70	6	57	8	4	3-M4	6	32	40	62	4.5
ΣZ2020		20					6 100	10 500				63								
ΣZ2040		40					4 050	7 020				57								
ΣZ2510	25	10	3.175	25.75	22.4	(18)	10 700	22 000	58	74	6	57	8	4	3-M4	6	38	45	66	4.5
ΣZ2520		20					6 860	13 100				63								
ΣZ2525		25					6 720	13 300				72								
ΣZ2550		50					4 490	8 270				64								
ΣZ3220	32	20	3.175	32.75	29.4	(25)	7 710	16 900	70	95	8	70	10	6	3-M5	10	44	53	82	6.6
ΣZ3232		32					7 590	16 700				91								
ΣZ4020	40	20	3.969	41.0	36.9	(30)	11 600	26 500	85	110	8	73	10	6	4-M5	10	58	67	96	6.6
ΣZ4040		40					11 300	26 200				107								
ΣZ4520	45	20	3.969	46.0	41.9	(35)	12 000	30 000	90	115	8	73	10	6	4-M5	10	63	72	101	6.6
ΣZ4540		40					11 800	29 700				107								

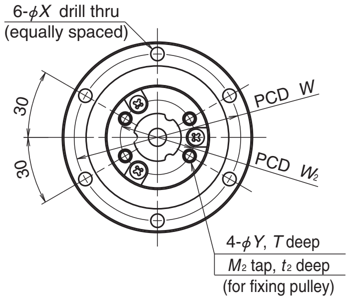
Model No.	Moment of inertia	Mass	Ball spline nut														
			Basic load ratings (N)		Basic torque (N·m)		Dimensions									Mass
	(kg·cm²)	(kg)	Dynamic C_r	Static C_{0r}	Dynamic C_t	Static C_{0t}	D_2	A_2	B_2	L_4	L_5	L_6	H	W_2	X_2	(kg)
ΣZ1610	0.41	0.50	5 530	7 270	61.5	91.3	35	55	6	60	10.5	6.5	45	4.5	4.5	0.35
ΣZ1632	0.44	0.55	5 890	8 000	65.5	100										
ΣZ2010	0.64	0.74	6 260	8 720	86.5	135	40	60	6	65	10.5	6.5	50	50	5.5	0.46
ΣZ2020	0.65	0.81	6 610	9 450	91.1	145										
ΣZ2040	0.64	0.74	6 610	9 450	91.1	145										
ΣZ2510	1.10	0.81	6 630	9 450	115	185	45	65	6	70	10.5	6.5	55	55	5.5	0.57
ΣZ2520	1.18	0.88	7 290	10 900	125	210										
ΣZ2525	1.30	1.00	7 290	10 900	125	210										
ΣZ2550	1.20	0.91	7 290	10 900	125	210										
ΣZ3220	2.60	1.46	7 630	11 600	165	285	50	70	6	75	10.5	6.5	60	60	5.5	0.64
ΣZ3232	3.15	1.83	7 950	12 400	175	305										
ΣZ4020	5.96	2.02	10 600	14 800	290	455	65	88	8	80	12	8	76	76	6.6	1.20
ΣZ4040	7.85	2.85	11 200	15 900	305	490										
ΣZ4520	7.73	2.17	11 200	15 900	340	550	70	93	8	85	12	8	81	81	6.6	1.39
ΣZ4540	10.3	3.06	11 700	17 000	360	590										

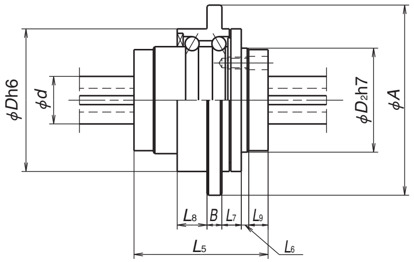
Σ Model for Robots





Σ C Model





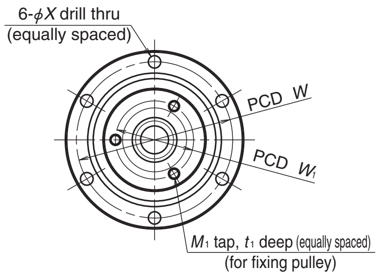
Unit: mm

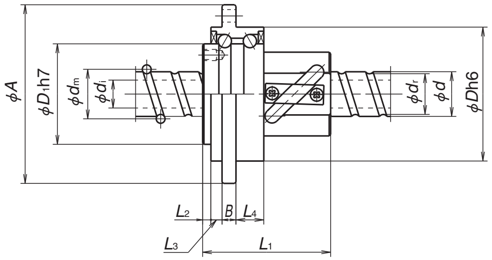
Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Screw shaft bore dia.	Ball screw nut																Mass
							Basic load ratings (N)		Dimensions													Moment of inertia	
	d	l	D_w	d_m	d_r	d_i	Dynamic C_a	Static C_{0a}	D	A	B	L_1	L_2	L_3	L_4	M_1	t_1	W_1	D_1	W	X	(kg·cm²)	(kg)
ΣC1610	16	10	3.175	16.75	13.4	(8)	5 670	8 300	48	64	5	46	3	4	10	3-M4	6	28	35	56	4.5	0.40	0.41
ΣC1632		32					3 600	5 200				51										0.43	0.43
ΣC2010	20	10	3.175	20.75	17.4	(14)	9 560	17 300	54	70	6	56	4	4	10	3-M4	6	32	40	62	4.5	0.63	0.53
ΣC2020		20					6 100	10 500				63										0.65	0.56
ΣC2040		40					4 050	7 020				56										0.63	0.53
ΣC2510	25	10	3.175	25.75	22.4	(18)	10 700	22 000	58	74	6	56	4	4	10	3-M4	6	38	45	66	4.5	1.04	0.60
ΣC2520		20					6 860	13 100				63										1.13	0.64
ΣC2525		25					6 720	13 300				71										1.24	0.69
ΣC2550		50					4 490	8 270				63										1.13	0.64

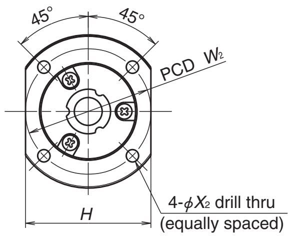
Model No.	Ball spline nut																					
	Basic load ratings (N)		Basic torque(N·m)		Dimensions																Moment of inertia	Mass
	Dynamic C_r	Static C_{0r}	Dynamic C_t	Static C_{0t}	D	A	B	L_5	L_6	L_7	L_8	L_9	Y	T	M_2	t_2	W_2	D_2	W	X	(kg·cm²)	(kg)
ΣC1610	4 300	5 090	47.9	63.9	48	64	5	45	2.5	6.5	10	6.5	4.5	6.5	M4	7	25	35	56	4.5	0.52	0.42
ΣC1632																						
ΣC2010	4 730	5 820	65.1	90.5	54	70	6	50	2.5	6.5	10	6.5	5.5	6.5	M5	8	30.5	40	62	4.5	0.86	0.56
ΣC2020	5 110	6 540	70.5	100																		
ΣC2040	5 110	6 540	70.5	100																		
ΣC2510	5 130	6 540	87.8	125	58	74	6	55	2.5	6.5	10	6.5	5.5	6.5	M5	8	35.5	45	66	4.5	1.44	0.67
ΣC2520	5 870	8 000	100	155																		
ΣC2525	5 870	8 000	100	155																		
ΣC2550	5 870	8 000	100	155																		

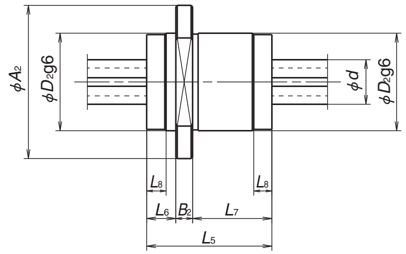
Σ Model for Robots

Σ CZ Model









Unit: mm

Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Screw shaft bore dia.	Ball screw nut																Ball spline nut														
							Basic load ratings (N)		Dimensions													Moment of inertia	Mass	Basic load ratings (N)		Basic torque(N·m)		Dimensions										Mass
	d	l	D_w	d_m	d_r	d_i	Dynamic C_a	Static C_{0a}	D	A	B	L_1	L_2	L_3	L_4	M_1	t_1	W_1	D_1	W	X	(kg·cm^2)	(kg)	Dynamic C_r	Static C_{0r}	Dynamic C_t	Static C_{0t}	D_2	A_2	B_2	L_5	L_6	L_7	L_8	H	W_2	X_2	(kg)
ΣCZ1610	16	10	3.175	16.75	13.4	(8)	5 670	8 300	48	64	5	46	3	4	10	3-M4	6	28	35	56	4.5	0.40	0.41	4 300	5 090	47.9	63.9	35	55	6	45	10.5	28.5	6.5	45	45	4.5	0.26
ΣCZ1632		32					3 600	5 200				51										0.43	0.43															
ΣCZ2010	20	10	3.175	20.75	17.4	(14)	9 560	17 300	54	70	6	56	4	4	10	3-M4	6	32	40	62	4.5	0.63	0.53	4 730	5 820	65.1	90.5	40	60	6	50	10.5	33.5	6.5	50	50	5.5	0.35
ΣCZ2020		20					6 100	10 500				63										0.65	0.56	5 110	6 540	70.5	100											
ΣCZ2040		40					4 050	7 020				56										0.63	0.53	5 110	6 540	70.5	100											
ΣCZ2510	25	10	3.175	25.75	22.4	(18)	10 700	22 000	58	74	6	56	4	4	10	3-M4	6	38	45	66	4.5	1.04	0.60	5 130	6 540	87.8	125	45	65	6	55	10.5	38.5	6.5	55	55	5.5	0.44
ΣCZ2520		20					6 860	13 100				63										1.13	0.64	5 870	8 000	100	155											
ΣCZ2525		25					6 720	13 300				71										1.24	0.69	5 870	8 000	100	155											
ΣCZ2550		50					4 490	8 270				63										1.13	0.64	5 870	8 000	100	155											

B-3-3.9 Ball Screws with the "NSK K1™" Lubrication Unit

1. Features

NSK K1 is a new, efficient lubrication unit. Equipped with NSK K1, ball screws demonstrate superb performance as shown below.

● Long-term, maintenance-free usage

In mechanical environments where lubrication is difficult to apply, long-term running efficiency is maintained by using the NSK K1 in combination with grease.

[ex.] For automotive component processing lines, etc.

● Does not pollute the environment

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

[ex.] Food processing equipment, medical equipment, flat panel display/semiconductor manufacturing equipment, etc.

● Good for environments where lubricant is washed away

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

[ex.] Food processing equipment, housing/construction machines, etc.

● Maintains efficiency in dusty environments

In environments where oil- and grease-absorbing dust is produced, long-term efficiency in lubrication and protection from foreign matter entry are maintained by using the NSK K1 in combination with grease.

[ex.] Woodworking machines, etc.

● Comparative duration test of samples with and without NSK K1

Samples, testing conditions, and test results are shown in **Table 1** and **Fig. 1**.

Without lubricant, operation became impossible after running 8.6 km. With NSK K1 alone, it was possible to continue running past 10 000 km.

NSK conducts various tests under different conditions. Please consult NSK for details.

Table 1 Sample and testing conditions

Ball screw	Shaft dia. 20 mm, lead 20 mm
Lubrication	Comparison with only NSK K1 against no lubrication
Speed	4 000 min^{-1} (80 m/min)
Stroke	600 mm

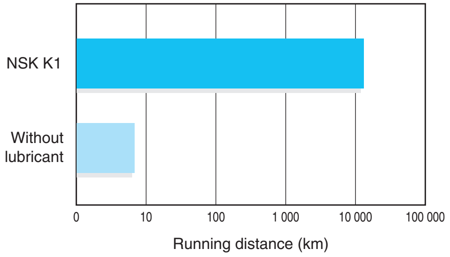


Fig. 1 Duration test results of ball screws without lubricant

2. Specifications

(1) Structure

The structure makes it possible to have stable contact between the NSK K1 and outside a ball screw with moderate force by a garter spring which fits outside the NSK K1.

NSK K1 is installed between the ball screw nut and the labyrinth seal. The overall nut length is slightly longer than that of standard ball screws.

Combinations of NSK standard grease (factory-packed in the nut) and NSK K1 are standard specifications.

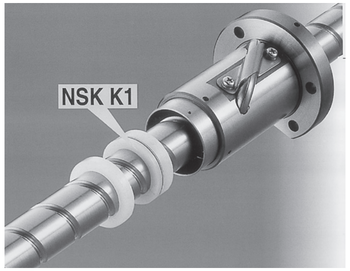


Fig. 2 NSK K1

(2) Accuracy grade and axial play

Accuracy grades, clearance and preload specifications remain unchanged from existing products. There is a slight increase in torque due to the equipped NSK K1.

(3) Overall nut length equipped with NSK K1™

The nut length becomes longer than that of standard ball screws. The nut length equipped with K1 is shown in pages B561 to B563 for each type of ball recirculation. NSK K1 can be installed on other types not listed in the dimension tables. Please consult with NSK if you require K1 for a special ball nut.

(4) Application examples

Ball screws equipped with NSK K1 are maintenance-free for a long period. Its application is expanding in various industries.

Semiconductor/flat panel display manufacturing equipment
Industrial robot
Wood working machines
Machine tools
Automobile manufacturing machines

◇Reference number for ball screws equipped with NSK K1

W1401 -＊＊ P K1 - C3 Z10

NSK K1 equipped ball screw code

3. Precautions for use

Temperature range for use: Maximum temperature: 50˚C
Momentary maximum temperature: 80˚C

Chemicals that should not contact K1:

Do not leave NSK K1 in organic solvents, white kerosene such as hexane, thinners which remove oil, and rust preventive oils which contain white kerosene.

Note: Water-type cutting oil, oil-type cutting oil, grease such as mineral-type AS2 and ester-type PS2 do not damage K1.

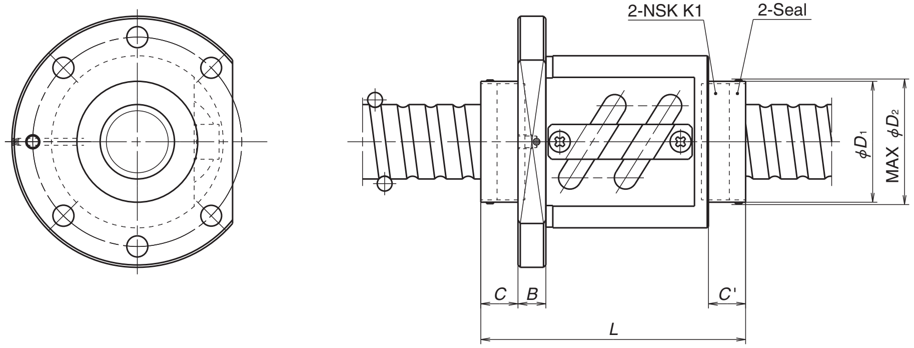
Note: NSK K1 is not applicable to the Compact FA model.

4. Example reference number

The following explains the codes used in reference numbers:

Note: "K1" is added at the end of the nut code and provisional Ref. No.

(1) Tube recirculation



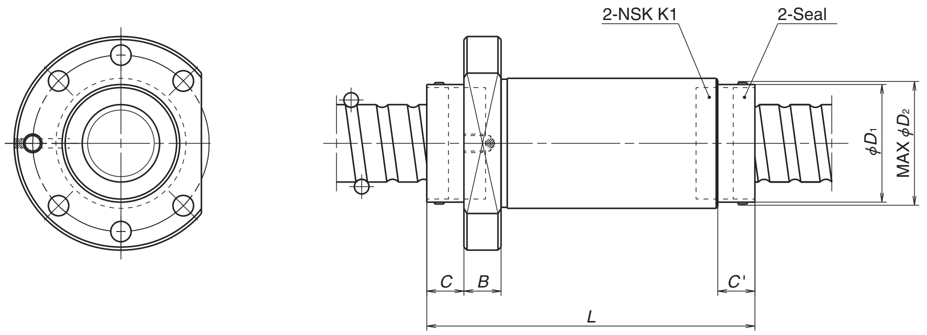
Tube recirculation

Model No.	Screw shaft dia.	Lead	K1 mounting dimensions		Flange width	Overall length with K1	K1 cap dimensions	
	d	*l*	*C*	*C'*	*B*	*L*	Cap dia. ϕD_1	Protrusion dimension ϕD_2
PFT1004-2.5	10	4	14	15	10	61.5	ϕ22	MAX ϕ24
PFT1205-2.5	12	5	14	15	10	66	ϕ26.5	MAX ϕ29
LPFT1210-2.5		10		17		79		
PFT1405-2.5	14	5	14	15	10	65	ϕ30	MAX ϕ32
LPFT1510-2.5	15	10	14	15	10	76	ϕ30	MAX ϕ32
PFT1605-2.5	16	5	14	15	10	67	ϕ32	MAX ϕ34
PFT2005-5	20	5	14	14	10	81	ϕ38	MAX ϕ40
LPFT2010-2.5		10				78		
LPFT2020-1.5		20				84		
ZFT2505-10	25	5	16	17	10	115	ϕ44	MAX ϕ46
PFT2506-5		6	16	17	12	93	ϕ44	MAX ϕ46
PFT2510-2.5		10	16	17	12	89	ϕ44	MAX ϕ46
ZFT2510-3						103		
LPFT2520-2.5		20	12	12	12	109	ϕ38	MAX ϕ40
LPFT2525-1.5		25	12	12	12	98	ϕ38	MAX ϕ40
DFT2805-5	28	5	16	17	12	137	ϕ48	MAX ϕ50
PFT2810-2.5		10				90		
DFT2810-3						174		
PFT3206-5	32	6	16	17	12	93	ϕ52	MAX ϕ54
ZFT3206-10						129		
PFT3210-5		10	16	17		122	ϕ52	MAX ϕ54
ZFT3210-5				17		122		
DFT3210-5				16		212		
PFT3212-3		12	16	17		114	ϕ52	MAX ϕ54
DFT3212-3				16		198		
LPFT3225-2.5		25	12	12		122	ϕ46	MAX ϕ48
LPFT3232-1.5		32	12	12		109	ϕ46	MAX ϕ48

Notes: 1. NSK K1 can be installed in other types not listed in the table. Please consult NSK.
2. *C*,*C'*, and *L* refer to dimensions when one NSK K1 is equipped to both ends of the nut.

Model No.	Screw shaft dia.	Lead	K1 mounting dimensions		Flange width	Overall length with K1	K1 cap dimensions	
	d	*l*	*C*	*C'*	*B*	*L*	Cap dia. ϕD_1	Protrusion dimension ϕD_2
PFT3610-5	36	10	19	20	15	131	ϕ56	MAX ϕ58
DFT3610-5				19		221		
HZF3616-5		16		19		163		
HZF3620-3.5		20		19		146		
PFT4008-5	40	8	19	20	16	117	ϕ62	MAX ϕ64
ZFT4008-10						165		
ZFT4010-7		10	19	20		152	ϕ62	MAX ϕ64
DFT4010-5				19		222	ϕ61	
PFT4012-5		12	19	20		144	ϕ62	MAX ϕ64
DFT4012-5				19		252	ϕ61	
HZF4016-5		16	19	19		164	ϕ61	MAX ϕ64
HZF4020-5		20	19	19		189	ϕ61	MAX ϕ64
LPFT4032-2.5		32	14	14		151	ϕ54	MAX ϕ56
LPFT4040-1.5		40	14	14		133	ϕ54	MAX ϕ56
DFT4510-5	45	10	19	19	16	222	ϕ72	MAX ϕ75
DFT4512-5		12			16	254		
HZF4520-5		20			18	190		
ZFT5010-10	50	10	19	20	18	194	ϕ73	MAX ϕ76
DFT5012-5		12		19		256		
ZFT5016-5		16		20		172		
DFT5016-5				19		300		
HZF5020-5		20		19		192		
HZF5025-5		25		19		221		
DFT5516-5	55	16	22	22	18	178	ϕ81	MAX ϕ87
HZF5520-5		20				198		
HZF5525-5		25				227		
DFT6316-5	63	16	22	22	18	322	ϕ89	MAX ϕ95
DFT6320-5		20				362		

(2) Deflector (bridge) recirculation



Deflector (bridge) recirculation

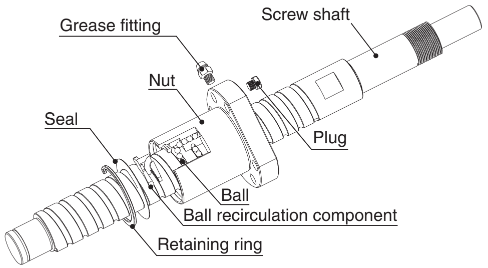
Model No.	Screw shaft dia.	Lead	K1 mounting dimensions		Flange width	Overall length with K1	K1 cap dimensions	
	d	l	C	C'	B	L	Cap dia. ϕD_1	Protrusion dimension ϕD_2
ZFD2005-6	20	5	9	9	12	87	ϕ32	MAX ϕ34
ZFD2506-6	25	6	12	–	12	102	ϕ38	MAX ϕ40
ZFD2510-4		10		12		106		
ZFD3208-8	32	8	12	12	12	136	ϕ46	MAX ϕ48
ZFD3210-6		10				138		
ZFD3212-6		12				153		
ZFD4010-8	40	10	14	14	16	167	ϕ54	MAX ϕ57
ZFD4012-8		12				189		
ZFD5010-8	50	10	14	14	18	169	ϕ64	MAX ϕ67
ZFD5012-6		12				167		

Notes: 1. NSK K1 can be installed in other types not listed in the table. Please consult NSK.
2. *C*, *C'*, and *L* refer to dimensions when one NSK K1 is equipped to both ends of the nut.

B-3-3.10 Ball screws for Rechargeable Battery Manufacturing Equipment CAT.No.3171

1. Features

Limited the use of hazardous copper and zinc plating in the manufacture of rechargeable batteries. Screw shafts, nuts, and other parts are also available in stainless steel. Low-dust emission is achieved by packing in metal element-free LGU grease.



2. Specifications

(1) Scope of application

Combination of shaft diameter and lead for rechargeable battery manufacturing equipment are shown in Table 1.1

Table1.1 Combination of shaft diameter and lead

Unit : mm

Shaft diameter	Lead	Shaft length						Material of components						Lubrication · Surface treatment
		300	500	1000	1200	1500	2000	Screw shaft · Nut	Ball	Ball recirculation component	Seal	Screws · ※2 Retaining ring	Grease※2 Fitting · Plug	
8	2※1	●						Accuracy Ct7 · Standard specifications Carbon steel · Stainless specifications Stainless	· Standard specifications Bearing steel	· Accuracy Ct7 Synthetic resin	· Accuracy Ct7 Synthetic resin	· Standard specifications Standard material	Stainless	Lubrication · LGU grease · AS2 grease · Antirust oil Surface treatment · Low temperature chrome plating · Fluoride low temperature chrome plating
	10	●												
10	2	●												
	5	●												
12	5		●											
	10		●											
14	5			○										
15	10				●									
	20				●									
20	5				●									
	10			○	●									
	20			○	●									
25	10					●	○	Accuracy Ct10 · Standard specifications Carbon steel	· Stainless specifications Stainless	· Accuracy Ct10 Standard material Synthetic resin	· Accuracy Ct10 Synthetic resin Stainless	· Stainless specifications Stainless		
	20					●								
	25						○							
32	10					●	○							
	32						○							
40	10					●								
	20					●								

● : Accuracy Ct7 ○ Accuracy Ct10

※1) Screw shaft diameter ϕ8 lead 2mm is only for standard specifications

※2) Available range : Accuracy Ct7, Screw shaft diameter ϕ10~ϕ25

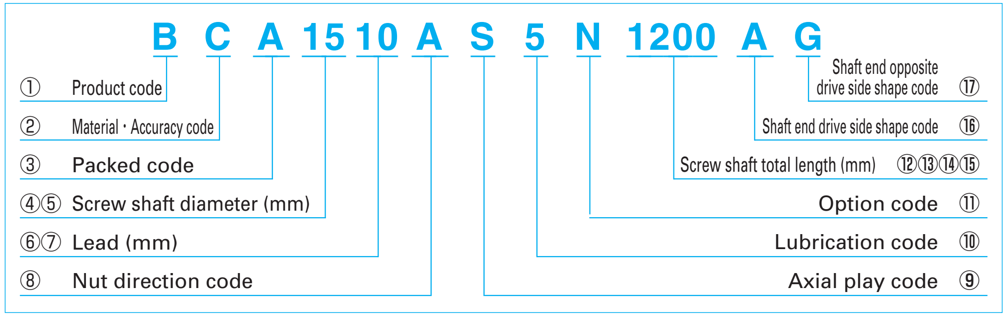
(2) Recommended specifications

Recommended ball screw specifications by usage environment is shown in Table 1.2.

Table 1.2 Recommended specifications by usage environment

	Low dew point · Clean environment	General environment
Screw shaft · Nut material	Standard specification Stainless specification	Standard specification Stainless specification
Screws	Stainless specification	Standard specification
Lubrications	LGU grease	AS2 Grease
Surface treatment	Low temperature chrome plating Fluoride low temperature chrome plating	—

3. Reference number for ball screws



No.	Classification	Detail	Code
①	Product code	Ball Screw for Rechargeable Battery Manufacturing Equipment	B
②	Material Accuracy	Carbon steel, Ct7	C
		Carbon steel + low temperature chrome plating, Ct7	D
		Carbon steel + fluoride low temperature chrome plating, Ct7	E
		Stainless, Ct7	S
		Stainless + low temperature chrome plating, Ct7	T
		Stainless + fluoride low temperature chrome plating, Ct7	H
		Carbon steel, Ct10	R
		Carbon steel + low temperature chrome plating, Ct10	V
		Carbon steel + fluoride low temperature chrome plating, Ct10	K
③	Paked code	Combination	A
④⑤	Shaft diameter	Screw shaft diameter (mm)	15
⑥⑦	Lead	Lead (mm)	10
⑧	Nut direction	Flange - Drive side	A
		Flange - Opposite drive side	B

No.	Classification	Detail	Code
⑨※1	Axial play	0.2mm or less	L
		0.010mm or less ※2	S
		0mm (Preload)	Z
⑩	Lubrication	AS2 (For general use / high load)	1
		LGU (For cleanroom environments)	5
		Antirust oil ※3	9
⑪	Option	—	N
⑫⑬⑭⑮	Screw shaft total length	4 digits (Round down decimal point)	1200
⑯※4	Shaft end drive side shape	Ct7, For coupling	A
		Ct7, For pulley	B
		Ct10, For coupling	C
		Ct10, For pulley	D
		Ct10, Blank shaft end	E
⑰	Shaft end opposite drive side shape	Free	F
		Support	G
		Ct10, Blank shaft end	H

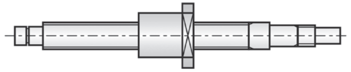
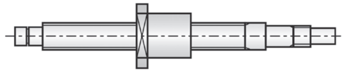
※1) Select「S」,「Z」in case of accuracy Ct7. Select「L」in case of accuracy Ct10
Screw shaft diameter ϕ8 lead 10 is only for「S」specification with clearance of 0.01mm

※2) Some may provide with pre-loaded

※3) In case of use of other grease or oil lubrication

※4) Screw shaft diameter ϕ14 or less is only for coupling and blank shaft end

Table 2 Nut direction (8th digit reference number)

Nut direction	Code	Appearance
Flange Drive side	A	
Flange Opposite drive side	B	

4.Options

Available options are listed in Table 3

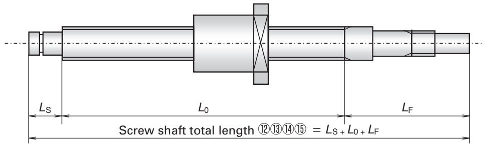
Table 3 Available options

Column	Detail
Nut direction	Flange Drive side/Opposite drive side
Lubrication	AS2 (For general use / high load) LGU (For cleanroom environments) Antirust oil
Screw shaft · Nut material	Carbon steel Stainless
Surface treatment	Low temperature chrome plating Fluoride low temperature chrome plating

5. Design precaution

The total length of the screw shaft is calculated by the screw shaft length and the shaft end lengths of the drive and opposite drive sides as shown in the figure below.

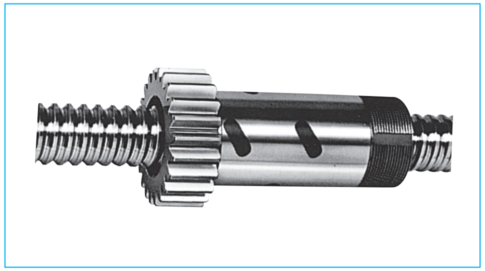
For general precautions regarding ball screws, Refer to “Design Precautions” (page B83) and “Handling Precautions” (page B103)



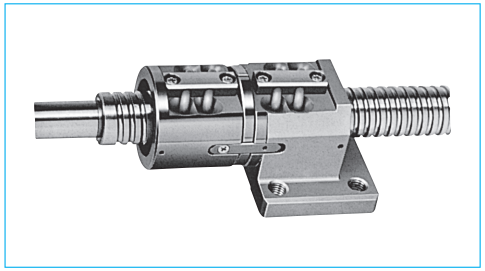
B-3-3.11 Special Ball Screws

In addition to standard ball screws, NSK manufactures various types of ball screws in special shapes as shown below.

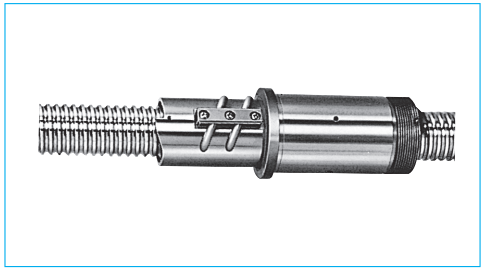
Thoroughly consult with NSK before determining specifications and ordering ball screws with special shapes.



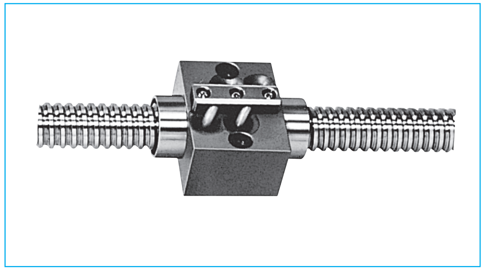
Nut with gear



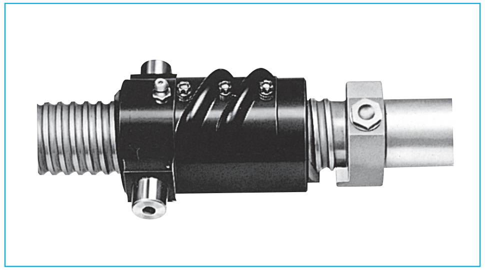
Double nut with flat mounting surface



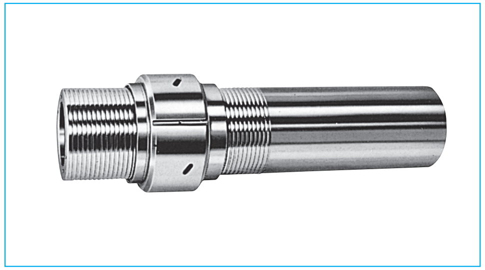
Lightly preloaded single nut with bearing seat



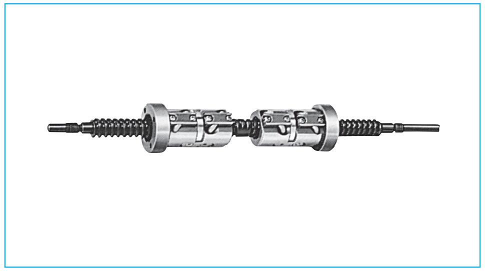
Lightly preloaded single nut with flat mounting surface



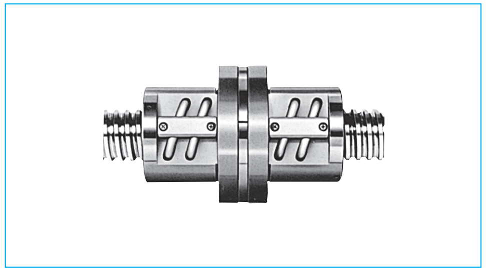
Nut with trunion



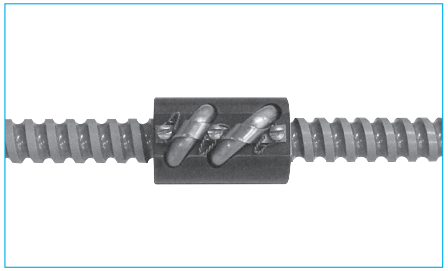
Hollow shaft, lightly preloaded single nut, with large shaft diameter and fine lead



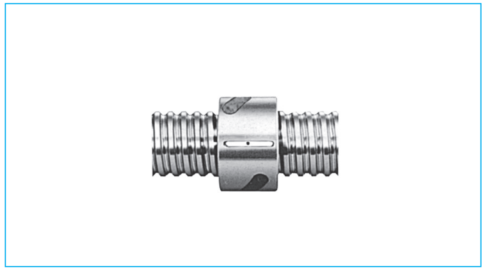
Double nut with right and left turn thread on each side of screw shaft



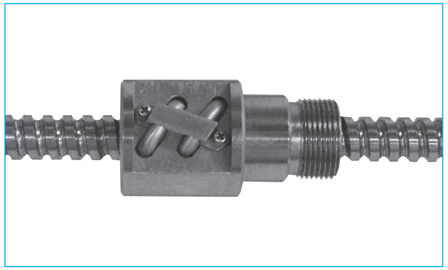
Flange to flange ball nut



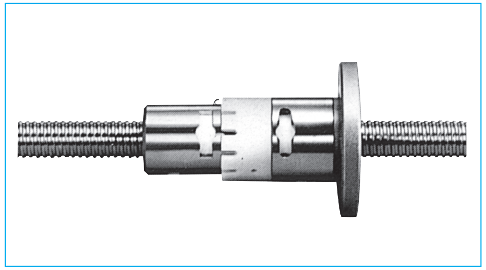
Ball screw for aircraft



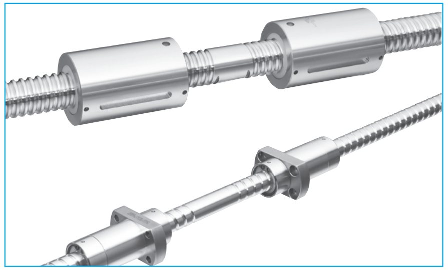
Cylindrical nut



Ball screw for nuclear power plants



Spring preloaded ball screw



Right and left hand thread on each side of screw

C-1 Monocarrier™

C-2 Toughcarrier™

C-3 Technical Materials

C BLOCK Monocarrier™ Toughcarrier™

C3-C92
C93 -C140
C141 -C148

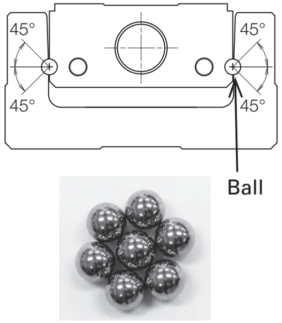
Monocarrier™, Toughcarrier™

All-in-one structure (integrated ball screw, linear guide and base) results in a light and compact actuator without extra work for design or adjustment when installing. Design and assembly loads can be reduced by unit type. Also, the many variations make it possible to deal with many different uses.

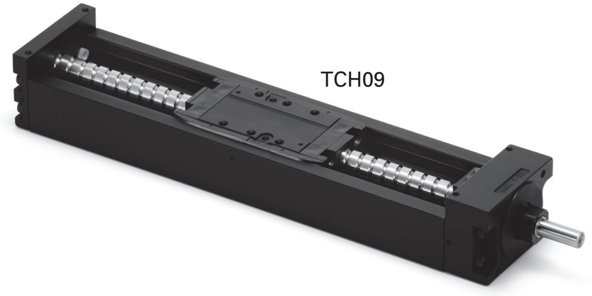
Monocarrier™ and Toughcarrier™ Classifications

●Monocarrier™

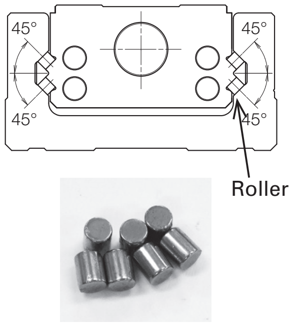
Rolling elements: Balls



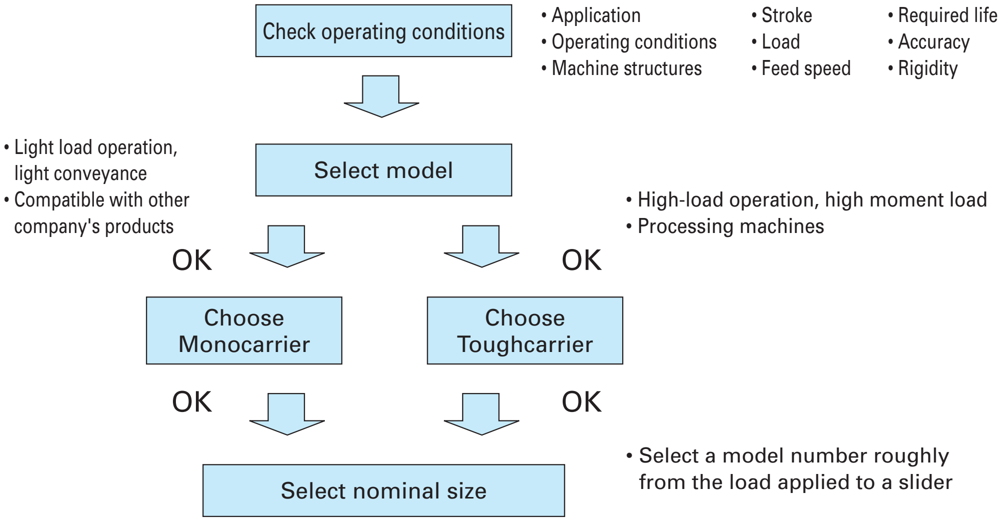
●Toughcarrier™: High load capacity



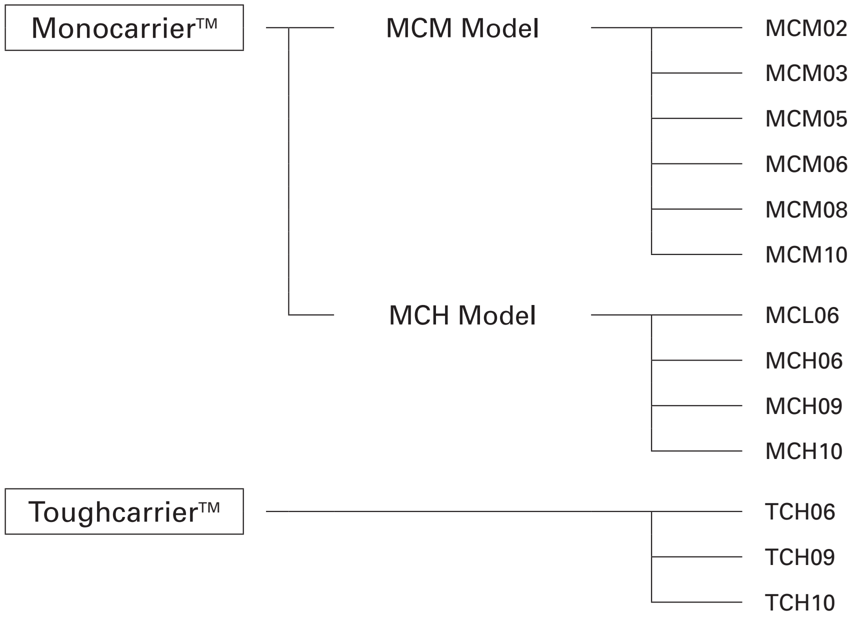
Rolling elements: Rollers



Selecting Monocarrier™ and Toughcarrier™ Actuators



Monocarrier™ and Toughcarrier™ Composition



C-1 Monocarrier™

C-1 Monocarrier™

C-1 Monocarrier™

C-1-1 Features

NSK's Monocarrier is the culmination of technology and innovation in linear motion. This lightweight, compact single axis linear actuator integrates quality NSK ball screw, linear guide and support bearings into one unit.

1 Light weight, compact design

○Available in two different shapes of cross-section, depending on application.
  Light weight type: MCM Series
  Rigid type: MCH Series

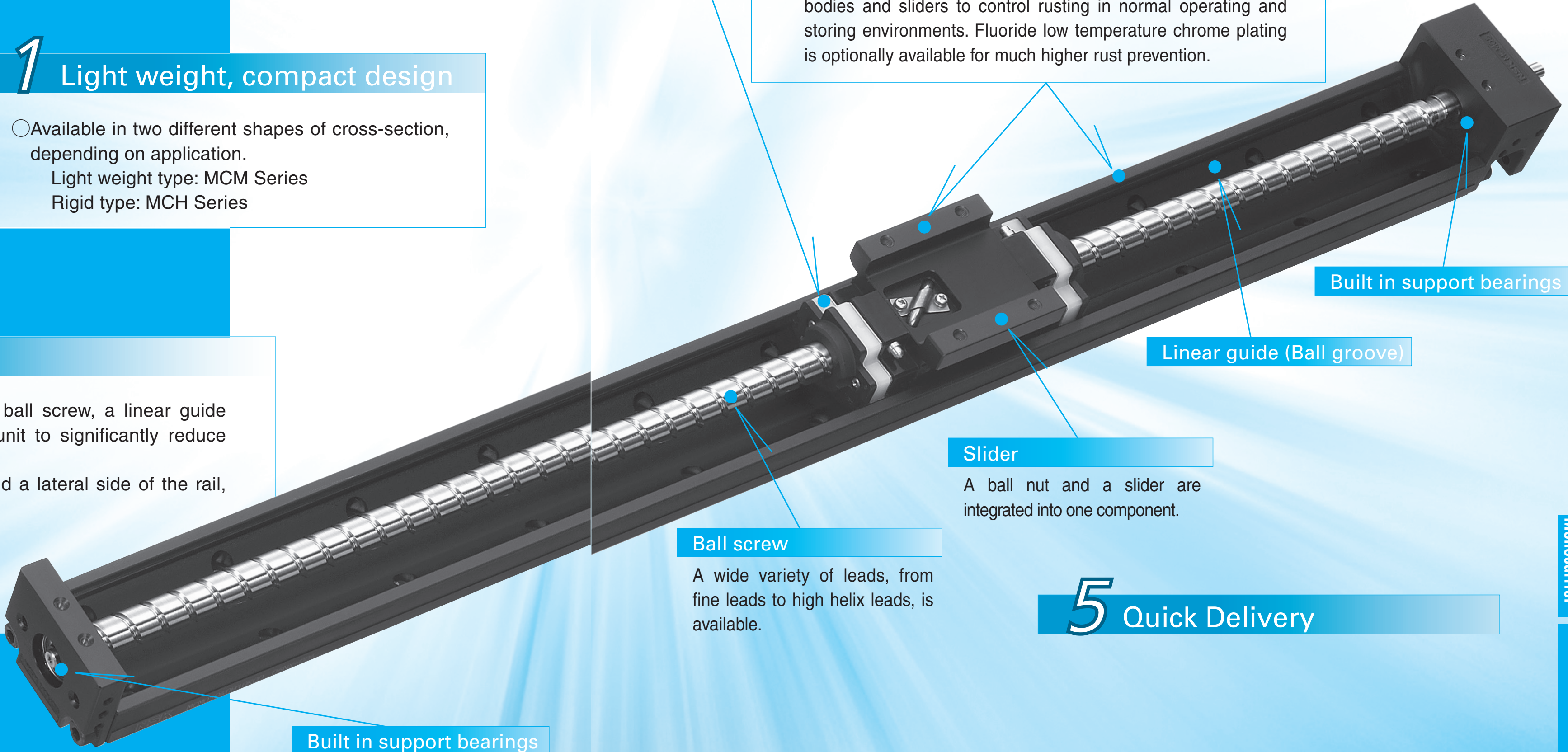
2 All -in-one structure

○The all-in-one structure integrates a ball screw, a linear guide and support bearings into a single unit to significantly reduce design and installation time.

○Multiple datum planes, the bottom and a lateral side of the rail, facilitate highly accurate installation.

○Immediate operation after installation and run-in is possible.

○A wide selection of fine to high helix leads are available.



Slider

A ball nut and a slider are integrated into one component.

Ball screw

A wide variety of leads, from fine leads to high helix leads, is available.

3 Superb antirust capability

○Low temperature chrome plating is a standard feature for the bodies and sliders to control rusting in normal operating and storing environments. Fluoride low temperature chrome plating is optionally available for much higher rust prevention.

4 Long term maintenance free

○Use of NSK K1 Lubrication Units and grease maintains smooth lubricating performance for long periods in mechanical environments where lubrication is difficult, where use of oil is not permitted because of hygienic issues, or where the mechanical equipment is subjected to frequent wash downs.

○NSK K1 lubrication unit is available for food processing machines and medical equipment.

○Grease for clean environments and for general machinery is available.

5 Quick Delivery

MONOCARRIER™

C-1-2 Classification and Models

Table 2.1

	Light Weight	Beam Rigidity	Moment Rigidity	Accuracy	Long Stroke	Size Variation
MCM Model	◎	○	○	◎	○	◎
MCH Model	○	◎	○	◎	◎	○

◎: Excellent ○: Suitable

【MCM Model Cross-sections】

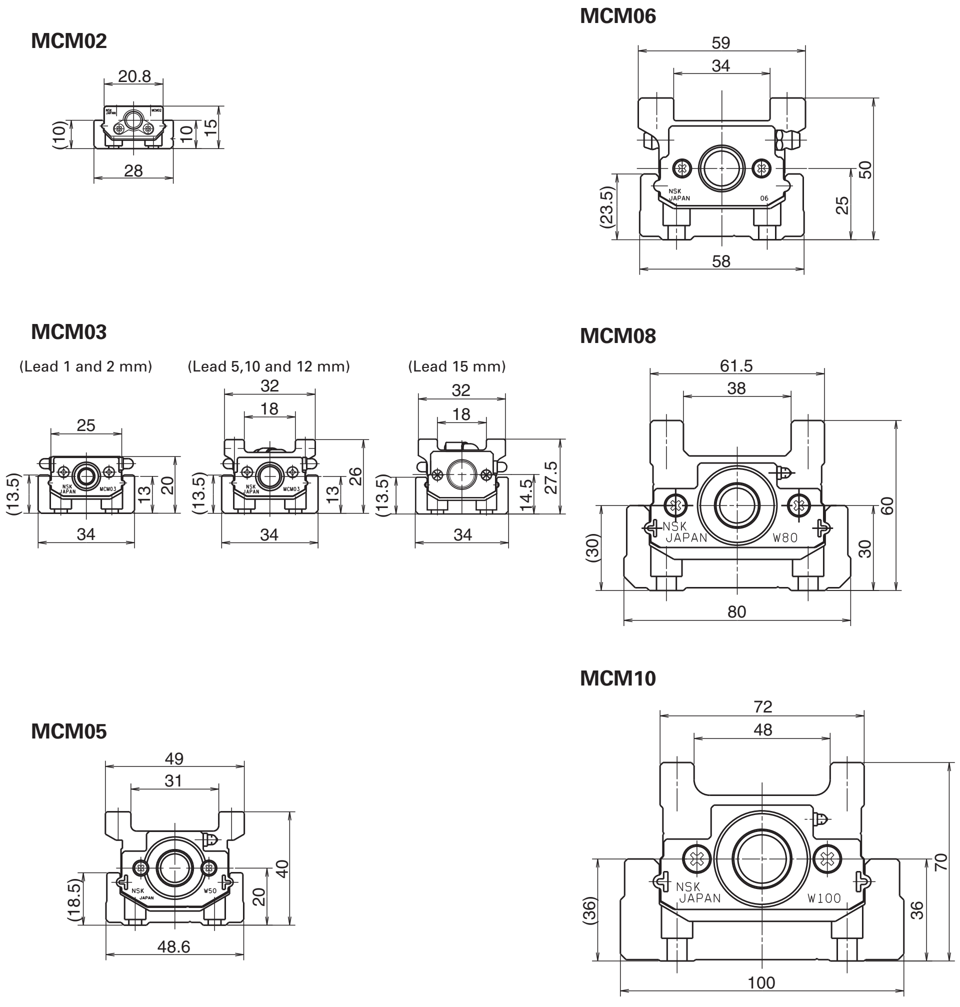


Fig. 2.1

【MCH Model Cross-sections】

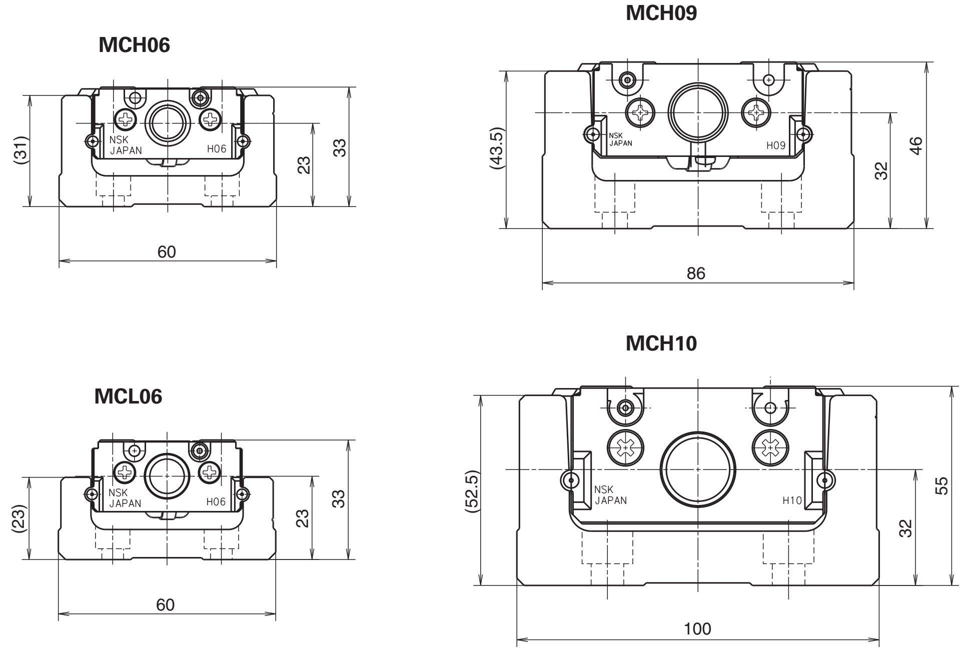


Fig. 2.2

C-1-3 Accessories

MCM Model

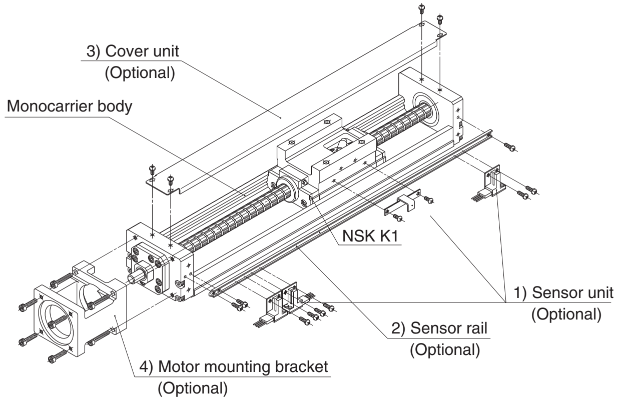


Fig. 3.1 Assembly: Accessories for MCM10 (example)

1) Sensor unit: Sensors, sensor mounting parts and a sensor dog are available in a set.
   * When a sensor unit is used, the full cover unit cannot be used.
2) Sensor rail: Rail for sensor mounting is available.
3) Cover unit: Top cover or full cover (included top cover and side cover) is available.
4) Motor bracket for motor mounting: Available for a variety of models.

Note: We assemble accessories upon request.

MCH Model

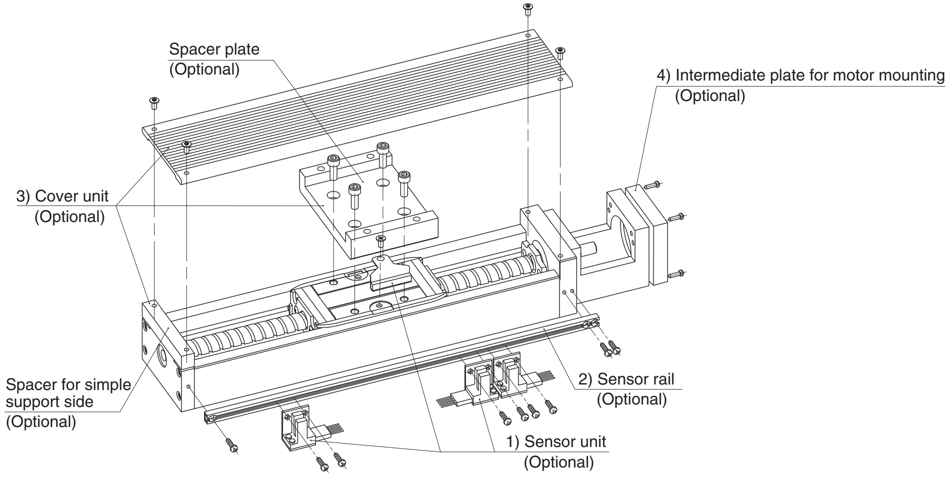


Fig. 3.2 Assembly: Accessories for MCH10 (example)

1) Sensor unit: Sensors, sensor mounting parts and a sensor dog are available in a set.
2) Sensor rail: Rail for sensor mounting is available.
3) Cover unit: Top cover (included spacer plate and spacer for simple support side) is available.
4) Intermediate plate for motor mounting: Available for a variety of models.

Note: We assemble accessories upon request.

C-1-4 Selection of Monocarrier

C-1-4. 1 Selection Procedures

Select a model of Monocarrier based on stroke and rigidity (refer to **Figs. 4.2**, and **4.3**).

⬇

Select a ball screw lead referring to "**C-1-4.3 Maximum Speed**" so that the rotational speed does not exceed the limit.

⬇

Study the loads to be applied to the linear guide and obtain the equivalent load (*F*e) substituting them for equation (1) or (2) on page C19. Obtain the mean effective load (*F*m) substituting them for equation 3) on page C20, then calculate the life.

⬇

Study the loads to be applied to the ball screw and support unit. Obtain the mean effective load (*F*m) substituting them for equation 3) on page C20, then calculate the life.

C-1-4. 2 Rigidity

Rigidity of rail

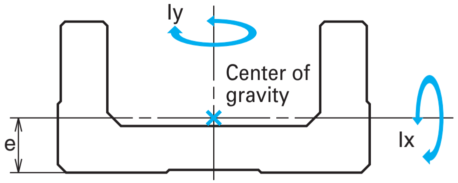


Fig. 4.1

Table 4.1 Rigidity of rail

Model No.	Geometrical moment of inertia ×10⁴ (mm⁴)		Center of gravity (mm)	Mass (kg/ 100 mm)
	Ix	Iy	e	w
MCM02	0.097	1.32	3.3	0.11
MCM03	0.30	3.3	4.5	0.18
MCM05	0.78	11.4	6.0	0.31
MCM06	2.14	26.1	7.0	0.57
MCM08	5.90	81.0	9.2	0.88
MCM10	15.6	219	12.2	1.52
MCL06	2.58	29.6	7.8	0.56
MCH06	6.5	38.2	10.8	0.67
MCH09	28.7	172	15.5	1.48
MCH10	54.0	307	18	1.93

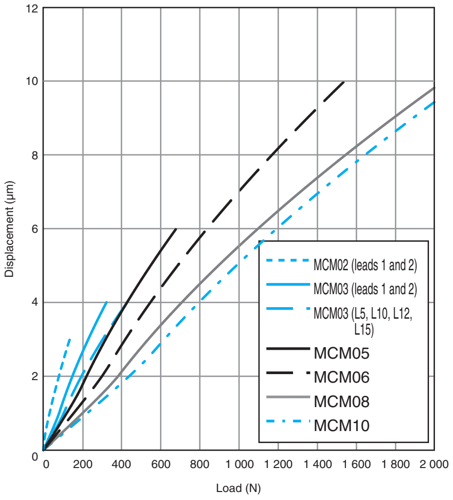


Fig. 4.2 MCM Model rigidity in radial direction

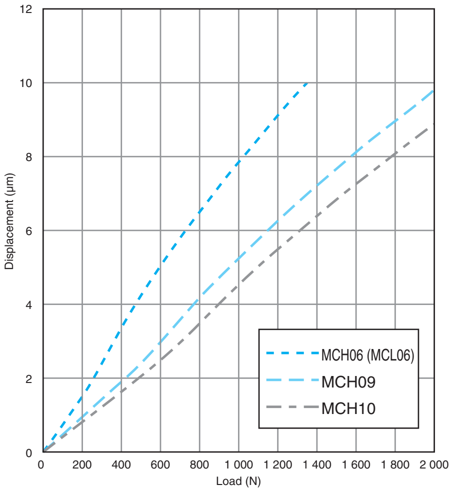


Fig. 4.3 MCH Model rigidity in radial direction

C-1-4. 3 Maximum Speed

(1) Maximum Speed of MCM Model

Maximum speed of a Monocarrier actuator is determined by critical speed of ball screw shaft and d • n value.

Do not exceed maximum speeds in the table below.

Table 4.2

	Ball screw lead	Stroke (mm)	Rail length L_2 (mm)	Maximum speed (mm/s)
MCM02 Single slider	1	50	100	50
		100	150	
		150	200	
	2	50	100	100
		100	150	
		150	200	
MCM03 Single slider	1	50	115	50
		100	190	
		150	240	
	2	50	115	100
		100	190	
		150	240	
	5	50 to 250	140 to 340	410
	10	50 to 250	140 to 340	830
	12	50 to 250	140 to 340	1 000
	15	50 to 250	140 to 340	1 250
MCM05 Single slider	5	50 to 400	180 to 530	410
		500	630	370
		600	730	270
	10	50 to 400	180 to 530	830
		500	630	750
		600	730	540
	20	50 to 400	180 to 530	1 660
		500	630	1 470
		600	730	1 070
	30	50 to 400	180 to 530	2 500
		500	630	2 160
		600	730	1 570
MCM05 Double slider	10	60 to 410	280 to 630	830
		510	730	710
	20	60 to 410	280 to 630	1 660
		510	730	1 460

	Ball screw lead	Stroke (mm)	Rail length L_2 (mm)	Maximum speed (mm/s)
MCM06 Single slider	5	50 to 500	190 to 640	410
		600	740	330
		700	840	250
		800	940	190
	10	50 to 500	190 to 640	830
		600	740	650
		700	840	500
		800	940	390
	20	50 to 500	190 to 640	1 660
		600	740	1 300
		700	840	990
		800	940	780
MCM06 Double slider	5	110 to 410	340 to 640	410
	10	110 to 510	190 to 640	830
		610	740	660
		710	840	500
	20	210 to 510	440 to 640	1 660
		610	740	1 310
		710	940	1 000

Notes: 1) Please consult NSK before operating Monocarrier actuators near maximum speed.
2) Maximum rotational speed is (5000 min^{-1}). (For leads 5,10,12,15,20 & 30)
3) Refer to the above table for maximum speed for each stroke.

	Ball screw lead	Stroke (mm)	Rail length L_2 (mm)	Maximum speed (mm/s)
MCM08 Single slider	5	50 to 500	220 to 670	410
		600	770	320
		700	870	250
		800	970	190
	10	50 to 500	220 to 670	830
		600	770	640
		700	870	490
		800	970	380
	20	50 to 500	220 to 670	1 660
		600	770	1 280
		700	870	980
		800	970	770
	30	400	570	2 500
		500	670	2 480
		600	770	1 830
		700	870	1 400
MCM08 Double slider	10	80 to 380	370 to 670	830
		480	770	810
		580	870	630
		680	970	500
	20	180 to 380	470 to 670	1 660
		480	770	1 640
		580	870	1 270
		680	970	1 010

	Ball screw lead	Stroke (mm)	Rail length L_2 (mm)	Maximum speed (mm/s)
MCM10 Single slider	10	50 to 600	280 to 780	830
		700	880	660
		800	980	520
		900	1 080	420
		1 000	1 180	340
	20	50 to 600	280 to 780	1 660
		700	880	1 310
		800	980	1 030
		900	1 080	840
		1 000	1 180	690
	30	500	680	2 500
		600	780	2 430
		700	880	1 870
		800	980	1 480
MCM10 Double slider	10	70 to 570	380 to 880	830
		670	980	660
		870	1 180	450
	20	170 to 570	480 to 880	1 660
		670	980	1 340
		870	1 180	910

Notes: 1) Please consult NSK before operating Monocarrier actuators near maximum speed.
2) Maximum rotational speed is (5000 min^{-1}). (For leads 5,10,12,15,20 & 30)
3) Refer to the above table for maximum speed for each stroke.

(2) Maximum Speed of MCH Model

Maximum speed of a Monocarrier actuator is determined by critical speed of ball screw shaft and d • n value.

Do not exceed maximum speeds in the table below.

Table 4.3

	Ball screw lead	Stroke (mm)	Rail length L_2 (mm)	Maximum speed (mm/s)
MCH06 MCL06 Single slider	5	50 to 500	150 to 600	410
	10	50 to 500	150 to 600	830
	20	50 to 400	150 to 500	1 660
		500	600	1 610
MCH06 Double slider	5	100 to 300	300 to 500	410
	10	100 to 400	300 to 600	830
	20	400	600	1 660
MCH09 Single slider	5	100 to 500	240 to 640	410
		600	740	360
		700	840	270
		800	940	210
	10	100 to 500	240 to 640	830
		600	740	710
		700	840	530
		800	940	410
	20	100 to 500	240 to 640	1 660
		600	740	1 410
		700	840	1 060
		800	940	830
MCH09 Double slider	5	150 to 350	440 to 640	410
	10	150 to 450	440 to 740	830
		650	940	530
	20	450	740	1 660
		650	940	1 080
MCH10 Single slider	10	50 to 600	280 to 780	830
		700	880	670
		800	980	530
		900	1 080	420
		1 000	1 180	350
		1 100	1 280	290
		1 200	1 380	250
	20	50 to 600	280 to 780	1 660
		700	880	1 330
		800	980	1 050
		900	1 080	840
		1 000	1 180	700
		1 100	1 280	580
		1 200	1 380	490
MCH10 Double slider	10	250 to 550	580 to 880	830
		650	980	660
	20	250 to 550	580 to 880	1 660
		650	980	1 340
		750	1 080	1 100
		850	1 180	910
		950	1 280	760
		1 050	1 380	630

Notes: 1) Please consult NSK before operating Monocarrier actuators near maximum speed.
2) Maximum rotational speed is (5000 min^{-1}). (For leads 5,10,12,15,20 & 30)
3) Refer to the above table for maximum speed for each stroke.

C-1-4. 4 Accuracy Grade

The accuracy grade of Monocarrier standard models is high grade (H), except for MCM02 and MCM03 with 1 or 2 mm leads.

When you require strokes longer than 1 200 mm, please consult NSK about the accuracy grade.

Table 4.4

Unit : μm

Accuracy	High grade (H)			Precision (P)			
Stroke (mm)	Repeatability	Running Parallelism (vertical)	Backlash	Repeatability	Positioning accuracy	Running Parallelism (vertical)	Backlash
to 200	±10	14	20 or less	±3	20	8	3 or less
to 400		16			25	10	
to 600		20			30	12	
to 700		23			30	15	
to 1 000		23			35	15	
to 1 200		30			40	20	

C-1-4. 5 Stroke and Ball Screw Lead

(1) MCM Model Standard Combinations of Stroke and Ball Screw Lead

Table 4.5 Single slider

Unit : mm

Model No.	MCM02		MCM03						MCM05				MCM06			MCM08				MCM10		
Lead / Stroke	1	2	1	2	5	10	12	15	5	10	20	30	5	10	20	5	10	20	30	10	20	30
50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓					
100	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	
150	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	
200					✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	
250					✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	
300									✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	
400									✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
500									✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
600									✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
700													✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
800													✓	✓	✓	✓	✓	✓		✓	✓	✓
900																				✓	✓	
1 000																				✓	✓	

Table 4.6 Double slider

Unit : mm

Model No.	MCM05		MCM06			MCM08		MCM10	
Lead / Stroke	10	20	5	10	20	10	20	10	20
60	✓								
70								✓	
80						✓			
110	✓		✓	✓					
160	✓								
170								✓	✓
180						✓	✓		
210	✓	✓	✓	✓	✓				
270								✓	✓
280						✓	✓		
310	✓	✓	✓	✓	✓				
370								✓	✓
380						✓	✓		
410	✓	✓	✓	✓	✓				
470								✓	✓
480						✓	✓		
510	✓	✓		✓	✓				
570								✓	✓
580						✓	✓		
610				✓	✓				
670								✓	✓
680						✓	✓		
710				✓	✓				
870								✓	✓

Note: Please consult NSK about double sliders for MCM02 and MCM03.

(2) MCH Model Standard Combinations of Stroke and Ball Screw Lead

Table 4.7 Single slider

Unit : mm

Model No.	MCH06			MCH09			MCH10	
Lead / Stroke	5	10	20	5	10	20	10	20
50	✓	✓	✓					
100	✓	✓	✓	✓	✓	✓	✓	✓
200	✓	✓	✓	✓	✓	✓	✓	✓
300	✓	✓	✓	✓	✓	✓	✓	✓
400	✓	✓	✓	✓	✓	✓	✓	✓
500	✓	✓	✓	✓	✓	✓	✓	✓
600				✓	✓	✓	✓	✓
700				✓	✓	✓	✓	✓
800				✓	✓	✓	✓	✓
900							✓	✓
1 000							✓	✓
1 100							✓	✓
1 200							✓	✓

Table 4.8 Double slider

Unit : mm

Model No.	MCH06			MCH09			MCH10	
Lead / Stroke	5	10	20	5	10	20	10	20
100	✓	✓						
150				✓	✓			
200	✓	✓						
250				✓	✓		✓	✓
300	✓	✓						
350				✓	✓		✓	✓
400		✓	✓					
450					✓	✓	✓	✓
550							✓	✓
650					✓	✓	✓	✓
750								✓
850								✓
950								✓
1 050								✓

Table 4.9 Limitations

	Model No.	Lead (mm)	Slider	Stroke (mm)
MCM model	MCM02	1,2	Single	150
	MCM03	1,2	Single	150
		5,10,12,15	Single	350
	MCM05	5,10,20,30*	Single	900
			Double	810
	MCM06	5,10,20	Single	1 000
			Double	910
	MCM08	5,10,20,30*	Single	1 000
			Double	880
	MCM10	10,20,30*	Single	1 750
			Double	1 600
MCH model	MCH06	5,10,20	Single	600
			Double	500
	MCH09	5,10,20	Single	1 000
			Double	850
	MCH10	10,20	Single	1 750
			Double	1 600
	MCL06	5,10,20	Single	500

*) Applicable only to single slider

C-1-4. 6 Basic Load Rating

(1) MCM Model Basic Load Ratings

Table 4.10 Basic Load Ratings

Model No.	Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N) Ball screw C_a	Linear guide C	Support unit C_a	Rated running distance L_a(km)	Basic static load ratings (N) Ball screw C_{0a}	Linear guide C_0	Support unit Allowable load (N)
MCM02	1	ϕ 6	405(High grade) 480(Precision)	4 910	615	1	555(High grade) 615(Precision)	2 120	490
	2		400(High grade) 475(Precision)	3 900		2	555(High grade) 610(Precision)		
MCM03	1	ϕ 6	870	10 900	3 350	1	1 230	4 900	725
	2		865	8 650		2	1 220		
	5	ϕ 8	2 090	7 850		5	2 830	6 620	
	10		1 310	6 250		10	1 710		
	12		1 320	5 880		12	1 730		
	15	ϕ 10	2 000	5 440		15	2 740		
MCM05	5	ϕ 12	4 390	15 600	5 550	5	6 260	10 900	1 020
	10		2 740	12 400		10	3 820		
	20		2 660	9 850		20	3 800		
	30		3 300	8 600	8 300	30	5 390		1 910
MCM06	5	ϕ 15	8 300	25 200	8 300	5	12 700	17 000	1 910
	10		8 140	20 000		10	12 800		
	20		5 080	15 900		20	7 460		
MCM08	5	ϕ 15	8 300	30 800	9 000	5	12 700	22 800	2 130
	10		8 140	24 400		10	12 800		
	20		5 080	19 400		20	7 460		
	30		5 500	16 930		30	8 580		
MCM10	10	ϕ 20	12 800	33 500	9 600	10	21 400	29 400	2 360
	20		8 190	26 600		20	12 600		
	30		13 200	23 200		30	22 900		

Notes: ●Basic dynamic and static load ratings indicate values for one slider. ●Basic load ratings for the linear guide are loads perpendicular to the axis that allow 90% of a group of the same Monocarriers to operate to the rated running distance in the table, that is equivalent to 1 million revolutions of ball screw and support unit under the same conditions without causing flaking by rolling contact fatigue. ●Basic dynamic load ratings for the ball screw are axial loads that allow 90% of ball screws of a group of the same Monocarriers to rotate 1 million revolutions under the same conditions without causing flaking by rolling contact fatigue. ●Basic dynamic load ratings for the support unit are constant axial loads that allow 90% of support units of the same group of Monocarriers to rotate 1 million revolutions under the same conditions without causing flaking by rolling contact fatigue. ●Basic static load ratings are loads that result in combined permanent deformations at the contact point between a ball and the ball groove to 0.01% of the ball diameter.

Table 4.11 Basic static moment loads of linear guide

Model No.	Lead (mm)	Slider	Basic static moments (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
MCM02	1, 2	Single	24	8	8
MCM03	1, 2		68	28	28
	5, 10, 12 ,15		92	51	51
MCM05	5, 10, 20, 30*	Single	229	89	89
		Double	455	765	765
MCM06	5, 10, 20	Single	415	174	174
		Double	825	1 220	1 220
MCM08	5, 10, 20, 30*	Single	770	300	300
		Double	1 540	2 050	2 050
MCM10	10, 20, 30*	Single	1 170	425	425
		Double	2 340	2 940	2 940

Notes: ● Basic static moments for double sliders are values when two sliders equipped with NSK K1 are butted against each other.
● Basic static moments are values when the rolling contact pressure of balls exceeds 4 000 N/mm².
● If support for extremely heavy loads is required, please consult NSK for estimation of fatigue life.
*) Applicable only to single slider

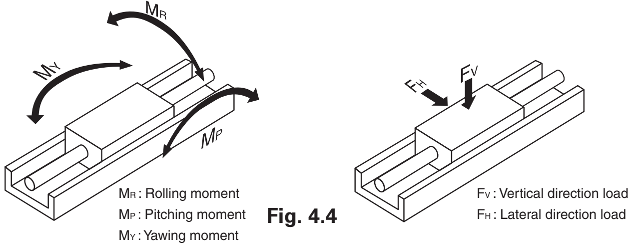


Fig. 4.4

(2) MCH Model Basic Load Ratings

Table 4.12 Basic Load Ratings

Model No.	Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N) Ball screw C_a	Linear guide C	Support unit C_a	Rated running distance L_a(km)	Basic static load ratings (N) Ball screw C_{0a}	Linear guide C_0	Support unit Allowable load (N)
MCH06 (MCL06)	5	ϕ 12	4 390	22 800	5 550	5	6 260	16 300	1 020
	10		2 740	18 100		10	3 820		
	20		2 660	14 400		20	3 800		
MCH09	5	ϕ 15	8 300	40 600	9 000	5	12 700	30 500	2 130
	10		8 140	32 200		10	12 800		
	20		5 080	25 500		20	7 460		
MCH10	10	ϕ 20	12 800	44 600	9 600	10	21 400	42 000	2 360
	20		8 190	35 400		20	12 600		

Notes: ●Basic dynamic and static load ratings indicate values for one slider. ●Basic load ratings for the linear guide are loads perpendicular to the axis that allow 90% of a group of the same Monocarriers to operate to the rated running distance in the table, that is equivalent to 1 million revolutions of ball screw and support unit under the same conditions without causing flaking by rolling contact fatigue. ●Basic dynamic load ratings for the ball screw are axial loads that allow 90% of ball screws of a group of the same Monocarriers to rotate 1 million revolutions under the same conditions without causing flaking by rolling contact fatigue. ●Basic dynamic load ratings for the support unit are constant axial loads that allow 90% of support units of the same group of Monocarriers to rotate 1 million revolutions under the same conditions without causing flaking by rolling contact fatigue. ●Basic static load ratings are loads that result in combined permanent deformations at the contact point between a ball and the ball groove to 0.01% of the ball diameter.

Table 4.13 Basic static moment loads of linear guide

Model No.	Slider	Basic static moments (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
MCH06 (MCL06)	Single	335	133	133
	Double	770	730	730
MCH09	Single	890	385	385
	Double	1 780	2 070	2 070
MCH10	Single	1 460	610	610
	Double	2 920	3 430	3 430

Notes: ● Basic static moments for double sliders are values when two sliders equipped with NSK K1 are butted against each other.
● Basic static moments are values when the rolling contact pressure of balls exceeds 4 000 N/mm².
● If support for extremely heavy loads is required, please consult NSK for estimation of fatigue life.
*) Applicable only to single slider

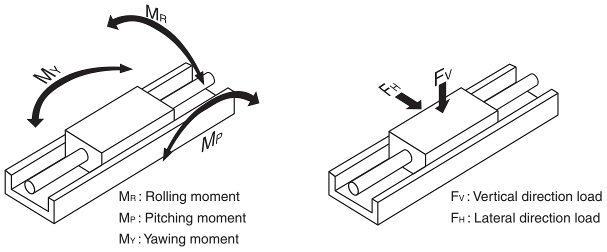


Fig. 4.5

C-1-4. 7 Estimation of Life Expectancy

(1) Life of Linear Guide

Study the load to be applied to the linear guide of Monocarrier (**Fig. 4.6**). Equivalent load F_e is determined by inputting the appropriate loads into the equations below. Use equation 1) for single sliders and equation 2) for double sliders.

● For a single slider

$$F_e = Y_H F_H + Y_V F_V + Y_R \varepsilon_R M_R + Y_P \varepsilon_P M_P + Y_Y \varepsilon_Y M_Y \cdots\cdots 1)$$

● For a double slider

$$F_e = \frac{Y_H F_H}{2} + \frac{Y_V F_V}{2} + Y_R \varepsilon_{Rd} M_R + Y_P \varepsilon_{Pd} M_P + Y_Y \varepsilon_{Yd} M_Y \cdots\cdots 2)$$

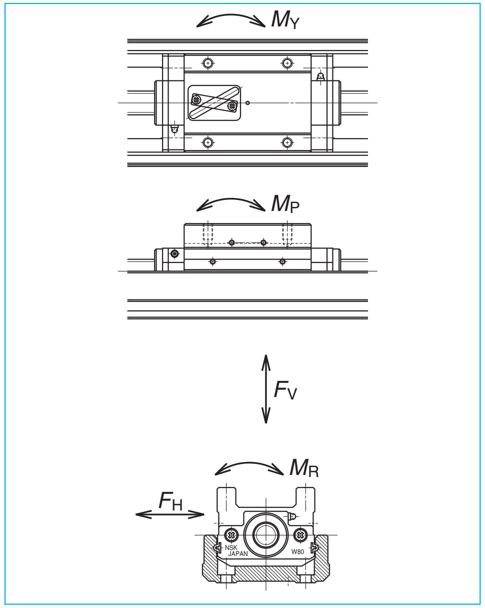


Fig. 4.6 Direction of load

F_H : Lateral direction load acting on the slider (N)
F_V : Vertical direction load acting on the slider (N)
M_R : Rolling moment acting on the slider (N · m)
M_P : Pitching moment acting on the slider (N · m)
M_Y : Yawing moment acting on the slider (N · m)
ε_R, ε_{Rd}
: Dynamic equivalent coefficient to rolling moment
ε_P, ε_{Pd}
: Dynamic equivalent coefficient to pitching moment
ε_Y, ε_{Yd}
: Dynamic equivalent coefficient to yawing moment

Refer to **Table 4.14** about Dynamic equivalent coefficients.

Y_H, Y_V, Y_R, Y_P, Y_Y
: 1.0 or 0.5

To obtain equivalent load F_e from equation 1) or 2), among F_H, F_V, $\varepsilon_P M_P$, $\varepsilon_R M_R$, $\varepsilon_Y M_Y$, the maximum load is assumed to be 1.0, and others to be 0.5.

Table 4.14 Dynamic equivalent coefficient

Model No.	MCM02	MCM03		MCM05	MCM06	MCM08	MCM10	MCH06 MCL06	MCH09	MCH10
		Lead 1, 2	Lead 5, 10, 12, 15							
ε_R	95.2	79.4	79.4	52.6	45.5	32.5	27.8	48.3	34.5	28.6
ε_P	174	113.9	84.2	81.3	65.1	48.8	45.2	75.1	47.9	41.0
ε_Y	174	113.9	84.2	81.3	65.1	48.8	45.2	75.1	47.9	41.0
ε_{Rd}	–	–	–	26.3	22.7	16.3	13.9	24.2	17.2	14.3
ε_{Pd}	–	–	–	10.4 (12.2)	9.7 (11.5)	7.6 (8.6)	7.1 (8.0)	11.4 (13.2)	8.11 (9.10)	6.98 (7.82)
ε_{Yd}	–	–	–	10.4 (12.2)	9.7 (11.5)	7.6 (8.6)	7.1 (8.0)	11.4 (13.2)	8.11 (9.10)	6.98 (7.82)

Note: Parenthesized figures are dynamic equivalent coefficients for Monocarrier actuators without NSK K1.

In cases when the load acting on the slider may fluctuate (In general, M_P, M_Y may fluctuate with the acceleration/deceleration of slider), the mean effective load is determined by Eq. 3).

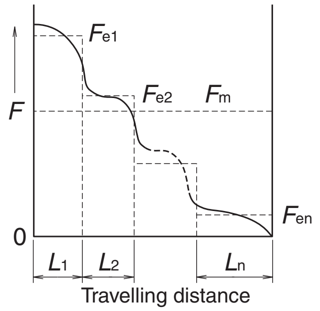


Fig. 4.7 Stepwise Fluctuating Load

Travelling distance under the equivalent load F_{e1} : L_1
Travelling distance under the equivalent load F_{e2} : L_2
· · · · · · · · · · · ·
Travelling distance under the equivalent load F_{en} : L_n

$$F_m = \sqrt[3]{\frac{1}{L}\left(F_{e1}{}^3 L_1 + F_{e2}{}^3 L_2 + \cdots F_{en}{}^3 L_n\right)} \cdots 3)$$

F_m : Mean effective load of fluctuating loads
L : Total travelling distance

The life of linear guide is calculated by Eq. 4).

$$L = L_a \times \left(\frac{C}{f_W \cdot F_m}\right)^3 \cdots\cdots 4)$$

L : Life of linear guide (km)
F_m : Mean effective load acting on the linear guide (N)
C : Basic dynamic load rating of the linear guide (N)
L_a : Travelling distance (km)
f_W : Load factor (refer to **Table 4.15**)

When the estimated life does not clear the required life, the life of the linear guide is to be calculated again after the following measures are taken:

1. Change from a single slider to a double slider.
2. Use a larger size Monocarrier.

(2) Life of Ball Screw (Support unit)

The mean effective load is determined from axial loads.

For calculation of the mean effective load, use Eq. 3.

The life of ball screw is calculated by Eq. 5).

$$L = \ell \times \left(\frac{C_a}{f_W \cdot F_m}\right)^3 \times 10^6 \cdots\cdots 5)$$

ℓ : Lead of ball screw (mm)
L : Life of ball screw (mm)
C_a : Basic dynamic load rating of the ball screw (N)
F_m : Mean effective load acting on the ball screw (N)
f_W : Load factor (refer to **Table 4.15**)

The life of a support unit is calculated by Eq. 5).

If the life of ball screw/support unit does not clear the required life, use a larger size Monocarrier.

After applying the calculations mentioned above, selection of the Monocarrier is completed.

Table 4.15 Values of load factor f_w

Operating conditions	Load factor f_W
Smooth operation with no mechanical shock	1.0 – 1.2
Normal operation	1.2 – 1.5
Operation with mechanical shock and vibrations	1.5 – 3.0

C-1-4. 8 Example Life Estimation

This section offers an example how to estimate the life of Monocarrier based on the life of each component.

<<Example calculation-1>>

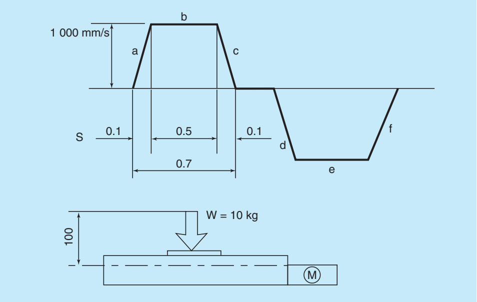


Fig. 4.8

1. Use condition

Stroke : 600 mm
Maximum speed : 1000 mm/s
Load mass : W = 10 kg
Acceleration : g = 9.80 m/s²
Setting position : Horizontal
Operating profile : See above figure

2. Selection of model (Interim Selection)

Firstly, select a greater ball screw lead as the maximum speed is 1000 mm/s. The interim selection is MCM06060H20K00, a single slider specification MCM06 that has 600 mm stroke, as the stroke is 600 mm.

3. Calculation

3-1. Linear guide

3-1-1. Fatigue life:

Multiply the result of Eq. 1) by the dynamic equivalent coefficient (**Table 4.14** single slider) to convert the load volume. From above operation profile,

i) Constant speed $F_{e1} = Y_V \cdot F_V = Y_V \cdot W \cdot g$
$= 1 \cdot 10 \cdot 9.8 = 98$ N

ii) Accelerating $F_{e2} = Y_V \cdot F_V + Y_P \cdot \varepsilon_P \cdot M_P$
$= 0.5 \cdot 10 \cdot 9.8 + 1 \cdot 65.1 \cdot 0.1 \cdot 100$
$= 700$ N

iii) Decelerating $F_{e3} = Y_V \cdot F_V + Y_P \cdot \varepsilon_P \cdot M_P$
$= 0.5 \cdot 10 \cdot 9.8 + 1 \cdot 65.1 \cdot 0.1 \cdot 100$
$= 700$ N

Mean effective load F_m

$$F_m = \sqrt[3]{\frac{1}{L}\left(F_{e1}{}^3 \cdot L_1 + F_{e2}{}^3 \cdot L_2 + F_{e3}{}^3 \cdot L_3\right)}$$

$$= \sqrt[3]{\frac{1}{600}\left(98^3 \cdot 500 + 700^3 \cdot 50 + 700^3 \cdot 50\right)}$$

$$= 387 \text{ N}$$

$$L = \left(\frac{C}{f_w \cdot F_m}\right)^3 \times L_a$$

$$= \left(\frac{15\,900}{1.2 \cdot 387}\right)^3 \times 20$$

$$= 8.02 \times 10^5 \text{ km}$$

3-1-2. Static safety factor: Divide the basic static load rating by the maximum load.

$$F_S = \frac{C_0}{F_e} = \frac{C_0}{F_{e2}} = \frac{17\,000}{700} = 24.2$$

3-2. Ball screw

3-2-1. Fatigue life: Obtain the axial load of each stage of operation referring to the operation profile, then calculate the mean load.

By the process above,

i) Constant speed
$F_{e1} = \mu \cdot W \cdot g = 0.01 \cdot 10 \cdot 9.8 = 0.98$

ii) Accelerating
$F_{e2} = F_{e1} + W \cdot \alpha = 101$ N

iii) Decelerating
$F_{e3} = F_{e1} - W \cdot \alpha = 99$ N

Axial mean effective load F_m

$$F_m = \sqrt[3]{\frac{1}{L}\left(F_{e1}{}^3 \cdot L_1 + F_{e2}{}^3 \cdot L_2 + F_{e3}{}^3 \cdot L_3\right)}$$

$$= \sqrt[3]{\frac{1}{600}\left(0.98^3 \cdot 500 + 101^3 \cdot 50 + 99^3 \cdot 50\right)}$$

$$= 55 \text{ N}$$

$$L = \left(\frac{C_a}{f_w \cdot F_m}\right)^3 \times \ell \times 10^6$$

$$= \left(\frac{5\,080}{1.2 \cdot 55}\right)^3 \times 20 \times 10^6 \text{ (mm)}$$

$$= 9.1 \times 10^6 \text{ km}$$

3-2-2. Static safety factor: Divide the basic static load rating by the maximum axial load.

$$F_S = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{7\,460}{101} = 73.8$$

3-2-3. Maximum rotational speed: According to the table of maximum speed on page C11, MCM06 with 20 mm lead and 600 mm stroke is possible to operate under the maximum speed of 1 300 mm/s.

3-3. Support unit

3-3-1. Fatigue life: Use the axial load F_m = 55 N, that is the result of above calculation 3-2-1.

$$L = \left(\frac{C_a}{f_w \cdot F_m}\right)^3 \times \ell \times 10^6 = \left(\frac{8\,300}{1.2 \times 55}\right)^3 \times 20 \times 10^6 \text{ (mm)}$$

$$= 3.97 \times 10^7 \text{ km}$$

3-3-2. Static safety factor: Divide the Allowable load by the maximum axial load.

$$F_S = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{1\,910}{101} = 18.9$$

3-4. Results

MCM06060H20K00	Linear guide	Ball screw	Support unit
Fatigue life	8.02×10^5 km	9.1×10^6 km	3.97×10^7 km
Static safety factor	24.2	73.8	18.9

In this case, the linear guide has the shortest fatigue life of the components. Therefore, the linear guide fatigue life is used as the life of the Monocarrier. The interim selection of MCM06060H20K00, that is chosen based on the use conditions, satisfies the required life.

<<Example calculation-2>>

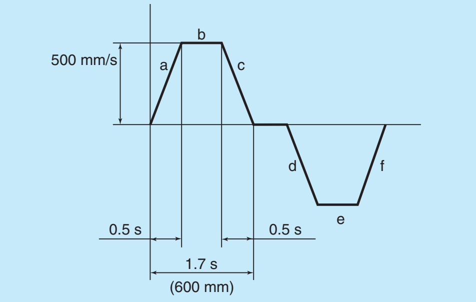


Fig. 4.9

1. Use condition

Stroke : 600 mm
Maximum speed : 500 mm/s
Load mass : W = 20 kg
Acceleration : 9.8 m/s²
Setting position : Horizontal
Operating profile : See above figure

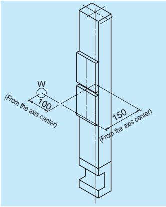


Fig. 4.10

2. Selection of model (Interim Selection) Select a 10 mm lead ball screw as the maximum speed is 500 mm/s.

The interim selection is MCM08068H10D00 as a double slider specification of MCM08 has 680 mm stroke, and the setting position is vertical.

3. Calculation

3-1. Linear guide

3-1-1. Fatigue life: Multiply the result of the Eq. 2) by the dynamic equivalent coefficient (**Table 4.14.** double slider) to convert the load volume. From operation profile (**Fig. 4.9**), the acceleration is 1 m/s².

i) Constant speed $F_{e1} = Y_P \cdot \varepsilon_{Pd} \cdot M_P + Y_Y \cdot \varepsilon_{Yd} \cdot M_Y$
$= 1 \cdot 7.6 \cdot 20 \cdot 9.8 \cdot 0.15 + 0.5 \cdot 7.6 \cdot 20 \cdot 9.8 \cdot 0.1$
$= 298$ N

ii) Accelerating $F_{e2} = Y_P \cdot \varepsilon_{Pd} \cdot M_P + Y_Y \cdot \varepsilon_{Yd} \cdot M_Y$
$= 1 \cdot 7.6 \cdot 20 \cdot (9.8 + 1.0) \cdot 0.15 + 0.5 \cdot 7.6 \cdot 20 \cdot (9.8 + 1.0) \cdot 0.1 = 329$ N

iii) Decelerating $F_{e3} = Y_P \cdot \varepsilon_{Pd} \cdot M_P + Y_Y \cdot \varepsilon_{Yd} \cdot M_Y$
$= 1 \cdot 7.6 \cdot 20 \cdot (9.8 - 1.0) \cdot 0.15 + 0.5 \cdot 7.6 \cdot 20 \cdot (9.8 - 1.0) \cdot 0.1 = 268$ N

Mean effective load F_m

$$F_m = \sqrt[3]{\frac{1}{L}\left(F_{e1}{}^3 \cdot L_1 + F_{e2}{}^3 \cdot L_2 + F_{e3}{}^3 \cdot L_3\right)}$$

$$= \sqrt[3]{\frac{1}{600}\left(298^3 \cdot 350 + 329^3 \cdot 125 + 268^3 \cdot 125\right)}$$

$$= 300 \text{ N}$$

$$L = L_a \times \left(\frac{C}{f_w \cdot F_m}\right)^3$$

$$= 10 \times \left(\frac{24\,400}{1.2 \cdot 300}\right)^3$$

$$= 3.11 \times 10^6 \text{ km}$$

3-1-2. Static safety factor: Divide the basic static load rating by the maximum load.

$$F_S = \frac{C_0}{F_e} = \frac{C_0}{F_{e2}} = \frac{22\,800}{329} = 69.3$$

3-2. Ball screw

3-2-1. Fatigue life: Obtain the axial load of each stage of operation referring to the operation profile, then calculate the mean load.

i) Constant speed
$F_{e1} = W \cdot g = 20 \cdot 9.8 = 196$ N

ii) Accelerating
$F_{e2} = F_{e1} + W \cdot \alpha = 196 + 20 \cdot 1 = 216$ N

iii) Decelerating
$F_{e3} = F_{e1} - W \cdot \alpha = 196 - 20 \cdot 1 = 176$ N

Axial mean effective load F_m

$$F_m = \sqrt[3]{\frac{1}{L}\left(F_{e1}{}^3 \cdot L_1 + F_{e2}{}^3 \cdot L_2 + F_{e3}{}^3 \cdot L_3\right)}$$

$$= \sqrt[3]{\frac{1}{600}\left(196^3 \cdot 350 + 216^3 \cdot 125 + 176^3 \cdot 125\right)}$$

$$= 197 \text{ N}$$

$$L = \ell \times \left(\frac{C_a}{f_w \cdot F_m}\right)^3 \times 10^6$$

$$= 10 \times \left(\frac{8\,140}{1.2 \cdot 197}\right)^3 \times 10^6 \text{ (mm)}$$

$$= 4.08 \times 10^5 \text{ km}$$

3-2-2. Static safety factor: Divide the basic static load rating by the maximum axial load.

$$F_S = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{12\,800}{216} = 59.2$$

3-3. Support unit

3-3-1. Fatigue life: Use the axial load F_m = 197 N, that is the result of above calculation 3-2-1.

$$L = \ell \times \left(\frac{C_a}{f_w \cdot F_m}\right)^3 \times 10^6 = 10 \times \left(\frac{9\,000}{1.2 \times 197}\right)^3 \times 10^6 \text{ (mm)}$$

$$= 5.51 \times 10^5 \text{ km}$$

3-3-2. Static safety factor: Divide the Allowable load by the maximum axial load.

$$F_S = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{2\,130}{216} = 9.8$$

3-4. Results

MCM08068H10D00	Linear guide	Ball screw	Support unit
Fatigue life	3.11 × 10^6 km	4.08 × 10^5 km	5.51 × 10^5 km
Static safety factor	69.3	59.2	9.8

C-1-5 MCM Model

MCM Model

C-1-5 MCM Model

C-1-5.1 MCM Model Reference Number Coding

[Body]

Example: MC M 08 040 H 10 K 0 0 *1

Monocarrier

M: MCM Model

Nominal size (rail width, Unit: 10 mm)

Stroke (Unit: 10 mm)

Accuracy grade (H, high grade; P, precision grade)

NSK management number (0 or 2)

Standard grease specification: 0 (AS2)
Clean grease specification: B (LG2)

Slider specification K: Single slider
D: Double slider (See page C15.)

Ball screw lead (mm)

Note: *1. The 14th digit is set by NSK and cannot be specified by a customer. For details, see the relevant page for the Reference No.

[With Accessories]

Example: MC E 08 040 H 10 K 0 0 K 0 0 0

E: With MCM Accessories

NSK management number

Sensor unit

Cover unit

Motor bracket

Note: Accessories are available separately.

Table 1 Sensor unit (See page C49.)

Reference No. code	Specification	Reference No.
0	N/A	—
1	Proximity switch (normally close contact 3 pieces)	MC – SRxx – 10
2	Proximity switch (normally open contact 3 pieces)	MC – SRxx – 11
3	Proximity switch (normally open contact 1 piece, normally close contact 2 pieces)	MC – SRxx – 12
4	Photo sensor 3 pieces	MC – SRxx – 13

Note 1) xx: Reference number
2) Sensor rails are not included with sensor units. If you require a rail, please specify this when ordering. (See page C50 to C52.)

Table 2 Cover unit (See pages C53 to C54.)

Reference No. code	Specification	Reference No.
0	N/A	—
1	With top cover	MC – CVxxxxx – 01 (02) *
—	Full cover	MC – CVxxxxx – 00

Note 1) xxxxx: Reference number and stroke number 2)*: "-02" is only used for Monocarrier MCM03.
3) When a sensor unit is used, full cover units cannot be used.

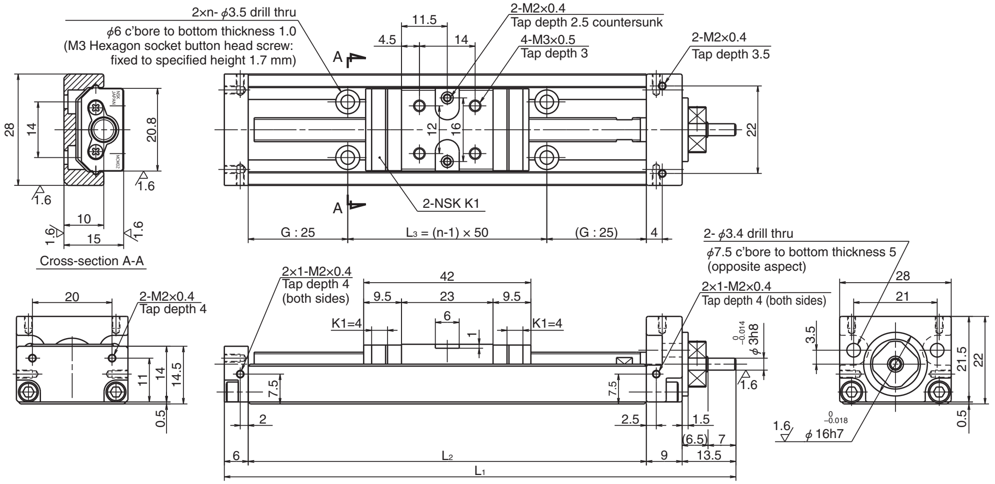
Table 3 Motor bracket (See pages C55 to C71.)

Reference No. code	Reference No.				
	MCM03	MCM05	MCM06	MCM08	MCM10
0	N/A	N/A	N/A	N/A	N/A
1	**MC-BK03-146-00**	**MC-BK05-145-00**	**MC-BK06-145-00**	**MC-BK08-145-00**	**MC-BK10-170-00**
2	**MC-BK03-148-01**	**MC-BK05-146-00**	**MC-BK06-146-00**	**MC-BK08-146-00**	**MC-BK10-170-01**
3	**MC-BK03-231-00**	**MC-BK05-148-00**	**MC-BK06-148-00**	**MC-BK08-160-00**	**MC-BK10-190-00**
4	—	**MC-BK05-160-00**	**MC-BK06-160-00**	**MC-BK08-170-00**	**MC-BK10-270-00**
5	—	**MC-BK05-250-00**	**MC-BK06-170-00**	**MC-BK08-170-01**	—
6	—	—	**MC-BK06-170-01**	**MC-BK08-190-00**	—
7	—	—	**MC-BK06-250-00**	**MC-BK08-250-00**	—
8	—	—	—	**MC-BK08-270-00**	—

N/A: Not applicable

C-1-5.2 MCM Model Dimension Tables for Standard Products

MCM02



Dimensions of MCM02 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes	Inertia × 10^{-7} (kg · m^2)	Mass (kg)
				L_1	L_2	L_3	n		
MCM02005H01K	50	58	1	128.5	100	50	2	0.93	0.26
MCM02005P01K									
MCM02005H02K			2						
MCM02005P02K									
MCM02010H01K	100	108	1	178.5	150	100	3	1.36	0.32
MCM02010P01K									
MCM02010H02K			2						
MCM02010P02K									
MCM02015H01K	150	158	1	228.5	200	150	4	1.81	0.39
MCM02015P01K									
MCM02015H02K			2						
MCM02015P02K									

Monocarrier dynamic torque specification (N · cm)

		High grade	Precision
Ball screw lead (mm)	1	0.1 – 1.3	0.2 – 1.6
	2		

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts, and support units.
3. Consult NSK for life estimates under large moment loads.
4. There is no LG2 specification for MCM02.

Basic load ratings

Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit load limit (N)
ℓ (mm)	d (mm)	Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
1	ϕ6	405 (High grade) 480 (Precision)	4 910	615	1	555 (High grade) 615 (Precision)	2 120	490
2		400 (High grade) 475 (Precision)	3 900		2	555 (High grade) 610 (Precision)		

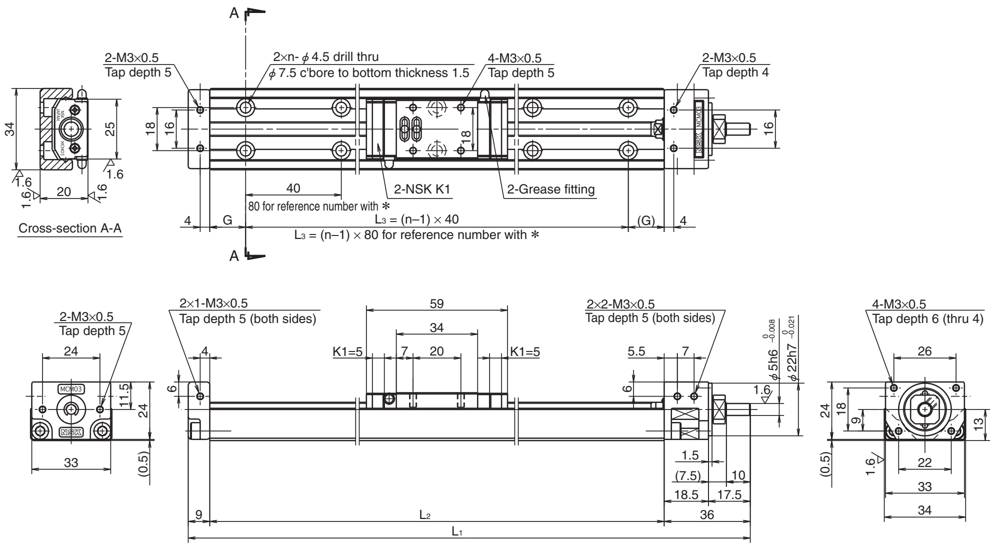
Basic static moment loads of linear guide

Slider	Basic static moment loads (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	24	8	8

MCM03

Accuracy grade: Precision (P)

Ball screw leads 1 and 2



Dimensions of MCM03 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm) L_1	L_2	G	L_3	No. of mounting holes n	Inertia ×10^{-5} (kg · m^2)	Mass (kg)
∗MCM03005P01K00	50	56 (66)	1	160	115	17.5	80	2	0.015	0.6
∗MCM03005P02K00			2						0.016	
MCM03010P01K00	100	131 (141)	1	235	190	15	160	5	0.021	0.7
MCM03010P02K00			2						0.022	
MCM03015P01K00	150	181 (191)	1	285	240	20	200	6	0.025	0.8
MCM03015P02K00			2						0.026	

Note: Bolt hole pitch L_3 on items marked with ∗ is 80 mm.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)		
	1	0.2 – 1.7
	2	

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.
4. A spacer plate is required when using a cover unit or sensor unit for MCM03 with a lead of 1 or 2 mm. (See page C53.)

Basic load ratings

Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit
ℓ	d	Ball screw	Linear guides	Support unit	Rated running distance	Ball screw	Linear guides	Allowable load
(mm)	(mm)	C_a	C	C_a	L_a (km)	C_{0a}	C_0	(N)
1	ϕ 6	870	10 900	3 350	1	1 230	4 900	725
2		865	8 650		2	1 220		

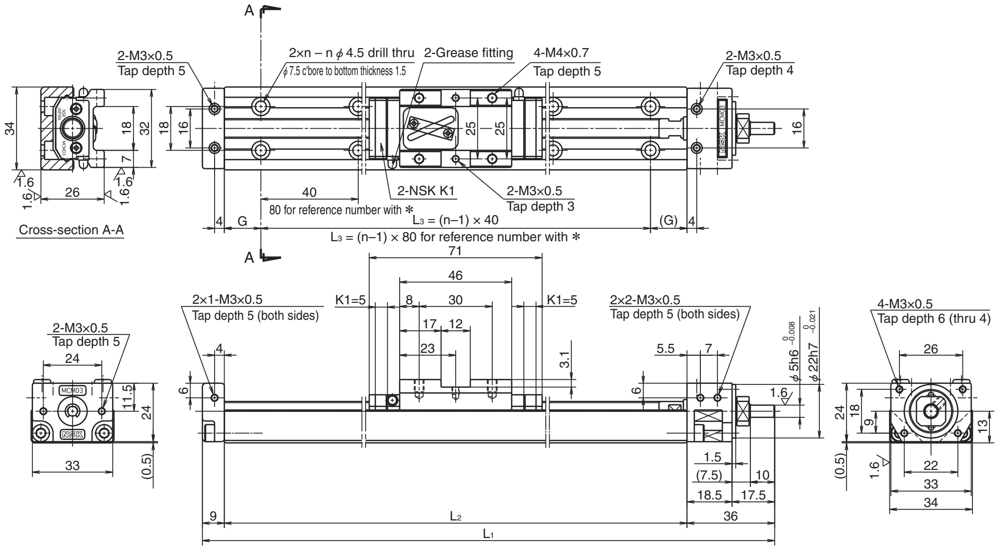
Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	68	28	28

MCM03

Accuracy grade: High grade (H)

Ball screw leads 5, 10 and 12



Dimensions of MCM03 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm) L_1	L_2	G	L_3	No. of mounting holes n	Inertia ×10^{-5} (kg · m^2)	Mass (kg)
∗MCM03005H05K00	50	69 (79)	5	185	140	30	80	2	0.057	0.6
∗MCM03005H10K00			10						0.080	
∗MCM03005H12K00			12						0.097	
MCM03010H05K00	100	119 (129)	5	235	190	15	160	5	0.073	0.7
MCM03010H10K00			10						0.092	
MCM03010H12K00			12						0.109	
MCM03015H05K00	150	169 (179)	5	285	240	20	200	6	0.089	0.8
MCM03015H10K00			10						0.105	
MCM03015H12K00			12						0.122	
MCM03020H05K00	200	219 (229)	5	335	290	25	240	7	0.104	0.9
MCM03020H10K00			10						0.118	
MCM03020H12K00			12						0.135	
MCM03025H05K00	250	269 (279)	5	385	340	30	280	8	0.120	1.0
MCM03025H10K00			10						0.131	
MCM03025H12K00			12						0.147	

Note: Bolt hole pitch L_3 on items marked with ∗ is 80 mm.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
5	0.2 – 2.5	0.6 – 4.4
10	0.3 – 3.0	0.7 – 4.9
12		

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit
ℓ	d	Ball screw	Linear guides	Support unit	Rated running distance	Ball screw	Linear guides	Allowable load
(mm)	(mm)	C_a	C	C_a	L_a (km)	C_{0a}	C_0	(N)
5	ϕ 8	2 090	7 850	3 350	5	2 830	6 620	725
10		1 310	6 250		10	1 710		
12		1 320	5 880		12	1 730		

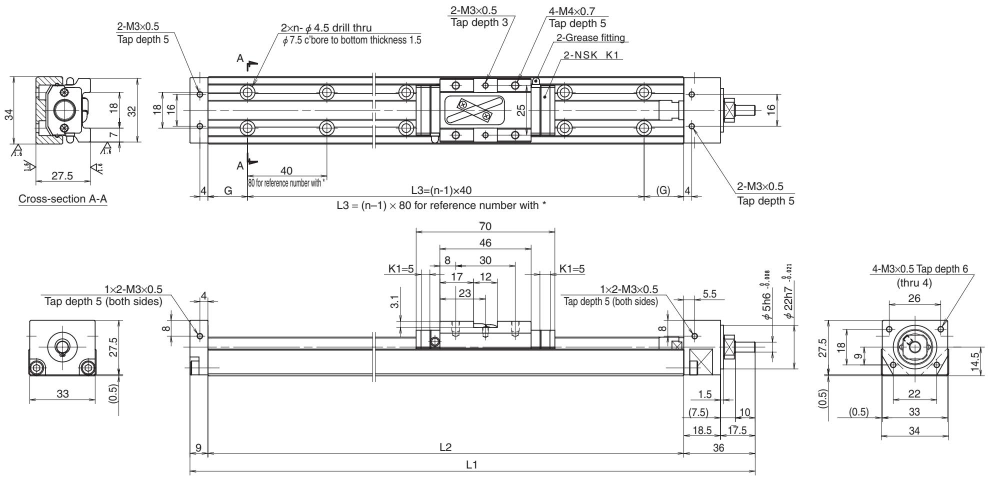
Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	92	51	51

MCM03

Ball screw lead 15

Accuracy grade: High grade (H)



Dimensions of MCM03 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (without K1)	Ball screw lead (mm)	Ball screw diameter (mm)	Body length (mm)				No. of mounting holes	Inertia	Mass
					L_1	L_2	G	L_3	n	$\times10^{-4}$ (kg·m²)	(kg)
∗ **MCM03005H15K00**	50	70 (80)	15	ϕ10	185	140	30	80	2	0.183	0.67
MCM03010H15K00	100	120(130)			235	190	15	160	5	0.222	0.77
MCM03015H15K00	150	170(180)			285	240	20	200	6	0.260	0.87
MCM03020H15K00	200	220(230)			335	290	25	240	7	0.298	0.97
MCM03025H15K00	250	270(280)			385	340	30	280	8	0.336	1.07

Note: Bolt hole pitch L_3 on items marked with ∗ is 80 mm.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	15	0.3 – 5.6

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in tables.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.
4. When a cover unit is added, an optional spacer plate is required. (See page C53.)
5. There is no P grade (precision grade) for Lead 15.

Basic load ratings

Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit
ℓ (mm)	d (mm)	Ball screw C_a	Linear guides C	Support unit Ca	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guide C_0	Allowable load (N)
15	ϕ10	2 000	5 440	3 350	15	2 740	6 620	725

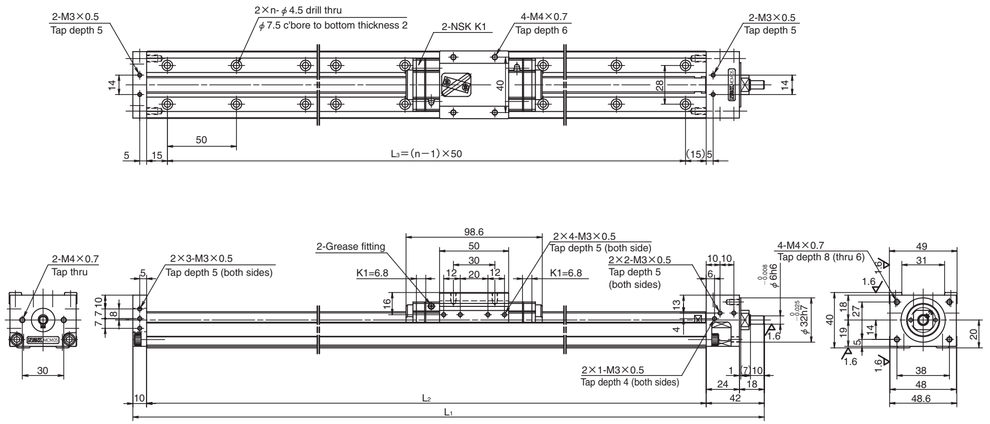
Basic static loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	92	51	51

MCM05

Accuracy grade: High grade (H)

Ball screw leads 5, 10 and 20



Dimensions of MCM05 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting holes n	Inertia ×10⁻⁴ (kg · m²)	Mass (kg)
MCM05005H05K00	50	81 (95)	5	232	180	150	4	0.025	1.4
MCM05005H10K00			10					0.035	
MCM05005H20K00			20					0.073	
MCM05010H05K00	100	131 (145)	5	282	230	200	5	0.031	1.6
MCM05010H10K00			10					0.040	
MCM05010H20K00			20					0.078	
MCM05015H05K00	150	181 (195)	5	332	280	250	6	0.036	1.8
MCM05015H10K00			10					0.046	
MCM05015H20K00			20					0.084	
MCM05020H05K00	200	231 (245)	5	382	330	300	7	0.042	2.0
MCM05020H10K00			10					0.051	
MCM05020H20K00			20					0.089	
MCM05025H05K00	250	281 (295)	5	432	380	350	8	0.047	2.2
MCM05025H10K00			10					0.057	
MCM05025H20K00			20					0.095	

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade High grade	Precision
5	1.0 – 4.8	1.9 – 7.7
10	1.1 – 5.8	2.1 – 8.7
20	1.6 – 7.9	2.5 – 10.7
30	1.8 – 13.1	—

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load ratings (N) Ball screw C_{0a}	Linear guides C_0	Support unit Allowable load (N)
5	ϕ12	4 390	15 600	5 550	5	6 260	10 900	1 020
10		2 740	12 400		10	3 820		
20		2 660	9 850		20	3 800		
30		3 300	8 600	8 300	30	5 390		1 910

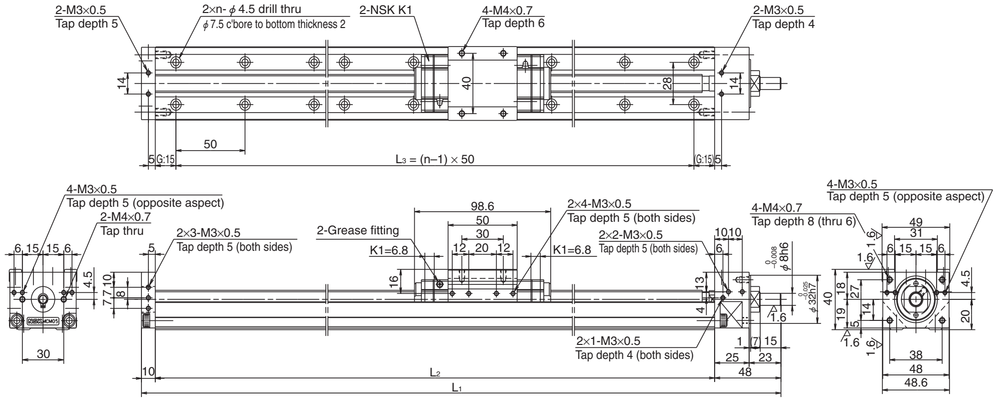
Basic static moment loads of linear guide

Slider	Basic static moment load (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	229	89	89

MCM05

Accuracy grade: High grade (H)

Ball screw lead 30



Dimensions of MCM05 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting holes n	Inertia ×10⁻⁴ (kg · m²)	Mass (kg)
MCM05030H05K00	300	331 (345)	5	482	430	400	9	0.053	2.3
MCM05030H10K00			10					0.063	
MCM05030H20K00			20					0.101	
MCM05030H30K00			30	488				0.164	
MCM05040H05K00	400	431 (445)	5	582	530	500	11	0.064	2.7
MCM05040H10K00			10					0.074	
MCM05040H20K00			20					0.112	
MCM05040H30K00			30	588				0.175	2.8
MCM05050H05K00	500	531 (545)	5	682	630	600	13	0.076	3.1
MCM05050H10K00			10					0.085	
MCM05050H20K00			20					0.123	
MCM05050H30K00			30	688				0.186	3.2
MCM05060H05K00	600	631 (645)	5	782	730	700	15	0.087	3.5
MCM05060H10K00			10					0.096	
MCM05060H20K00			20					0.134	
MCM05060H30K00			30	788				0.198	3.6

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade High grade	Precision
5	1.0 – 4.8	1.9 – 7.7
10	1.1 – 5.8	2.1 – 8.7
20	1.6 – 7.9	2.5 – 10.7
30	1.8 – 13.1	—

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

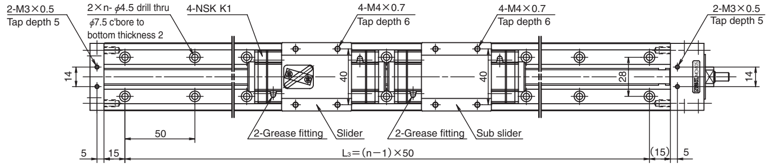
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load ratings (N) Ball screw C_{0a}	Linear guides C_0	Support unit Allowable load (N)
5	ϕ12	4 390	15 600	5 550	5	6 260	10 900	1 020
10		2 740	12 400		10	3 820		
20		2 660	9 850		20	3 800		
30		3 300	8 600	8 300	30	5 390		1 910

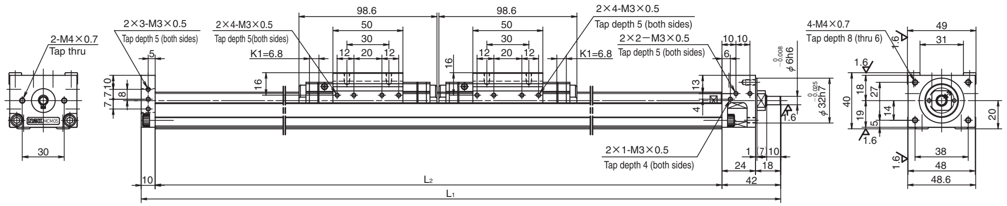
Basic static moment loads of linear guide

Slider	Basic static moment load (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	229	89	89

MCM05 (Double slider)

Accuracy grade: High grade (H)





Dimensions of MCM05 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting holes n	Inertia $\times 10^{-4}$ (kg · m^2)	Mass (kg)
MCM05006H10D00	60	82 (110)	10	332	280	250	6	0.058	2.3
MCM05011H10D00	110	132 (160)	10	382	330	300	7	0.064	2.5
MCM05016H10D00	160	182 (210)	10	432	380	350	8	0.070	2.7
MCM05021H10D00	210	232 (260)	10	482	430	400	9	0.075	2.8
MCM05021H20D00			20					0.151	

Ball screw lead(mm)	Accuracy grade High grade	Precision
10	1.5 – 7.6	2.4 – 10.6
20	2.3 – 11.8	3.2 – 14.8

Monocarrier dynamic torque specification (N · cm)

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

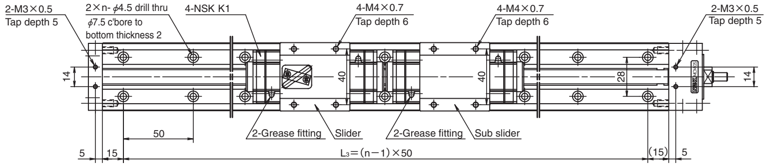
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load ratings (N) Ball screw C_{0a}	Linear guides C_0	Support unit Allowable load (N)
5	ϕ12	4 390	15 600	5 550	5	6 260	10 900	1 020
10		2 740	12 400		10	3 820		
20		2 660	9 850		20	3 800		

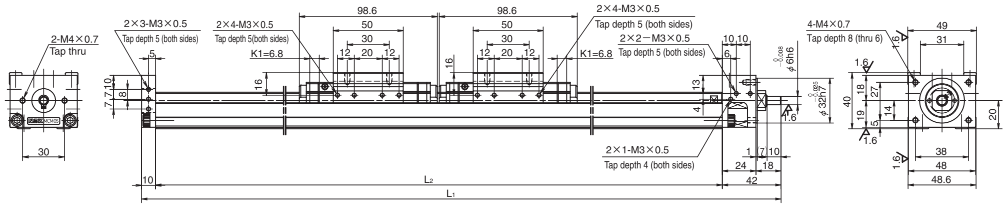
Basic static moment loads of linear guide

Slider	Basic static moment load (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	455	765	765

MCM05 (Double slider)

Accuracy grade: High grade (H)





Dimensions of MCM05 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting holes n	Inertia $\times 10^{-4}$ (kg · m^2)	Mass (kg)
MCM05031H10D00	310	332 (360)	10	582	530	500	11	0.086	3.2
MCM05031H20D00			20					0.162	
MCM05041H10D00	410	432 (460)	10	682	630	600	13	0.098	3.6
MCM05041H20D00			20					0.174	
MCM05051H10D00	510	532 (560)	10	782	730	700	15	0.109	4.2
MCM05051H20D00			20					0.185	

Ball screw lead(mm)	Accuracy grade High grade	Precision
10	1.5 – 7.6	2.4 – 10.6
20	2.3 – 11.8	3.2 – 14.8

Monocarrier dynamic torque specification (N · cm)

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

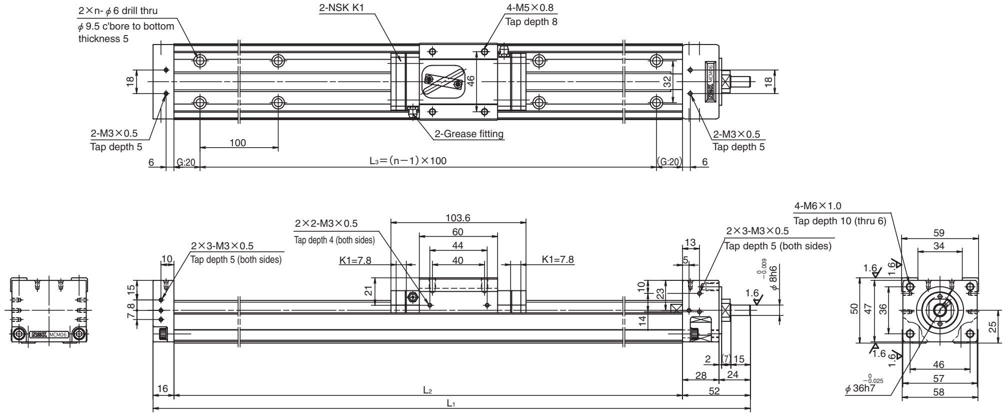
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load ratings (N) Ball screw C_{0a}	Linear guides C_0	Support unit Allowable load (N)
5	ϕ12	4 390	15 600	5 550	5	6 260	10 900	1 020
10		2 740	12 400		10	3 820		
20		2 660	9 850		20	3 800		

Basic static moment loads of linear guide

Slider	Basic static moment load (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	455	765	765

MCM06

Accuracy grade: High grade (H)



Dimensions of MCM06 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes	Inertia	Mass
				L_1	L_2	L_3	n	$\times 10^{-4}$ (kg · m^2)	(kg)
◇MCM06005H05K02	50	86 (102)	5	258	190	100	2	0.066	2.7
◇MCM06005H10K00			10					0.077	
◇MCM06005H20K00			20					0.122	
MCM06010H05K02	100	136 (152)	5	308	240	200	3	0.080	3.0
MCM06010H10K00			10					0.092	
MCM06010H20K00			20					0.137	
◇MCM06015H05K02	150	186 (202)	5	358	290	200	3	0.095	3.5
◇MCM06015H10K00			10					0.106	
◇MCM06015H20K00			20					0.152	
MCM06020H05K02	200	236 (252)	5	408	340	300	4	0.110	3.8
MCM06020H10K00			10					0.121	
MCM06020H20K00			20					0.167	
◇MCM06025H05K02	250	286 (302)	5	458	390	300	4	0.125	4.2
◇MCM06025H10K00			10					0.136	
◇MCM06025H20K00			20					0.181	
MCM06030H05K02	300	336 (352)	5	508	440	400	5	0.139	4.5
MCM06030H10K00			10					0.150	
MCM06030H20K00			20					0.196	

Notes: 1. Dimension G is 45 for items marked with ◇.
2. Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	Lead	High-grade, precision-grade
Standard	5	02
	10, 20	00
LG2	5	B2
	10, 20	B0

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
5	1.9 – 7.4	3.4 – 12.3
10	2.2 – 8.6	3.6 – 14.0
20	2.8 – 11.0	4.2 – 16.5

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

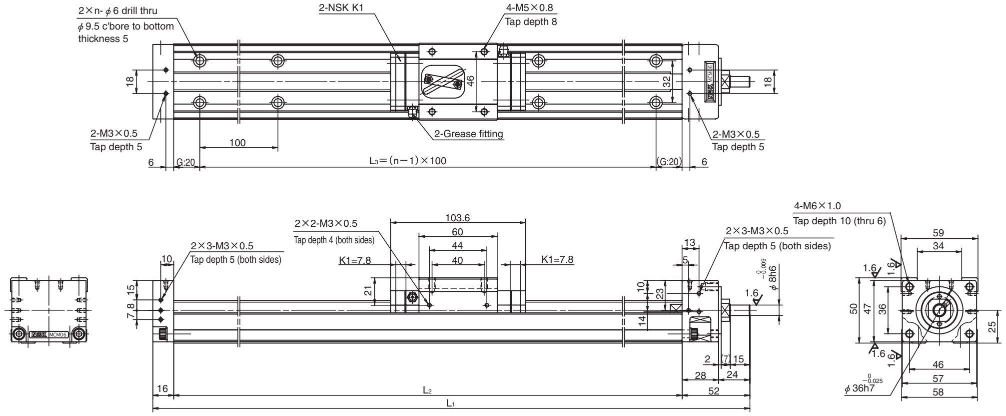
Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit
ℓ	d	Ball screw	Linear guides	Support unit	Rated running distance	Ball screw	Linear guides	Allowable load
(mm)	(mm)	C_a	C	C_a	L_a (km)	C_{0a}	C_0	(N)
5	ϕ 15	8 300	25 200	8 300	5	12 700	17 000	1 910
10		8 140	20 000		10	12 800		
20		5 080	15 900		20	7 460		

Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	415	174	174

MCM06

Accuracy grade: High grade (H)



Dimensions of MCM06 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes	Inertia	Mass
				L_1	L_2	L_3	n	$\times 10^{-4}$ (kg · m^2)	(kg)
MCM06040H05K02	400	436 (452)	5	608	540	500	6	0.169	5.2
MCM06040H10K00			10					0.180	
MCM06040H20K00			20					0.225	
MCM06050H05K02	500	536 (552)	5	708	640	600	7	0.198	6.0
MCM06050H10K00			10					0.209	
MCM06050H20K00			20					0.255	
MCM06060H05K02	600	636 (652)	5	808	740	700	8	0.228	6.7
MCM06060H10K00			10					0.239	
MCM06060H20K00			20					0.284	
MCM06070H05K02	700	736 (752)	5	908	840	800	9	0.257	7.4
MCM06070H10K00			10					0.268	
MCM06070H20K00			20					0.314	
MCM06080H05K02	800	836 (852)	5	1 008	940	900	10	0.286	8.1
MCM06080H10K00			10					0.298	
MCM06080H20K00			20					0.343	

Note: Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	Lead	High-grade, precision-grade
Standard	5	02
	10, 20	00
LG2	5	B2
	10, 20	B0

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
5	1.9 – 7.4	3.4 – 12.3
10	2.2 – 8.6	3.6 – 14.0
20	2.8 – 11.0	4.2 – 16.5

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

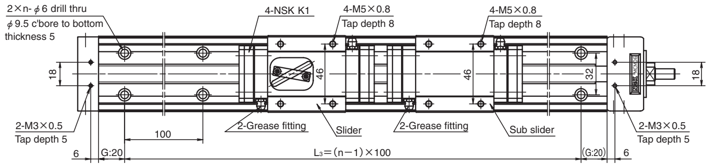
Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit
ℓ	d	Ball screw	Linear guides	Support unit	Rated running distance	Ball screw	Linear guides	Allowable load
(mm)	(mm)	C_a	C	C_a	L_a (km)	C_{0a}	C_0	(N)
5	ϕ 15	8 300	25 200	8 300	5	12 700	17 000	1 910
10		8 140	20 000		10	12 800		
20		5 080	15 900		20	7 460		

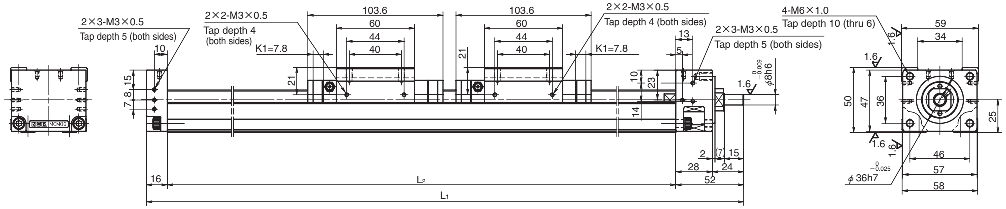
Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	415	174	174

MCM06 (Double slider)

Accuracy grade: High grade (H)





Dimensions of MCM06 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes	Inertia $\times 10^{-4}$ (kg · m²)	Mass (kg)
				L_1	L_2	L_3	n		
MCM06011H05D02	110	132 (164)	5	408	340	300	4	0.114	4.4
MCM06011H10D00			10					0.136	
MCM06021H05D02	210	232 (264)	5	508	440	400	5	0.143	5.1
MCM06021H10D00			10					0.166	
MCM06021H20D00			20					0.257	
MCM06031H05D02	310	332 (364)	5	608	540	500	6	0.173	5.8
MCM06031H10D00			10					0.195	
MCM06031H20D00			20					0.286	

Note: Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	Lead	High-grade, precision-grade
Standard	5	02
	10, 20	00
LG2	5	B2
	10, 20	B0

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
5	2.3 – 8.5	3.7 – 13.5
10	2.7 – 10.9	4.2 – 16.4
20	4.0 – 15.9	5.5 – 21.3

Notes:

1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

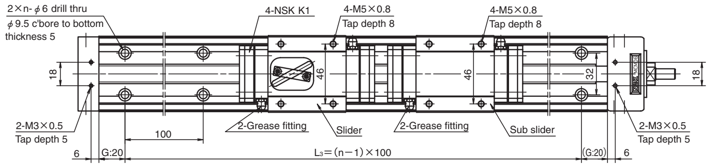
Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit
ℓ	d	Ball screw	Linear guides	Support unit	Rated running distance	Ball screw	Linear guides	Allowable load
(mm)	(mm)	C_a	C	C_a	L_a (km)	C_{0a}	C_0	(N)
5	ϕ15	8 300	25 200	8 300	5	12 700	17 000	1 910
10		8 140	20 000		10	12 800		
20		5 080	15 900		20	7 460		

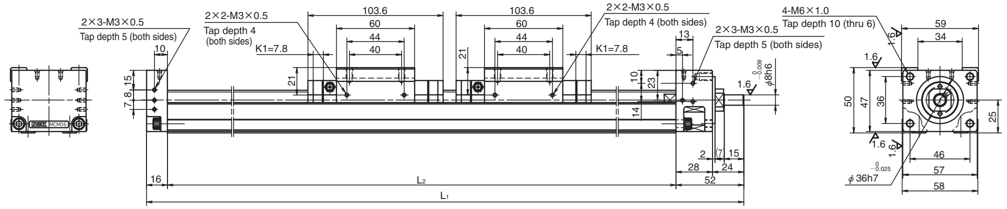
Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	825	1 220	1 220

MCM06 (Double slider)

Accuracy grade: High grade (H)





Dimensions of MCM06 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes	Inertia $\times 10^{-4}$ (kg · m²)	Mass (kg)
				L_1	L_2	L_3	n		
MCM06041H05D02	410	432 (464)	5	708	640	600	7	0.202	6.6
MCM06041H10D00			10					0.224	
MCM06041H20D00			20					0.316	
MCM06051H10D00	510	532 (564)	10	808	740	700	8	0.254	7.3
MCM06051H20D00			20					0.345	
MCM06061H10D00	610	632 (664)	10	908	840	800	9	0.283	8.0
MCM06061H20D00			20					0.375	
MCM06071H10D00	710	732 (764)	10	1 008	940	900	10	0.313	8.7
MCM06071H20D00			20					0.404	

Note: Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	Lead	High-grade, precision-grade
Standard	5	02
	10, 20	00
LG2	5	B2
	10, 20	B0

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
5	2.3 – 8.5	3.7 – 13.5
10	2.7 – 10.9	4.2 – 16.4
20	4.0 – 15.9	5.5 – 21.3

Notes:

1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit
ℓ	d	Ball screw	Linear guides	Support unit	Rated running distance	Ball screw	Linear guides	Allowable load
(mm)	(mm)	C_a	C	C_a	L_a (km)	C_{0a}	C_0	(N)
5	ϕ15	8 300	25 200	8 300	5	12 700	17 000	1 910
10		8 140	20 000		10	12 800		
20		5 080	15 900		20	7 460		

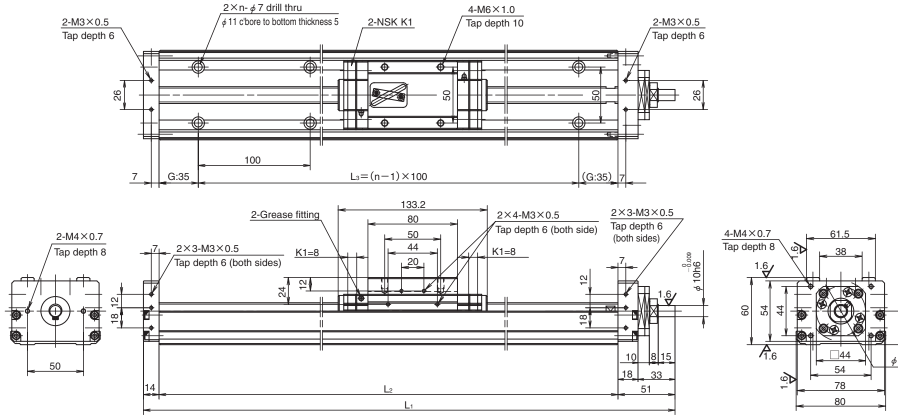
Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	825	1 220	1 220

MCM08

Accuracy grade: High grade (H)

Ball screw lead 5, 10 and 20



Dimensions of MCM08 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting holes n	Inertia x 10^{-4} (kg · m^2)	Mass (kg)
◇**MCM08005H05K02**	50	86 (102)	5	285	220	100	2	0.082	4.1
◇**MCM08005H10K00**			10					0.100	
MCM08010H05K02	100	136 (152)	5	335	270	200	3	0.097	4.6
MCM08010H10K00			10					0.114	
MCM08010H20K00			20					0.190	
◇**MCM08015H05K02**	150	186 (202)	5	385	320	200	3	0.111	5.1
◇**MCM08015H10K00**			10					0.129	
◇**MCM08015H20K00**			20					0.205	
MCM08020H05K02	200	236 (252)	5	435	370	300	4	0.126	5.5
MCM08020H10K00			10					0.144	
MCM08020H20K00			20					0.220	
◇**MCM08025H05K02**	250	286 (302)	5	485	420	300	4	0.141	6.0
◇**MCM08025H10K00**			10					0.159	
◇**MCM08025H20K00**			20					0.235	
MCM08030H05K02	300	336 (352)	5	535	470	400	5	0.156	6.5
MCM08030H10K00			10					0.173	
MCM08030H20K00			20					0.249	

Notes: 1. Dimension G is 60 for items marked with ◇.
2. Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	Lead	High-grade, precision-grade
Standard	5	02
	10, 20	00
LG2	5	B2
	10, 20	B0

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
5	1.0 – 5.9	3.1 – 11.5
10	2.0 – 7.8	3.2 – 13.3
20	2.5 – 10.8	4.0 – 16.4
30	2.8 – 12.0	—

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit
ℓ (mm)	d (mm)	Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	Allowable load (N)
5	ϕ15	8 300	30 800	9 000	5	12 700	22 800	2 130
10		8 140	24 400		10	12 800		
20		5 080	19 400		20	7 460		
30		5 500	16 930		30	8 580		

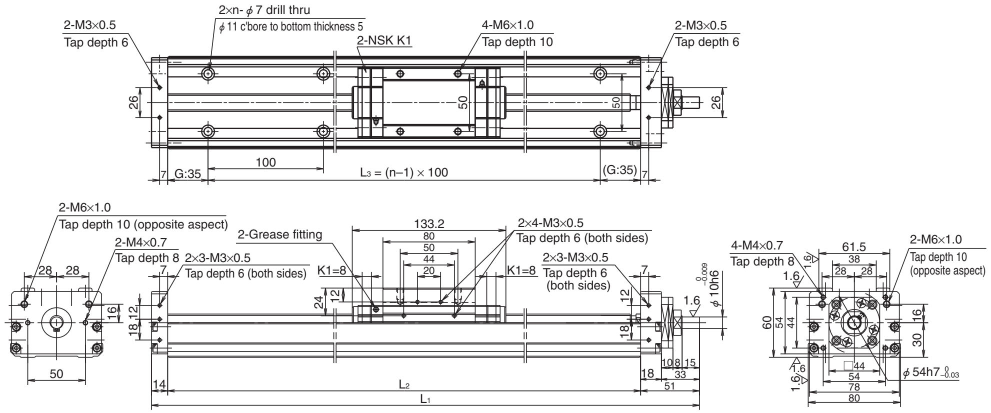
Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	770	300	300

MCM08

Accuracy grade: High grade (H)

Ball screw lead 30



Dimensions of MCM08 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting holes n	Inertia x 10^{-4} (kg · m^2)	Mass (kg)
MCM08040H05K02	400	436 (452)	5	635	570	500	6	0.185	7.4
MCM08040H10K00			10					0.203	
MCM08040H20K00			20					0.279	
MCM08040H30K00			30					0.405	
MCM08050H05K02	500	536 (552)	5	735	670	600	7	0.214	8.4
MCM08050H10K00			10					0.232	
MCM08050H20K00			20					0.308	
MCM08050H30K00			30					0.435	
MCM08060H05K02	600	636 (652)	5	835	770	700	8	0.244	9.3
MCM08060H10K00			10					0.262	
MCM08060H20K00			20					0.338	
MCM08060H30K00			30					0.464	
MCM08070H05K02	700	736 (752)	5	935	870	800	9	0.273	10.5
MCM08070H10K00			10					0.291	
MCM08070H20K00			20					0.367	
MCM08070H30K00			30					0.494	
MCM08080H05K02	800	836 (852)	5	1 035	970	900	10	0.303	11.2
MCM08080H10K00			10					0.320	
MCM08080H20K00			20					0.396	

Note: Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	Lead	High-grade, precision-grade
Standard	5	02
	10, 20	00
LG2	5	B2
	10, 20	B0

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
5	1.0 – 5.9	3.1 – 11.5
10	2.0 – 7.8	3.2 – 13.3
20	2.5 – 10.8	4.0 – 16.4
30	2.8 – 12.0	—

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

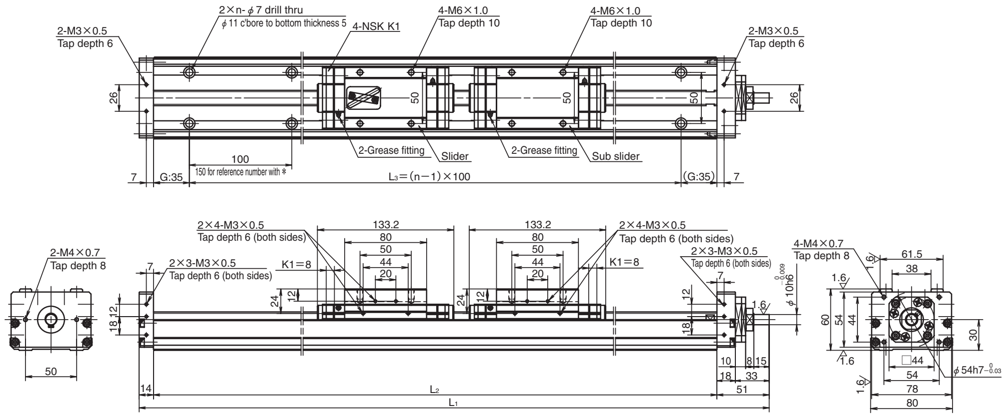
Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit
ℓ (mm)	d (mm)	Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	Allowable load (N)
5	ϕ15	8 300	30 800	9 000	5	12 700	22 800	2 130
10		8 140	24 400		10	12 800		
20		5 080	19 400		20	7 460		
30		5 500	16 930		30	8 580		

Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	770	300	300

MCM08 (Double slider)

Accuracy grade: High grade (H)



Dimensions of MCM08 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes	Inertia	Mass
				L_1	L_2	L_3	n	$\times 10^{-4}$ (kg · m^2)	(kg)
∗MCM08008H10D00	80	103 (135)	10	435	370	300	3	0.169	6.5
MCM08018H10D00	180	203 (235)	10	535	470	400	5	0.199	7.5
MCM08018H20D00			20					0.351	
MCM08028H10D00	280	303 (335)	10	635	570	500	6	0.228	8.4
MCM08028H20D00			20					0.380	
MCM08038H10D00	380	403 (435)	10	735	670	600	7	0.257	9.4
MCM08038H20D00			20					0.409	

Notes: 1. Bolt hole pitch L3 on item marked with * is 150 mm.
2. Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	Lead	High-grade, precision-grade
Standard	10, 20	00
LG2	10, 20	B0

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
10	2.5 – 10.8	3.9 – 16.2
20	4.0 – 17.2	5.4 – 22.6

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load rating

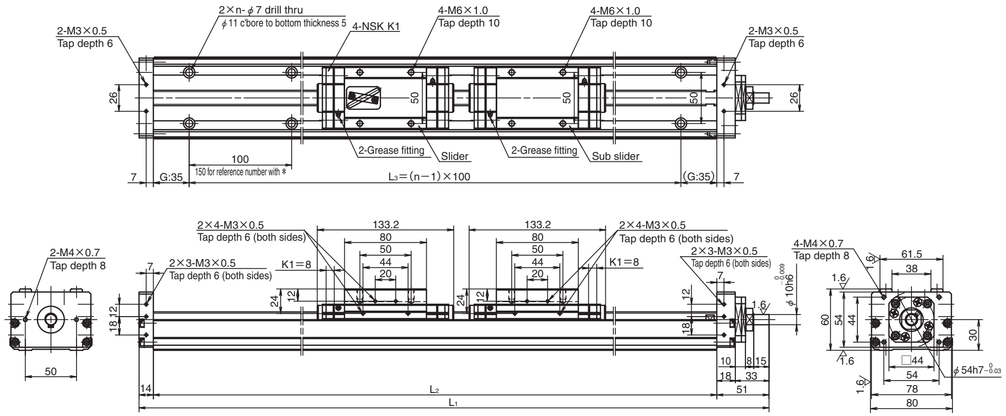
Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit
ℓ	d	Ball screw	Linear guides	Support unit	Rated running distance	Ball screw	Linear guides	Allowable load
(mm)	(mm)	C_a	C	C_a	L_a (km)	C_{0a}	C_0	(N)
10	ϕ15	8 140	24 400	9 000	10	12 800	22 800	2 130
20		5 080	19 400		20	7 460		

Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	1 540	2 050	2 050

MCM08 (Double slider)

Accuracy grade: High grade (H)



Dimensions of MCM08 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes	Inertia	Mass
				L_1	L_2	L_3	n	$\times 10^{-4}$ (kg · m^2)	(kg)
MCM08048H10D00	480	503 (535)	10	835	770	700	8	0.287	10.3
MCM08048H20D00			20					0.439	
MCM08058H10D00	580	603 (635)	10	935	870	800	9	0.316	11.5
MCM08058H20D00			20					0.468	
MCM08068H10D00	680	703 (735)	10	1 035	970	900	10	0.346	12.2
MCM08068H20D00			20					0.498	

Note: Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	Lead	High-grade, precision-grade
Standard	10, 20	00
LG2	10, 20	B0

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
10	2.5 – 10.8	3.9 – 16.2
20	4.0 – 17.2	5.4 – 22.6

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit
ℓ	d	Ball screw	Linear guides	Support unit	Rated running distance	Ball screw	Linear guides	Allowable load
(mm)	(mm)	C_a	C	C_a	L_a (km)	C_{0a}	C_0	(N)
10	ϕ15	8 140	24 400	9 000	10	12 800	22 800	2 130
20		5 080	19 400		20	7 460		

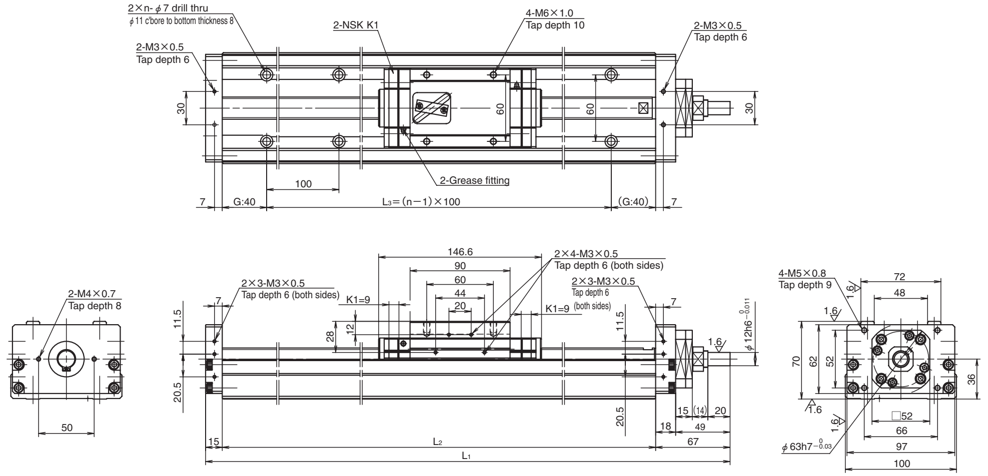
Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	1 540	2 050	2 050

MCM10

Accuracy grade: High grade (H)

Ball screw lead 10 and 20



Dimensions of MCM10 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes	Inertia	Mass
				L_1	L_2	L_3	n	$\times 10^{-4}$ (kg · m^2)	(kg)
MCM10010H10K00	100	133 (151)	10	362	280	200	2*	0.332	7.8
MCM10010H20K00			20					0.446	
◇**MCM10015H10K00**	150	183 (201)	10	412	330	300	4	0.378	8.7
◇**MCM10015H20K00**			20					0.492	
MCM10020H10K00	200	233 (251)	10	462	380	300	4	0.425	9.5
MCM10020H20K00			20					0.539	
◇**MCM10025H10K00**	250	283 (301)	10	512	430	400	5	0.472	10.4
◇**MCM10025H20K00**			20					0.586	
MCM10030H10K00	300	333 (351)	10	562	480	400	5	0.519	11.2
MCM10030H20K00			20					0.633	
MCM10040H10K00	400	433 (451)	10	662	580	500	6	0.612	13.0
MCM10040H20K00			20					0.726	
MCM10050H10K00	500	533 (551)	10	762	680	600	7	0.706	14.6
MCM10050H20K00			20					0.820	
MCM10050H30K00			30					1.010	

Notes: 1) Dimension G is 15 for items marked with ◇.

2) *: Use mounting holes on each end of the rail.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
10	2.7 – 10.8	4.7 – 19.7
20	3.1 – 12.7	5.2 – 21.6
30	5.1 – 18.0	—

Notes:

1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit
ℓ	*d*	Ball screw	Linear guides	Support unit	Rated running distance	Ball screw	Linear guides	Allowable load
(mm)	(mm)	C_a	C	C_a	L_a (km)	C_{0a}	C_0	(N)
10	ϕ20	12 800	33 500	9 600	10	21 400	29 400	2 360
20		8 190	26 600		20	12 600		
30		13 200	23 200		30	22 900		

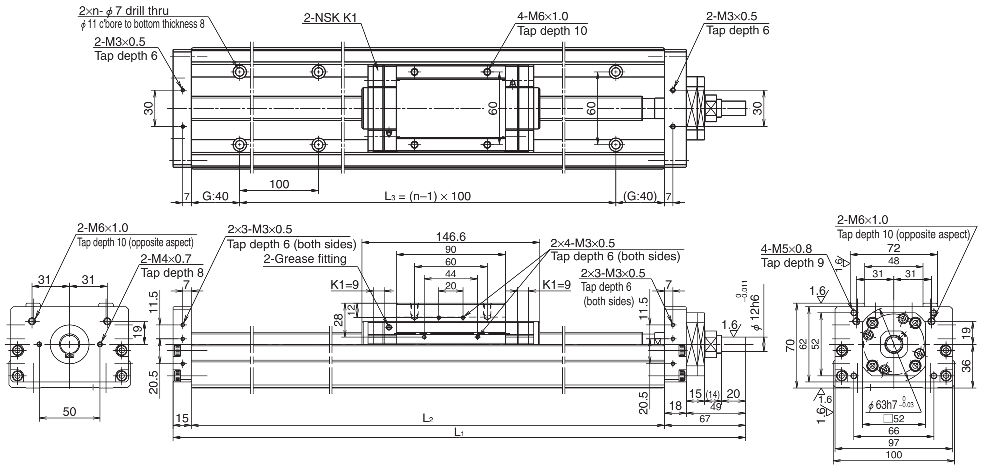
Basic static moment loads of linear guide

Slider	Basic static moment loads (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	1 170	425	425

MCM10

Accuracy grade: High grade (H)

Ball screw lead 30



Dimensions of MCM10 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting holes	Inertia	Mass
				L_1	L_2	L_3	n	$\times 10^{-4}$ (kg · m^2)	(kg)
MCM10060H10K00	600	633 (651)	10	862	780	700	8	0.800	16.3
MCM10060H20K00			20					0.914	
MCM10060H30K00			30					1.104	
MCM10070H10K00	700	733 (751)	10	962	880	800	9	0.893	18.0
MCM10070H20K00			20					1.007	
MCM10070H30K00			30					1.197	
MCM10080H10K00	800	833 (851)	10	1 062	980	900	10	0.987	19.7
MCM10080H20K00			20					1.101	
MCM10080H30K00			30					1.291	
MCM10090H10K00	900	933 (951)	10	1 162	1 080	1 000	11	1.081	21.4
MCM10090H20K00			20					1.195	
◇**MCM10100H10K00**	1 000	1 033 (1 051)	10	1 262	1 180	1 000	11	1.174	23.1
◇**MCM10100H20K00**			20					1.288	

Note: Dimension G is 90 for items marked with ◇.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
10	2.7 – 10.8	4.7 – 19.7
20	3.1 – 12.7	5.2 – 21.6
30	5.1 – 18.0	—

Notes:

1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

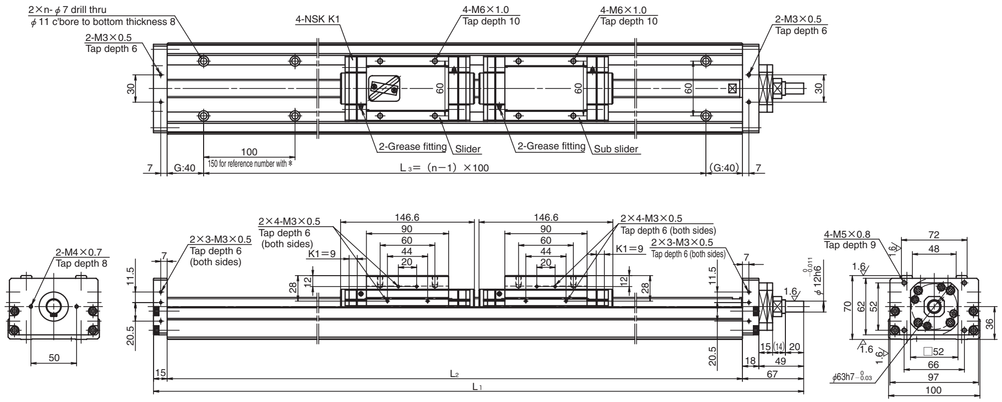
Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit
ℓ	*d*	Ball screw	Linear guides	Support unit	Rated running distance	Ball screw	Linear guides	Allowable load
(mm)	(mm)	C_a	C	C_a	L_a (km)	C_{0a}	C_0	(N)
10	ϕ20	12 800	33 500	9 600	10	21 400	29 400	2 360
20		8 190	26 600		20	12 600		
30		13 200	23 200		30	22 900		

Basic static moment loads of linear guide

Slider	Basic static moment loads (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	1 170	425	425

MCM10 (Double slider)

Accuracy grade: High grade (H)



Dimensions of MCM10 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting holes n	Inertia ×10⁻⁴ (kg · m²)	Mass (kg)
∗MCM10007H10D00	70	86 (122)	10	462	380	300	3	0.463	11.0
MCM10017H10D00	170	186 (222)	10	562	480	400	5	0.557	12.7
MCM10017H20D00			20					0.785	
MCM10027H10D00	270	286 (322)	10	662	580	500	6	0.650	13.4
MCM10027H20D00			20					0.878	
MCM10037H10D00	370	386 (422)	10	762	680	600	7	0.744	15.1
MCM10037H20D00			20					0.972	
MCM10047H10D00	470	486 (522)	10	862	780	700	8	0.838	17.8
MCM10047H20D00			20					1.066	

Note: Bolt hole pitch L_3 on item marked with ∗ is 150 mm.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead(mm)	Accuracy grade High grade	Precision
10	4.2 – 15.6	6.1 – 24.5
20	5.0 – 19.6	7.0 – 28.5

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

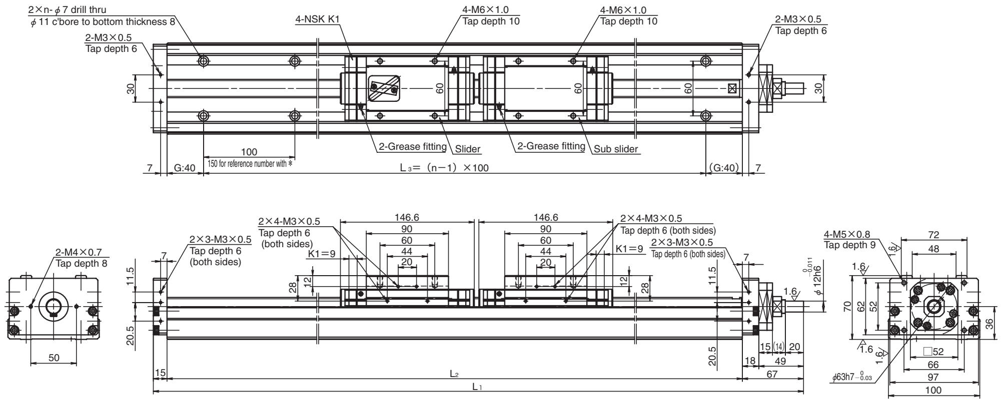
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load ratings (N) Ball screw C_{0a}	Linear guides C_0	Support unit Allowable load (N)
10	ϕ20	12 800	33 500	9 600	10	21 400	29 400	2 360
20		8 190	26 600		20	12 600		

Basic static moment loads of linear guide

Slider	Basic static moment load (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	2 340	2 940	2 940

MCM10 (Double slider)

Accuracy grade: High grade (H)



Dimensions of MCM10 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting holes n	Inertia ×10⁻⁴ (kg · m²)	Mass (kg)
MCM10057H10D00	570	586 (622)	10	962	880	800	9	0.931	19.5
MCM10057H20D00			20					1.159	
MCM10067H10D00	670	686 (722)	10	1 062	980	900	10	1.025	21.2
MCM10067H20D00			20					1.253	
◇MCM10087H10D00	870	886 (922)	10	1 262	1 180	1 000	11	1.212	23.6
◇MCM10087H20D00			20					1.440	

Note: Dimension G is 90 for items marked with ◇.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead(mm)	Accuracy grade High grade	Precision
10	4.2 – 15.6	6.1 – 24.5
20	5.0 – 19.6	7.0 – 28.5

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load ratings (N) Ball screw C_{0a}	Linear guides C_0	Support unit Allowable load (N)
10	ϕ20	12 800	33 500	9 600	10	21 400	29 400	2 360
20		8 190	26 600		20	12 600		

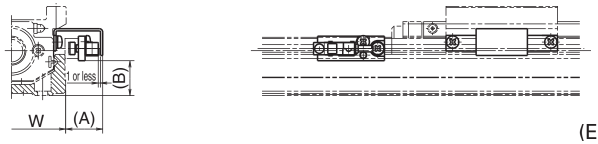
Basic static moment loads of linear guide

Slider	Basic static moment load (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	2 340	2 940	2 940

C-1-5.3 MCM Model Accessories

C-1-5. 3. 1 Sensor Unit

●Proximity switch

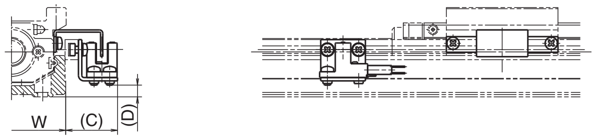


(Example assembly)

Model No.	Reference No.			A (mm)	B (mm)	Body width W (mm)
MCM02	MC-SR02-00	MC-SR02-01	MC-SR02-02	17	2	28
MCM03	MC-SR03-10	MC-SR03-11	MC-SR03-12	17	3	34
MCM05	MC-SR05-10	MC-SR05-11	MC-SR05-12	17	15	48.6
MCM06	MC-SR06-10	MC-SR06-11	MC-SR06-12	17	19	58
MCM08	MC-SR08-10	MC-SR08-11	MC-SR08-12	16	27	80
MCM10	MC-SR10-10	MC-SR10-11	MC-SR10-12	16	35	100
Quantity Proximity switch (normally open contact)	—	3	1	E2S-W13 (OMRON Corp.)		
Quantity Proximity switch (normally close contact)	3	—	2	E2S-W14 (OMRON Corp.)		

Notes: 1. See page C137 for proximity switch specifications.
2. A sensor unit consists of sensors, a sensor dog, and sensor mounting parts.
3. Sensor units for MCM02 contain two sensor dogs.
4. A spacer plate is required when using a cover unit or sensor unit for MCM03 with a lead of 1 or 2 mm. (Refer to page C53.)

●Photo sensor



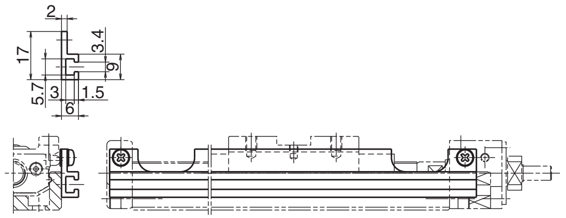
(Example assembly)

Model No.	Reference No.	C (mm)	D (mm)	Body width W (mm)	Remarks
MCM03	MC-SR03-13	24	0.5	34	EE-SX674 (OMRON Corp.) 3 sets (EE-1001 connector attachment)
MCM05	MC-SR05-13	24	5	48.6	
MCM06	MC-SR06-13	24	9	58	
MCM08	MC-SR08-13	23	17	80	
MCM10	MC-SR10-13	22	24	100	

Notes: 1. See page C138 for photo sensor specifications.
2. A sensor unit consists of sensors, a sensor dog, and sensor mounting parts.
3. A spacer plate is required when using a cover unit or sensor unit for MCM03 with a lead of 1 or 2 mm. (Refer to page C53.)

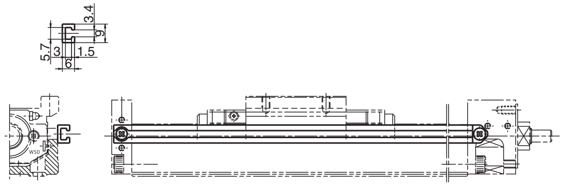
(1) Sensor Rail

Sensor rail for MCM03: MC-SRL3- ＊＊＊＊



(Example assembly)

Sensor rail for MCM05: MC-SRL5- ＊＊＊＊



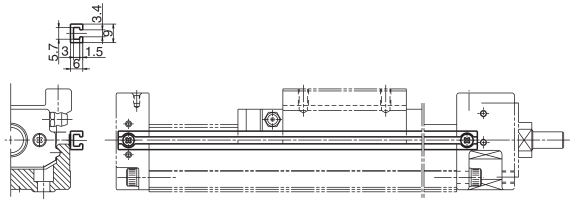
(Example assembly)

Sensor rail for MCM02: MC-SRL2- ＊＊＊＊

Sensor rail for MCM06: MC-SRL6- ＊＊＊＊

Sensor rail for MCM08: MC-SRL8- ＊＊＊＊

Sensor rail for MCM10: MC-SRL1- ＊＊＊＊



(Example assembly)

Notes: 1. ＊＊＊＊ is the same as rail dimension L_2.
2. Please assemble the attached seat between the sensor rail and the support unit for MCM03, MCM05, MCM06 and MCM08.
3. For combinations of sensors and rails, see pages C51 to C52.

MCM Model Sensor Rail Combinations

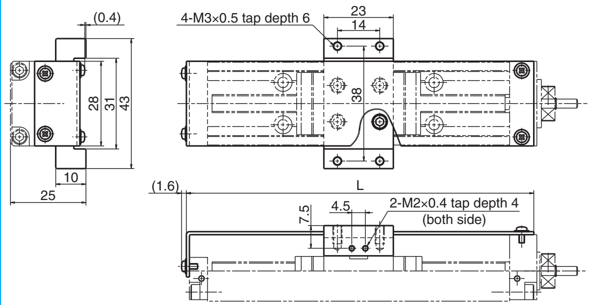
Table 4

Model No.	Body length L_2 (mm)	Reference No.	Sensor rail reference No.
MCM02	100	MCM02005H01K MCM02005P01K MCM02005H02K MCM02005P02K	MC-SRL2-0100※
	150	MCM02010H01K MCM02010P01K MCM02010H02K MCM02010P02K	MC-SRL2-0150
	200	MCM02015H01K MCM02015P01K MCM02015H02K MCM02015P02K	MC-SRL2-0200
MCM03	115	MCM03005P01K00 MCM03005P02K00	MC-SRL3-0115
	140	MCM03005H05K00 MCM03005H10K00 MCM03005H12K00 MCM03005H15K00	MC-SRL3-0140
	190	MCM03010P01K00 MCM03010P02K00 MCM03010H05K00 MCM03010H10K00 MCM03010H12K00 MCM03010H15K00	MC-SRL3-0190
	240	MCM03015P01K00 MCM03015P02K00 MCM03015H05K00 MCM03015H10K00 MCM03015H12K00 MCM03015H15K00	MC-SRL3-0240
	290	MCM03020H05K00 MCM03020H10K00 MCM03020H12K00 MCM03020H15K00	MC-SRL3-0290
	340	MCM03025H05K00 MCM03025H10K00 MCM03025H12K00 MCM03025H15K00	MC-SRL3-0340
MCM05	180	MCM05005H05K00 MCM05005H10K00 MCM05005H20K00	MC-SRL5-0180
	230	MCM05010H05K00 MCM05010H10K00 MCM05010H20K00	MC-SRL5-0230
	280	MCM05015H05K00 MCM05015H10K00 MCM05015H20K00 MCM05006H10D00	MC-SRL5-0280
	330	MCM05020H05K00 MCM05020H10K00 MCM05020H20K00 MCM05011H10D00	MC-SRL5-0330
	380	MCM05025H05K00 MCM05025H10K00 MCM05025H20K00 MCM05016H10D00	MC-SRL5-0380
	430	MCM05030H05K00 MCM05030H10K00 MCM05030H20K00 MCM05030H30K00 MCM05021H10D00 MCM05021H20D00	MC-SRL5-0430
	530	MCM05040H05K00 MCM05040H10K00 MCM05040H20K00 MCM05040H30K00 MCM05031H10D00 MCM05031H20D00	MC-SRL5-0530
	630	MCM05050H05K00 MCM05050H10K00 MCM05050H20K00 MCM05050H30K00 MCM05041H10D00 MCM05041H20D00	MC-SRL5-0630
	730	MCM05060H05K00 MCM05060H10K00 MCM05060H20K00 MCM05060H30K00 MCM05051H10D00 MCM05051H20D00	MC-SRL5-0730
MCM06	190	MCM06005H05K02 MCM06005H10K00 MCM06005H20K00	MC-SRL6-0190
	240	MCM06010H05K02 MCM06010H10K00 MCM06010H20K00	MC-SRL6-0240
	290	MCM06015H05K02 MCM06015H10K00 MCM06015H20K00	MC-SRL6-0290
	340	MCM06020H05K02 MCM06020H10K00 MCM06020H20K00 MCM06011H05D02 MCM06011H10D00	MC-SRL6-0340
	390	MCM06025H05K02 MCM06025H10K00 MCM06025H20K00	MC-SRL6-0390
	440	MCM06030H05K02 MCM06030H10K00 MCM06030H20K00 MCM06021H05D02 MCM06021H10D00 MCM06021H20D00	MC-SRL6-0440
	540	MCM06040H05K02 MCM06040H10K00 MCM06040H20K00 MCM06031H05D02 MCM06031H10D00 MCM06031H20D00	MC-SRL6-0540
	640	MCM06050H05K02 MCM06050H10K00 MCM06050H20K00 MCM06041H05D02 MCM06041H10D00 MCM06041H20D00	MC-SRL6-0640
	740	MCM06060H05K02 MCM06060H10K00 MCM06060H20K00 MCM06051H10D00 MCM06051H20D00	MC-SRL6-0740
	840	MCM06070H05K02 MCM06070H10K00 MCM06070H20K00 MCM06061H10D00 MCM06061H20D00	MC-SRL6-0840
	940	MCM06080H05K02 MCM06080H10K00 MCM06080H20K00 MCM06071H10D00 MCM06071H20D00	MC-SRL6-0940
MCM08	220	MCM08005H05K02 MCM08005H10K00	MC-SRL8-0220
	270	MCM08010H05K02 MCM08010H10K00 MCM08010H20K00	MC-SRL8-0270
	320	MCM08015H05K02 MCM08015H10K00 MCM08015H20K00	MC-SRL8-0320
	370	MCM08020H05K02 MCM08020H10K00 MCM08020H20K00 MCM08008H10D00	MC-SRL8-0370
	420	MCM08025H05K02 MCM08025H10K00 MCM08025H20K00	MC-SRL8-0420
	470	MCM08030H05K02 MCM08030H10K00 MCM08030H20K00 MCM08018H10D00 MCM08018H20D00	MC-SRL8-0470
	570	MCM08040H05K02 MCM08040H10K00 MCM08040H20K00 MCM08040H30K00 MCM08028H10D00 MCM08028H20D00	MC-SRL8-0570
	670	MCM08050H05K02 MCM08050H10K00 MCM08050H20K00 MCM08050H30K00 MCM08038H10D00 MCM08038H20D00	MC-SRL8-0670
	770	MCM08060H05K02 MCM08060H10K00 MCM08060H20K00 MCM08060H30K00 MCM08048H10D00 MCM08048H20D00	MC-SRL8-0770
	870	MCM08070H05K02 MCM08070H10K00 MCM08070H20K00 MCM08070H30K00 MCM08058H10D00 MCM08058H20D00	MC-SRL8-0870
	970	MCM08080H05K02 MCM08080H10K00 MCM08080H20K00 MCM08080H30K00 MCM08068H10D00 MCM08068H20D00	MC-SRL8-0970
MCM10	280	MCM10010H10K00 MCM10010H20K00	MC-SRL1-0280
	330	MCM10015H10K00 MCM10015H20K00	MC-SRL1-0330
	380	MCM10020H10K00 MCM10020H20K00 MCM10007H10D00	MC-SRL1-0380
	430	MCM10025H10K00 MCM10025H20K00	MC-SRL1-0430
	480	MCM10030H10K00 MCM10030H20K00 MCM10017H10D00 MCM10017H20D00	MC-SRL1-0480
	580	MCM10040H10K00 MCM10040H20K00 MCM10027H10D00 MCM10027H20D00	MC-SRL1-0580
	680	MCM10050H10K00 MCM10050H20K00 MCM10050H30K00 MCM10037H10D00 MCM10037H20D00	MC-SRL1-0680
	780	MCM10060H10K00 MCM10060H20K00 MCM10060H30K00 MCM10047H10D00 MCM10047H20D00	MC-SRL1-0780
	880	MCM10070H10K00 MCM10070H20K00 MCM10070H30K00 MCM10057H10D00 MCM10057H20D00	MC-SRL1-0880
	980	MCM10080H10K00 MCM10080H20K00 MCM10080H30K00 MCM10067H10D00 MCM10067H20D00	MC-SRL1-0980
	1 080	MCM10090H10K00 MCM10090H20K00	MC-SRL1-1080
	1 180	MCM10100H10K00 MCM10100H20K00 MCM10087H10D00 MCM10087H20D00	MC-SRL1-1180

*) When using NSK standard sensors, prepare two sensor rails. Two sensor rails will also be required for other Monocarriers depending on signal points of sensors. Contact NSK for details.

C-1-5. 3. 2 Cover Unit

Cover Unit for MCM02



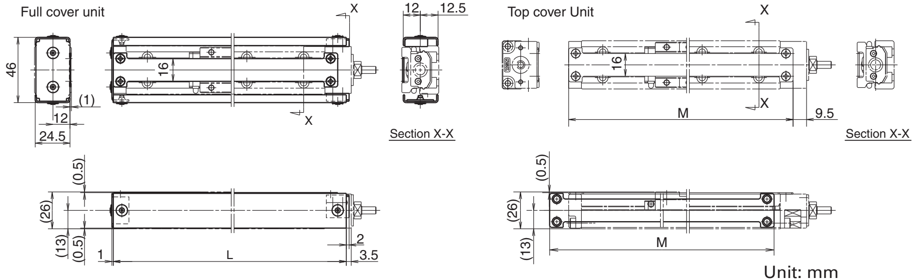
Unit: mm

Stroke	Reference No.	Length(*L*)
50	**MC-CV02005-00**	115
100	**MC-CV02010-00**	165
150	**MC-CV02015-00**	215

Height of screw head is not included.

Cover Unit for MCM03

Notes:1. When the cover is used for leads 1 and 2, an optional spacer plate (nominal No.: MC-SP03-00) is required.
2. When the cover is used for lead 15, an optional spacer plate (nominal No.: MC-SP03-01) is required.
3. A full cover unit cannot be installed for lead 15.



Unit: mm

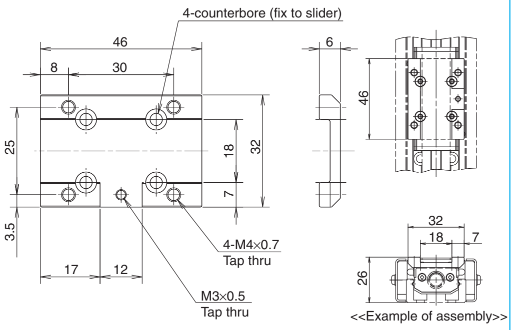
Stroke	Reference No.		Cover length	
	Top cover unit	Full cover unit	Length (*L*)	Length (*M*)
50 (lead 1, 2)	**MC-CV03005-02**	**∗MC-CV03005-01**	139	133
50 (lead 5, 10, 12, 15)	**MC-CV03005-02A**	**∗MC-CV03005-01A**	164	158
100	**MC-CV03010-02**	**∗MC-CV03010-01**	214	208
150	**MC-CV03015-02**	**∗MC-CV03015-01**	264	258
200	**MC-CV03020-02**	**∗MC-CV03020-01**	314	308
250	**MC-CV03025-02**	**∗MC-CV03025-01**	364	358

∗) The full-cover unit cannot be used when the sensor unit is used.

Height of screw head is not included.

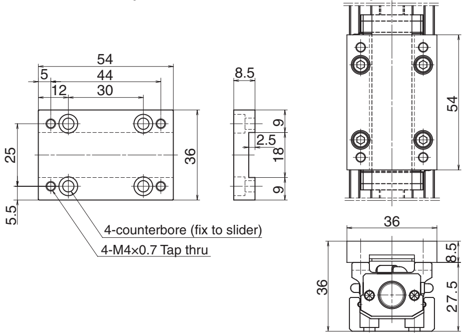
Spacer for MCM03 (Optional)

MC-SP03-00 (for ball screw lead 1 and 2 mm)



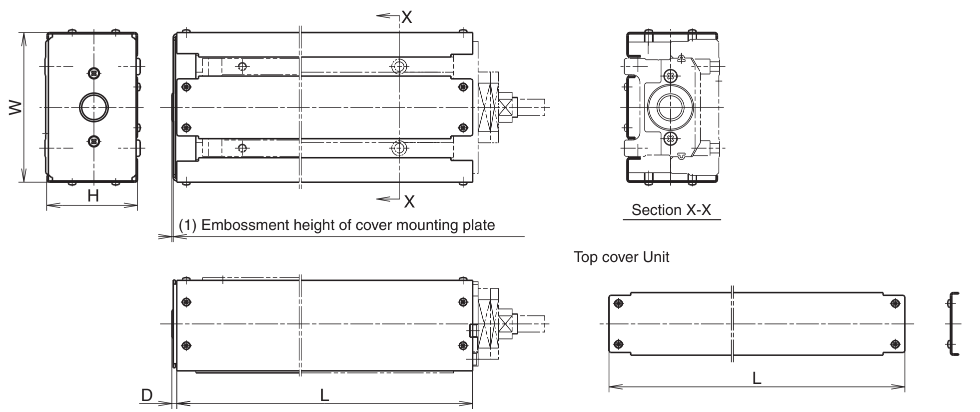
Note: Spacer is required when using sensor unit and cover unit.

MC-SP03-01 (for ball screw lead 15 mm)



Note: To use an upper surface cover, use it during assembly.

Cover unit for MCM05, 06, 08, and 10



Unit: mm

Model No.	Stroke		Cover unit reference No.		Cover length			
	Single slider	Double slider	Top cover Unit	Full cover Unit∗1	Length (L)	Height (H)	Width (W)	End part (D)
MCM05	50	—	MC-CV05005-01	MC-CV05005-00	200	38.5	65	2.6
	100	—	MC-CV05010-01	MC-CV05010-00	250			
	150	60	MC-CV05015-01	MC-CV05015-00	300			
	200	110	MC-CV05020-01	MC-CV05020-00	350			
	250	160	MC-CV05025-01	MC-CV05025-00	400			
	300	210	MC-CV05030-01	MC-CV05030-00	450			
	400	310	MC-CV05040-01	MC-CV05040-00	550			
	500	410	MC-CV05050-01	MC-CV05050-00	650			
	600	510	MC-CV05060-01∗3	MC-CV05060-00∗3	750			
MCM06	50	—	MC-CV06005-01	MC-CV06005-00	225	48.5	75	—∗2
	100	—	MC-CV06010-01	MC-CV06010-00	275			
	150	—	MC-CV06015-01	MC-CV06015-00	325			
	200	110	MC-CV06020-01	MC-CV06020-00	375			
	250	—	MC-CV06025-01	MC-CV06025-00	425			
	300	210	MC-CV06030-01	MC-CV06030-00	475			
	400	310	MC-CV06040-01	MC-CV06040-00	575			
	500	410	MC-CV06050-01	MC-CV06050-00	675			
	600	510	MC-CV06060-01	MC-CV06060-00	775			
	700	610	MC-CV06070-01	MC-CV06070-00	875			
	800	710	MC-CV06080-01∗3	MC-CV06080-00∗3	975			
MCM08	50	—	MC-CV08005-01	MC-CV08005-00	248	56.5	90	2.6
	100	—	MC-CV08010-01	MC-CV08010-00	298			
	150	—	MC-CV08015-01	MC-CV08015-00	348			
	200	80	MC-CV08020-01	MC-CV08020-00	398			
	250	—	MC-CV08025-01	MC-CV08025-00	448			
	300	180	MC-CV08030-01	MC-CV08030-00	498			
	400	280	MC-CV08040-01	MC-CV08040-00	598			
	500	380	MC-CV08050-01	MC-CV08050-00	698			
	600	480	MC-CV08060-01	MC-CV08060-00	798			
	700	580	MC-CV08070-01	MC-CV08070-00	898			
	800	680	MC-CV08080-01	MC-CV08080-00	998			
MCM10	100	—	MC-CV10010-01	MC-CV10010-00	308	66.5	110	3.6
	150	—	MC-CV10015-01	MC-CV10015-00	358			
	200	70	MC-CV10020-01	MC-CV10020-00	408			
	250	—	MC-CV10025-01	MC-CV10025-00	458			
	300	170	MC-CV10030-01	MC-CV10030-00	508			
	400	270	MC-CV10040-01	MC-CV10040-00	608			
	500	370	MC-CV10050-01	MC-CV10050-00	708			
	600	470	MC-CV10060-01	MC-CV10060-00	808			
	700	570	MC-CV10070-01	MC-CV10070-00	908			
	800	670	MC-CV10080-01	MC-CV10080-00	1008			
	900	—	MC-CV10090-01	MC-CV10090-00	1108			
	1000	870	MC-CV10100-01∗3	MC-CV10100-00∗3	1208			

Note: The dimensions of covers shown above do not include the head height of fixing machine screws. Add the head of machine screws of approximately 2.5 mm to the outer measurement of a cover unit. Set a margin for mechanical interference with surrounding components.

∗1) When using sensor units, full-cover units cannot be used.

∗2) A cover mounting plate is not used with MCM06.

∗3) Do not use the target nominal number for ceiling suspension.

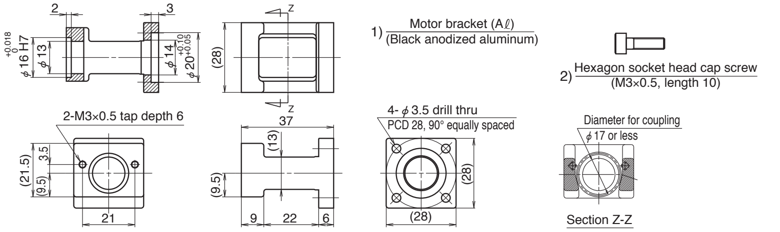
C-1-5. 3. 3 Motor Bracket

Motor models are subject to change at motor manufacturers. For details, please contact the manufacturer.

Motor bracket for MCM02

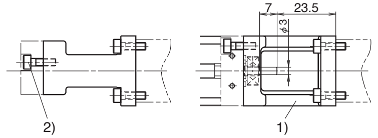
■Reference number

MC-BK02-128-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw
(M3×0.5, length 10)

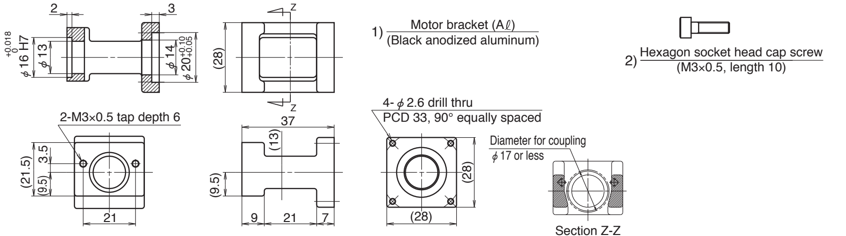


Note: Be sure to align centerlines when installing motor.

Compatible motor		
Maker	Serise	Motor models(Servo motor)
YASKAWA Electric Corp.	Σ-Vmini	SGMMV-A1(10W), SGMMV-A2(20W) SGMMV-A3(30W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-AK0136(10W), HG-AK0236(20W) HG-AK0336(30W)

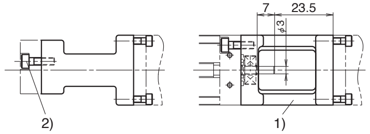
■Reference number

MC-BK02-133-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw
(M3×0.5, length 10)

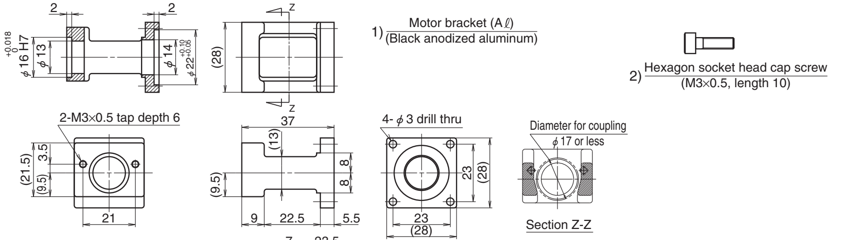


Note: Be sure to align centerlines when installing motor.

Compatible motor		
Maker	Serise	Motor models(Servo motor)
Mitsubishi Electric Corp.	–	HC-AQ013(10W)∗1 HC-AQ023(20W)∗1

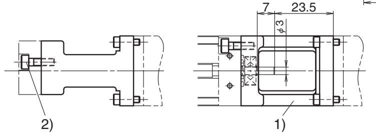
■Reference number

MC-BK02-223-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw
(M3×0.5, length 10)



Note: Be sure to align centerlines when installing motor.

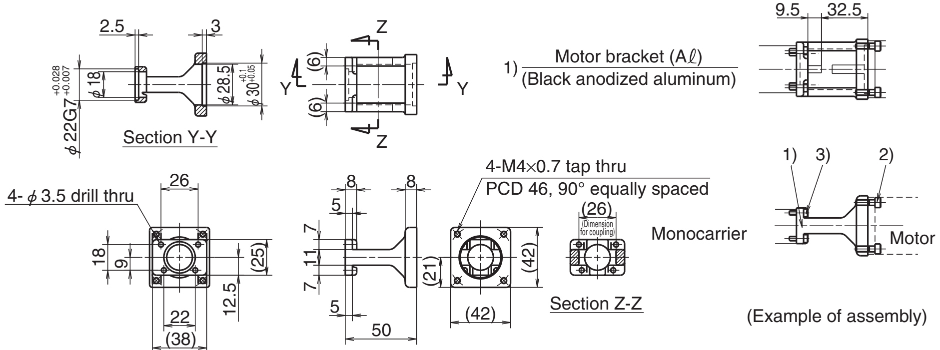
Compatible motor		
Maker	Serise	Motor models(Stepper motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR2x
SANYO DENKI Co., Ltd.	SANMOTION Model No.PB	PBDM28

∗1 The manufacturer models listed are discontinued motors.

Motor bracket for MCM03

■Reference number

MC-BK03-146-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

2) Hexagon socket head cap screw (M4, length 12)

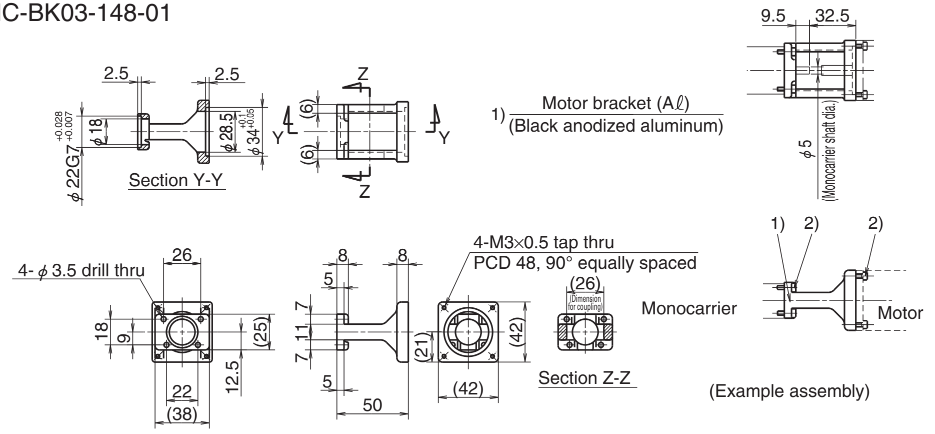
3) Hexagon socket head cap screw (M3, length 10)

Compatible motor		
Maker	Serise	Motor models(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7J-A5(50W), SGM7A-A5(50W)
Mitsubishi Electric Corp	MELSERVO-J4	HG-KR053(50W), HG-MR053(50W)
OMRON Corp.	G5	R88M-K05030(50W)
SANYO DENKI Co., Ltd.	SANMOTION R	R2□A04003(30W), R2□A04005(50W)

Motor bracket for MCM03

■Reference number

MC-BK03-148-01



1) Motor bracket (Aℓ)
(Black anodized aluminum)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

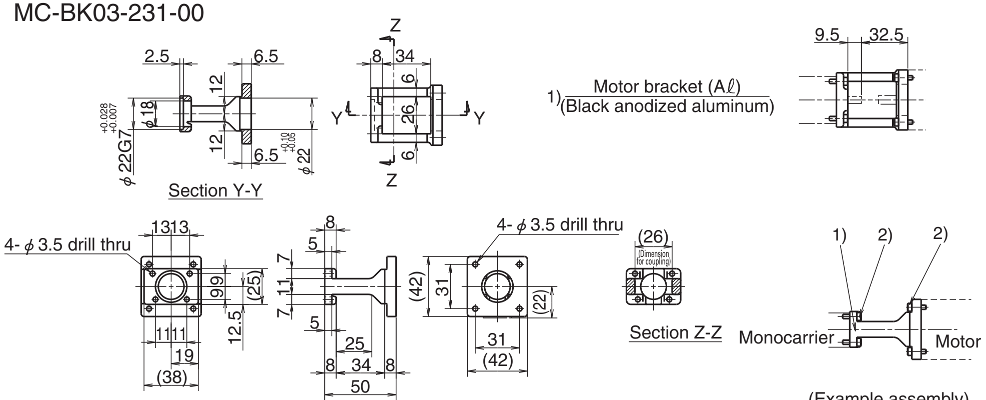
2) Hexagon socket head cap screw (M3, length 10)

Compatible motor		
Maker	Serise	Motor models(Servo motor)
SANYO DENKI Co., Ltd.	–	P50B04006(60W)∗1 P50B04010(100W)∗1

∗1 The manufacturer models listed are discontinued motors.

Motor bracket for MCM03

■Reference number
MC-BK03-231-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

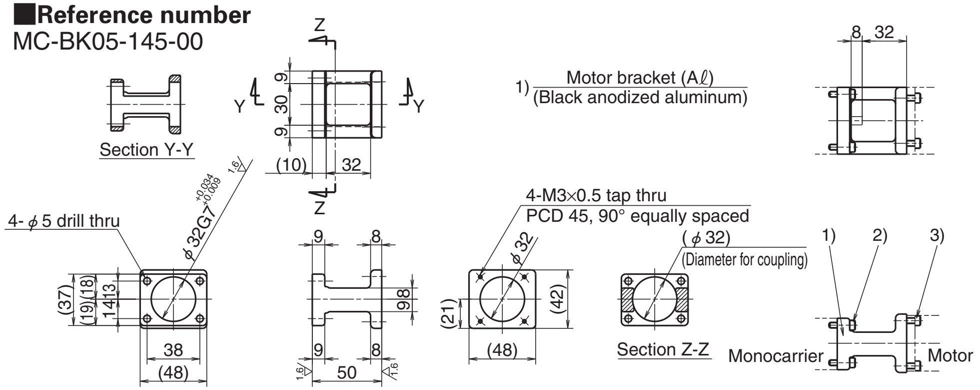
2) Hexagon socket head cap screw (M3, length 10)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Serise	Moter models(Stepper motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR46x, ARL46x, AZ46x
	CRK, CVK, RKⅡ	CRK54x, CVK54x, RKS54x.CVK24x
SANYO DENKI Co., Ltd.	SANMOTION Model No.PB	PBxM423, PBxR423, PBxP423

Motor bracket for MCM05

■Reference number
MC-BK05-145-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M4, length 15)

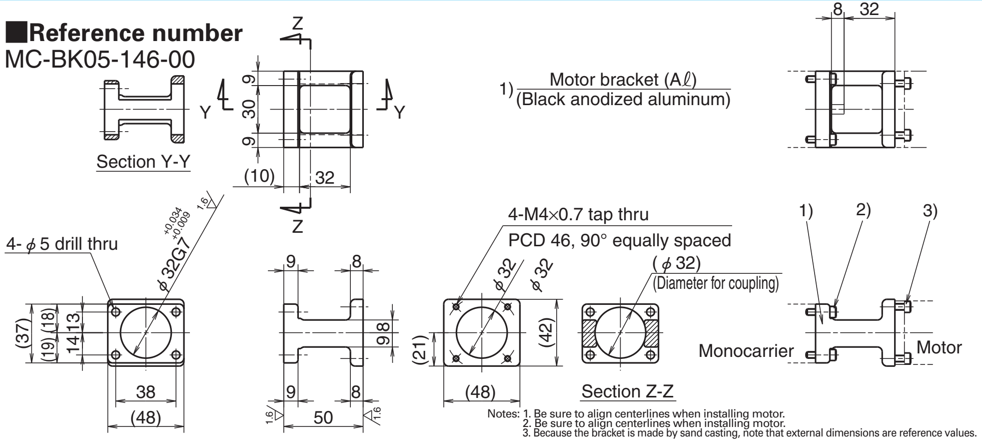
3) Hexagon socket head cap screw (M3, length 12)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Serise	Moter models(Servo motor)
PANASONIC Co.,Ltd.	MINAS A6	MSMF5A(50W), MSMF01(100W)

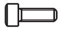
Motor bracket for MCM05

■Reference number
MC-BK05-146-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M4, length 15)



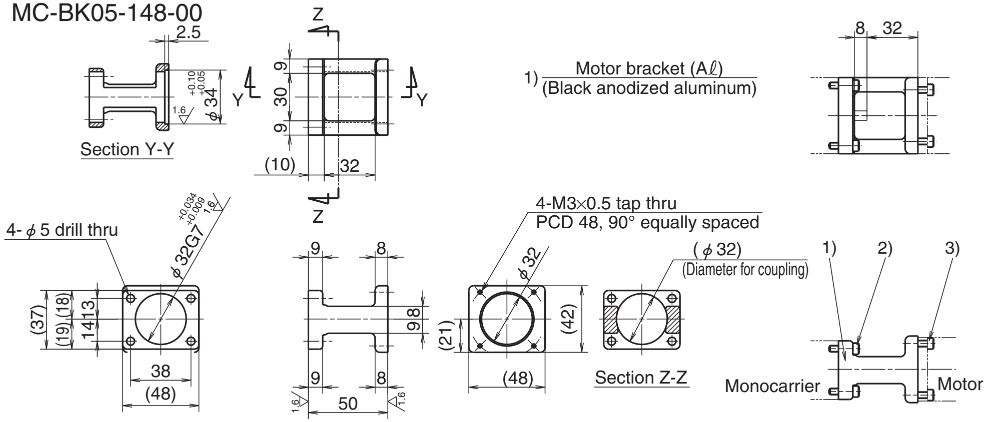
3) Hexagon socket head cap screw (M4, length 12)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Serise	Moter models(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-A5(50W), SGM7A-01(100W), SGM7A-C2(150W) SGM7J-A5(50W), SGM7J-01(100W), SGM7J-C2(150W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR053(50W), HG-MR053(50W) HG-KR13(100W), HG-MR13(100W)
OMRON Corp.	G5	R88M-K05030(50W), R88M-K10030(100W)
SANYO DENKI Co., Ltd.	SANMOTION R	R2□A04005(50W), R2□A04010(100W)

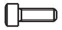
Motor bracket for MCM05

■Reference number
MC-BK05-148-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M4, length 15)



3) Hexagon socket head cap screw (M3, length 12)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

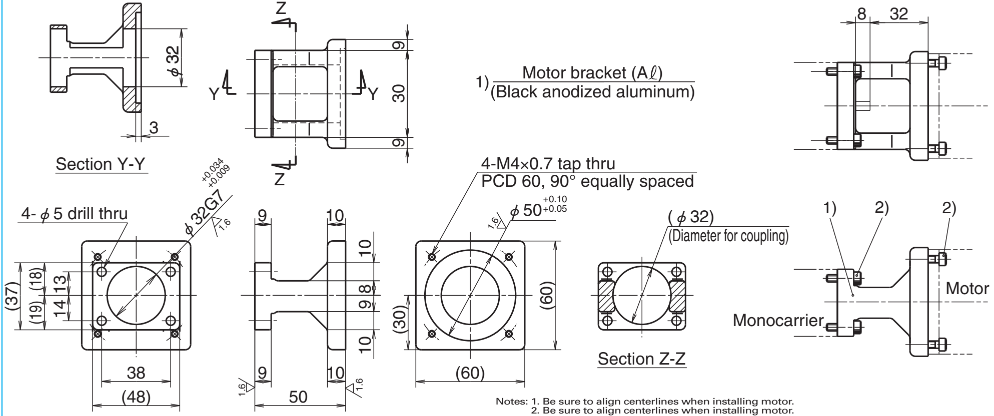
Compatible motor		
Maker	Serise	Moter models(Servo motor)
PANASONIC Co.,Ltd.	–	MAMA01(100W)∗1

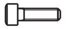
∗1 The manufacturer models listed are discontinued motors.

Motor bracket for MCM05

■Reference number

MC-BK05-160-00





2) Hexagon socket head cap screw
(M4, length 15)

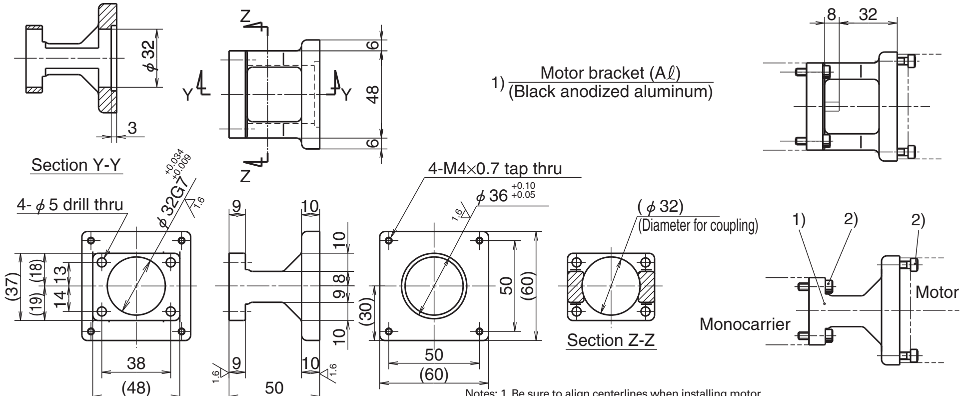
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

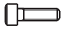
Compatible motor		
Maker	Serise	Motor type(Servo motor)
SANYO DENKI Co., Ltd.	–	P50B05005(50W)∗1 P50B05010(100W)∗1 P50B05020(200W)∗1

Motor bracket for MCM05

■Reference number

MC-BK05-250-00





2) Hexagon socket head cap screw
(M4, length 15)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

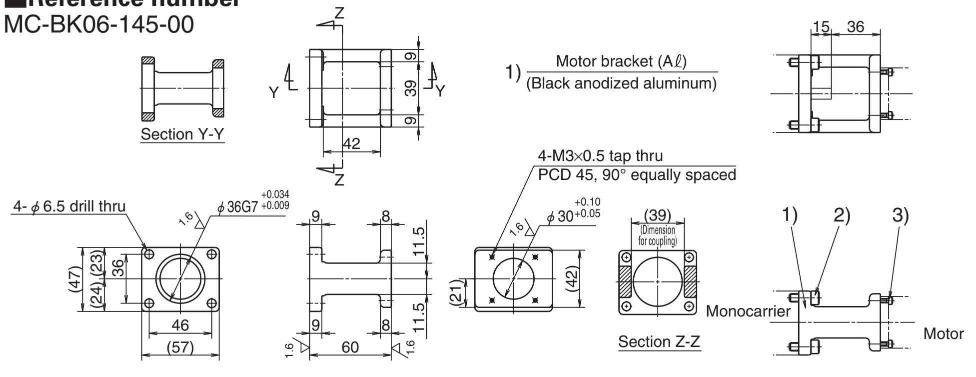
Compatible motor		
Maker	Serise	Moter models(Stepper motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x, ARL6x, AZ6x
	CRK, CVK, RKⅡ	CRK56x, CVK56x, RKS56x
SANYO DENKI Co., Ltd.	SANMOTION Model No.PB	PBDM60x, PB□R60x PB□P60x

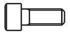
∗1 The manufacturer models listed are discontinued motors.

Motor bracket for MCM06

■Reference number

MC-BK06-145-00





2) Hexagon socket head cap screw (M6, length 16)

3) Hexagon socket head cap screw (M3, length 12)

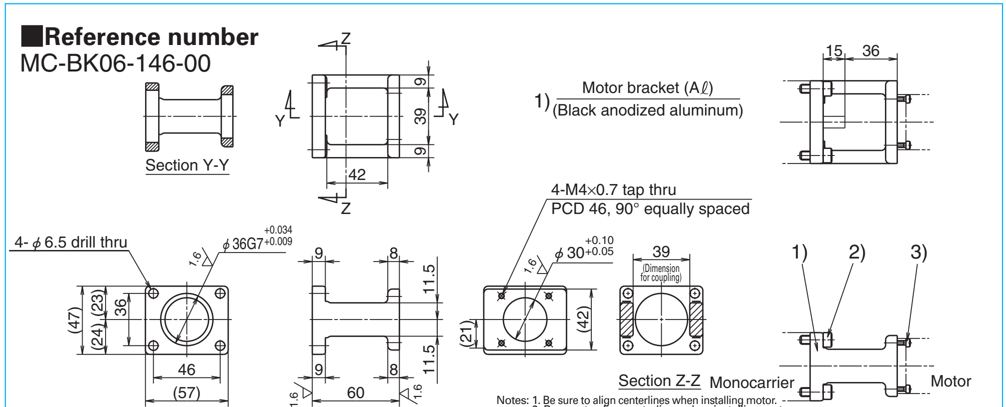
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

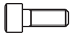
Compatible motor		
Maker	Serise	Motor type(Servo motor)
PANASONIC Co.,Ltd.	MINAS A6	MSMF5A(50W), MSMF01(100W)

Motor bracket for MCM06

■Reference number

MC-BK06-146-00





2) Hexagon socket head cap screw (M6, length 16)

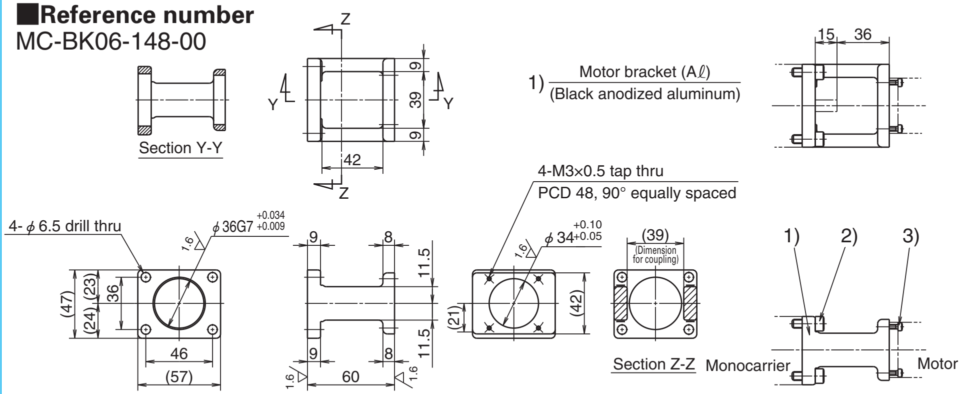
3) Hexagon socket head cap screw (M4, length 12)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

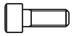
Compatible motor		
Maker	Serise	Motor type(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-A5(50W), SGM7J-A5(50W), SGM7A-01(100W), SGM7J-01(100W) SGM7A-C2(150W), SGM7J-C2(150W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR053(50W), HG-MR053(50W) HG-KR13(100W), HG-MR13(100W)
OMRON Corp.	G5	R88M-K05030(50W), R88M-K10030(100W)
SANYO DENKI Co.,Ltd.	SANMOTION R	R2□A04005(50W), R2□A04010(100W)

Motor bracket for MCM06

■Reference number
MC-BK06-148-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)



2) Hexagon socket head cap screw (M6, length 16)

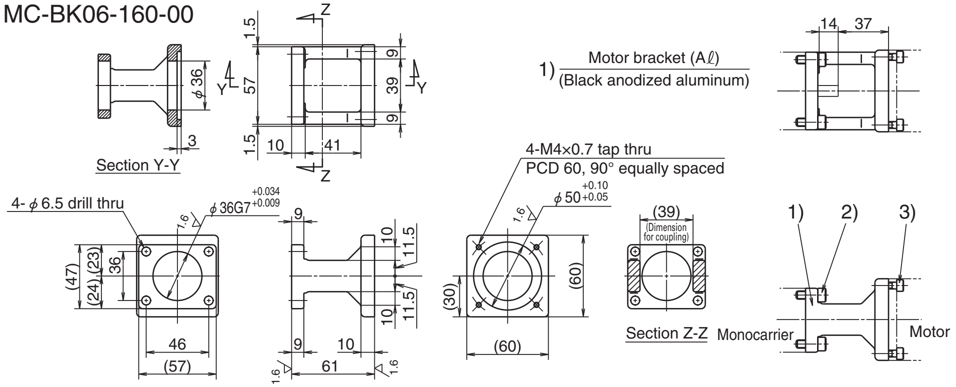
3) Hexagon socket head cap screw (M3, length 12)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

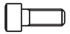
Compatible motor		
Maker	Serise	Motor type(Servo motor)
Panasonic Co., Ltd.	–	MAMA01(100W)∗1

Motor bracket for MCM06

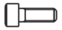
■Reference number
MC-BK06-160-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)



2) Hexagon socket head cap screw (M6, length 16)



3) Hexagon socket head cap screw (M4, length 14)

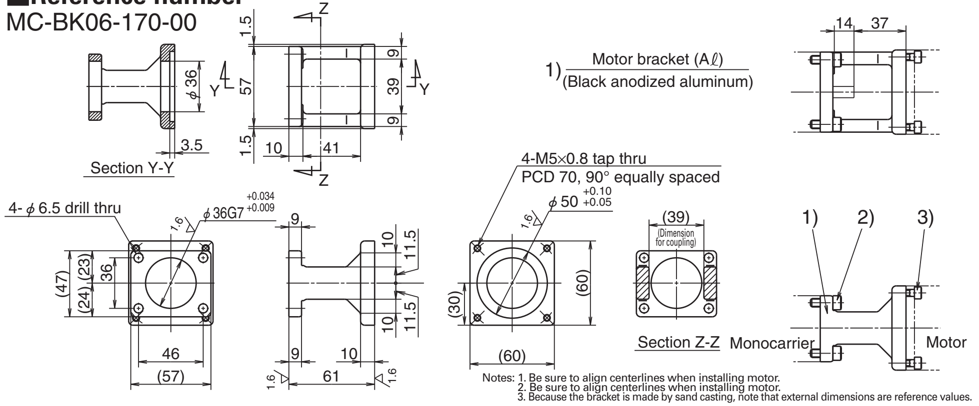
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Serise	Motor type(Servo motor)
SANYO DENKI Co., Ltd.	–	P50B05005(50W)∗1 P50B05010(100W)∗1 P50B05020(200W)∗1

∗1 The manufacturer models listed are discontinued motors.

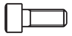
Motor bracket for MCM06

■Reference number
MC-BK06-170-00

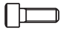


1) Motor bracket (Aℓ)
(Black anodized aluminum)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.



2) Hexagon socket head cap screw (M6, length 16)

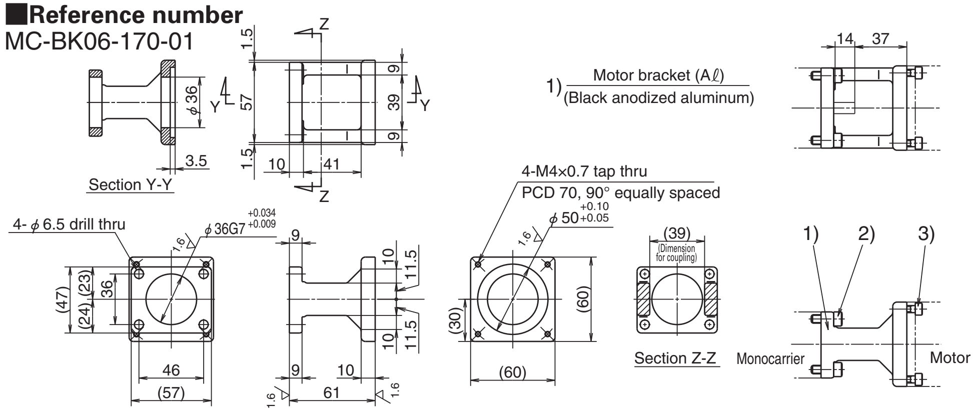


3) Hexagon socket head cap screw (M5, length 14)

Compatible motor		
Maker	Serise	Motor type(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-02A(200W), SGM7J-02(200W) SGM7A-04A(400W), SGM7J-04(400W) SGM7A-06A(600W), SGM7J-06(600W)
Mitsubishi Electric Corp	MELSERVO-J4	HG-KR23(200W), HG-MR23(200W) HG-KR43(400W), HG-MR43(400W)
SANYO DENKI Co., Ltd.	SANMOTION R	R2□A06020(200W), R2□A06040(400W)

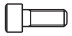
Motor bracket for MCM06

■Reference number
MC-BK06-170-01

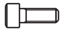


1) Motor bracket (Aℓ)
(Black anodized aluminum)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.



2) Hexagon socket head cap screw (M6, length 16)



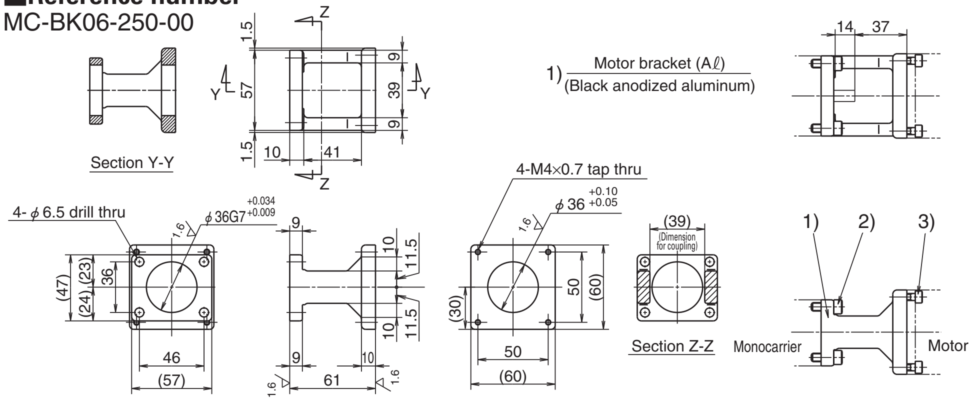
3) Hexagon socket head cap screw (M4, length 14)

Compatible motor		
Maker	Serise	Motor type(Servo motor)
Panasonic Co., Ltd.	MINAS A6	MSMF02(200W), MSMF04(400W)
OMRON Corp.	G5	R88M-K20030(200W) R88M-K40030(400W)

Motor bracket for MCM06

■Reference number

MC-BK06-250-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M6, length 16)

3) Hexagon socket head cap screw (M4, length 14)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

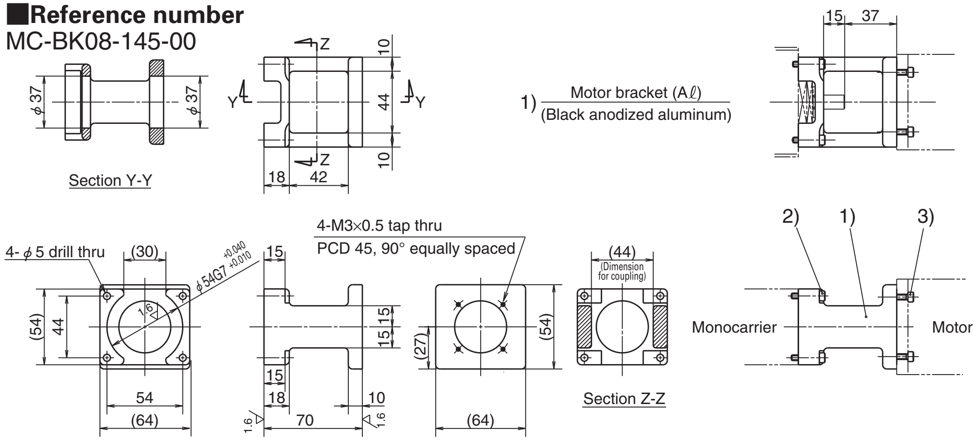
Compatible motor

Maker	Serise	Motor type(Stepper motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x, ARL6x, AZ6x
	CRK, CVK, RKⅡ	CRK56x, CVK56x, RKS56x
SANYO DENKI Co., Ltd.	SANMOTION Model No.PB	PBDM60x, PB□R60x, PB□P60x

Motor bracket for MCM08

■Reference number

MC-BK08-145-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M4, length 20)

3) Hexagon socket head cap screw (M3, length 12)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

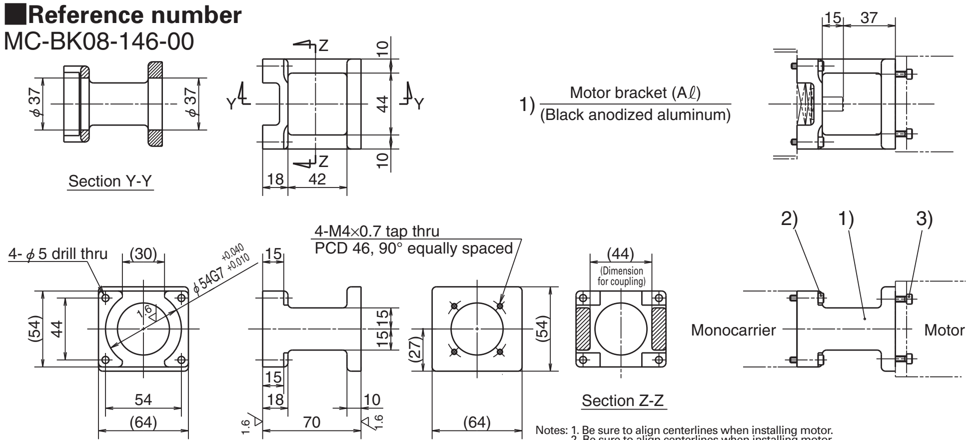
Compatible motor

Maker	Serise	Motor type(Servo motor)
Panasonic Co., Ltd.	MINAS A6	MSMF5A(50W), MSMF01(100W)

Motor bracket for MCM08

■Reference number

MC-BK08-146-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M4, length 20)

3) Hexagon socket head cap screw (M4, length 14)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

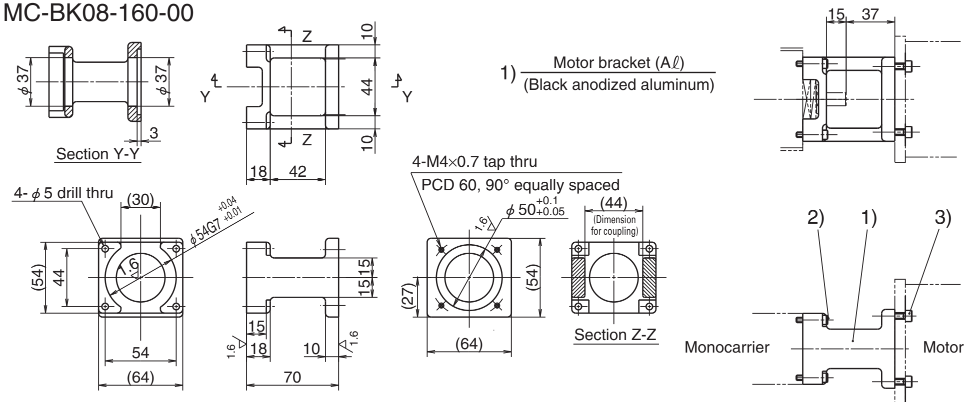
Compatible motor

Maker	Serise	Motor type(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-A5(50W), SGM7A-01(100W), SGM7A-C2(150W) SGM7J-A5(50W), SGM7J-01(100W), SGM7J-C2(150W)
Mitsubishi Electric Corp	MELSERVO-J4	HG-KR053(50W), HG-MR053(50W), HG-KR13(100W), HG-MR13(100W)
OMRON Corp.	G5	R88M-K05030(50W), R88M-K10030(100W)
SANYO DENKI Co., Ltd.	SANMOTION R	R2□A04005(50W), R2□A04010(100W)

Motor bracket for MCM08

■Reference number

MC-BK08-160-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M4, length 20)

3) Hexagon socket head cap screw (M4, length 14)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor

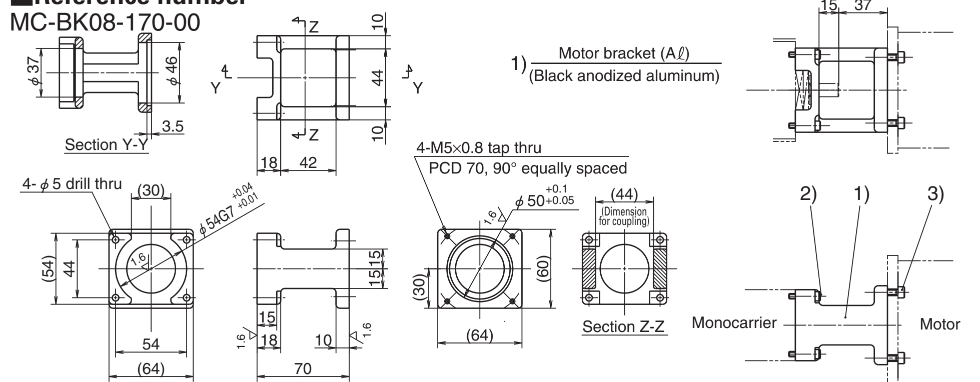
Maker	Serise	Motor type(Servo motor)
SANYO DENKI Co., Ltd.	–	P50B05005(50W)∗1 P50B05010(100W)∗1 P50B05020(200W)∗1

∗1 The manufacturer models listed are discontinued motors.

Motor bracket for MCM08

■Reference number

MC-BK08-170-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M4, length 20)

3) Hexagon socket head cap screw (M5, length 14)

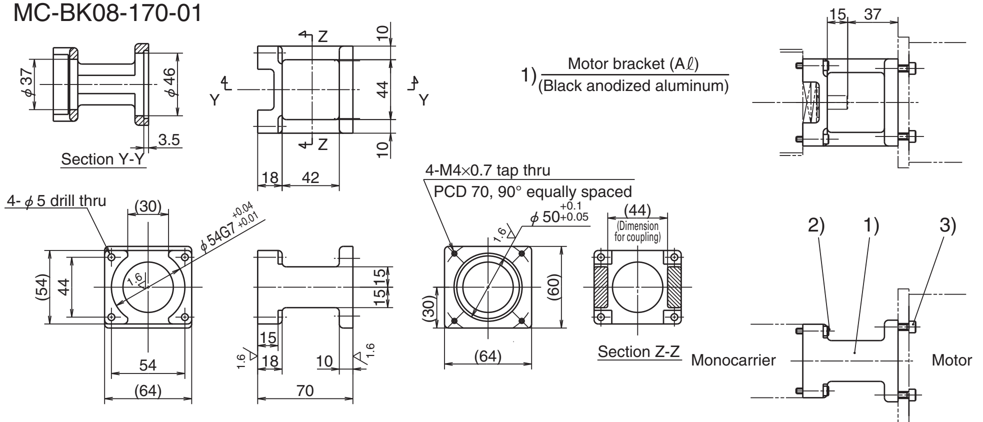
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Serise	Motor type(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-02A(200W), SGM7J-02(200W) SGM7A-04A(400W), SGM7J-04(400W) SGM7A-06A(600W), SGM7J-06(600W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR23(200W), HG-MR23(200W) HG-KR43(400W), HG-MR43(400W)
SANYO DENKI Co., Ltd.	SANMOTION R	R2□A06020(200W), R2□A06040(400W)

Motor bracket for MCM08

■Reference number

MC-BK08-170-01



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M4, length 20)

3) Hexagon socket head cap screw (M4, length 14)

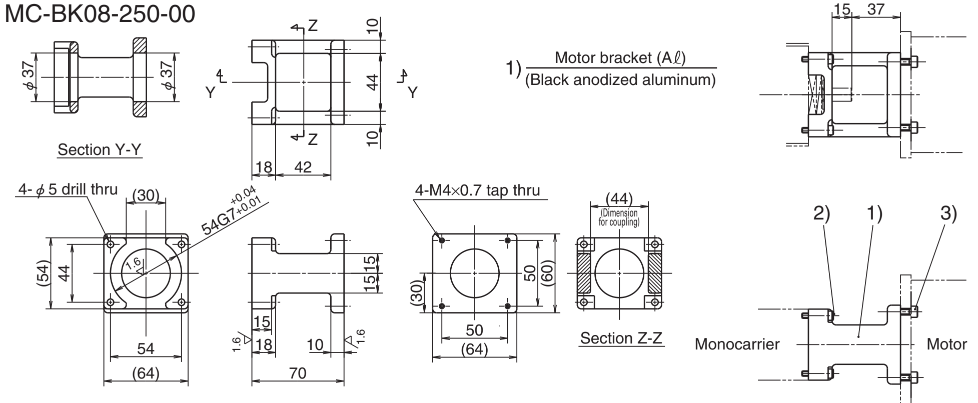
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Serise	Motor type(Servo motor)
Panasonic Co., Ltd.	MINAS A6	MSMF02(200W), MSMF04(400W)
OMRON Corp.	G5	R88M-K20030(200W), R88M-K40030(400W)

Motor bracket for MCM08

■Reference number

MC-BK08-250-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M4, length 20)

3) Hexagon socket head cap screw (M4, length 14)

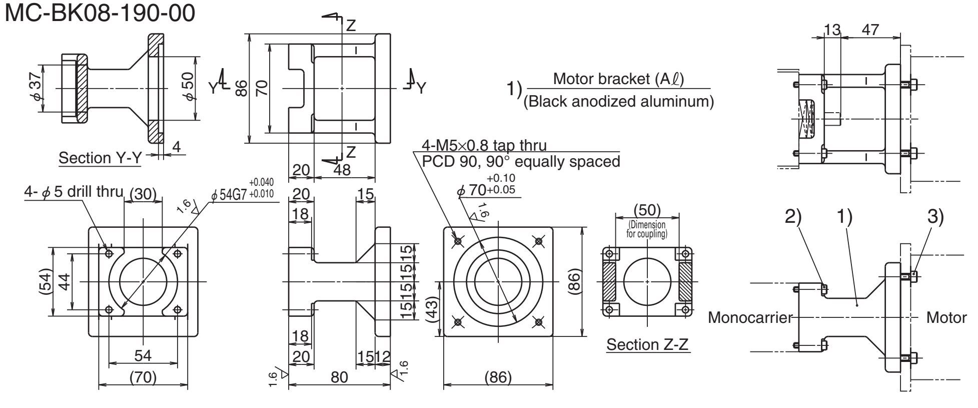
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Serise	Motor type(Stepper motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x, ARL6x, AZ6x
	CRK, CVK, RKⅡ	CRK56x, CVK56x, RKS56x
SANYO DENKI Co., Ltd.	SANMOTION Model No.PB	PBDM60x, PB□R60x, PB□P60x

Motor bracket for MCM08

■Reference number

MC-BK08-190-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M4, length 22)

3) Hexagon socket head cap screw (M5, length 16)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

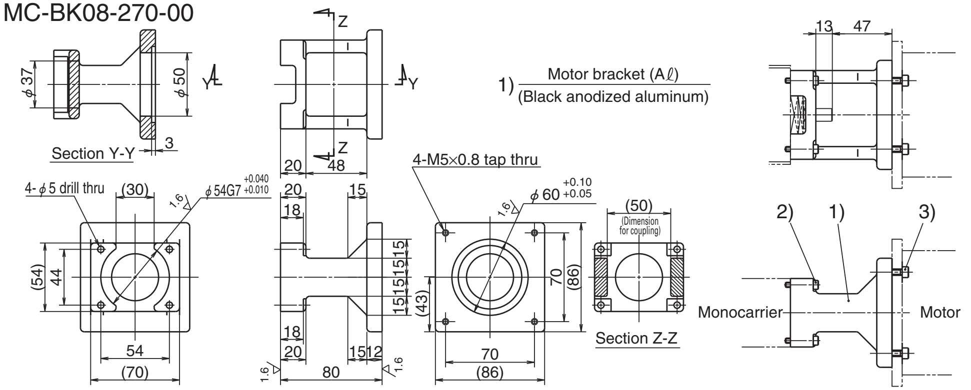
Compatible motor		
Maker	Serise	Motor type(Servo motor)
SANYO DENKI Co., Ltd.	–	P50B07020(200W)∗1 P50B07030(300W)∗1 P50B07040(400W)∗1

∗1 The manufacturer models listed are discontinued motors.

Motor bracket for MCM08

■Reference number

MC-BK08-270-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M4, length 22)

3) Hexagon socket head cap screw (M5, length 16)

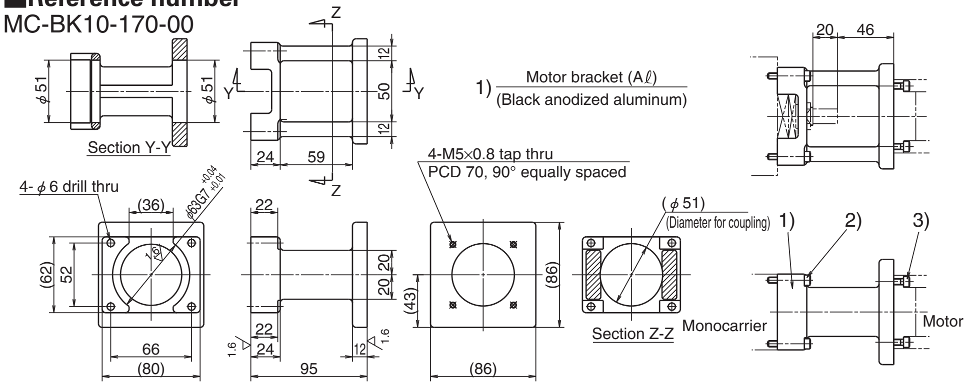
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Serise	Motor type(Stepper motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR9x, ARL9x, AZ9x
	RKⅡ	RKS59x

Motor bracket for MCM10

■Reference number

MC-BK10-170-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M5, length 30)

3) Hexagon socket head cap screw (M5, length 16)

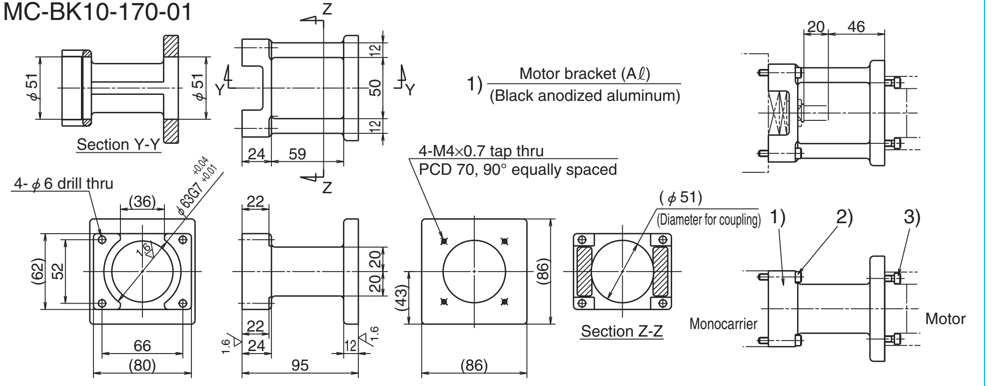
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Serise	Motor type(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-02A(200W), SGM7J-02(200W) SGM7A-04A(400W), SGM7J-04(400W) SGM7A-06A(600W), SGM7J-06(600W)
Mitsubishi Electric Corp	MELSERVO-J4	HG-KR23(200W), HG-MR23(200W) HG-KR43(400W), HG-MR43(400W)
SANYO DENKI Co., Ltd.	SANMOTION R	R2□A06020(200W), R2□A06040(400W)

Motor bracket for MCM10

■Reference number

MC-BK10-170-01



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M5, length 30)

3) Hexagon socket head cap screw (M4, length 16)

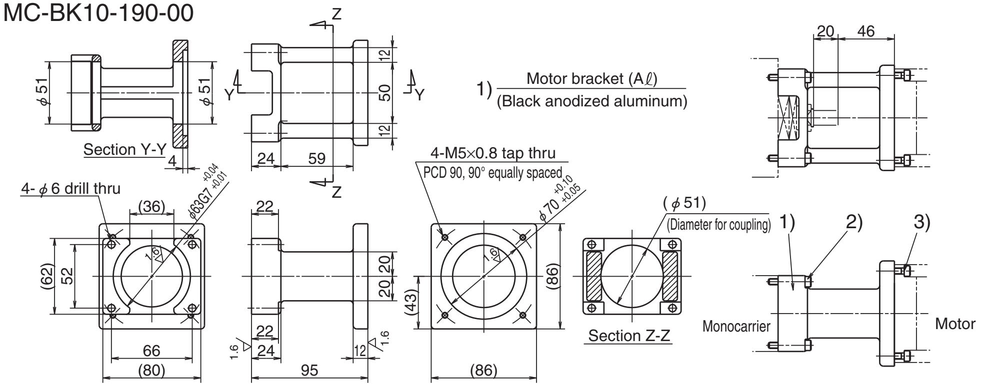
Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Serise	Motor type(Servo motor)
Panasonic Co., Ltd.	MINAS A6	MSMF02(200W), MSMF04(400W)
OMRON Corp.	G5	R88M-K20030(200W) R88M-K40030(400W)

Motor bracket for MCM10

■Reference number

MC-BK10-190-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M5, length 30)

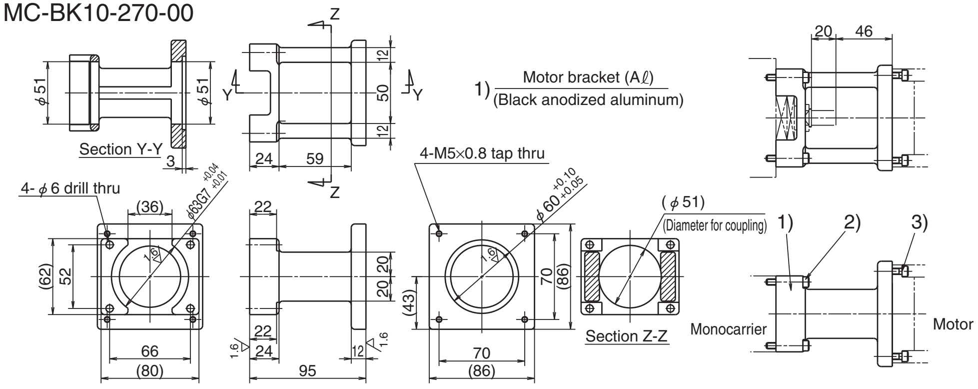
3) Hexagon socket head cap screw (M5, length 16)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

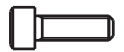
Compatible motor		
Maker	Serise	Motor type(Servo motor)
Panasonic Co., Ltd.	MINAS A6	MSMF08(750W)
OMRON Corp.	G5	R88M-K75030(750W)

Motor bracket for MCM10

■Reference number
MC-BK10-270-00



2) 
Hexagon socket head cap screw (M5, length 30)

3) 
Hexagon socket head cap screw (M5, length 18)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be sure to align centerlines when installing motor.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Serise	Motor type(Stepper motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR9x, ARL9x, AZ9x
	RKⅡ	RKS59x

MCM Model Motor Bracket Compatibility

Table 5

Model No	Reference No. code	Motor bracket reference No.	Moter manufacturer	Serise	Stepper motor model No.	Wattage of AC servo motor											
						10	20	30	50	60	100	150	200	300	400	600	750
MCM02	1	MC-BK02-128-00	YASKAWA Electric Corp.	Σ-Vmini		SGMMV-A1	SGMMV-A2	SGMMV-A3									
			Mitsubishi Electric Corp.	MELSERVO-J4		HG-AK0136	HG-AK0236	HG-AK0336									
	2	MC-BK03-133-00*1	Mitsubishi Electric Corp.	–		HC-AQ013*1	HC-AQ023*1										
	3	MC-BK02-223-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR2x												
			SANYO DENKI Co., Ltd.	SANMOTION Model No.PB	PBDM28												
MCM03	1	MC-BK03-146-00	YASKAWA Electric Corp.	Σ-7					SGM7J-A5 SGM7A-A5								
			Mitsubishi Electric Corp.	MELSERVO-J4					HG-KR053 HG-MR053								
			OMRON Corp.	G5					R88M-K05030								
			SANYO DENKI Co., Ltd.	SANMOTION R				R2□A04003	R2□A04005								
	2	MC-BK03-148-01*1	SANYO DENKI Co., Ltd.	–						P50B04006*1	P50B04010*1						
	3	MC-BK03-231-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR46x,ARL46x, AZ46x												
				CRK, CVK, RKⅡ	CRK54x, CVK54x, RKS54x, CVK24x												
			SANYO DENKI Co., Ltd.	SANMOTION Model No.PB	PBxM423, PBxR423, PBxP423												
MCM05	1	MC-BK05-145-00	Panasonic Co., Ltd.	MINAS A6					MSMF5A		MSMF01						
	2	MC-BK05-146-00	YASKAWA Electric Corp.	Σ-7					SGM7A-A5 SGM7J-A5		SGM7A-01 SGM7J-01	SGM7A-C2 SGM7J-C2					
			Mitsubishi Electric Corp.	MELSERVO-J4					HG-KR053 HG-MR053		HG-KR13 HG-MR13						
			OMRON Corp.	G5					R88M-K05030		R88M-K10030						
			SANYO DENKI Co., Ltd.	SANMOTION R					R2□A04005		R2□A04010						
	3	MC-BK05-148-00*1	Panasonic Co., Ltd.	–							MAMA01*1						
	4	MC-BK05-160-00*1	SANYO DENKI Co., Ltd.	–					P50B05005*1		P50B05010*1		P50B05020*1				
	5	MC-BK05-250-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x, ARL6x, AZ6x												
				CRK, CVK, RKⅡ	CRK56x, CVK56x, RKS56x												
			SANYO DENKI Co., Ltd.	SANMOTION Model No.PB	PBDM60x, PB□R60x, PB□P60x												
MCM06	1	MC-BK06-145-00	Panasonic Co., Ltd.	MINAS A6					MSMF5A		MSMF01						
	2	MC-BK06-146-00	YASKAWA Electric Corp.	Σ-7					SGM7A-A5 SGM7J-A5		SGM7A-01 SGM7J-01	SGM7A-C2 SGM7J-C2					
			Mitsubishi Electric Corp.	MELSERVO-J4					HG-KR053 HG-MR053		HG-KR13 HG-MR13						
			OMRON Corp.	G5					R88M-K05030		R88M-K10030						
			SANYO DENKI Co., Ltd.	SANMOTION R					R2□A04005		R2□A04010						
	3	MC-BK06-148-00*1	Panasonic Co., Ltd.	–							MAMA01*1						
	4	MC-BK06-160-00*1	SANYO DENKI Co., Ltd.	–					P50B05005*1		P50B05010*1		P50B05020*1				
	5	MC-BK06-170-00	YASKAWA Electric Corp.	Σ-7									SGM7A-02A SGM7J-02		SGM7A-04A SGM7J-04	SGM7A-06A SGM7J-06	
			Mitsubishi Electric Corp.	MELSERVO-J4									HG-KR23 HG-MR23		HG-KR43 HG-MR43		
			SANYO DENKI Co., Ltd.	SANMOTION R									R2□A06020		R2□A06040		
	6	MC-BK06-170-01	Panasonic Co., Ltd.	MINAS A6									MSMF02		MSMF04		
			OMRON Corp.	G5									R88M-K20030		R88M-K40030		
	7	MC-BK06-250-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x, ARL6x, AZ6x												
				CRK, CVK, RKⅡ	CRK56x, CVK56x, RKS56x												
			SANYO DENKI Co., Ltd.	SANMOTION Model No.PB	PBDM60x, PB□R60x, PB□P60x												

*1 The manufacturer models listed are discontinued motors.

(Table 5 cont.)

Model No	Reference No. code	Motor bracket reference No.	Moter manufacturer	Serise	Stepper motor model No.	Wattage of AC servo motor											
						10	20	30	50	60	100	150	200	300	400	600	750
MCM08	1	MC-BK08-145-00	Panasonic Co., Ltd.	MINAS A6					MSMF5A		MSMF01						
	2	MC-BK08-146-00	YASKAWA Electric Corp.	Σ-7					SGM7A-A5 SGM7J-A5		SGM7A-01 SGM7J-01	SGM7A-C2 SGM7J-C2					
			Mitsubishi Electric Corp.	MELSERVO-J4					HG-KR053 HG-MR053		HG-KR13 HG-MR13						
			OMRON Corp.	G5					R88M-K05030		R88M-K10030						
			SANYO DENKI Co., Ltd.	SANMOTION R					R2□A04005		R2□A04010						
	3	MC-BK08-160-00∗1	SANYO DENKI Co., Ltd.	-					P50B05005∗1		P50B05010∗1		P50B05020∗1				
	4	MC-BK08-170-00	YASKAWA Electric Corp.	Σ-7									SGM7A-02A SGM7J-02		SGM7A-04A SGM7J-04	SGM7A-06A SGM7J-06	
			Mitsubishi Electric Corp.	MELSERVO-J4									HG-KR23 HG-MR23		HG-KR43 HG-MR43		
			SANYO DENKI Co., Ltd.	SANMOTION R									R2□A06020		R2□A06040		
	5	MC-BK08-170-01	Panasonic Co., Ltd.	MINAS A6									MSMF02		MSMF04		
			OMRON Corp.	G5									R88M-K20030		R88M-K40030		
	6	MC-BK08-190-00∗1	SANYO DENKI Co., Ltd.	-									P50B07020∗1	P50B07030∗1	P50B07040∗1		
	7	MC-BK08-250-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x,ARL6x, AZ6x												
				CRK, CVK, RKⅡ	CRK56x, CVK56x, RKS56x												
			SANYO DENKI Co., Ltd.	SANMOTION Model No.PB	PBDM60x, PB□R60x, PB□P60x												
	8	MC-BK08-270-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR9x,ARL9x, AZ9x												
				RKⅡ	RKS59x												
MCM10	1	MC-BK10-170-00	YASKAWA Electric Corp.	Σ-7									SGM7A-02A SGM7J-02		SGM7A-04A SGM7J-04	SGM7A-06A SGM7J-06	
			Mitsubishi Electric Corp.	MELSERVO-J4									HG-KR23 HG-MR23		HG-KR43 HG-MR43		
			SANYO DENKI Co., Ltd.	SANMOTION R									R2□A06020		R2□A06040		
	2	MC-BK10-170-01	Panasonic Co., Ltd.	MINAS A6									MSMF02		MSMF04		
			OMRON Corp.	G5									R88M-K20030		R88M-K40030		
	3	MC-BK10-190-00	Panasonic Co., Ltd.	MINAS A6													MSMF08
			OMRON Corp.	G5													R88M-K75030
	4	MC-BK10-270-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR9x,ARL9x, AZ9x												
				RKⅡ	RKS59x												

∗1 The manufacturer models listed are discontinued motors.

C-1-6 MCH Model

MCH Model

C-1-6 MCH Model

C-1-6. 1 MCH Model Reference Number Coding

[Body]

Example: MC H 06 040 H 10 K (B 2) *1

Monocarrier

H: MCH Model
L: MCH Model low profile rail (only for 06 size)

Nominal size (rail width, Unit: 10mm)

Stroke (Unit: 10mm)

Accuracy grade (H, high grade; P, precision grade)

NSK management number (0 or 2)

Grease specification: B (LG2) (See page C142.)

Slider specification K: Single slider
D: Double slider (See page C16.)

Ball screw lead (mm)

Note: *1: These two code fields are added except for standard grease.

The 14th digit is set by NSK and cannot be specified by a customer.
For details, see the relevant page for the Reference No.

[With Accessories]

Example: MC S 06 040 H 10 K 0 2 K 0 0 0

S: With MCH Accessories
R: With MCL Accessories

NSK management number

Sensor unit

Cover unit

Intermediate plate for motor

Note: Option parts are available separately.

Table 1 Sensor unit (See page C83.)

Reference No. code	Specification	Reference No.
0	N/A	—
1	Proximity switch (Normally close contact 3 pieces)	MC—SRHxx—10
2	Proximity switch (Normally open contact 3 pieces)	MC—SRHxx—11
3	Proximity switch (Normally open contact 1 piece, Normally close contact 2 pieces)	MC—SRHxx—12
4	Photo sensor 3 pieces	MC—SRHxx—13

Notes: 1) xx: Nominal size
2) Sensor rails are not included with sensor units. If you require a rail, please specify this when ordering. (See page C83 to C84.)

Table 2 Cover unit (See page C85 to C87.)

Reference No. code	Specification	Reference No.
0	N/A	—
1	For single slider	MC—HVxxxxx—00
	For double slider	MC—HVxxxxxD00

Note: xxxxx; Nominal size and stroke number

Table 3 Intermediate plate for motor (See page C89 to C92.)

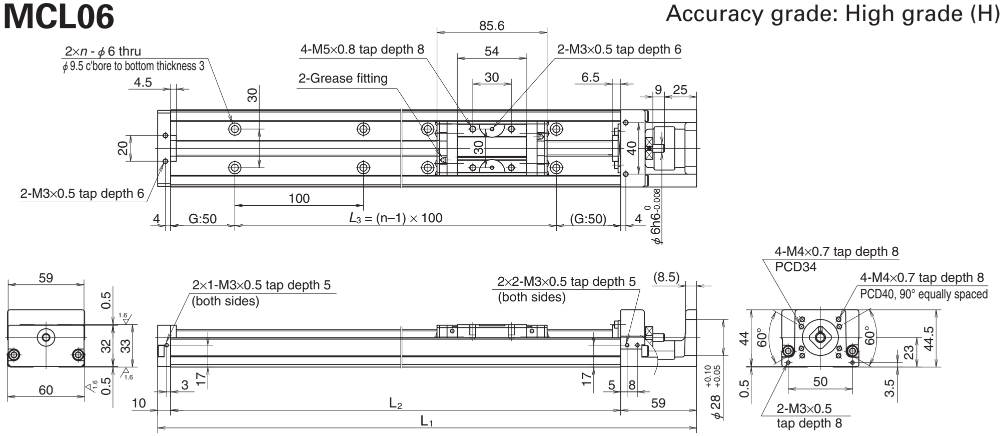
Reference No. code	Model No.		
	MCH06 (MCL06)	MCH09	MCH10
0	N/A	N/A	N/A
1	**MC-BKH06-145-00**	**MC-BKH09-145-00**	**MC-BKH10-170-00**
2	**MC-BKH06-146-00**	**MC-BKH09-146-00**	**MC-BKH10-170-01**
3	**MC-BKH06-231-00**	**MC-BKH09-170-00**	**MC-BKH10-190-00**
4	**MC-BKH06-250-00**	**MC-BKH09-170-01**	**MC-BKH10-190-01**
5	—	**MC-BKH09-231-00**	**MC-BKH10-250-00**
6	—	**MC-BKH09-250-00**	**MC-BKH10-270-00**

N/A: Not applicable

C-1-6. 2 MCH Model Dimension Tables for Standard Products

MCL06

Accuracy grade: High grade (H)



- ●Rail for MCL 06 is made lighter than that for MCH 06 by lowering rail height. Weight ratio between MCH 06 and MCL 06 is 5 to 4.
- ●Double slider specification is also available for MCL 06.
- ●Combinations of stroke and ball screw lead for MCL 06 are the same as those for MCH 06.

Dimensions of MCL06 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)				Inertia × 10^{-6}(kg · m^2)	Mass (kg)
				L_1	L_2	L_3	n		
◇MCL06005H05K02	50	53	5	219	150	100	2	2.38	1.0
◇MCL06005H10K02		(65)	10					3.45	
MCL06010H05K02	100	103	5	269	200	100	2	3.17	1.3
MCL06010H10K02		(115)	10					4.12	
MCL06020H05K02	200	203	5	369	300	200	3	4.51	1.9
MCL06020H10K02		(215)	10					5.46	
MCL06030H10K02	300	303	10	469	400	300	4	6.80	2.6
MCL06030H20K02		(315)	20					10.6	
MCL06040H10K02	400	403	10	569	500	400	5	8.13	3.2
MCL06040H20K02		(415)	20					11.9	
MCL06050H10K02	500	503	10	669	600	500	6	9.47	3.9
MCL06050H20K02		(515)	20					13.3	

Notes: 1. Dimension G is 25 for items marked with ◇.
2. Reference numbers above are high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	High-grade	Precision-grade
Standard	02	(None)
LG2	B2	B0

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
5	1.0 – 4.8	1.9 – 7.6
10	1.1 – 5.8	2.1 – 8.9
20	1.6 – 7.9	2.5 – 10.6

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into the ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

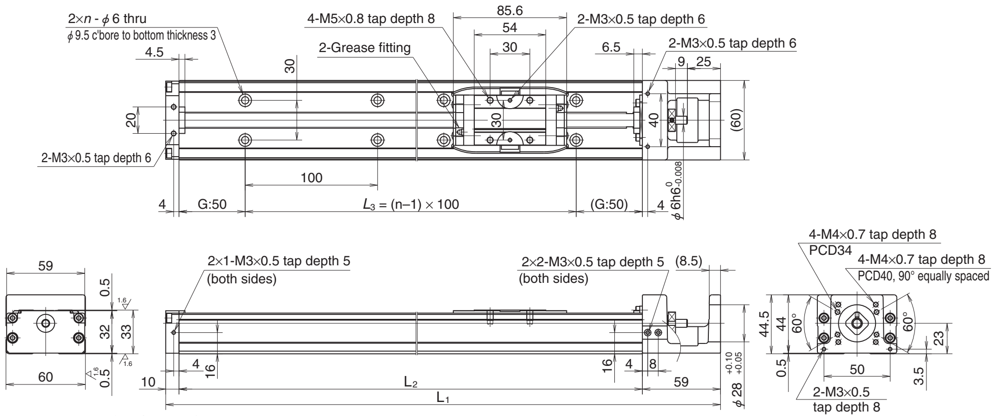
Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit load limit (N)
ℓ (mm)	d (mm)	Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
5	ϕ12	4 390	22 800	5 550	5	6 260	16 300	1 020
10		2 740	18 100		10	3 820		
20		2 660	14 400		20	3 800		

Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	335	133	133

MCH06

Accuracy grade: High grade (H)



Dimensions of MCH06 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)				Inertia $\times 10^{-6}$(kg · m^2)	Mass (kg)
				L_1	L_2	L_3	n		
◇MCH06005H05K02	50	53 (65)	5	219	150	100	2	2.38	1.8
◇MCH06005H10K02			10					3.45	
◇MCH06005H20K02			20					7.25	
MCH06010H05K02	100	103 (115)	5	269	200	100	2	3.17	2.2
MCH06010H10K02			10					4.12	
MCH06010H20K02			20					7,92	
MCH06020H05K02	200	203 (215)	5	369	300	200	3	4.51	3.0
MCH06020H10K02			10					5.46	
MCH06020H20K02			20					9.26	
MCH06030H05K02	300	303 (315)	5	469	400	300	4	5.85	3.7
MCH06030H10K02			10					6.80	
MCH06030H20K02			20					10.6	
MCH06040H05K02	400	403 (415)	5	569	500	400	5	7.18	4.5
MCH06040H10K02			10					8.13	
MCH06040H20K02			20					11.9	
MCH06050H05K02	500	503 (515)	5	669	600	500	6	8.52	5.2
MCH06050H10K02			10					9.47	
MCH06050H20K02			20					13.3	

Notes: 1. Dimension G is 25 for items marked with ◇.
2. Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	High-grade	Precision-grade
Standard	02	(None)
LG2	B2	B0

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
5	1.0 – 4.8	1.9 – 7.6
10	1.1 – 5.8	2.1 – 8.9
20	1.6 – 7.9	2.5 – 10.6

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into the ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

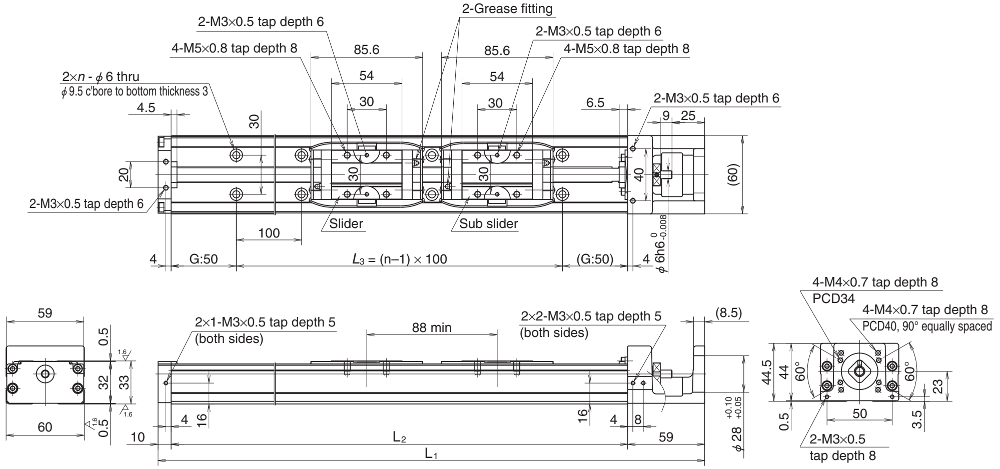
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit load limit (N)
		Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
5	ϕ12	4 390	22 800	5 550	5	6 260	16 300	1 020
10		2 740	18 100		10	3 820		
20		2 660	14 400		20	3 800		

Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	335	133	133

MCH06 (Double slider)

Accuracy grade: High grade (H)



Dimensions of MCH06 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)				Inertia $\times 10^{-6}$(kg · m2)	Mass (kg)
				L_1	L_2	L_3	n		
MCH06010H05D02	100	115	5	369	300	200	3	4.82	3.5
MCH06010H10D02		(139)	10					6.72	
MCH06020H05D02	200	215	5	469	400	300	4	6.16	4.2
MCH06020H10D02		(239)	10					8.06	
MCH06030H05D02	300	315	5	569	500	400	5	7.50	5.0
MCH06030H10D02		(339)	10					9.40	
MCH06040H10D02	400	415	10	669	600	500	6	10.7	5.7
MCH06040H20D02		(439)	20					18.3	

Note: Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	High-grade	Precision-grade
Standard	02	(None)
LG2	B2	B0

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
5	1.2 – 5.2	2.1 – 8.5
10	1.5 – 9.6	2.5 – 10.7
20	2.3 – 11.8	3.4 – 14.1

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into the ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

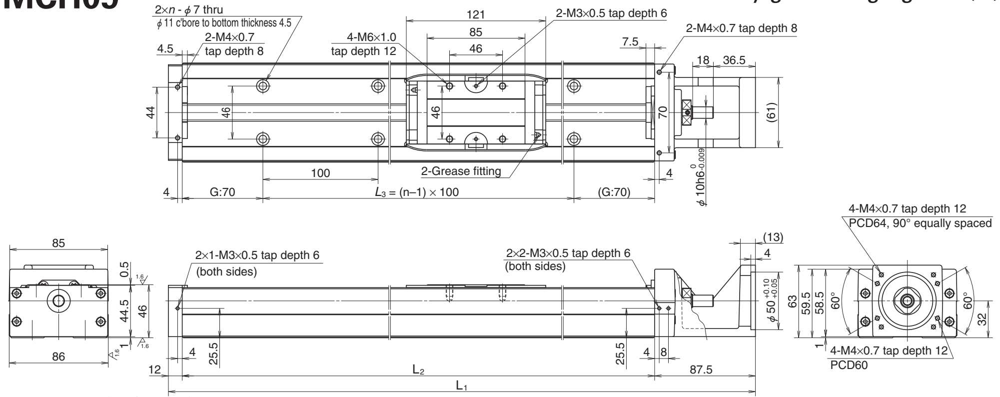
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit load limit (N)
		Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
5	ϕ12	4 390	22 800	5 550	5	6 260	16 300	1 020
10		2 740	18 100		10	3 820		
20		2 660	14 400		20	3 800		

Basic static moment loads of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	770	730	730

MCH09

Accuracy grade: High grade (H)



Dimension of MCH09 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)				Inertia $\times 10^{-6}$(kg · m^2)	Mass (kg)
				L_1	L_2	L_3	n		
MCH09010H05K02	100	107 (121)	5	339.5	240	100	2	9.2	5.0
MCH09010H10K02			10					10.7	
MCH09010H20K02			20					16.8	
MCH09020H05K02	200	207 (221)	5	439.5	340	200	3	12.4	6.5
MCH09020H10K02			10					13.9	
MCH09020H20K02			20					20.0	
MCH09030H05K02	300	307 (321)	5	539.5	440	300	4	15.6	8.1
MCH09030H10K02			10					17.1	
MCH09030H20K02			20					23.2	
MCH09040H05K02	400	407 (421)	5	639.5	540	400	5	18.8	9.7
MCH09040H10K02			10					20.3	
MCH09040H20K02			20					26.4	
MCH09050H05K02	500	507 (521)	5	739.5	640	500	6	22.0	11
MCH09050H10K02			10					23.5	
MCH09050H20K02			20					29.6	
MCH09060H05K02	600	607 (621)	5	839.5	740	600	7	25.2	13
MCH09060H10K02			10					26.7	
MCH09060H20K02			20					32.8	
MCH09070H05K02	700	707 (721)	5	939.5	840	700	8	28.4	14.5
MCH09070H10K02			10					30.0	
MCH09070H20K02			20					36.0	
MCH09080H05K02	800	807 (821)	5	1 039.5	940	800	9	31.6	16
MCH09080H10K02			10					33.2	
MCH09080H20K02			20					39.2	

Note: Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	High-grade	Precision-grade
Standard	02	(None)
LG2	B2	B0

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
5	1.0 – 5.9	2.5 – 11.0
10	2.0 – 7.8	2.8 – 13.4
20	2.0 – 10.8	3.4 – 16.1

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

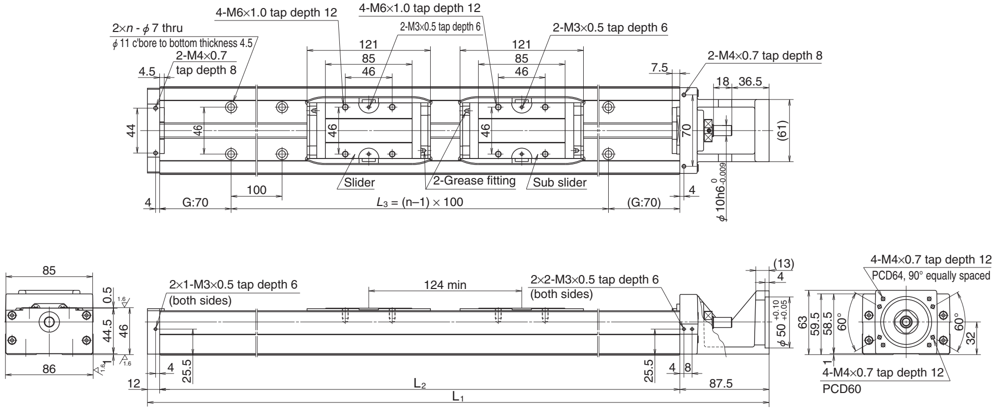
Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit load limit (N)
ℓ (mm)	d (mm)	Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
5	ϕ 15	8 300	40 600	9 000	5	12 700	30 500	2 130
10		8 140	32 200		10	12 800		
20		5 080	25 500		20	7 460		

Basic static moment loads of linear guide

Slider	Basic static moment loads (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	890	385	385

MCH09 (Double slider)

Accuracy grade: High grade (H)



Dimensions of MCH09 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)				Inertia $\times 10^{-6}$(kg · m^2)	Mass (kg)
				L_1	L_2	L_3	n		
MCH09015H05D02	150	183	5	539.5	440	300	4	16.1	8.9
MCH09015H10D02		(211)	10					19.2	
MCH09025H05D02	250	283	5	639.5	540	400	5	19.3	11
MCH09025H10D02		(311)	10					22.4	
MCH09035H05D02	350	383	5	739.5	640	500	6	22.5	12
MCH09035H10D02		(411)	10					25.6	
MCH09045H10D02	450	483	10	839.5	740	600	7	28.8	14
MCH09045H20D02		(511)	20					40.9	
MCH09065H10D02	650	683	10	1 039.5	940	800	9	35.2	17
MCH09065H20D02		(711)	20					47.3	

Note: Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	High-grade	Precision-grade
Standard	02	(None)
LG2	B2	B0

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
5	1.5 – 7.0	2.8 – 12.4
10	2.5 – 10.8	3.4 – 16.2
20	4.0 – 17.2	4.5 – 21.7

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

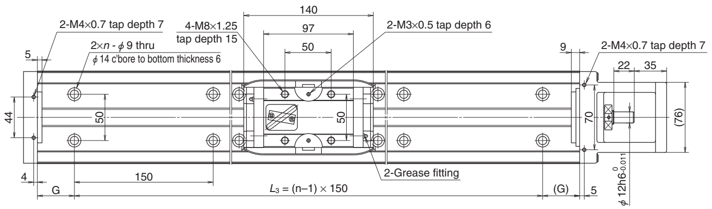
Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit load limit (N)
ℓ (mm)	d (mm)	Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
5	ϕ 15	8 300	40 600	9 000	5	12 700	30 500	2 130
10		8 140	32 200		10	12 800		
20		5 080	25 500		20	7 460		

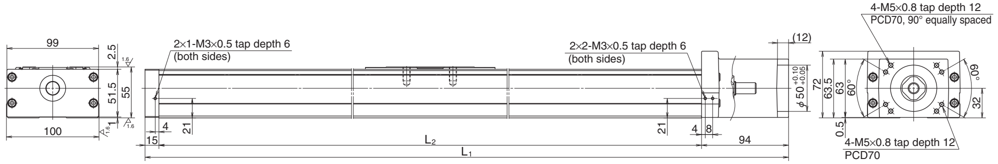
Basic static moment loads of linear guide

Slider	Basic static moment loads (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	1 780	2 070	2 070

MCH10

Accuracy grade: High grade (H)





Dimensions of MCH10 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)					Inertia × 10⁻⁶(kg · m²)	Mass (kg)
				L_1	L_2	G	L_3	n		
MCH10010H10K02	100	126	10	389	280	65	150	2	33.2	7.3
MCH10010H20K02		(142)	20						41.1	
MCH10020H10K02	200	226	10	489	380	40	300	3	43.4	9.5
MCH10020H20K02		(242)	20						51.3	
MCH10030H10K02	300	326	10	589	480	15	450	4	53.7	12
MCH10030H20K02		(342)	20						61.6	
MCH10040H10K02	400	426	10	689	580	65	450	4	62.4	14
MCH10040H20K02		(442)	20						71.8	
MCH10050H10K02	500	526	10	789	680	40	600	5	74.7	16
MCH10050H20K02		(542)	20						82.3	
MCH10060H10K02	600	626	10	889	780	15	750	6	84.9	19
MCH10060H20K02		(642)	20						92.5	
MCH10070H10K02	700	726	10	989	880	65	750	6	95.1	21
MCH10070H20K02		(742)	20						103	
MCH10080H10K02	800	826	10	1 089	980	40	900	7	105	23
MCH10080H20K02		(842)	20						113	
MCH10090H10K02	900	926	10	1 189	1 080	15	1 050	8	116	25
MCH10090H20K02		(942)	20						123	
MCH10100H10K02	1 000	1 026	10	1 289	1 180	65	1 050	8	126	27
MCH10100H20K02		(1 042)	20						133	
MCH10110H10K02	1 100	1 126	10	1 389	1 280	40	1 200	9	136	29
MCH10110H20K02		(1 142)	20						143	
MCH10120H10K02	1 200	1 226	10	1 489	1 380	15	1 350	10	146	32
MCH10120H20K02		(1 242)	20						154	

Note: Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	High-grade	Precision-grade
Standard	02	(None)
LG2	B2	B0

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
10	2.7 – 10.8	3.3 – 17.5
20	3.1 – 12.7	3.8 – 20.4

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load ratings

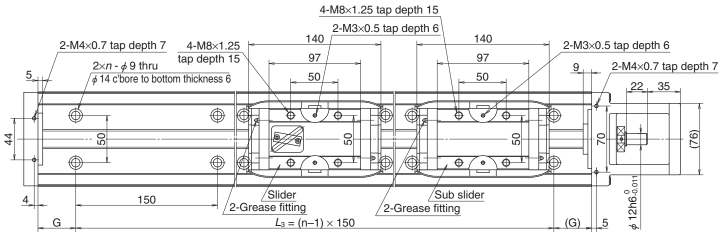
Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit load limit (N)
ℓ (mm)	d (mm)	Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
10	ϕ 20	12 800	44 600	9 600	10	21 400	42 000	2 360
20		8 190	35 400		20	12 600		

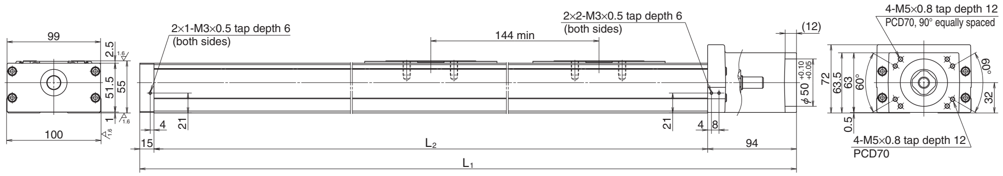
Basic static moment loads of linear guide

Slider	Basic static moment loads (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	1 460	610	610

MCH10 (Double slider)

Accuracy grade: High grade (H)





Dimensions of MCH10 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)					Inertia × 10⁻⁶(kg · m²)	Mass (kg)
				L_1	L_2	G	L_3	n		
MCH10025H10D02	250	282	10	689	580	65	450	4	67.1	15
MCH10025H20D02		(314)	20						82.4	
MCH10035H10D02	350	382	10	789	680	40	600	5	77.3	17
MCH10035H20D02		(414)	20						92.5	
MCH10045H10D02	450	482	10	889	780	15	750	6	87.5	20
MCH10045H20D02		(514)	20						103	
MCH10055H10D02	550	582	10	989	880	65	750	6	97.7	22
MCH10055H20D02		(614)	20						113	
MCH10065H10D02	650	682	10	1 089	980	40	900	7	108	24
MCH10065H20D02		(714)	20						123	
MCH10075H20D02	750	782 (814)	20	1 189	1 080	15	1 050	8	133	26
MCH10085H20D02	850	882 (914)	20	1 289	1 180	65	1 050	8	143	28
MCH10095H20D02	950	982 (1 014)	20	1 389	1 280	40	1 200	9	154	30
MCH10105H20D02	1 050	1 082 (1 114)	20	1 489	1 380	15	1 350	10	164	33

Note: Reference numbers above are for high-grade grease specifications. In the case of other specifications, see the following table for the 13th and 14th digits.

Coding for columns 13 and 14

Grease	High-grade	Precision-grade
Standard	02	(None)
LG2	B2	B0

Monocarrier dynamic torque specification (N · cm)

Ball screw lead(mm)	Accuracy grade	
	High grade	Precision
10	4.2 – 15.6	4.4 – 21.6
20	5.0 – 19.6	5.6 – 27.4

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screws, linear guide parts and support units.
3. Consult NSK for life estimates under large moment loads.

Basic load rating

Lead	Shaft dia	Basic dynamic load ratings (N)				Basic static load ratings (N)		Support unit load limit (N)
ℓ (mm)	d (mm)	Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
10	ϕ 20	12 800	44 600	9 600	10	21 400	42 000	2 360
20		8 190	35 400		20	12 600		

Basic static moment loads of linear guide

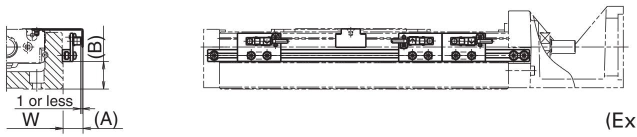
Slider	Basic static moment loads (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	2 920	3 430	3 430

C-1-6. 3 MCH Model Accessories

C-1-6. 3. 1 Sensor Unit

●Proximity switch

Sensor rails are not included with sensor units



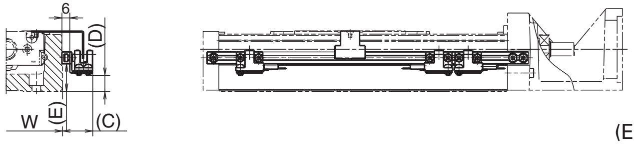
(Example assembly)

Model No.		Reference No.			A (mm)	B (mm)	Body width W (mm)
MCH06		MC-SRH06-10	MC-SRH06-11	MC-SRH06-12	17	10	60
MCH09		MC-SRH09-10	MC-SRH09-11	MC-SRH09-12	16	21	86
MCH10		MC-SRH10-10	MC-SRH10-11	MC-SRH10-12	16	16	100
Quantity	Proximity switch (normally open contact)	—	3	1	E2S-W13 (OMRON Corp.)		
	Proximity switch (normally close contact)	3	—	2	E2S-W14 (OMRON Corp.)		

Notes: 1. See page C137 for proximity switch specifications. 2. A sensor unit consists of sensors, a sensor dog and sensor mounting parts.

●Photo sensor

Sensor rails are not included with sensor units



(Example assembly)

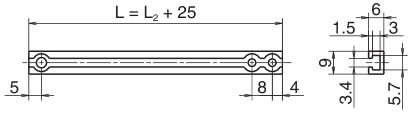
Model No.	Reference No.	C (mm)	D (mm)	E (mm)	Body width W (mm)	Remarks
MCH06	MC-SRH06-13	24	2	11	60	EE-SX674 (OMRON Corp.)
MCH09	MC-SRH09-13	23	12	21	86	3 sets
MCH10	MC-SRH10-13	23	29	16	100	(EE-1001 connector attachment)

Notes: 1. See page C138 for proximity switch specifications. 2. A sensor unit consists of sensors, a sensor dog and sensor mounting parts.

(1) Sensor rail

Reference number: MC-SRL- ＊＊＊＊

- ＊＊＊＊ is the same as rail dimension L_2.



Note: For combinations of sensors and rails, see page C82.

MCH Model Sensor Rail Combinations

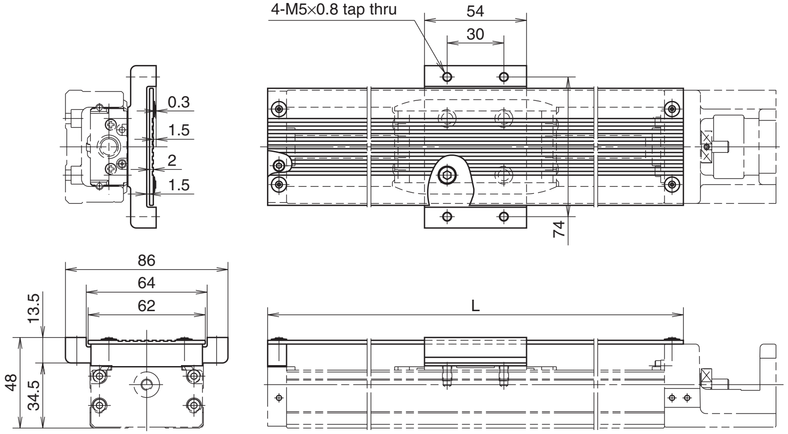
Table 4

Model No.	Body length L_2 (mm)	Reference No.	Sensor rail reference No.
MCH06	150	MCH06005H05K02 MCH06005H10K02 MCH06005H20K02	MC-SRL-0150
	200	MCH06010H05K02 MCH06010H10K02 MCH06010H20K02	MC-SRL-0200
	300	MCH06020H05K02 MCH06020H10K02 MCH06020H20K02 MCH06010H05D02 MCH06010H10D02	MC-SRL-0300
	400	MCH06030H05K02 MCH06030H10K02 MCH06030H20K02 MCH06020H05D02 MCH06020H10D02	MC-SRL-0400
	500	MCH06040H05K02 MCH06040H10K02 MCH06040H20K02 MCH06030H05D02 MCH06030H10D02	MC-SRL-0500
	600	MCH06050H05K02 MCH06050H10K02 MCH06050H20K02 MCH06040H10D02 MCH06040H20D02	MC-SRL-0600
MCL06	150	MCL06005H05K02 MCL06005H10K02	MC-SRL-0150
	200	MCL06010H05K02 MCL06010H10K02	MC-SRL-0200
	300	MCL06020H05K02 MCL06020H10K02	MC-SRL-0300
	400	MCL06030H10K02 MCL06030H20K02	MC-SRL-0400
	500	MCL06040H10K02 MCL06040H20K02	MC-SRL-0500
	600	MCL06050H10K02 MCL06050H20K02	MC-SRL-0600
MCH09	240	MCH09010H05K02 MCH09010H10K02 MCH09010H20K02	MC-SRL-0240
	340	MCH09020H05K02 MCH09020H10K02 MCH09020H20K02	MC-SRL-0340
	440	MCH09030H05K02 MCH09030H10K02 MCH09030H20K02 MCH09015H05D02 MCH09015H10D02	MC-SRL-0440
	540	MCH09040H05K02 MCH09040H10K02 MCH09040H20K02 MCH09025H05D02 MCH09025H10D02	MC-SRL-0540
	640	MCH09050H05K02 MCH09050H10K02 MCH09050H20K02 MCH09035H05D02 MCH09035H10D02	MC-SRL-0640
	740	MCH09060H05K02 MCH09060H10K02 MCH09060H20K02 MCH09045H10D02 MCH09045H20D02	MC-SRL-0740

Model No.	Body length L_2 (mm)	Reference No.	Sensor rail reference No.
MCH09	840	MCH09070H05K02 MCH09070H10K02 MCH09070H20K02	MC-SRL-0840
	940	MCH09080H05K02 MCH09080H10K02 MCH09080H20K02 MCH09065H10D02 MCH09065H20D02	MC-SRL-0940
MCH10	280	MCH10010H10K02 MCH10010H20K02	MC-SRL-0280
	380	MCH10020H10K02 MCH10020H20K02	MC-SRL-0380
	480	MCH10030H10K02 MCH10030H20K02	MC-SRL-0480
	580	MCH10040H10K02 MCH10025H10D02	MC-SRL-0580
	680	MCH10050H10K02 MCH10050H20K02 MCH10035H10D02 MCH10035H20D02	MC-SRL-0680
	780	MCH10060H10K02 MCH10060H20K02 MCH10045H10D02 MCH10045H20D02	MC-SRL-0780
	880	MCH10070H10K02 MCH10070H20K02 MCH10055H10D02 MCH10055H20D02	MC-SRL-0880
	980	MCH10080H10K02 MCH10080H20K02 MCH10065H10D02 MCH10065H20D02	MC-SRL-0980
	1 080	MCH10090H10K02 MCH10090H20K02 MCH10075H20D02	MC-SRL-1080
	1 180	MCH10100H10K02 MCH10100H20K02 MCH10085H20D02	MC-SRL-1180
	1 280	MCH10110H10K02 MCH10110H20K02 MCH10095H20D02	MC-SRL-1280
	1 380	MCH10120H10K02 MCH10120H20K02 MCH10105H20D02	MC-SRL-1380

C-1-6. 3. 2 Cover Unit

Cover unit for MCH06 and MCL06

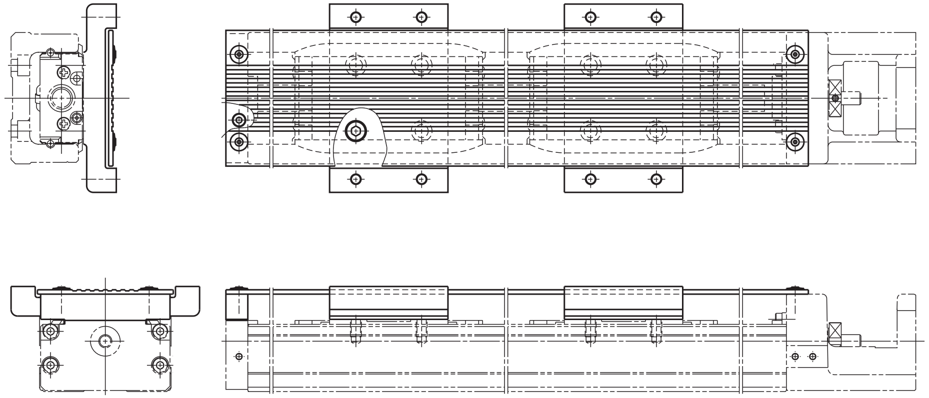


Unit: mm

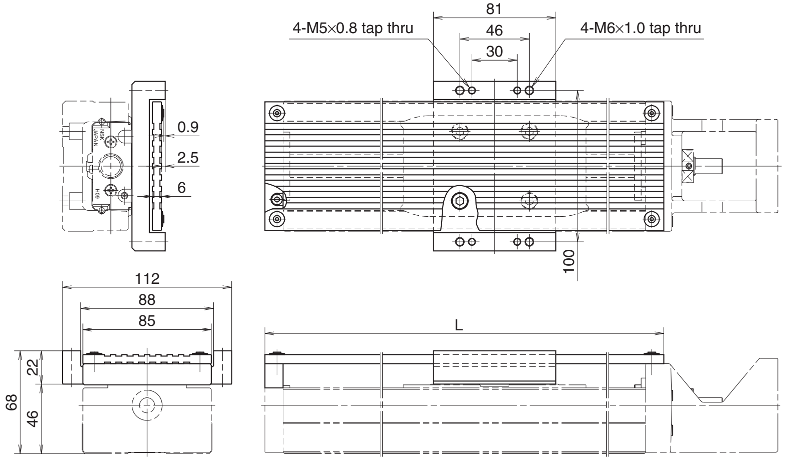
Single slider		Double slider		Top cover length
Stroke	Reference No.	Stroke	Reference No.	*L*
50	MC-HV06005-00	–	–	170
100	MC-HV06010-00	–	–	220
200	MC-HV06020-00	100	MC-HV06010D00	320
300	MC-HV06030-00	200	MC-HV06020D00	420
400	MC-HV06040-00	300	MC-HV06030D00	520
500	MC-HV06050-00	400	MC-HV06040D00	620

●Cover unit for double sliders

Two spacers are provided for double sliders.



Cover unit for MCH09

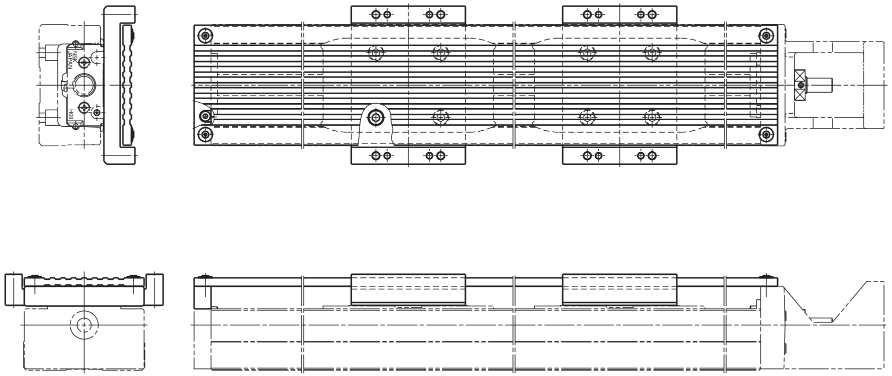


Unit: mm

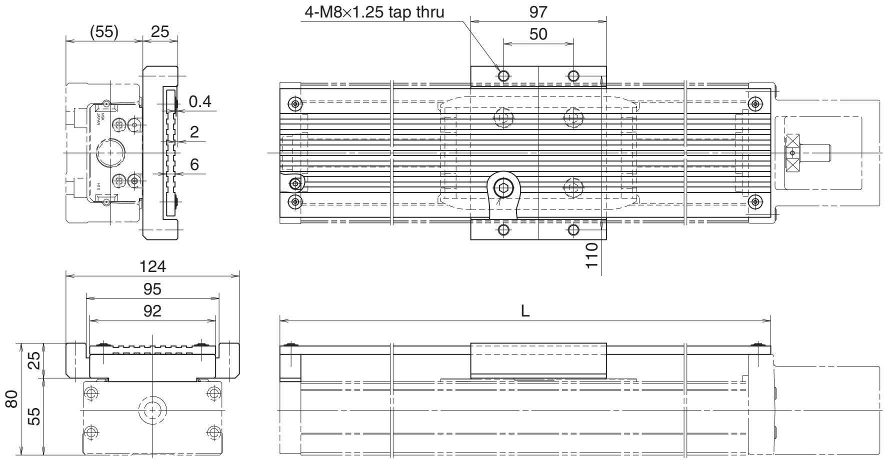
Single slider		Double slider		Top cover length
Stroke	Reference No.	Stroke	Reference No.	*L*
100	MC-HV09010-00	–	–	264
200	MC-HV09020-00	–	–	364
300	MC-HV09030-00	150	MC-HV09015D00	464
400	MC-HV09040-00	250	MC-HV09025D00	564
500	MC-HV09050-00	350	MC-HV09035D00	664
600	MC-HV09060-00	450	MC-HV09045D00	764
700	MC-HV09070-00	–	–	864
800	MC-HV09080-00	650	MC-HV09065D00	964

●Cover unit for double sliders

Two spacers are provided for double sliders.



Cover unit for MCH10

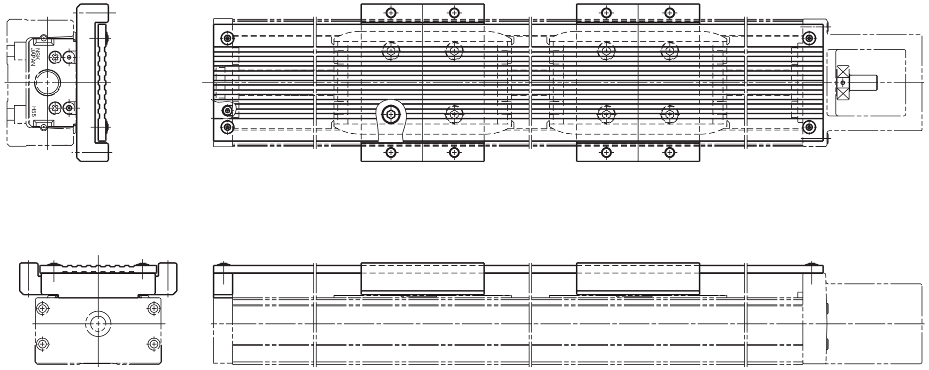


Unit: mm

Single slider		Double slider		Top cover length
Stroke	Reference No.	Stroke	Reference No.	*L*
100	MC-HV10010-00	–	–	310
200	MC-HV10020-00	–	–	410
300	MC-HV10030-00	–	–	510
400	MC-HV10040-00	250	MC-HV10025D00	610
500	MC-HV10050-00	350	MC-HV10035D00	710
600	MC-HV10060-00	450	MC-HV10045D00	810
700	MC-HV10070-00	550	MC-HV10055D00	910
800	MC-HV10080-00	650	MC-HV10065D00	1 010
900	MC-HV10090-00	750	MC-HV10075D00	1 110
1 000	MC-HV10100-00	850	MC-HV10085D00	1 210
1 100	MC-HV10110-00	950	MC-HV10095D00	1 310
1 200	MC-HV10120-00	1 050	MC-HV10105D00	1 410

●Cover unit for double sliders

Two spacers are provided for double sliders.

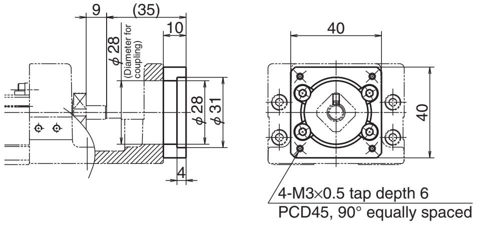


C-1-6. 3. 3 Intermediate Plate for Motor

- ●Please ask NSK about motors not listed in the compatible motor list.
- ●If using a parallel motor mount, please consult with NSK. ●Be sure to align centerlines when installing motor.
- ●Motor models are subject to change at motor manufacturers. For details, please contact the manufacturer.

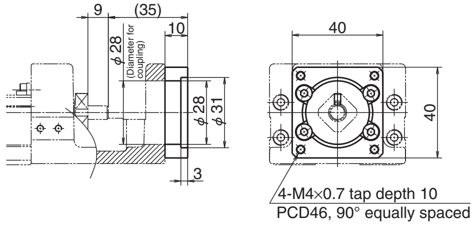
Motor Bracket for MCH06 and MCL06

Reference number: MC-BKH06-145-00



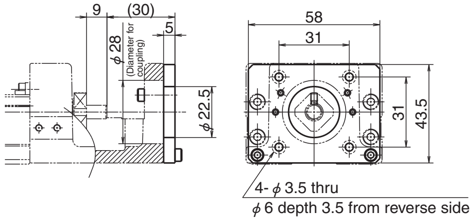
Compatible motor		
Maker	Serise	Motor models(Servo motor)
Panasonic Co.,Ltd.	MINAS A6	MSMF5A(50W), MSMF01(100W)

Reference number: MC-BKH06-146-00



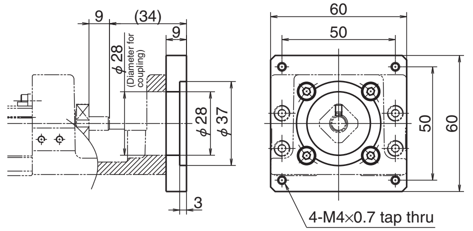
Compatible motor		
Maker	Serise	Motor models(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-A5(50W),SGM7J-A5(50W) SGM7A-01(100W),SGM7J-01(100W) SGM7A-C2(150W),SGM7J-C2(150W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR053(50W),HG-MR053(50W) HG-KR13(100W),HG-MR13(100W)
OMRON Corp.	G5	R88M-K05030(50W),R88M-K10030(100W)
SANYO DENKI Co., Ltd.	SANMOTION R	R2□A04005(50W),R2□A04010(100W)

Reference number: MC-BKH06-231-00



Compatible motor		
Maker	Serise	Motor models(Stepper motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR46x, ARL46x, AZ46x
	CRK, CVK, RKⅡ	CRK54x, CVK54x, RKS54x, CVK24x
SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM423x, PB□R423x, PB□P423x

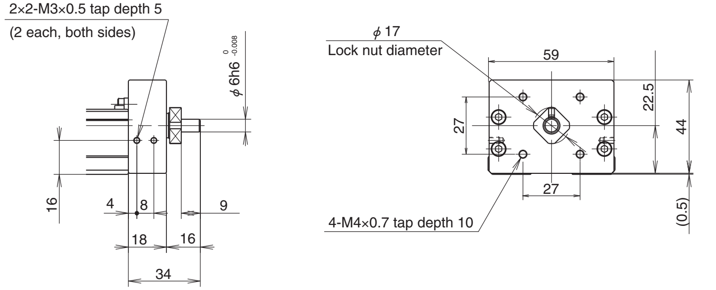
Reference number: MC-BKH06-250-00



Compatible motor		
Maker	Serise	Motor models(stepping motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x,ARL6x,AZ6x
	CRK, CVK, RKⅡ	CRK56x, CVK56x, RKS56x
SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM60x, PB□R60x PB□P60x

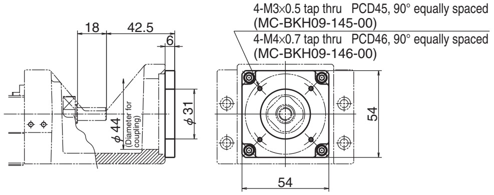
Diameter of ball screw shaft end to install a pulley for parallel motor mount of MCH06

(* These specifications are not subject to catalog standards.)



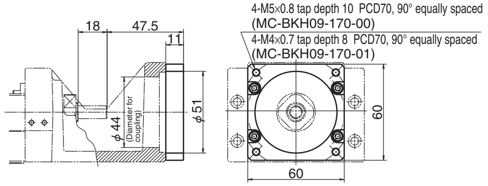
Motor Bracket for MCH09

Reference number: MC-BKH09-145-00
MC-BKH09-146-00



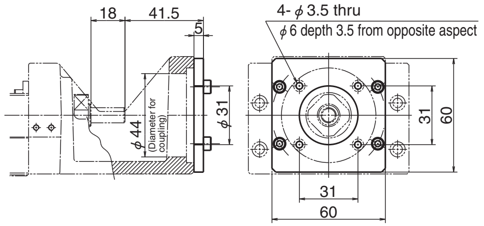
Referrnce No.	Compatible motor		
	Maker	Serise	Motor models(Servo motor)
MC-BKH09-145-00	Panasonic Co.,Ltd.	MINAS A6	MSMF5A(50W),MSMF01(100W)
MC-BKH09-146-00	YASKAWA Electric Corp.	Σ-7	SGM7A-A5(50W),SGM7J-A5(50W) SGM7A-01(100W),SGM7J-01(100W) SGM7A-C2(150W),SGM7J-C2(150W)
	Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR053(50W),HG-MR053(50W) HG-KR13(100W),HG-MR13(100W)
	OMRON Corp.	G5	R88M-K05030(50W),R88M-K10030(100W)
	SANYO DENKI Co.,Ltd.	SANMOTION R	R2□A04005(50W),R2□A04010(100W)

Reference number: MC-BKH09-170-00
MC-BKH09-170-01



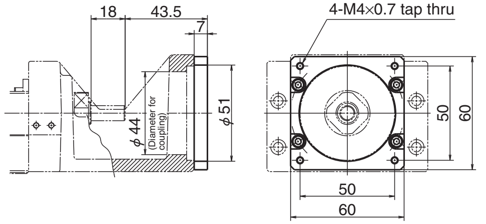
Referrnce No.	Compatible motor		
	Maker	Serise	Motor models(Servo motor)
MC-BKH09-170-00	YASKAWA Electric Corp.	Σ-7	SGM7A-02A(200W),SGM7J-02(200W) SGM7A-04A(400W),SGM7J-04(400W) SGM7A-06A(600W),SGM7J-06(600W)
	Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR23(200W),HG-MR23(200W) HG-KR43(400W),HG-MR43(400W)
	SANYO DENKI Co., Ltd.	SANMOTION R	R2□A06020(200W)R2□A06040(400W)
MC-BKH09-170-01	Panasonic Co.,Ltd.	MINAS A6	MSMF02(200W),MSMF04(400W)
	OMRON Corp.	G5	R88M-K20030(200W),R88M-K40030(400W)

Reference number: MC-BKH09-231-00



Compatible motor		
Maker	Serise	Motor models(stepping motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR46x, ARL46x, AZ46x
	CRK, CVK, RKⅡ	CRK54x, CVK54x, RKS54x, CVK24x
SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM423x, PB□R423x, PB□P423x

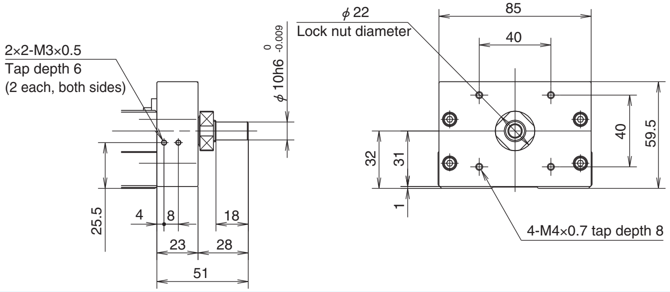
Reference number: MC-BKH09-250-00



Compatible motor		
Maker	Serise	Motor models(Stepper motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x, ARL6x, AZ6x
	CRK, CVK, RKⅡ	CRK56x, CVK56x, RKS56x
SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM60x, PB□R60x PB□P60x

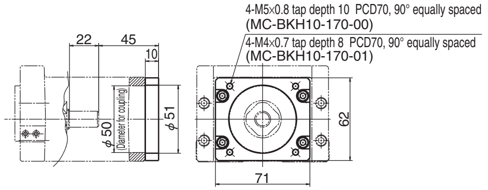
Diameter of ball screw shaft end to install a pulley for parallel motor mount of MCH09

(* These specifications are not subject to catalog standards.)



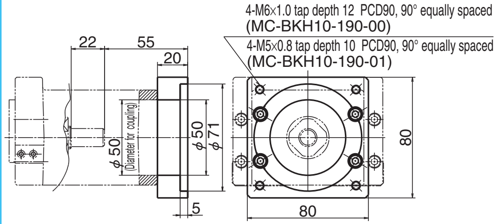
Motor Bracket for MCH10

Reference number: MC-BKH10-170-00
MC-BKH10-170-01



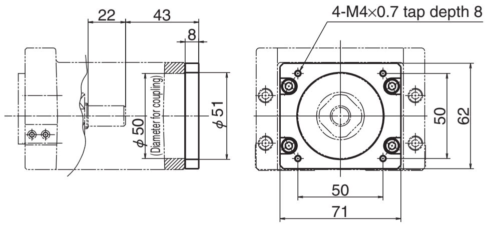
Referrnce No.	Compatible motor		
	Maker	Serise	Motor models(Servo motor)
MC-BKH10-170-00	YASKAWA Electric Corp.	Σ-7	SGM7A-02A(200W),SGM7J-02(200W) SGM7A-04A(400W),SGM7J-04(400W) SGM7A-06A(600W),SGM7J-06(600W)
	Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR23(200W),HG-MR23(200W) HG-KR43(400W),HG-MR43(400W)
	SANYO DENKI Co.,Ltd.	SANMOTION R	R2□A06020(200W)R2□A06040(400W)
MC-BKH10-170-01	Panasonic Co.,Ltd.	MINAS A6	MSMF02(200W),MSMF04(400W)
	OMRON Corp.	G5	R88M-K20030(200W),R88M-K40030(400W)

Reference number: MC-BKH10-190-00
MC-BKH10-190-01



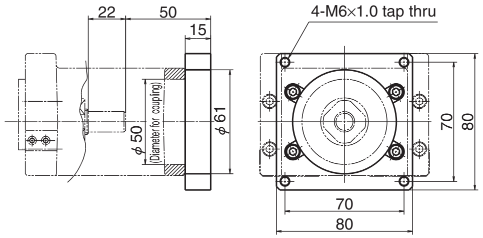
Referrnce No.	Compatible motor		
	Maker	Serise	Motor models(Servo motor)
MC-BKH10-190-00	YASKAWA Electric Corp.	Σ-7	SGM7A-08A(750W),SGM7J-A08(750W)
	Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR73(750W),HG-MR73(750W)
MC-BKH10-190-01	Panasonic Co.,Ltd.	MINAS A6	MSMF08(750W)
	OMRON Corp.	G5	R88M-K75030(750W)

Reference number: MC-BKH10-250-00



Compatible motor		
Maker	Serise	Motor models(stepping motor)
OMRON Corp.	αSTEP	AR6x, ARL6x, AZ6x
	CRK, CVK, RKⅡ	CRK56x, CVK56x, RKS56x
SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM60x, PB□R60x, PB□P60x

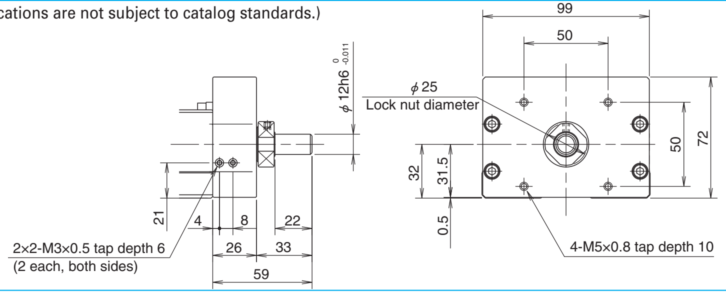
Reference number: MC-BKH10-270-00



Compatible motor		
Maker	Serise	Motor models(stepping motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR46x, ARL46x, AZ46x
	CRK, CVK, RKⅡ	CRK54x, CVK54x, RKS54x, CVK24x

Diameter of ball screw shaft end to install a pulley for parallel motor mount of MCH10

(* These specifications are not subject to catalog standards.)



Compatible Motors for Intermediate Plates of the MCH Model

Model No.	Reference No. code	Motor bracket reference No.	Motor manufacturer	Motor Serise	Stepping motor model No.	Wattage of AC servo motor						
						50	100	150	200	400	600	750
MCH06 MCL06	1	MC-BKH06-145-00	Panasonic Co.,Ltd.	MINAS A6		MSMF5A	MSMF01					
	2	MC-BKH06-146-00	YASKAWA Electric Corp.	Σ-7		SGM7A-A5 SGM7J-A5	SGM7A-01 SGM7J-01	SGM7A-C2 SGM7J-C2				
			Mitsubishi Electric Corp.	MELSERVO-J4		HG-KR053 HG-MR053	HG-KR13 HG-MR13					
			OMRON Corp.	G5		R88M-K05030	R88M-K10030					
			SANYO DENKI Co.,Ltd.	SANMOTION R		R2□A04005	R2□A04010					
	3	MC-BKH06-231-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR46x, ARL46x, AZ46x							
				CRK, CVK, RKⅡ, CVK	CRK54x, CVK54x, RKS54x, CVK24x							
			SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM423x, PB□R423x, PB□P423x							
	4	MC-BKH06-250-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x,ARL6x,AZ6x							
				CRK, CVK, RKⅡ	CRK56x, CVK56x, RKS56x							
			SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM60x, PB□R60x, PB□P60x							
MCH09	1	MC-BKH09-145-00	Panasonic Co.,Ltd.	MINAS A6		MSMF5A	MSMF01					
	2	MC-BKH09-146-00	YASKAWA Electric Corp.	Σ-7		SGM7J-A5 SGM7A-A5	SGM7A-01 SGM7J-01	SGM7A-C2 SGM7J-C2				
			Mitsubishi Electric Corp.	MELSERVO-J4		HG-KR053 HG-MR053	HG-KR13 HG-MR13					
			OMRON Corp.	G5		R88M-K05030	R88M-K10030					
			SANYO DENKI Co.,Ltd.	SANMOTION R		R2□A04005	R2□A04010					
	3	MC-BKH09-170-00	YASKAWA Electric Corp.	Σ-7					SGM7A-02A SGM7J-02	SGM7A-04A SGM7J-04	SGM7A-06A SGM7J-06	
			Mitsubishi Electric Corp.	MELSERVO-J4					HG-KR23 HG-MR23	HG-KR43 HG-MR43		
			SANYO DENKI Co.,Ltd.	SANMOTION R					R2□A06020	R2□A06040		
	4	MC-BKH09-170-01	Panasonic Co.,Ltd.	MINAS A6					MSMF02	MSMF04		
			OMRON Corp.	G5					R88M-K20030	R88M-K40030		
	5	MC-BKH09-231-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR46x, ARL46x, AZ46x							
				CRK, CVK, RKⅡ, CVK	CRK54x, CVK54x, RKS54x, CVK24x							
			SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM423x, PB□R423x, PB□P423x							
	6	MC-BKH09-250-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x,ARL6x,AZ6x							
				CRK, CVK, RKⅡ	CRK56x, CVK56x, RKS56x							
			SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM60x, PB□R60x, PB□P60x							
MCH10	1	MC-BKH10-170-00	YASKAWA Electric Corp.	Σ-7					SGM7A-02A SGM7J-02	SGM7A-04A SGM7J-04	SGM7A-06A SGM7J-06	
			Mitsubishi Electric Corp.	MELSERVO-J4					HG-KR23 HG-MR23	HG-KR43 HG-MR43		
			SANYO DENKI Co.,Ltd.	SANMOTION R					R2□A06020	R2□A06040		
	2	MC-BKH10-170-01	Panasonic Co.,Ltd.	MINAS A6					MSMF02	MSMF04		
			OMRON Corp.	G5					R88M-K20030	R88M-K40030		
	3	MC-BKH10-190-00	YASKAWA Electric Corp.	Σ-7								SGM7A-08A SGM7J-A08
			Mitsubishi Electric Corp.	MELSERVO-J4								HG-KR73 HG-MR73
	4	MC-BKH10-190-01	Panasonic Co.,Ltd.	MINAS A6								MSMF08
			OMRON Corp.	G5								R88M-K75030
	5	MC-BKH10-250-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x,ARL6x,AZ6x							
				CRK, CVK, RKⅡ	CRK56x, CVK56x, RKS56x							
			SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM60x, PB□R60x, PB□P60x							
	6	MC-BKH10-270-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR9x,ARL9x,AZ9x							
				RKⅡ	RKS59x							

C-2 Toughcarrier™

C-2 Toughcarrier™

C-2 Toughcarrier™

C-2-1 Features

Greatly improved load capacity due to switching of rolling elements to rollers.
Mounting dimensions are compatible with those of the MCH Model, allowing substitution.

- Lightweight and compact design

Taking into account part composition and rigidity, the cross sections of the rail and slider are the same as the MCH model.

- Superb rust-preventive ability

Low-temperature chrome plating comes standard.

- All-in-one structure

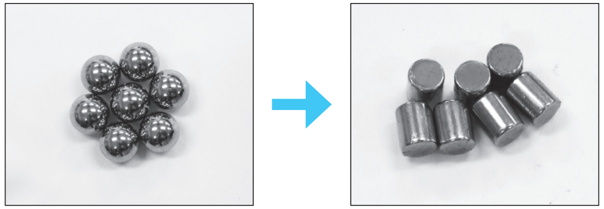
1) The all-in-one structure integrates a ball screw, a linear guide, and a support unit into a single structure to significantly reduce design time.
2) The bottom and one side of the rail are datum surfaces to facilitate highly accurate installation. Models with pin holes are also available as standard.
3) Immediate operation after installation and run-in is possible due to pre-packed grease.
4) A wide selection of ball screw leads are available.

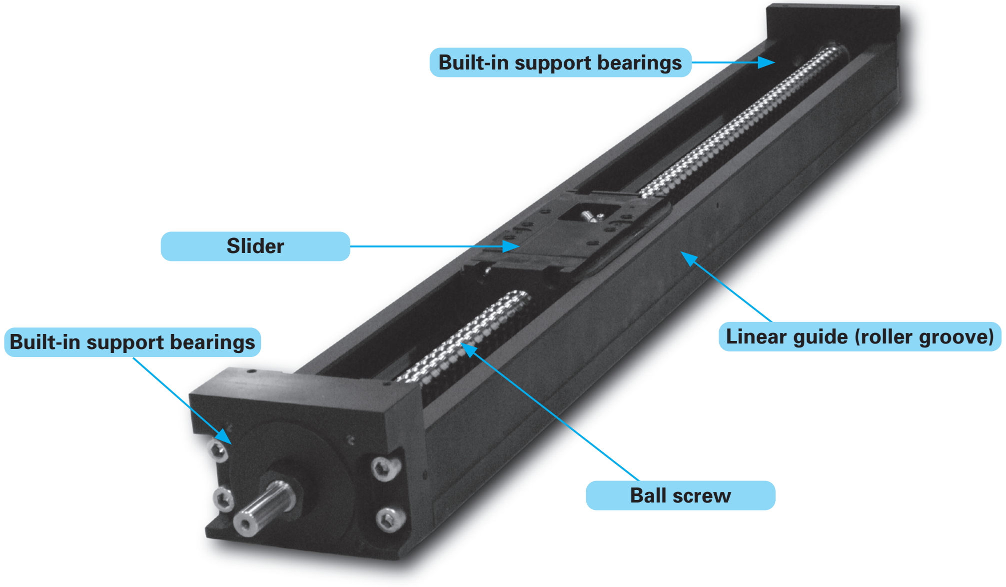
- Long-term maintenance-free operation

Use of NSK K1 lubrication unit and grease maintains smooth lubricating performance for long periods.

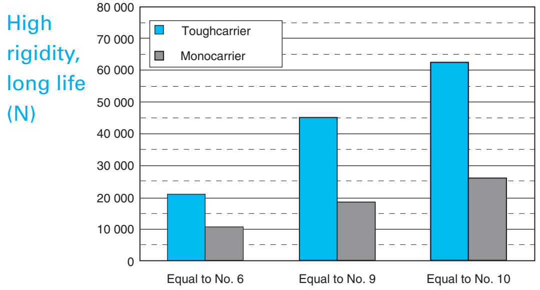
- Updated rolling elements

Rollers are installed as rolling elements for the first time anywhere.

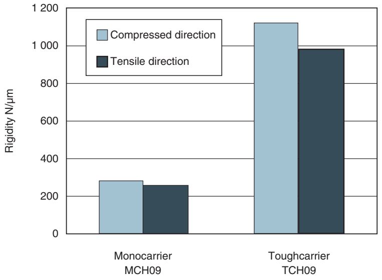




- High rigidity, long life



Twice the dynamic load rating and nine-times longer life compared to Monocarrier actuators



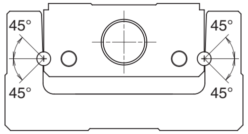
Four-times higher rigidity than Monocarrier actuators

C-2-2 Classification and Models

Structure

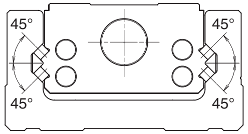
Rolling elements: Balls

MCH Model



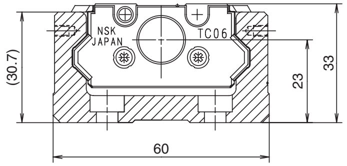
Rolling elements: Rollers

TCH Model

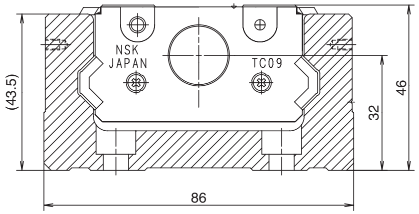


Cross-sections of TCH Models

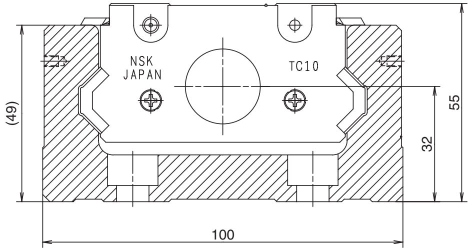
TCH06



TCH09

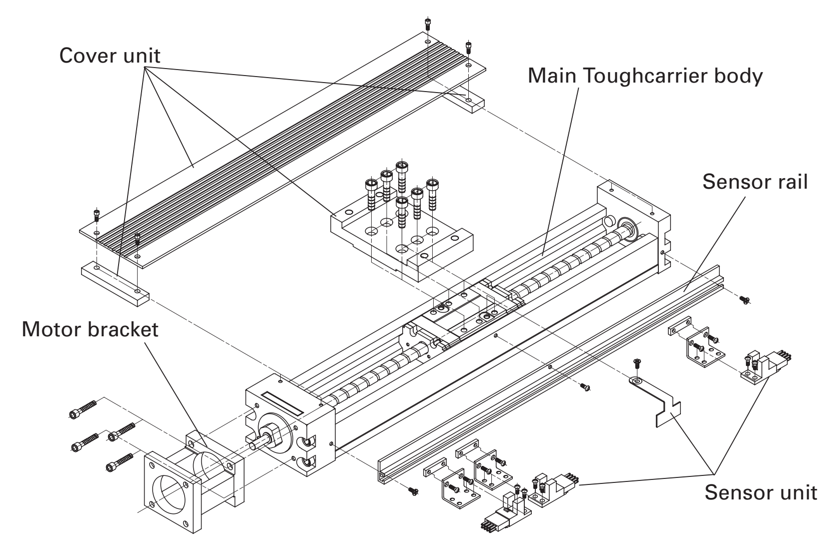


TCH10



C-2-3 Accessories

Accessories for Toughcarrier



Assembly Example

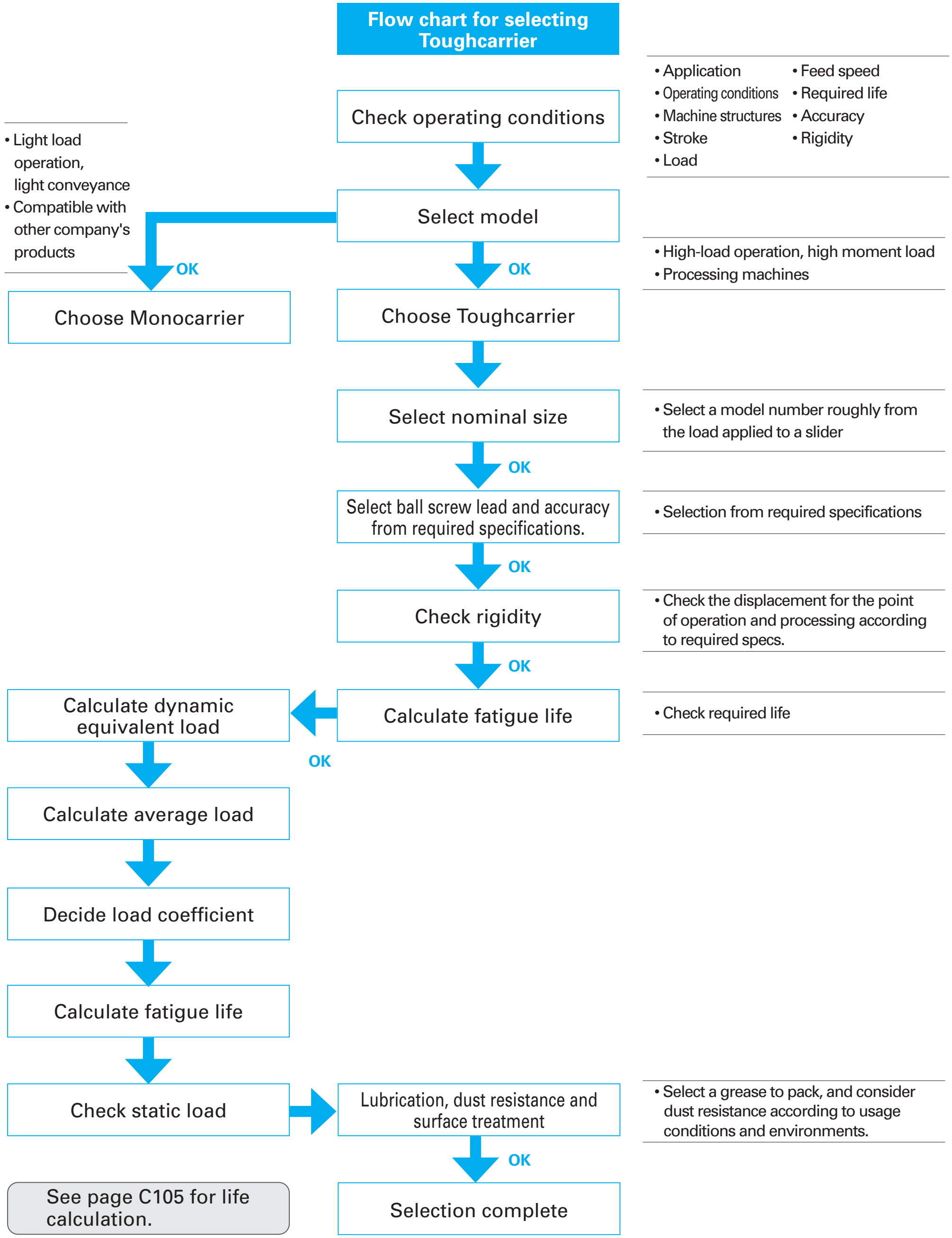
Sensor units, cover units, motor brackets and sensor rails are available as options for Toughcarrier actuators.

Contact NSK for specifications other than those of NSK standard accessories.

1. Sensor unit:
   ●Photo sensor…Use both OMRON EE-SX674 and EE-1001
   ●Proximity switch…Use OMRON E2S-W13, E2S-W14
   Available in a unit including sensor fitting clamps.
2. Sensor rail : This rail holds the sensor. Please order the appropriate rail according to the stroke.
3. Cover unit : This unit consists of a top cover and spacer plate.
4. Motor bracket: Brackets are available for a variety of models from different motor manufacturers. Please consult NSK when mounting dimensions differ.

C-2-4 Selection of Toughcarrier

C-2-4. 1 Selection Procedure



- Application
- Operating conditions
- Machine structures
- Stroke
- Load
- Feed speed
- Required life
- Accuracy
- Rigidity

- Light load operation, light conveyance
- Compatible with other company's products

- High-load operation, high moment load
- Processing machines

- Select a model number roughly from the load applied to a slider

- Selection from required specifications

- Check the displacement for the point of operation and processing according to required specs.

- Check required life

- Select a grease to pack, and consider dust resistance according to usage conditions and environments.

C-2-4. 2 Stroke and Lead

◆ Combinations of rail length and lead

● TCH06

Slider type	Standard slider						Short slider					
	Single slider			Double slider			Single slider			Double slider		
Lead (mm) / Rail length (mm)	5	10	20	5	10	20	5	10	20	5	10	20
150	✓	✓	✓				✓	✓				
200	✓	✓	✓				✓	✓				
300	✓	✓	✓	✓	✓		✓	✓		✓	✓	
400	✓	✓	✓	✓	✓		✓	✓		✓	✓	
500	✓	✓	✓	✓	✓		✓	✓		✓	✓	
600	✓	✓	✓		✓	✓	✓	✓			✓	

∗20 mm lead for short sliders not available.

● TCH09

Slider type	Standard slider						Short slider					
	Single slider			Double slider			Single slider			Double slider		
Lead (mm) / Rail length (mm)	5	10	20	5	10	20	5	10	20	5	10	20
240	✓	✓	✓				✓	✓	✓			
340	✓	✓	✓				✓	✓	✓			
440	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	
540	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	
640	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	
740	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓
840	✓	✓	✓				✓	✓	✓			
940	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓

● TCH10

Slider type	Standard slider				Short slider			
	Single slider		Double slider		Single slider		Double slider	
Lead (mm) / Rail length (mm)	10	20	10	20	10	20	10	20
280	✓	✓			✓	✓		
380	✓	✓			✓	✓		
480	✓	✓			✓	✓		
580	✓	✓	✓	✓	✓	✓	✓	✓
680	✓	✓	✓	✓	✓	✓	✓	✓
780	✓	✓	✓	✓	✓	✓	✓	✓
880	✓	✓	✓	✓	✓	✓	✓	✓
980	✓	✓	✓	✓	✓	✓	✓	✓
1 080	✓	✓		✓	✓	✓		✓
1 180	✓	✓		✓	✓	✓		✓
1 280	✓	✓		✓	✓	✓		✓
1 380	✓	✓		✓	✓	✓		✓

◆ Availability

Model No.	Lead (mm)	Slider	Rail length (mm)
TCH06	5, 10, 20	Single	600
		Double	
TCH09	5, 10, 20	Single	940
		Double	
TCH10	10, 20	Single	1 380
		Double	

C-2-4. 3 Reference Number Coding and Accuracy Grade

● Reference number coding for TCH Model

Body
Reference number: TC H 06 030 H 10 K 0 0

- TC: Toughcarrier
- H: Model: TCH Model (with accessories: TCS)
- 06: Nominal size (rail width, 10 mm units)
- 030: Stroke (10 mm units)
- H: Accuracy grade: H, High grade; P, Precision grade
- 10: Ball screw lead (mm)
- K: Slider specification*
- 0: Grease (0: YS2, standard)
- 0: NSK control number (0: without pin holes) (1: with pin holes)

∗ K: Single slider
D: Double slider
A: Single short slider
B: Double short slider

Special specifications
Reference number: TC H 06 030 H 10 K – ☐ XXB

- ☐: 3: Toughcarrier for special specs; 5: Toughcarrier high-thrust model*
- XXB: Design serial number

∗ For the specifications of the High-Thrust Model, see page C134.

● Reference number for accessories

1. Sensor unit

Reference number: TC – SRH XX – 00

- TC: Toughcarrier
- SRH: Sensor unit
- XX: Nominal size: 06, 09 and 10
- 00: Control no. : see page C117

2. Sensor rail

Reference number: TC – SRL X – XXXX

- TC: Toughcarrier
- SRL: Sensor rail
- X: Nominal size: 06 is 6, 09 is 9, and 10 is 1.
- XXXX: Body rail length

3. Cover unit

Reference number: TC – HV XX XXX K 00

- TC: Toughcarrier
- HV: Cover unit
- XX: Nominal size: 06, 09 and 10
- XXX: Stroke (nominal)
- K: Slider specs: refer to the body reference no.
- 00: Control no.: See pages C118 to C120

4. Motor bracket

Reference number: TC – BKH XX – XXX – 00

- TC: Toughcarrier
- BKH: Motor bracket
- XX: Nominal size: 06, 09 and 10
- XXX: Dimension for motor mounting
- 00: Control no.

◆ Accuracy grade

Unit: μm

Grade	High grade (H grade)			Precision grade (P grade)			
Stroke (mm)	Repeatability	Running parallelism (vertical)	Backlash	Repeatability	Positioning accuracy	Running parallelism (vertical)	Backlash
to 200	±10	14	20 or less	±3	20	8	3 or less
to 400		16			25	10	
to 600		20			30	12	
to 700		23				15	
to 1 000					35		
to 1 200		30			40	20	

High and precision grades are available. Consult NSK for your requirements.

C-2-4. 4 Maximum Speed

● Maximum speed (standard slider)

Maximum speed of a Toughcarrier actuator is determined by the critical speed of the ball screw shaft and the d · n value.

Do not exceed the maximum speed in the table below.

	Stroke (nominal)	Ball screw lead (mm)	Body rail length L_2 (mm)	Maximum speed (mm/s)
TCH06 Single slider	50	5	150	250
	100		200	
	200		300	
	300		400	
	400		500	
	500		600	
	50	10	150	500
	100		200	
	200		300	
	300		400	
	400		500	
	500		600	
	50	20	150	1 000
	100		200	
	200		300	
	300		400	
	400		500	
	500		600	
TCH06 Double slider	130	5	300	250
	230		400	
	330		500	
	130	10	300	500
	230		400	
	330		500	
	430		600	
	430	20	600	1 000
TCH09 Single slider	100	5	240	250
	200		340	
	300		440	
	400		540	
	500		640	
	600		740	
	700		840	
	800		940	210
	100	10	240	500
	200		340	
	300		440	
	400		540	
	500		640	
	600		740	
	700		840	
	800		940	410
	100	20	240	1 000
	200		340	
	300		440	
	400		540	
	500		640	
	600		740	
	700		840	
	800		940	820
TCH09 Double slider	170	5	440	250
	270		540	
	370		640	
	170	10	440	500
	270		540	
	370		640	
	470		740	
	670		940	
	470	20	740	1 000
	670		940	
TCH10 Single slider	100	10	280	500
	200		380	
	300		480	
	400		580	
	500		680	
	600		780	
	700		880	
	800		980	
	900		1 080	440
	1 000		1 180	360
	1 100		1 280	300
	1 200		1 380	250
	100	20	280	1 000
	200		380	
	300		480	
	400		580	
	500		680	
	600		780	
	700		880	
	800		980	
	900		1 080	870
	1 000		1 180	720
	1 100		1 280	600
	1 200		1 380	510
TCH10 Double slider	270	10	580	500
	370		680	
	470		780	
	570		880	
	670		980	
	270	20	580	1 000
	370		680	
	470		780	
	570		880	
	670		980	
	770		1 080	
	870		1 180	930
	970		1 280	780
	1 070		1 380	650

Notes: 1) Please consult NSK before operating Toughcarrier actuators near maximum speed.
2) Maximum rotational speed is (3000 min^{-1}).
3) Refer to the above table for maximum speed for each stroke.

● Maximum speed (short slider)

Maximum speed of a Toughcarrier actuator is determined by the critical speed of the ball screw shaft and the d · n value.

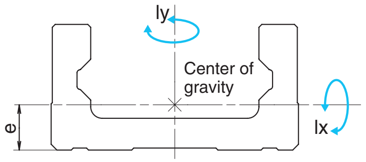
Do not exceed the maximum speed in the table below.

	Stroke (nominal)	Ball screw lead (mm)	Body rail length L_2 (mm)	Maximum speed (mm/s)
TCH06 Single slider	70	5	150	250
	120		200	
	220		300	
	320		400	
	420		500	
	520		600	
	70	10	150	500
	120		200	
	220		300	
	320		400	
	420		500	
	520		600	
TCH06 Double slider	170	5	300	250
	270		400	
	370		500	
	170	10	300	500
	270		400	
	370		500	
	470		600	
TCH09 Single slider	140	5	240	250
	240		340	
	340		440	
	440		540	
	540		640	
	640		740	
	740		840	240
	840		940	190
	140	10	240	500
	240		340	
	340		440	
	440		540	
	540		640	
	640		740	
	740		840	480
	840		940	380
	140	20	240	1 000
	240		340	
	340		440	
	440		540	
	540		640	
	640		740	
	740		840	960
	840		940	760
TCH09 Double slider	250	5	440	250
	350		540	
	450		640	
	250	10	440	500
	350		540	
	450		640	
	550		740	
	750		940	460
	550	20	740	1 000
	750		940	930
TCH10 Single slider	160	10	280	500
	260		380	
	360		480	
	460		580	
	560		680	
	660		780	
	760		880	
	860		980	490
	960		1 080	400
	1 060		1 180	330
	1 160		1 280	280
	1 260		1 380	240
	160	20	280	1 000
	260		380	
	360		480	
	460		580	
	560		680	
	660		780	
	760		880	
	860		980	980
	960		1 080	800
	1 060		1 180	660
	1 160		1 280	560
	1 260		1 380	480
TCH10 Double slider	360	10	580	500
	460		680	
	560		780	
	660		880	
	760		980	
	360	20	580	1 000
	460		680	
	560		780	
	660		880	
	760		980	
	860		1 080	980
	960		1 180	800
	1 060		1 280	660
	1 160		1 380	560

Notes: 1) Please consult NSK before operating Toughcarrier actuators near maximum speed.
2) Maximum rotational speed is (3000 min^{-1}).
3) Refer to the above table for maximum speed for each stroke.

C-2-4. 5 Rigidity

Rigidity of rail

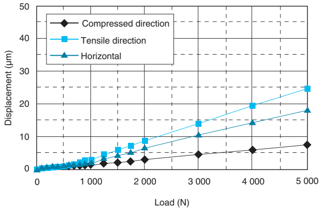


Model no.	Geometrical moment of inertia×10^4 (mm^4)		Center of gravity (mm)	Mass (kg/100mm)
	Ix	Iy	e	w
TCH06	6.47	36.2	10.6	0.6
TCH09	28.4	162	15.7	1.32
TCH10	46	283	17.2	1.73

◆ Rigidity in radial direction

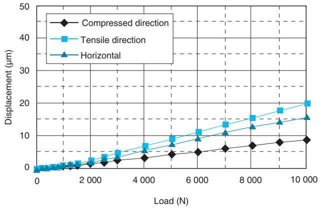
TCH06 standard slider

Rigidity in radial direction



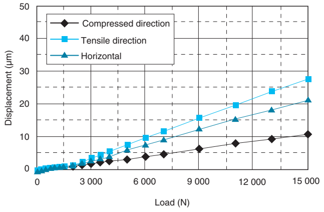
TCH09 standard slider

Rigidity in radial direction



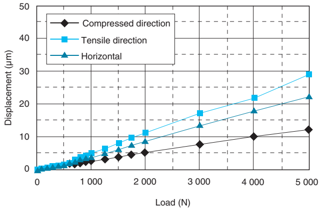
TCH10 standard slider

Rigidity in radial direction



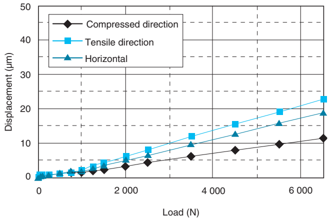
TCH06 short slider

Rigidity in radial direction



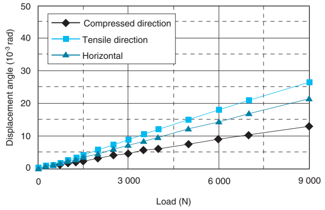
TCH09 short slider

Rigidity in radial direction



TCH10 short slider

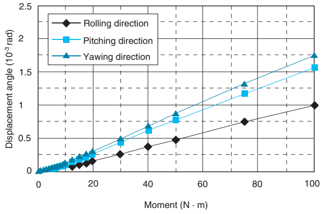
Rigidity in radial direction



◆ Moment in radial direction

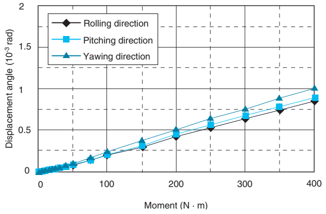
TCH06 standard slider

Moment rigidity



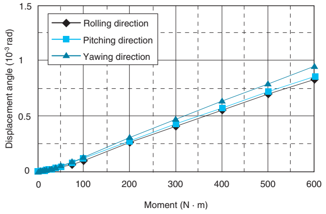
TCH09 standard slider

Moment rigidity



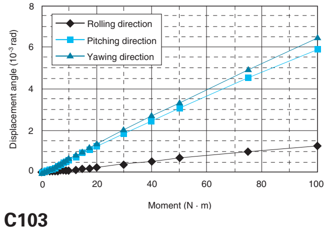
TCH10 standard slider

Moment rigidity



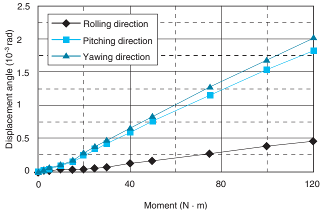
TCH06 short slider

Moment rigidity



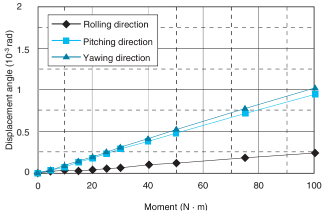
TCH09 short slider

Moment rigidity



TCH10 short slider

Moment rigidity



C-2-4. 6 Basic Load Ratings

◆ Basic load ratings for TCH model

Standard slider

Model no.	Lead ℓ (mm)	Shaft dia. d (mm)	Basic dynamic load ratings (N)			Basic static load ratings (N)		Support unit Allowable load (N)
			Ball screw C_a	Linear guide C	Support bearings C_a	Ball screw C_{0a}	Linear guide C_0	
TCH06	5	ϕ 12	4 390	20 900	8 300	6 260	45 000	1 890
	10		2 740			3 820		
	20		2 660			3 800		
TCH09	5	ϕ 15	8 300	44 900	11 100	12 700	96 900	3 560
	10		8 140			12 800		
	20		5 080			7 460		
TCH10	10	ϕ 20	12 800	62 400	12 100	21 400	132 000	3 970
	20		8 190			12 600		

Short slider

Model no.	Lead ℓ (mm)	Shaft dia. d (mm)	Basic dynamic load ratings (N)			Basic static load ratings (N)		Support unit Allowable load (N)
			Ball screw C_a	Linear guide C	Support bearings C_a	Ball screw C_{0a}	Linear guide C_0	
TCH06	5	ϕ 12	4 390	12 200	8 300	6 260	22 500	1 890
	10		2 740			3 820		
TCH09	5	ϕ 15	8 300	27 900	11 100	12 700	52 500	3 560
	10		8 140			12 800		
	20		5 080			7 460		
TCH10	10	ϕ 20	12 800	38 700	12 100	21 400	71 500	3 970
	20		8 190			12 600		

- Basic dynamic and static load ratings indicate values for one slider.
- The basic dynamic load rating for a linear guide is a load that allows for a 50-km rating fatigue life and is vertical and constant on the ball mounting surface.
- The basic dynamic load rating for a ball screw is a load in the axial direction that allows 90% of ball screws of a group of the same Toughcarriers to rotate 1 million revolutions under the same conditions without causing flaking by rolling contact fatigue.
- The basic dynamic load rating for support bearings is a load that allows 1 million revolutions under the same conditions.
- Basic static load rating is load that results in combined permanent deformations at contact points of rolling elements and rolling surfaces of respective parts at a diameter of 0.01%.

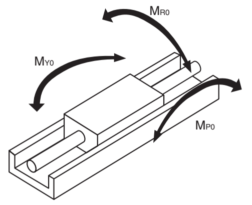
◆ Basic static moment loads of linear guide

Standard slider

Model no.	Slider	Basic static moment loads (N·m)		
		Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
TCH06	Single	800	340	340
TCH09	Single	2 510	1 340	1 340
TCH10	Single	3 980	2 150	2 150

Short slider

Model no.	Slider	Basic static moment loads (N·m)		
		Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
TCH06	Single	400	85	85
TCH09	Single	1 350	390	390
TCH10	Single	2 150	630	630



M_{RO} : Rolling moment
M_{PO} : Pitching moment
M_{YO} : Yawing moment

C-2-4. 7 Estimation of Life Expectancy

(1) Life of linear guide for Toughcarrier

Study the load to be applied to the linear guide of Toughcarrier (**Fig. 1**). Equivalent load F_e is determined by inputting the appropriate loads into the equations below. Use equation 1) for single sliders and equation 2) for double sliders.

● For single sliders

$$F_e = Y_H F_H + Y_V F_V + Y_R \varepsilon_R M_R + Y_P \varepsilon_P M_P + Y_Y \varepsilon_Y M_Y \quad \cdots\cdots 1)$$

● For double sliders

For double sliders, calculation of the load applied to each slider is required.

Dynamic equivalent load is only for rolling moment.

This is the same procedure as for linear guide selection where two sliders are installed in a rail. Check the mean load for each slider, and calculate shortest life becomes the life of linear guide.

When lateral direction (F_H) and vertical direction (F_V) loads are applied to the center of the coordinate in **Fig. 1**,

$$F_{HA} = \frac{F_H}{2} + \frac{M_Y}{\ell},\ F_{VA} = \frac{F_V}{2} + \frac{M_P}{\ell}$$

$$F_{HB} = \frac{F_H}{2} - \frac{M_Y}{\ell},\ F_{VB} = \frac{F_V}{2} - \frac{M_P}{\ell}$$

[Slider A]

$$F_{eA} = Y_H \cdot F_{HA} + Y_V \cdot F_{VA} + Y_R \varepsilon_R \frac{M_R}{2} \quad \cdots\cdots 2)$$

$$= Y_H \left(\frac{F_H}{2} + \frac{M_Y}{\ell}\right) + Y_V \left(\frac{F_V}{2} + \frac{M_P}{\ell}\right) + Y_R \varepsilon_R \frac{M_R}{2}$$

[Slider B]

$$F_{eB} = Y_H \cdot F_{HB} + Y_V \cdot F_{VB} + Y_R \varepsilon_R \frac{M_R}{2} \quad \cdots\cdots 2)'$$

$$= Y_H \left(\frac{F_H}{2} - \frac{M_Y}{\ell}\right) + Y_V \left(\frac{F_V}{2} - \frac{M_P}{\ell}\right) + Y_R \varepsilon_R \frac{M_R}{2}$$

F_H : Lateral direction load acting on the slider (N)
F_V : Vertical direction load acting on the slider (N)
M_R : Rolling moment acting on the slider (N · m)
M_P : Pitching moment acting on the slider (N · m)
M_Y : Yawing moment acting on the slider (N · m)
ε_R : Dynamic equivalent coefficient to rolling moment
ε_P : Dynamic equivalent coefficient to pitching moment
ε_Y : Dynamic equivalent coefficient to yawing moment
ℓ : Sliders span (m)

*For dynamic equivalent coefficients, see **Table 1**.

Y_H, Y_V, Y_R, Y_P, Y_Y: 1.0 or 0.5

In equations 1), 2) and 2') for obtaining equivalent load F_e, the maximum value of Y in the values for each equation is assumed to be 1.0. For others it is assumed to be 0.5.

Fig.1 Direction of load

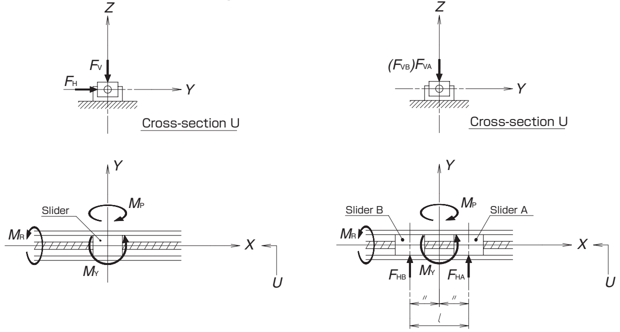
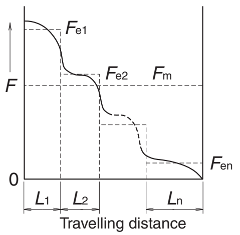


Fig. 2 Stepwise Fluctuating Load



If the loads acting on the slider fluctuate (in general, M_P and M_Y may fluctuate with the acceleration/deceleration of slider), the mean effective load is determined by Eq. 3).

Travelling distance under the equivalent load F_{e1} : L_1
Travelling distance under the equivalent load F_{e2} : L_2
· · · · · · · · · · · ·
Travelling distance under the equivalent load F_{en} : L_n

Mean effective load F_m is calculated by the following equation.

$$F_m = \sqrt[\frac{10}{3}]{\frac{1}{L}\left(F_{e1}^{\frac{10}{3}} \cdot L_1 + F_{e2}^{\frac{10}{3}} \cdot L_2 + \cdots + F_{en}^{\frac{10}{3}} \cdot L_n\right)} \cdots 3)$$

F_m: Mean effective load of fluctuating loads (N)
L : Total travelling distance (mm)

The life of linear guide for Toughcarrier is determined by Eq. 4).

$$L = 50 \times \left(\frac{C}{f_w \cdot F_m}\right)^{\frac{10}{3}} \quad \cdots\cdots 4)$$

L : Life of linear guide (km)
C : Basic dynamic load rating of linear guide (N)
F_m : Mean effective load acting on linear guide (N)
f_w : Load coefficient (see **Table 2**)

When the estimated life does meet clear the required life, the life of the linear guide is calculated again after following measures are taken,

1: Change from single slider to double slider.
2: Use a larger Toughcarrier.

(2) Life of Ball Screw (Support Bearing)

The mean effective load is determined from the axial load.

Axial direction mean effective load F_m

$$F_m = \sqrt[3]{\frac{1}{L}\left(F_{e1}{}^3 \cdot L_1 + F_{e2}{}^3 \cdot L_2 + \cdots + F_{en}{}^3 \cdot L_n\right)} \cdots 5)$$

The life of ball screw is determined by Eq. 6).

$$L = \ell \times \left(\frac{C_a}{f_w \bullet F_m}\right)^3 \times 10^6 \quad \cdots\cdots 6)$$

ℓ : Ball screw lead (mm)
L : Life of ball screw (mm)
C_a : Basic dynamic load rating of ball screw (N)
F_m : Mean effective load acting on ball screw (N)
f_w : Load factor (**see Table 2**)

The life of a support bearing is calculated by Eq. 6). If the life of ball screw/support bearing does not meet the required life, use a larger size Toughcarrier. After applying the calculations mentioned above, selection of the Toughcarrier is completed.

Table 2 Value of load factor

Operating conditions	Load factor f_w
Smooth operation with no mechanical shock	1.0 – 1.2
Normal operation	1.2 – 1.5
Operation with mechanical shock and vibration	1.5 – 3.0

*When the bottom of rail is not fastened, the load factor is 1.5 or greater.

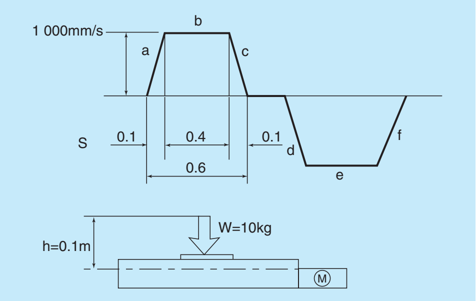
Table 1 Dynamic equivalent coefficient

	TCH06			TCH09			TCH10		
	Rolling	Pitching	Yawing	Rolling	Pitching	Yawing	Rolling	Pitching	Yawing
Standard slider	56	93	93	39	51	51	33	44	44
Short slider	56	186	186	39	95	95	33	80	80

C-2-4. 8 Example Life Estimation

Example life estimation for Toughcarrier

Example-1



1. Use condition

Stroke	: 500 mm
Maximum speed	: 1 000 mm/s
Load mass	: W = 10 kg
Acceleration	: 9.80 m/s²
Setting position	: Horizontal
Operating profile	: See figure to above

2. Selection of model (interim selection)

First, select a greater ball screw lead as the maximum speed is 1 000 mm/s.

The interim selection is TCH06050H20K00, a single slider specification TCH06 that has 500 mm stroke, as the stroke is 500 mm.

3. Calculation

3-1. Linear guide

3-1-1. Fatigue life: Multiply the result of Eq. 1) by the dynamic equivalent coefficient (**Table 1** single slider) to convert the load volume. From operation profile in the above figure, the acceleration is 10 m/s².

i) Constant speed $F_{e1} = Y_V \cdot F_V = Y_V \cdot W \cdot g$

$= 1 \cdot 10 \cdot 9.8 = 98$ N

ii) Accelerating $F_{e2} = Y_V \cdot F_V + Y_P \cdot \varepsilon_P \cdot M_P$

$= Y_V \cdot W \cdot g + Y_P \cdot \varepsilon_P hW\alpha$

$= 0.5 \cdot 10 \cdot 9.8 + 1 \cdot 93 \cdot 0.1 \cdot 10 \cdot 10$

$= 979$ N

iii) Decelerating $F_{e3} = Y_V \cdot F_V + Y_P \cdot \varepsilon_P \cdot M_P$

$= Y_V \cdot W \cdot g + Y_P \cdot \varepsilon_P hW\alpha$

$= 0.5 \cdot 10 \cdot 9.8 + 1 \cdot 93 \cdot 0.1 \cdot 10 \cdot 10$

$= 979$ N

Mean effective load F_m

$$F_m = \sqrt[\frac{10}{3}]{\frac{1}{L}\left(F_{e1}^{\frac{10}{3}} \cdot L_1 + F_{e2}^{\frac{10}{3}} \cdot L_2 + F_{e3}^{\frac{10}{3}} \cdot L_3\right)}$$

$$= \sqrt[\frac{10}{3}]{\frac{1}{500}\left(98^{\frac{10}{3}} \cdot 400 + 979^{\frac{10}{3}} \cdot 50 + 979^{\frac{10}{3}} \cdot 50\right)}$$

$$= 605 \text{ N}$$

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

$$= 50 \times \left(\frac{20\,900}{1.2 \cdot 605}\right)^{\frac{10}{3}}$$

$$= 3.65 \times 10^6 \text{ km}$$

3-1-2. Static safety factor: Divide the basic static load rating by the maximum load.

$$F_S = \frac{C_0}{F_e} = \frac{C_0}{F_{e2}} = \frac{45\,000}{979} = 45.9$$

3-2. Ball screw

3-2-1. Fatigue life: Obtain the axial load of each stage of operation referring to the operation profile, and then calculate the mean load.

By the process above,

i) Constant speed

$F_{e1} = \mu \cdot W \cdot g = 0.01 \cdot 10 \cdot 9.8 = 0.98$ N

ii) Accelerating

$F_{e2} = F_{e1} + W \cdot \alpha = 0.98 + 10 \cdot 10 = 101$ N

iii) Decelerating

$F_{e3} = F_{e1} + W \cdot \alpha = 0.98 - 10 \cdot 10 = 99$ N

Axial mean effective load

$$F_m = \sqrt[3]{\frac{1}{L}\left(F_{e1}^{3} \cdot L_1 + F_{e2}^{3} \cdot L_2 + F_{e3}^{3} \cdot L_3\right)}$$

$$= \sqrt[3]{\frac{1}{500}\left(0.98^{3} \cdot 400 + 101^{3} \cdot 50 + 99^{3} \cdot 50\right)}$$

$$= 59 \text{ N}$$

$$L = \ell \times \left(\frac{C_a}{f_w \cdot F_m}\right)^{3} \times 10^6$$

$$= 20 \times \left(\frac{2\,660}{1.2 \cdot 59}\right)^{3} \times 10^6$$

$$= 10.6 \times 10^5 \text{ km}$$

3-2-2. Static safety factor: Divide the basic static load rating by the maximum axial load.

$$F_S = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{3\,800}{101} = 37.6$$

3-3. Support bearings

3-3-1. Fatigue life: Use the axial load F_m = 59 N that is the result of the calculation in 3-2-1, above.

$$L = \ell \times \left(\frac{C_a}{f_w \cdot F_m}\right)^{3} \times 10^6$$

$$= 20 \times \left(\frac{8\,300}{1.2 \cdot 59}\right)^{3} \times 10^6$$

$$= 3.22 \times 10^7 \text{ km}$$

3-3-2. Static safety factor: Divide the Allowable load by the maximum axial load.

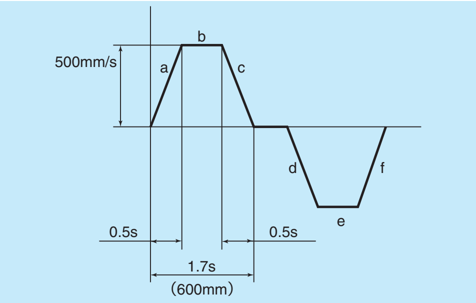
$$F_S = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{1\,890}{101} = 18.7$$

3-4. Results

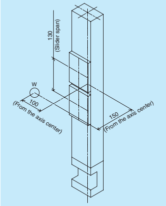
TCH06050H20K00	Linear guide	Ball screw	Support bearings
Fatigue life	3.65 × 10⁶ km	10.6 × 10⁵ km	3.22 × 10⁷ km
Static safety factor	45.9	37.6	18.7

Example life estimation

Example-2



1. Use condition



Stroke	: 600 mm
Maximum speed	: 500 mm/s
Load mass	: W = 20 kg
Acceleration	: 9.8 m/s²
Setting position	: Vertical
Operating profile	: See fiure to above

2. Selection of model (interim selection)

Select a 10 mm lead ball screw as the maximum speed is 500 mm/s.

The interim selection is TCH09067H10D00 (double slider specification) from the stroke and the vertical setting position.

3. Calculation

3-1. Linear guide

3-1-1. Fatigue life: Multiply the result of Eq. 2) and 2') by the dynamic equivalent coefficient (**Table 1** double slider) to convert the load volume. From operation profile in the above figure, the acceleration is 1 m/s². The interim slider span is 0.13.

Under this condition,

$F_H = 0,\ F_V = 0,\ M_R = 0$

in Eq. 2), and both sliders have the same load with different direction.

i) Constant speed

$$F_{e1} = Y_H \cdot \frac{M_Y}{\ell} + Y_V \cdot \frac{M_P}{\ell}$$

$$= 0.5 \cdot \frac{0.1 \cdot 20 \cdot 9.8}{0.13} + 1.0 \cdot \frac{0.15 \cdot 20 \cdot 9.8}{0.13}$$

$$= 302 \text{ N}$$

ii) Accelerating

$$F_{e2} = Y_H \cdot \frac{M_Y}{\ell} + Y_V \cdot \frac{M_P}{\ell}$$

$$= 0.5 \cdot \frac{0.1 \cdot 20 \cdot (9.8 + 1.0)}{0.13} + 1.0 \cdot \frac{0.15 \cdot 20 \cdot (9.8 + 1.0)}{0.13}$$

$$= 333 \text{ N}$$

iii) Decelerating

$$F_{e3} = Y_H \cdot \frac{M_Y}{\ell} + Y_V \cdot \frac{M_P}{\ell}$$

$$= 0.5 \cdot \frac{0.1 \cdot 20 \cdot (9.8 - 1.0)}{0.13} + 1.0 \cdot \frac{0.15 \cdot 20 \cdot (9.8 - 1.0)}{0.13}$$

$$= 271 \text{ N}$$

Mean effective load F_m

$$F_m = \sqrt[\frac{10}{3}]{\frac{1}{L}\left(F_{e1}^{\frac{10}{3}} \cdot L_1 + F_{e2}^{\frac{10}{3}} \cdot L_2 + F_{e3}^{\frac{10}{3}} \cdot L_3\right)}$$

$$= \sqrt[\frac{10}{3}]{\frac{1}{600}\left(302^{\frac{10}{3}} \cdot 350 + 333^{\frac{10}{3}} \cdot 125 + 271^{\frac{10}{3}} \cdot 125\right)}$$

$$= 304 \text{ N}$$

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

$$= 50 \times \left(\frac{44\,900}{1.2 \cdot 304}\right)^{\frac{10}{3}}$$

$$= 4.63 \times 10^8 \text{ km}$$

3-1-2. Static safety factor: Divide the basic static load rating by the maximum load.

$$F_s = \frac{C_0}{F_e} = \frac{C_0}{F_{e2}} = \frac{96\,900}{333} = 290$$

3-2. Ball screw

3-2-1. Fatigue life: Obtain the axial load of each stage of operation referring to the operation profile, and then calculate the mean load.

i) Constant speed

$F_{e1} = W \cdot g = 20 \cdot 9.8 = 196$ N

ii) Accelerating

$F_{e2} = F_{e1} + W \cdot \alpha = 196 + 20 \cdot 1.0 = 216$ N

iii) Decelerating

$F_{e3} = F_{e1} - W \cdot \alpha = 196 - 20 \cdot 1.0 = 176$ N

Axial mean effective load F_m

$$F_m = \sqrt[3]{\frac{1}{L}\left(F_{e1}^3 \cdot L_1 + F_{e2}^3 \cdot L_2 + F_{e3}^3 \cdot L_3\right)}$$

$$= \sqrt[3]{\frac{1}{600}\left(196^3 \cdot 350 + 216^3 \cdot 125 + 176^3 \cdot 125\right)}$$

$$= 197 \text{ N}$$

$$L = \ell \times \left(\frac{C_a}{f_w \cdot F_m}\right)^3 \times 10^6$$

$$= 10 \times \left(\frac{8\,140}{1.2 \cdot 197}\right)^3 \times 10^6$$

$$= 4.08 \times 10^5 \text{ km}$$

3-2-2. Static safety factor: Divide the basic static load rating by the maximum axial load.

$$F_s = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{12\,800}{216} = 59.2$$

3-3. Support bearings

3-3-1. Fatigue life: Use the axial load F_m = 197 N that is the result of the calculation in 3-2-1, above.

$$L = \ell \times \left(\frac{C_a}{f_w \cdot F_m}\right)^3 \times 10^6$$

$$= 10 \times \left(\frac{11\,000}{1.2 \cdot 197}\right)^3 \times 10^6$$

$$= 1.00 \times 10^6 \text{ km}$$

3-3-2. Static safety factor: Divide the Allowable load by the maximum axial load.

$$F_s = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{3\,560}{216} = 16.4$$

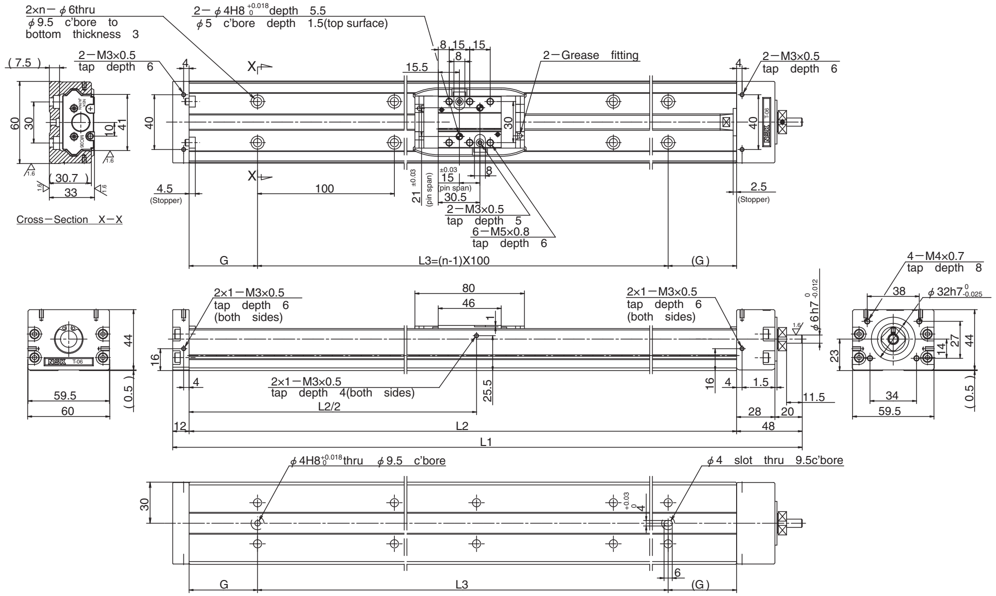
3-4. Result

TCH09067H10D00	Linear guide	Ball screw	Support bearings
Fatigue life	4.63×10^8 km	4.08×10^5 km	1.00×10^6 km
Static safety factor	290	59.2	16.4

C-2-5 TCH Model Dimension Tables for Standard Products

C-2-5. 1 TCH06 model

◆ TCH06 Single Standard Slider Specifications(with pin holes)



TCH06 Standard Slider Specifications (Single)

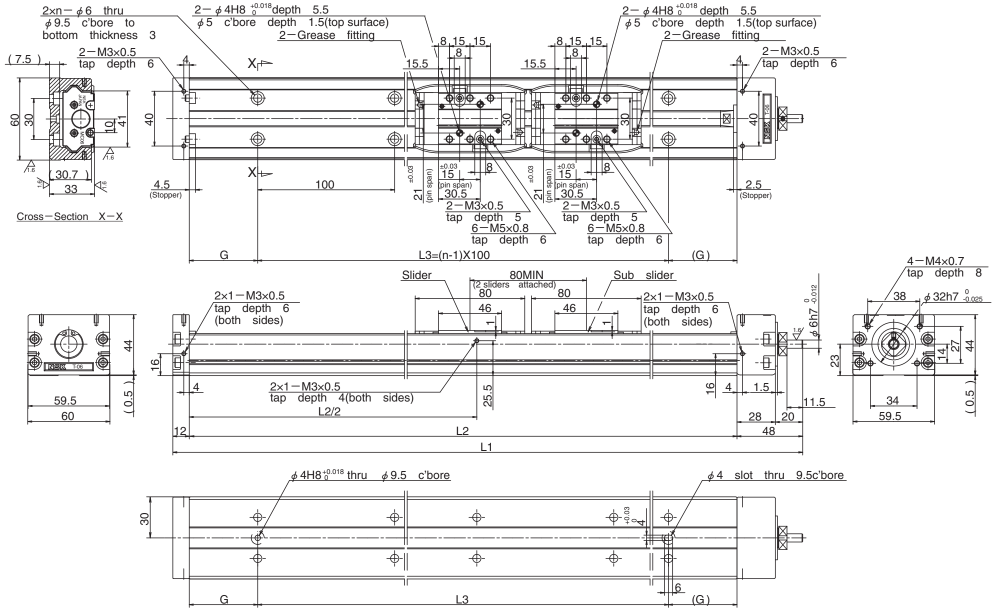
Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)				No. of mounting holes	Inertia	Mass
				L_1	L_2	L_3	G	n	x 10^{-6} (kg · m^2)	(kg)
∗TCH06005H05K00 (01)	50	63	5	210	150	100	25	2	2.94	2.2
∗TCH06005H10K00 (01)			10						3.38	
∗TCH06005H20K00 (01)			20						5.10	
∗TCH06010H05K00 (01)	100	113	5	260	200	100	50	2	3.74	2.5
∗TCH06010H10K00 (01)			10						4.18	
∗TCH06010H20K00 (01)			20						5.90	
TCH06020H05K00 (01)	200	213	5	360	300	200	50	3	5.34	3.3
TCH06020H10K00 (01)			10						5.78	
TCH06020H20K00 (01)			20						7.50	
TCH06030H05K00 (01)	300	313	5	460	400	300	50	4	6.84	3.9
TCH06030H10K00 (01)			10						7.28	
TCH06030H20K00 (01)			20						9.00	
TCH06040H05K00 (01)	400	413	5	560	500	400	50	5	8.44	4.6
TCH06040H10K00 (01)			10						8.88	
TCH06040H20K00 (01)			20						10.6	
TCH06050H05K00 (01)	500	513	5	660	600	500	50	6	10.1	5.3
TCH06050H10K00 (01)			10						10.5	
TCH06050H20K00 (01)			20						12.2	

Items marked with ∗ are unavailable for upside-down operation.

Toughcarrier dynamic torque specifications Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH06	Single standard slider	5	1.0 – 6.0	1.8 – 9.0
		10	1.1 – 7.2	2.0 – 10.6
		20	1.6 – 9.5	2.2 – 12.9

◆ TCH06 Double standard slider Specifications(with pin holes)



TCH06 Standard Slider Specifications (Double)

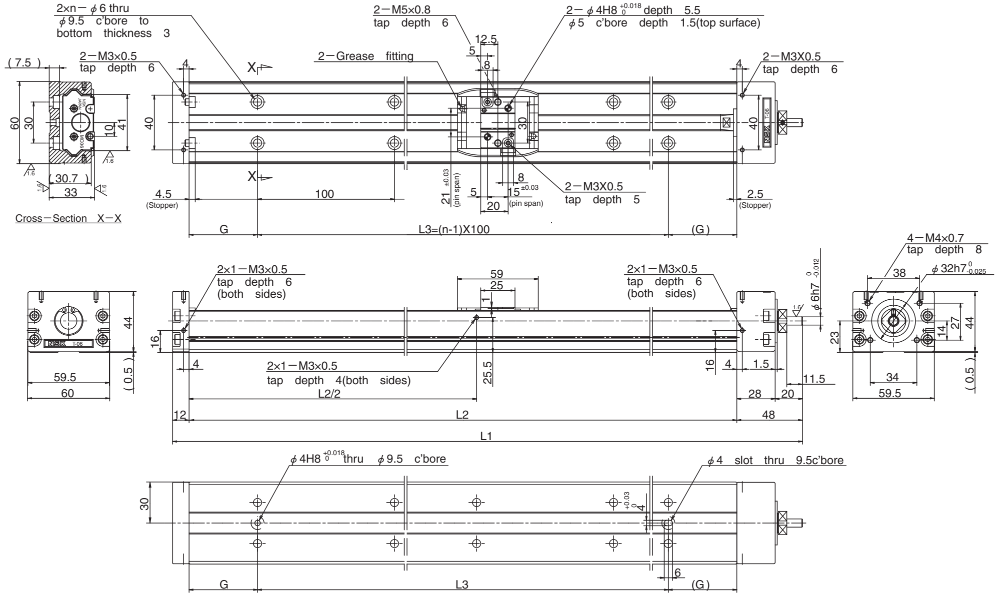
Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)				No. of mounting holes	Inertia	Mass
				L_1	L_2	L_3	G	n	x 10^{-6} (kg · m^2)	(kg)
∗TCH06013H05D00 (01)	130	133	5	360	300	200	50	3	5.47	3.6
∗TCH06013H10D00 (01)			10						6.32	
∗TCH06023H05D00 (01)	230	233	5	460	400	300	50	4	7.06	4.2
∗TCH06023H10D00 (01)			10						7.91	
∗TCH06033H05D00 (01)	330	333	5	560	500	400	50	5	8.64	4.9
∗TCH06033H10D00 (01)			10						9.49	
TCH06043H10D00 (01)	430	433	10	660	600	500	50	6	11.08	5.6
TCH06043H20D00 (01)			20						14.4	

Items marked with ∗ are unavailable for upside-down operation.

Toughcarrier dynamic torque specifications Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH06	Double standard sliders	5	1.2 – 7.2	2.0 – 10.1
		10	1.2 – 9.5	2.2 – 12.9
		20	1.8 – 14.1	2.8 – 17.5

◆ TCH06 Single Short Slider Specifications(with pin holes)



TCH06 Short Slider Specifications (Single)

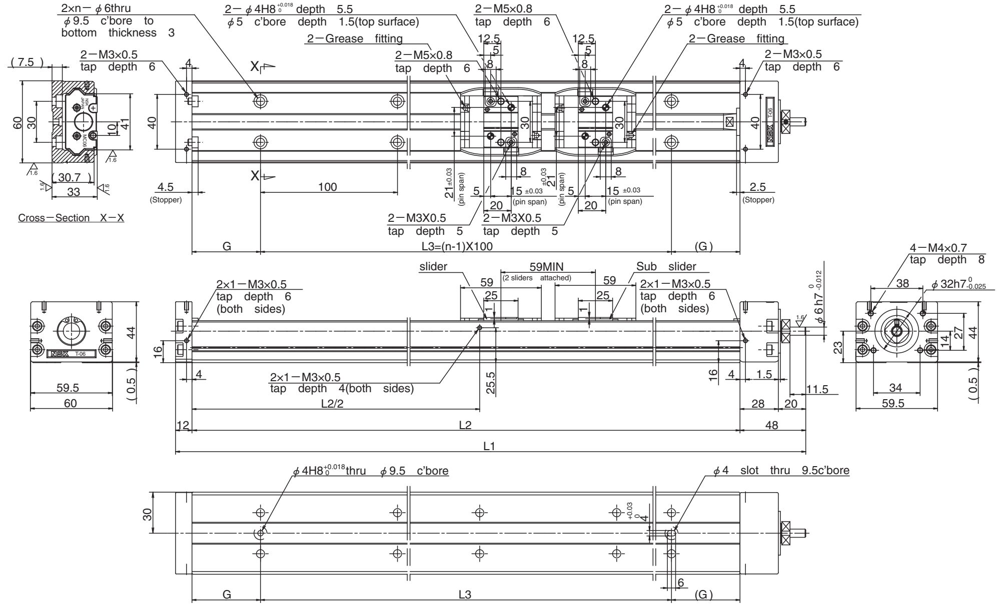
Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)				No. of mounting holes	Inertia	Mass (kg)
				L_1	L_2	L_3	G	n	x 10^{-6} (kg · m^2)	
∗TCH06007H05A00 (01)	70	84	5	210	150	100	25	2	2.87	2.1
∗TCH06007H10A00 (01)			10						3.06	
∗TCH06012H05A00 (01)	120	134	5	260	200	100	50	2	3.67	2.4
∗TCH06012H10A00 (01)			10						3.86	
TCH06022H05A00 (01)	220	234	5	360	300	200	50	3	5.27	3.2
TCH06022H10A00 (01)			10						5.46	
TCH06032H05A00 (01)	320	334	5	460	400	300	50	4	6.77	3.8
TCH06032H10A00 (01)			10						6.96	
TCH06042H05A00 (01)	420	434	5	560	500	400	50	5	8.37	4.5
TCH06042H10A00 (01)			10						8.56	
TCH06052H05A00 (01)	520	534	5	660	600	500	50	6	9.97	5.2
TCH06052H10A00 (01)			10						10.2	

Items marked with ∗ are unavailable for upside-down operation.

Toughcarrier dynamic torque specifications Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH06	Single short slider	5	0.8 – 5.9	1.8 – 8.9
		10	1.0 – 7.0	2.0 – 10.4

◆ TCH06 Double Short slider Specifications(with pin holes)



TCH06 Short Slider Specifications (Double)

Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)				No. of mounting holes	Inertia	Mass (kg)
				L_1	L_2	L_3	G	n	x 10^{-6} (kg · m^2)	
∗TCH06017H05B00 (01)	170	175	5	360	300	200	50	3	5.34	3.4
∗TCH06017H10B00 (01)			10						5.81	
TCH06027H05B00 (01)	270	275	5	460	400	300	50	4	6.93	4.0
TCH06027H10B00 (01)			10						7.40	
TCH06037H05B00 (01)	370	375	5	560	500	400	50	5	8.51	4.7
TCH06037H10B00 (01)			10						8.98	
TCH06047H10B00 (01)	470	475	10	660	600	500	50	6	10.57	5.4

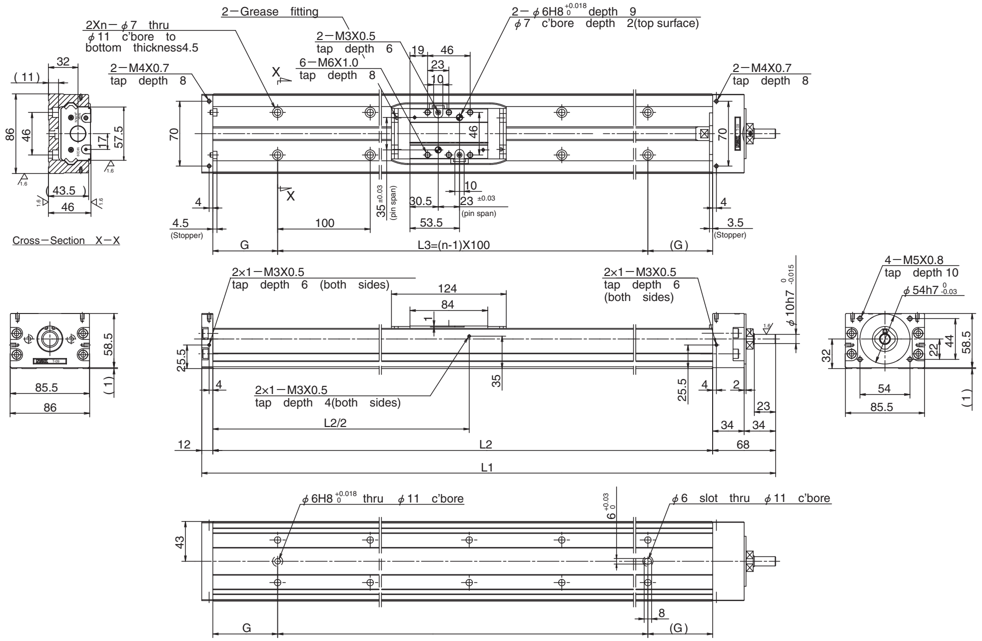
Items marked with ∗ are unavailable for upside-down operation.

Toughcarrier dynamic torque specifications Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH06	Double short sliders	5	1.0 – 7.0	2.0 – 10.0
		10	1.2 – 9.2	2.2 – 12.6

C-2-5. 2 TCH09 Model

◆ TCH09 Single Standard Slider Specifications(with pin holes)



TCH09 Standard Slider Specifications (Single)

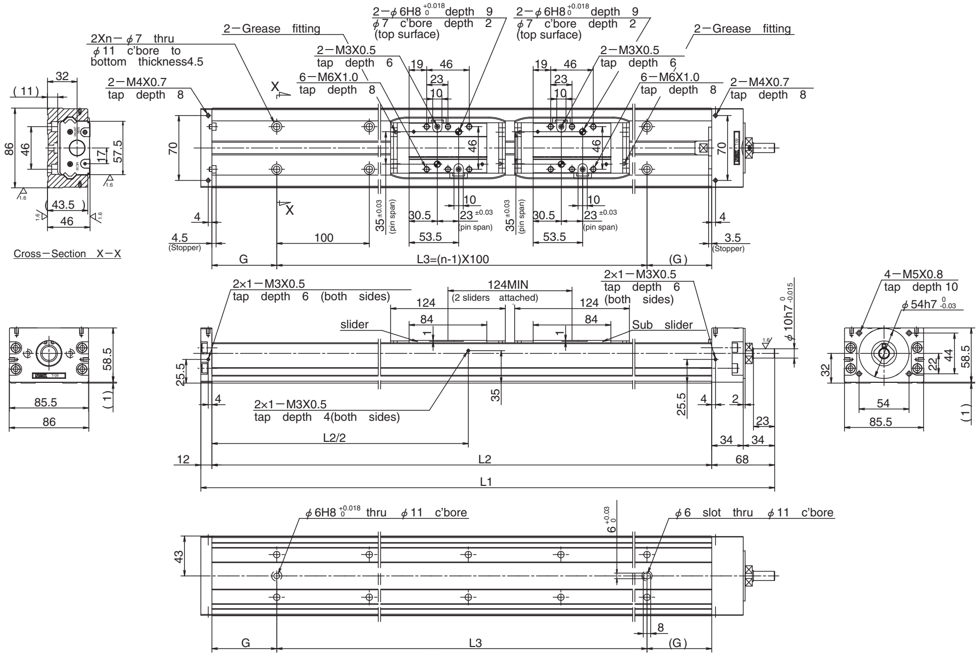
Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)				No. of mounting holes	Inertia	Mass
				L_1	L_2	L_3	G	*n*	x 10^{-6} (kg · m^2)	(kg)
∗TCH09010H05K00 (01)	100	108	5	320	240	100	70	2	9.13	6.5
∗TCH09010H10K00 (01)			10						11.0	
∗TCH09010H20K00 (01)			20						18.6	
TCH09020H05K00 (01)	200	208	5	420	340	200	70	3	14.2	7.9
TCH09020H10K00 (01)			10						16.0	
TCH09020H20K00 (01)			20						23.6	
TCH09030H05K00 (01)	300	308	5	520	440	300	70	4	18.1	9.4
TCH09030H10K00 (01)			10						19.9	
TCH09030H20K00 (01)			20						27.5	
TCH09040H05K00 (01)	400	408	5	620	540	400	70	5	21.9	10.8
TCH09040H10K00 (01)			10						23.8	
TCH09040H20K00 (01)			20						31.4	
TCH09050H05K00 (01)	500	508	5	720	640	500	70	6	25.9	12.3
TCH09050H10K00 (01)			10						27.7	
TCH09050H20K00 (01)			20						35.3	
TCH09060H05K00 (01)	600	608	5	820	740	600	70	7	29.4	13.6
TCH09060H10K00 (01)			10						31.3	
TCH09060H20K00 (01)			20						38.9	
TCH09070H05K00 (01)	700	708	5	920	840	700	70	8	33.5	15.0
TCH09070H10K00 (01)			10						35.4	
TCH09070H20K00 (01)			20						43.0	
TCH09080H05K00 (01)	800	808	5	1 020	940	800	70	9	37.4	16.4
TCH09080H10K00 (01)			10						39.3	
TCH09080H20K00 (01)			20						46.9	

Items marked with ∗ are unavailable for upside-down operation.

Toughcarrier dynamic torque specifications Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH09	Single standard slider	5	2.8 – 7.7	4.2 – 12.8
		10	3.7 – 9.5	4.5 – 15.1
		20	3.7 – 12.6	5.1 – 17.9

◆ TCH09 Double standard slider Specifications(with pin holes)



TCH09 Standard Slider Specifications (Double)

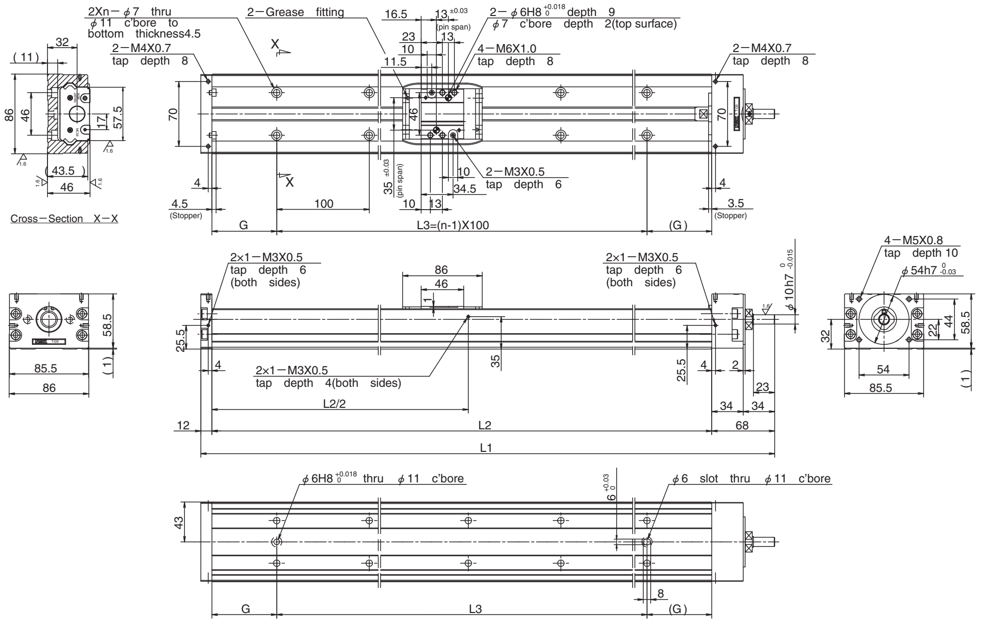
Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)				No. of mounting holes	Inertia	Mass
				L_1	L_2	L_3	G	*n*	x 10^{-6} (kg · m^2)	(kg)
∗TCH09017H05D00 (01)	170	184	5	520	440	300	70	4	19.47	10.3
∗TCH09017H10D00 (01)			10						22.89	
∗TCH09027H05D00 (01)	270	284	5	620	540	400	70	5	23.35	11.7
∗TCH09027H10D00 (01)			10						26.77	
TCH09037H05D00 (01)	370	384	5	720	640	500	70	6	27.22	13.2
TCH09037H10D00 (01)			10						30.64	
TCH09047H10D00 (01)	470	484	10	820	740	600	70	7	34.55	14.5
TCH09047H20D00 (01)			20						48.24	
TCH09067H10D00 (01)	670	684	10	1 020	940	800	70	9	42.27	17.3
TCH09067H20D00 (01)			20						55.96	

Items marked with ∗ are unavailable for upside-down operation.

Toughcarrier dynamic torque specifications Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH09	Double standard sliders	5	3.2 – 8.7	4.5 – 14.1
		10	4.2 – 12.6	5.1 – 17.9
		20	5.7 – 18.9	6.3 – 23.3

◆ TCH09 Single Short Slider Specifications(with pin holes)



TCH09 Short Slider Specifications (Single)

Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)				No. of mounting holes	Inertia	Mass
				L_1	L_2	L_3	G	*n*	x 10^{-6} (kg · m^2)	(kg)
∗**TCH09014H05A00 (01)**	140	146	5	320	240	100	70	2	8.9	6.1
∗**TCH09014H10A00 (01)**			10						10.1	
∗**TCH09014H20A00 (01)**			20						14.6	
TCH09024H05A00 (01)	240	246	5	420	340	200	70	3	13.9	7.5
TCH09024H10A00 (01)			10						15.1	
TCH09024H20A00 (01)			20						19.6	
TCH09034H05A00 (01)	340	346	5	520	440	300	70	4	17.8	9.0
TCH09034H10A00 (01)			10						18.9	
TCH09034H20A00 (01)			20						23.5	
TCH09044H05A00 (01)	440	446	5	620	540	400	70	5	21.7	10.4
TCH09044H10A00 (01)			10						22.8	
TCH09044H20A00 (01)			20						27.4	
TCH09054H05A00 (01)	540	546	5	720	640	500	70	6	25.6	11.9
TCH09054H10A00 (01)			10						26.7	
TCH09054H20A00 (01)			20						31.3	
TCH09064H05A00 (01)	640	646	5	820	740	600	70	7	29.2	13.2
TCH09064H10A00 (01)			10						30.3	
TCH09064H20A00 (01)			20						34.9	
TCH09074H05A00 (01)	740	746	5	920	840	700	70	8	33.3	14.6
TCH09074H10A00 (01)			10						34.4	
TCH09074H20A00 (01)			20						39.9	
TCH09084H05A00 (01)	840	846	5	1 020	940	800	70	9	37.2	16.0
TCH09084H10A00 (01)			10						38.3	
TCH09084H20A00 (01)			20						42.8	

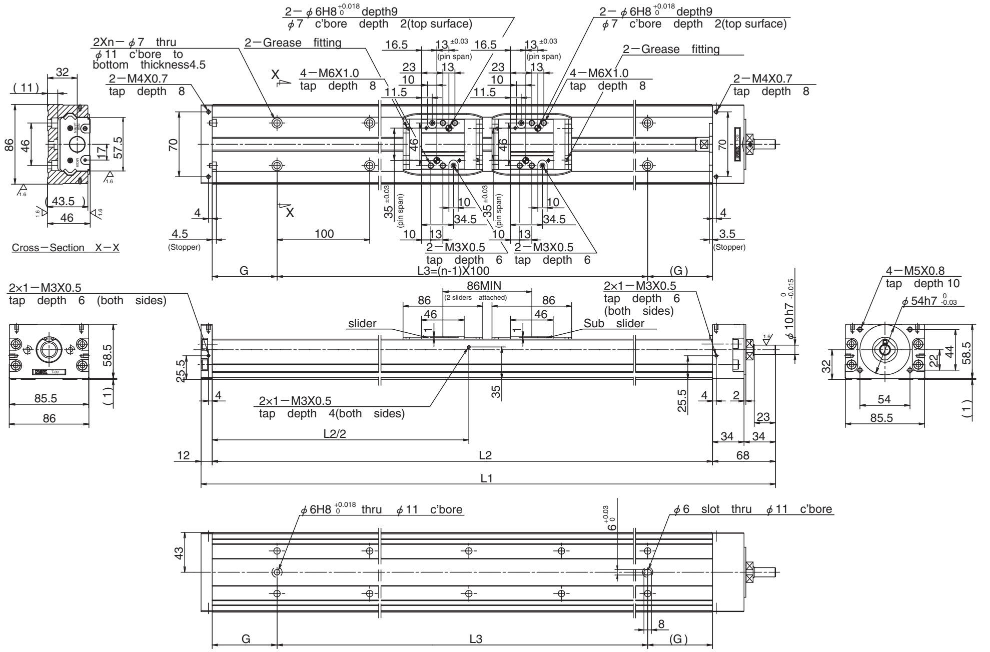
Items marked with ∗ are unavailable for upside-down operation.

Toughcarrier dynamic torque specifications

Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH09	Single short slider	5	2.0 – 6.9	3.5 – 12.0
		10	2.9 – 8.7	3.8 – 14.3
		20	2.9 – 11.8	4.3 – 17.1

◆ TCH09 Double Short slider Specifications(with pin holes)



TCH09 Short Slider Specifications (Double)

Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)				No. of mounting holes	Inertia	Mass
				L_1	L_2	L_3	G	*n*	x 10^{-6} (kg · m^2)	(kg)
TCH09025H05B00 (01)	250	260	5	520	440	300	70	4	18.96	9.5
TCH09025H10B00 (01)			10						20.86	
TCH09035H05B00 (01)	350	360	5	620	540	400	70	5	22.84	10.9
TCH09035H10B00 (01)			10						24.74	
TCH09045H05B00 (01)	450	460	5	720	640	500	70	6	26.71	12.4
TCH09045H10B00 (01)			10						28.61	
TCH09055H10B00 (01)	550	560	10	820	740	600	70	7	32.52	13.7
TCH09055H20B00 (01)			20						40.13	
TCH09075H10B00 (01)	750	760	10	1 020	940	800	70	9	40.24	16.5
TCH09075H20B00 (01)			20						47.85	

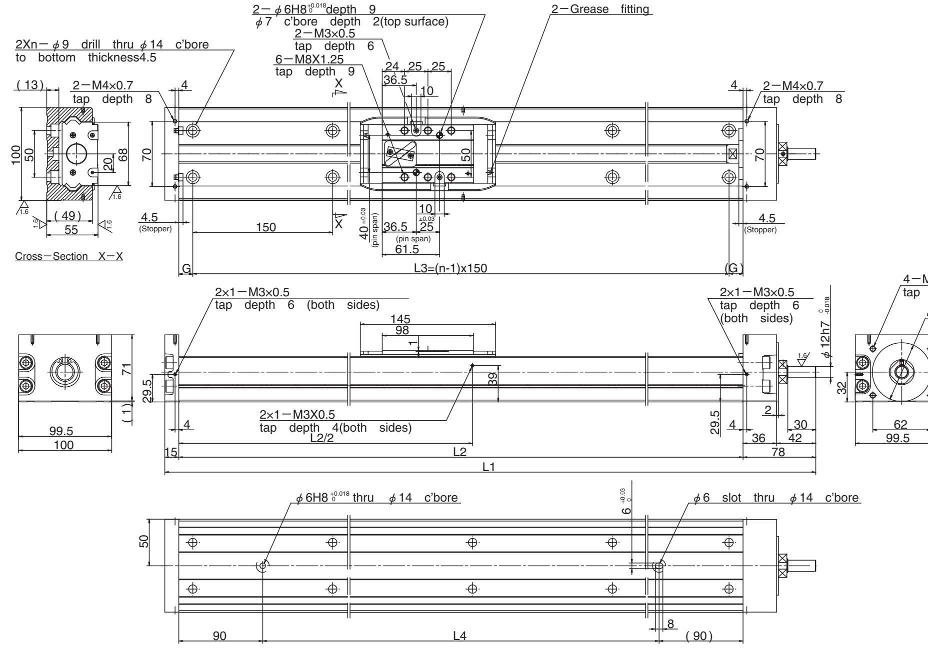
Toughcarrier dynamic torque specifications

Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH09	Double short sliders	5	2.5 – 7.9	3.8 – 13.3
		10	3.4 – 11.8	4.3 – 17.1
		20	4.9 – 18.1	5.5 – 22.6

C-2-5. 3 TCH 10 Model

◆ TCH10 Single Standard Slider Specifications(with pin holes)



TCH10 Standard Slider Specifications (Single)

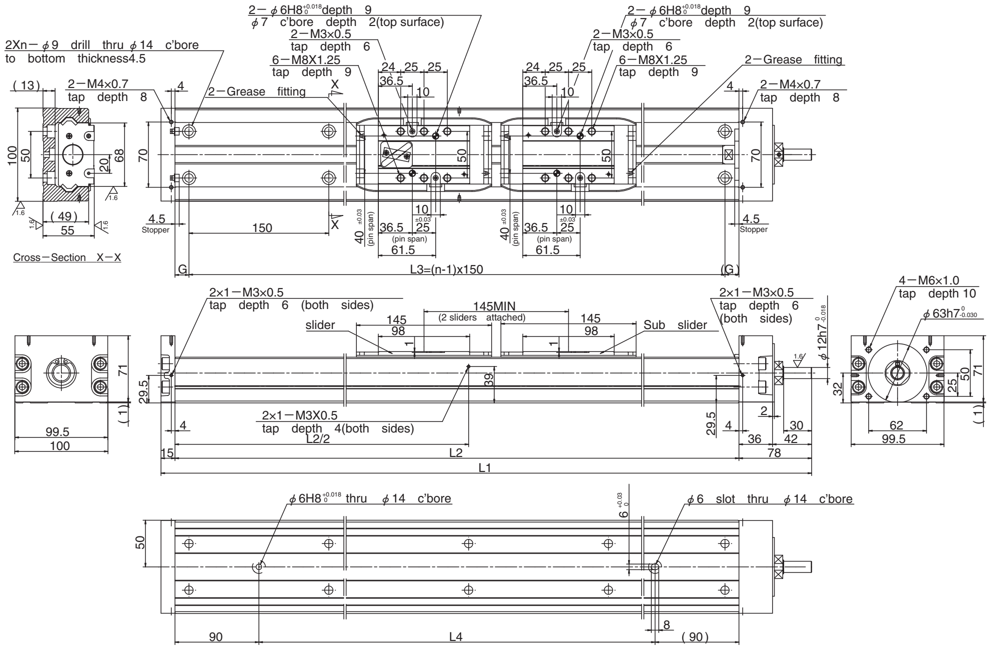
Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)					No. of mounting holes n	Inertia × 10^{-6} (kg · m^2)	Mass (kg)
				L_1	L_2	L_3	L_4	G			
∗TCH10010H10K00 (01)	100	126	10	373	280	150	100	65	2	42.72	9.6
∗TCH10010H20K00 (01)			20							58.52	
TCH10020H10K00 (01)	200	226	10	473	380	300	200	40	3	54.97	11.5
TCH10020H20K00 (01)			20							65.62	
TCH10030H10K00 (01)	300	326	10	573	480	450	300	15	4	67.22	13.5
TCH10030H20K00 (01)			20							77.87	
TCH10040H10K00 (01)	400	426	10	673	580	450	400	65	4	79.47	15.4
TCH10040H20K00 (01)			20							90.12	
TCH10050H10K00 (01)	500	526	10	773	680	600	500	40	5	91.72	17.4
TCH10050H20K00 (01)			20							102.37	
TCH10060H10K00 (01)	600	626	10	873	780	750	600	15	6	104.02	19.3
TCH10060H20K00 (01)			20							114.67	
TCH10070H10K00 (01)	700	726	10	973	880	750	700	65	6	116.22	21.2
TCH10070H20K00 (01)			20							126.87	
TCH10080H10K00 (01)	800	826	10	1 073	980	900	800	40	7	128.52	23.2
TCH10080H20K00 (01)			20							139.17	
TCH10090H10K00 (01)	900	926	10	1 173	1 080	1 050	900	15	8	140.70	25.2
TCH10090H20K00 (01)			20							151.35	
TCH10100H10K00 (01)	1 000	1 026	10	1 273	1 180	1 050	1 000	65	8	152.94	27.1
TCH10100H20K00 (01)			20							163.59	
TCH10110H10K00 (01)	1 100	1 126	10	1 373	1 280	1 200	1 100	40	9	165.19	29.1
TCH10110H20K00 (01)			20							175.84	
TCH10120H10K00 (01)	1 200	1 226	10	1 473	1 380	1 350	1 200	15	10	177.43	31.1
TCH10120H20K00 (01)			20							188.08	

Items marked with ∗ are unavailable for upside-down operation

Toughcarrier dynamic torque specifications Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH10	Single standard slider	10	3.5 – 12.3	3.7 – 21.2
		20	4.1 – 16.6	4.3 – 25.5

◆ TCH10 Double standard slider Specifications(with pin holes)



TCH10 Standard Slider Specifications (Double)

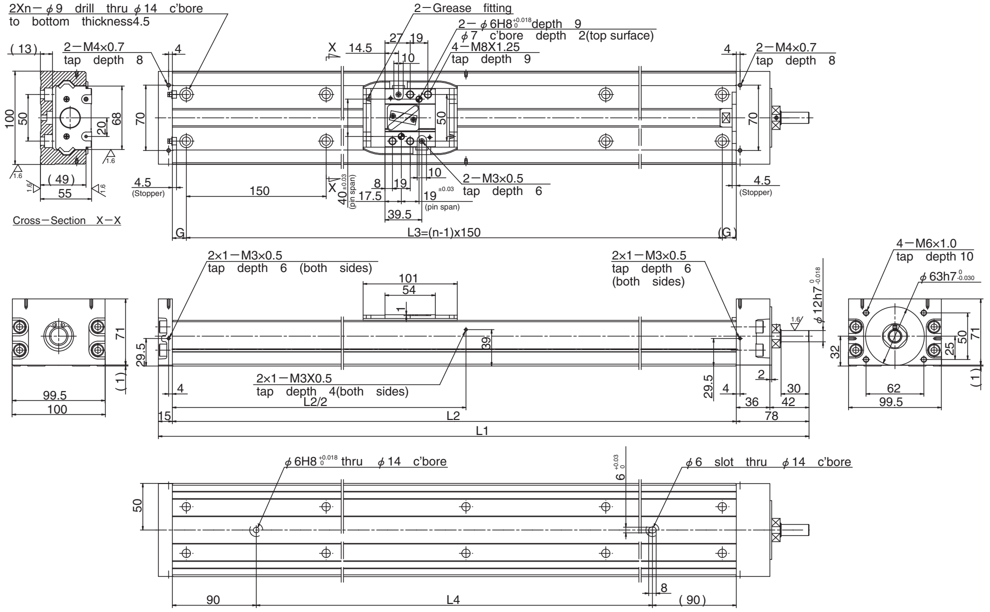
Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)					No. of mounting holes n	Inertia × 10^{-6} (kg · m^2)	Mass (kg)
				L_1	L_2	L_3	L_4	G			
∗TCH10027H10D00 (01)	270	281	10	673	580	450	400	65	4	83.02	16.8
∗TCH10027H20D00 (01)			20							104.31	
∗TCH10037H10D00 (01)	370	381	10	773	680	600	500	40	5	95.27	18.8
∗TCH10037H20D00 (01)			20							116.56	
TCH10047H10D00 (01)	470	481	10	873	780	750	600	15	6	107.57	20.7
TCH10047H20D00 (01)			20							128.86	
TCH10057H10D00 (01)	570	581	10	973	880	750	700	65	6	119.77	22.6
TCH10057H20D00 (01)			20							141.06	
TCH10067H10D00 (01)	670	681	10	1 073	980	900	800	40	7	132.07	24.6
TCH10067H20D00 (01)			20							153.36	
TCH10077H20D00 (01)	770	781	20	1 173	1 080	1 050	900	15	8	165.54	26.6
TCH10087H20D00 (01)	870	881	20	1 273	1 180	1 050	1 000	65	8	177.78	28.5
TCH10097H20D00 (01)	970	981	20	1 373	1 280	1 200	1 100	40	9	190.03	30.5
TCH10107H20D00 (01)	1 070	1 081	20	1 473	1 380	1 350	1 200	15	10	202.27	32.5

Items marked with ∗ are unavailable for upside-down operation

Toughcarrier dynamic torque specifications Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH10	Double standard sliders	10	4.1 – 16.6	4.3 – 25.5
		20	5.4 – 25.2	5.6 – 34.1

◆ TCH10 Single Short Slider Specifications(with pin holes)



TCH10 Short Slider Specifications (Single)

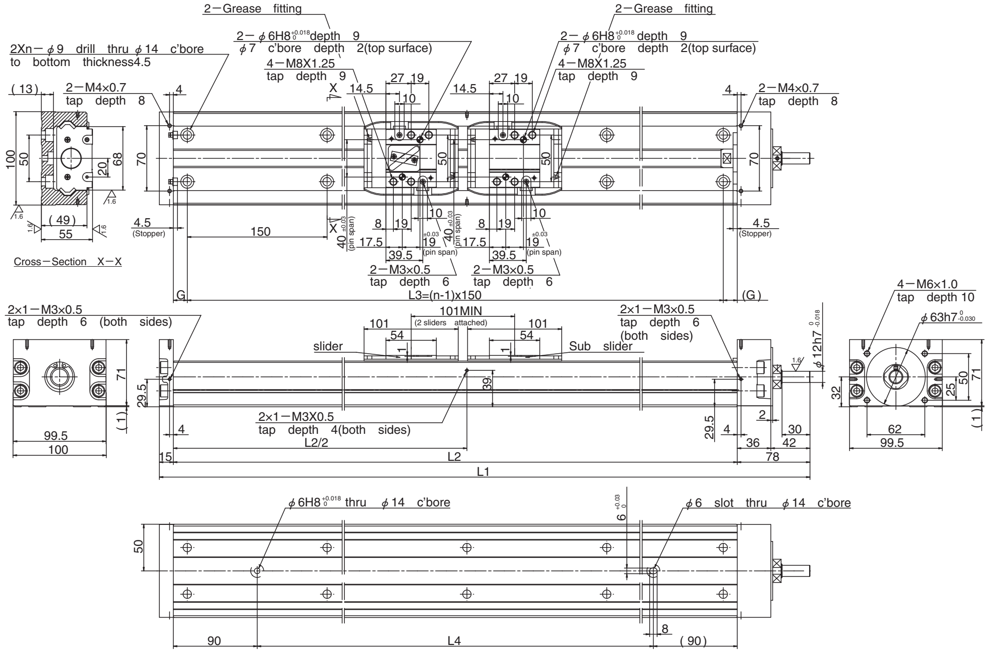
Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)					No. of mounting holes n	Inertia x 10^{-6} (kg · m^2)	Mass (kg)
				L_1	L_2	L_3	L_4	G			
∗TCH10016H10A00 (01)	160	170	10	373	280	150	100	65	2	41.19	8.9
∗TCH10016H20A00 (01)			20							47.36	
TCH10026H10A00 (01)	260	270	10	473	380	300	200	40	3	53.45	10.9
TCH10026H20A00 (01)			20							59.54	
TCH10036H10A00 (01)	360	370	10	573	480	450	300	15	4	65.70	12.8
TCH10036H20A00 (01)			20							71.79	
TCH10046H10A00 (01)	460	470	10	673	580	450	400	65	4	77.95	14.8
TCH10046H20A00 (01)			20							84.04	
TCH10056H10A00 (01)	560	570	10	773	680	600	500	40	5	90.20	16.7
TCH10056H20A00 (01)			20							96.29	
TCH10066H10A00 (01)	660	670	10	873	780	750	600	15	6	102.50	18.6
TCH10066H20A00 (01)			20							108.59	
TCH10076H10A00 (01)	760	770	10	973	880	750	700	65	6	114.70	20.6
TCH10076H20A00 (01)			20							120.79	
TCH10086H10A00 (01)	860	870	10	1 073	980	900	800	40	7	127.00	22.6
TCH10086H20A00 (01)			20							133.09	
TCH10096H10A00 (01)	960	970	10	1 173	1 080	1 050	900	15	8	139.18	24.5
TCH10096H20A00 (01)			20							145.27	
TCH10106H10A00 (01)	1 060	1 070	10	1 273	1 180	1 050	1 000	65	8	151.42	26.5
TCH10106H20A00 (01)			20							157.51	
TCH10116H10A00 (01)	1 160	1 170	10	1 373	1 280	1 200	1 100	40	9	163.67	28.4
TCH10116H20A00 (01)			20							169.76	
TCH10126H10A00 (01)	1 260	1 270	10	1 473	1 380	1 350	1 200	15	10	175.91	30.4
TCH10126H20A00 (01)			20							182.00	

Items marked with ∗ are unavailable for upside-down operation

Toughcarrier dynamic torque specifications Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH10	Single short slider	10	3.6 – 11.7	3.8 – 20.5
		20	4.4 – 15.4	4.6 – 24.2

◆ TCH10 Double Short slider Specifications(with pin holes)



TCH10 Short Slider Specifications (Double)

Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)					No. of mounting holes n	Inertia x 10^{-6} (kg · m^2)	Mass (kg)
				L_1	L_2	L_3	L_4	G			
TCH10036H10B00 (01)	360	369	10	673	580	450	400	65	4	79.97	15.6
TCH10036H20B00 (01)			20							92.14	
TCH10046H10B00 (01)	460	469	10	773	680	600	500	40	5	92.22	17.5
TCH10046H20B00 (01)			20							104.39	
TCH10056H10B00 (01)	560	569	10	873	780	750	600	15	6	104.52	19.4
TCH10056H20B00 (01)			20							116.69	
TCH10066H10B00 (01)	660	669	10	973	880	750	700	65	6	116.72	21.4
TCH10066H20B00 (01)			20							128.89	
TCH10076H10B00 (01)	760	769	10	1 073	980	900	800	40	7	129.02	23.4
TCH10076H20B00 (01)			20							141.19	
TCH10086H20B00 (01)	860	869	20	1 173	1 080	1 050	900	15	8	153.37	25.3
TCH10096H20B00 (01)	960	969	20	1 273	1 180	1 050	1 000	65	8	165.61	27.3
TCH10106H20B00 (01)	1 060	1 069	20	1 373	1 280	1 200	1 100	40	9	177.86	29.2
TCH10116H20B00 (01)	1 160	1 169	20	1 473	1 380	1 350	1 200	15	10	190.10	31.2

Items marked with ∗ are unavailable for upside-down operation

Toughcarrier dynamic torque specifications Unit: N · cm

Model no.	Slider specifications	Ball screw lead (mm)	Accuracy grade	
			High grade	Precision grade
TCH10	Double short sliders	10	4.4 – 15.4	4.6 – 24.2
		20	6.0 – 22.7	6.2 – 31.5

C-2-6 Accessories

C-2-6. 1 Sensor Unit

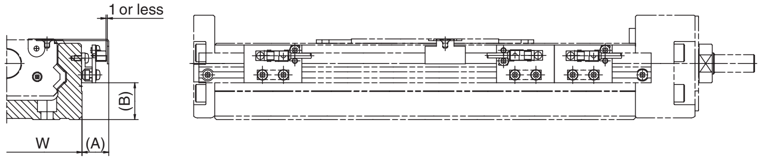
Reference number TC — SRH □□— 1 □

Nominal size

Coding for model no.

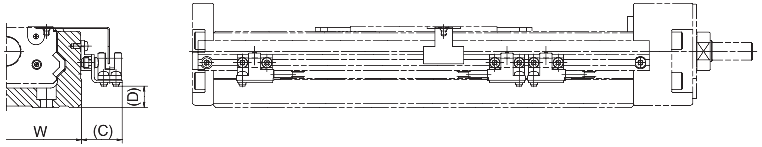
- 0: Proximity switch (3 b-contacts)
- 1: Proximity switch (3 a-contacts)
- 2: Proximity switch (1 a-contact, 2 b-contacts)
- 3: Photo sensor (3 sensors)

◆ Proximity switch



Model no.		Reference number			Dimensions		
					A (mm)	B (mm)	Body width W (mm)
TCH06		TC-SRH06-10	TC-SRH06-11	TC-SRH06-12	17	10	60
TCH09		TC-SRH09-10	TC-SRH09-11	TC-SRH09-12	16	21	86
TCH10		TC-SRH10-10	TC-SRH10-11	TC-SRH10-12	16	25	100
Quantity	Proximity switch (a-contact)	—	3	1	E2S-W13 (OMRON Corp.)		
	Proximity switch (b-contact)	3	—	2	E2S-W14 (OMRON Corp.)		

◆ Photo sensor



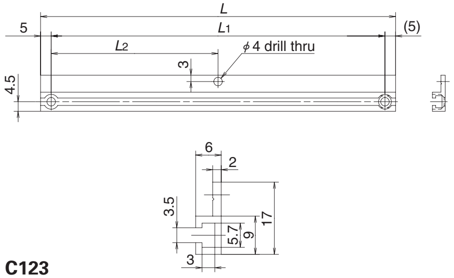
Model no.	Reference number	Dimensions			Note
		C (mm)	D (mm)	Body width W (mm)	
TCH06	TC-SRH06-13	24	2	60	EE-SX674 (OMRON Corp.) 3 sets (EE-1001 connector included
TCH09	TC-SRH09-13	24	12	86	
TCH10	TC-SRH10-13	24	16	100	

(1) Sensor Rail

Reference number TC — SRL □—□□□□

Body rail length

Nominal no. 06→6
09→9
10→1

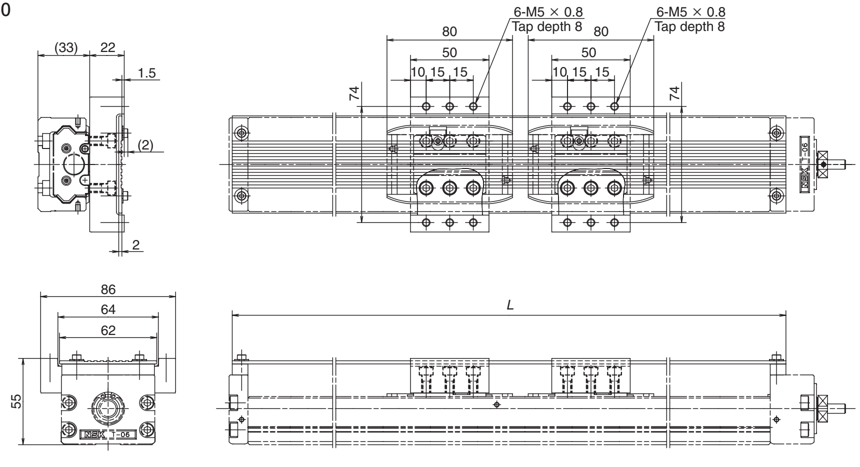


Model no.	Body rail length	Dimensions		
		L	L_1	L_2
TCH06	150	168	158	79
	200	218	208	104
	300	318	308	154
	400	418	408	204
	500	518	508	254
	600	618	608	304
TCH09	240	258	248	124
	340	358	348	174
	440	458	448	224
	540	558	548	274
	640	658	648	324
	740	758	748	374
	840	858	848	424
	940	958	948	474
TCH10	280	298	288	144
	380	398	388	194
	480	498	488	244
	580	598	588	294
	680	698	688	344
	780	798	788	394
	880	898	888	444
	980	998	988	494
	1 080	1 098	1 088	544
	1 180	1 198	1 188	594
	1 280	1 298	1 288	644
	1 380	1 398	1 388	694

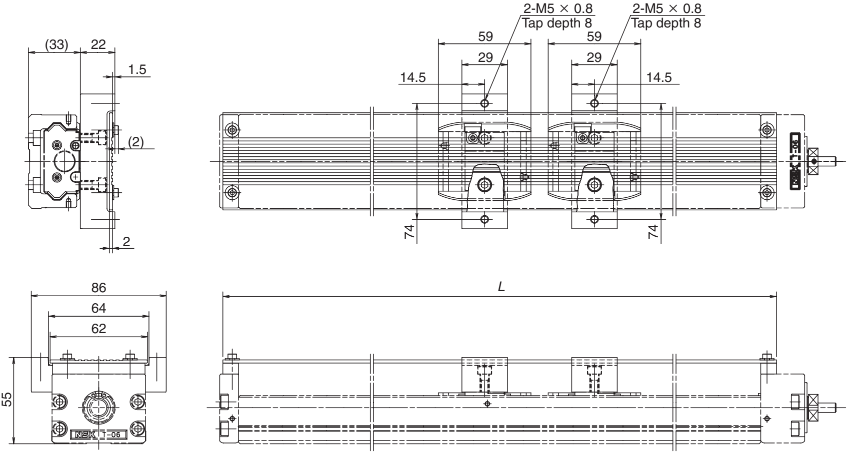
C-2-6. 2 Cover Unit

◆ Cover Unit

TC-HV06XXXK00
TC-HV06XXXD00



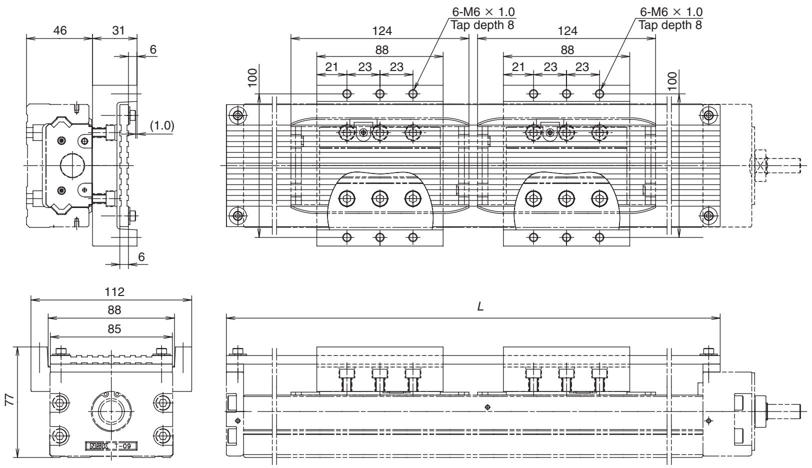
TC-HV06XXXA00
TC-HV06XXXB00



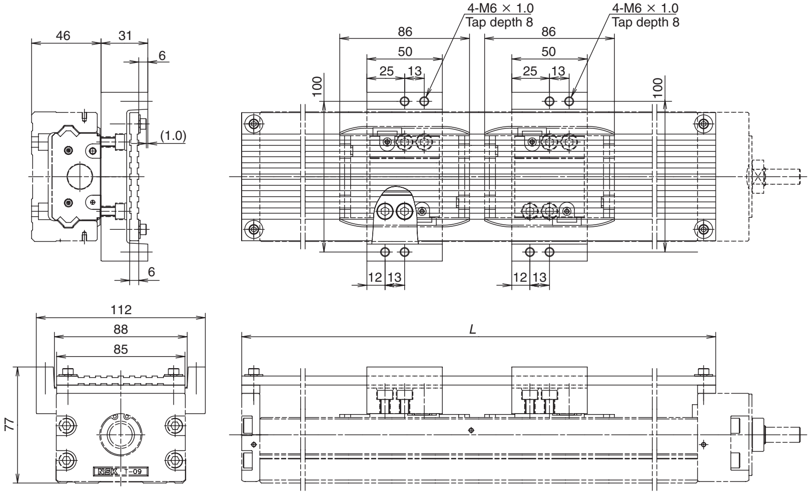
TCH06

Body rail length	Dimensions	Slider specifications			
		Standard		Short	
	L	Single	Double	Single	Double
150	170	TC-HV06005K00	—	TC-HV06007A00	—
200	220	TC-HV06010K00	—	TC-HV06012A00	—
300	320	TC-HV06020K00	TC-HV06013D00	TC-HV06022A00	TC-HV06017B00
400	420	TC-HV06030K00	TC-HV06023D00	TC-HV06032A00	TC-HV06027B00
500	520	TC-HV06040K00	TC-HV06033D00	TC-HV06042A00	TC-HV06037B00
600	620	TC-HV06050K00	TC-HV06043D00	TC-HV06052A00	TC-HV06047B00

TC-HV09XXXK00
TC-HV09XXXD00



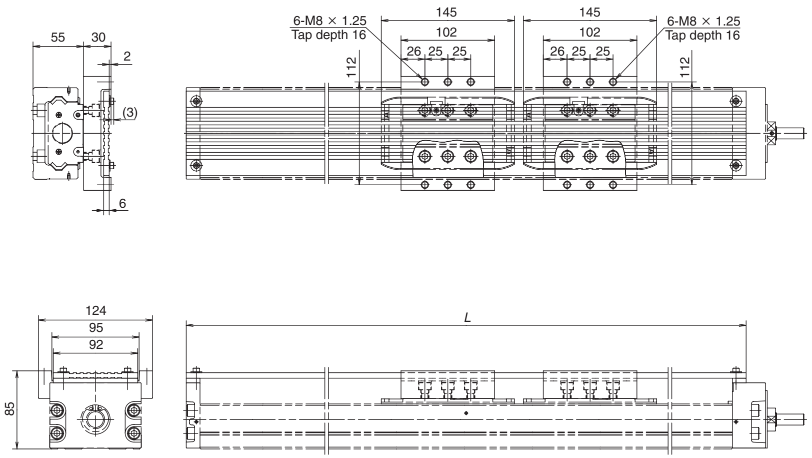
TC-HV09XXXA00
TC-HV09XXXB00



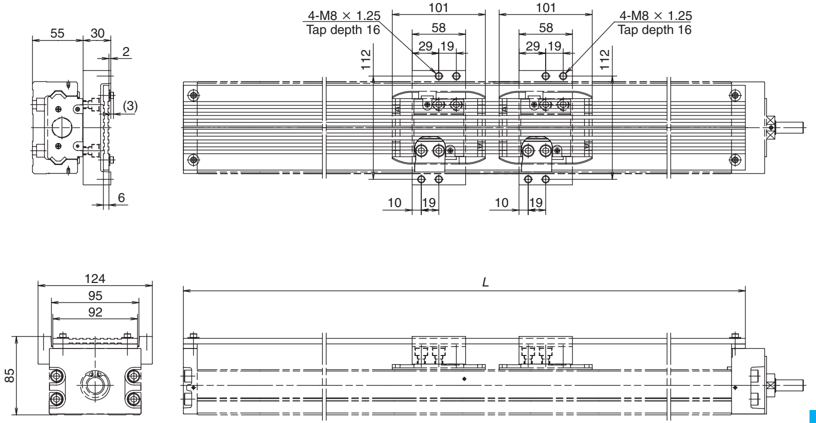
TCH09

Body rail length	Dimensions *L*	Slider specifications			
		Standard		Short	
		Single	Double	Single	Double
240	264	TC-HV09010K00	—	TC-HV09014A00	—
340	364	TC-HV09020K00	—	TC-HV09024A00	—
440	464	TC-HV09030K00	TC-HV09017D00	TC-HV09034A00	TC-HV09025B00
540	564	TC-HV09040K00	TC-HV09027D00	TC-HV09044A00	TC-HV09035B00
640	664	TC-HV09050K00	TC-HV09037D00	TC-HV09054A00	TC-HV09045B00
740	764	TC-HV09060K00	TC-HV09047D00	TC-HV09064A00	TC-HV09055B00
840	864	TC-HV09070K00	—	TC-HV09074A00	—
940	964	TC-HV09080K00	TC-HV09067D00	TC-HV09084A00	TC-HV09075B00

TC-HV10XXXK00
TC-HV10XXXD00



TC-HV10XXXA00
TC-HV10XXXB00



TCH10

Body rail length	Dimensions *L*	Slider specifications			
		Standard		Short	
		Single	Double	Single	Double
280	310	TC-HV10010K00	—	TC-HV10016A00	—
380	410	TC-HV10020K00	—	TC-HV10026A00	—
480	510	TC-HV10030K00	—	TC-HV10036A00	—
580	610	TC-HV10040K00	TC-HV10027D00	TC-HV10046A00	TC-HV10036B00
680	710	TC-HV10050K00	TC-HV10037D00	TC-HV10056A00	TC-HV10046B00
780	810	TC-HV10060K00	TC-HV10047D00	TC-HV10066A00	TC-HV10056B00
880	910	TC-HV10070K00	TC-HV10057D00	TC-HV10076A00	TC-HV10066B00
980	1 010	TC-HV10080K00	TC-HV10067D00	TC-HV10086A00	TC-HV10076B00
1 080	1 110	TC-HV10090K00	TC-HV10077D00	TC-HV10096A00	TC-HV10086B00
1 180	1 210	TC-HV10100K00	TC-HV10087D00	TC-HV10106A00	TC-HV10096B00
1 280	1 310	TC-HV10110K00	TC-HV10097D00	TC-HV10116A00	TC-HV10106B00
1 380	1 410	TC-HV10120K00	TC-HV10107D00	TC-HV10126A00	TC-HV10116B00

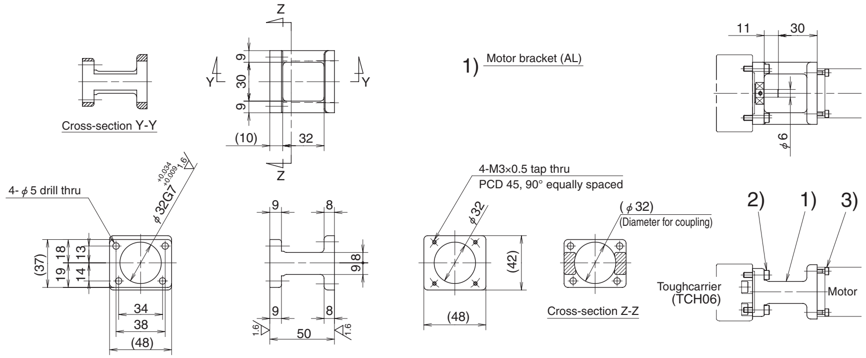
C-2-6. 3 Motor Bracket

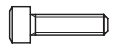
◆ Motor bracket

Motor models are subject to change at motor manufacturers. For details, please contact the manufacturer. For motors other than shown below, please contact NSK.

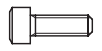
■Reference number

TC-BKH06-145-00





2) Hexagon socket head cap screw (M4, length 16)



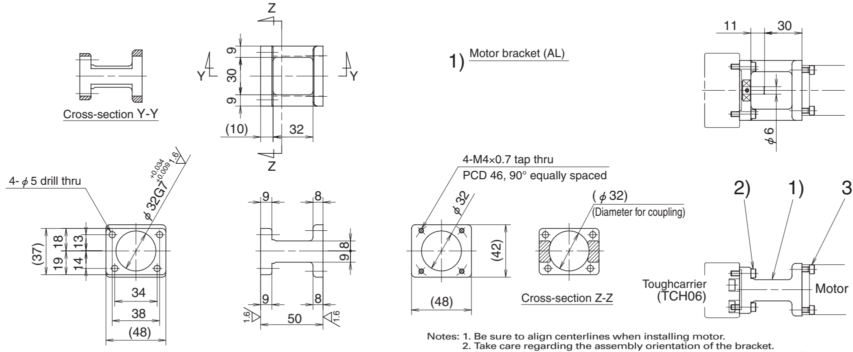
3) Hexagon socket head cap screw (M3, length 12)

Notes: 1. Be sure to align the center lines when installing the motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

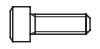
Compatible motor		
Maker	Serise	Motor models(Servo motor)
Panasonic Co., Ltd.	MINAS A6	MSMF5A(50W), MSMF01(100W)

■Reference number

TC-BKH06-146-00



2) Hexagon socket head cap screw (M4, length 16)



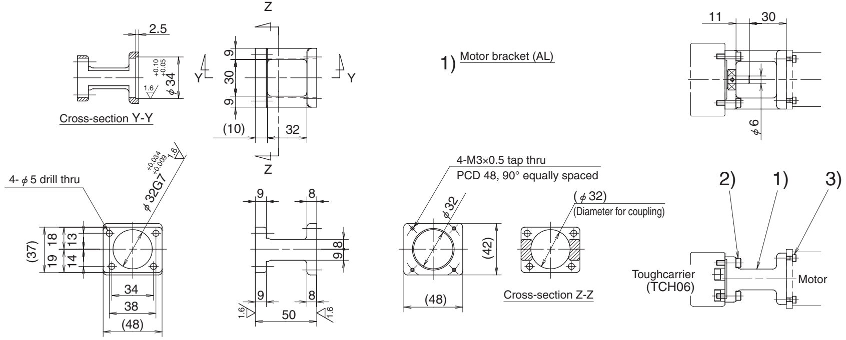
3) Hexagon socket head cap screw (M4, length 14)

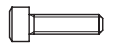
Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Serise	Motor models(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-A5(50W),SGM7A-01(100W),SGM7A-C2(150W) SGM7J-A5(50W),SGM7J-01(100W),SGM7J-C2(150W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR053(50W),HG-MR053(50W) HG-KR13(100W),HG-MR13(100W)
OMRON Corp.	G5	R88M-K05030(50W),R88M-K10030(100W)
SANYO DENKI Co.,Ltd.	SANMOTION R	R2□A04005(50W),R2□A04010(100W)

■Reference number

TC-BKH06-148-00





2) Hexagon socket head cap screw (M4, length 16)

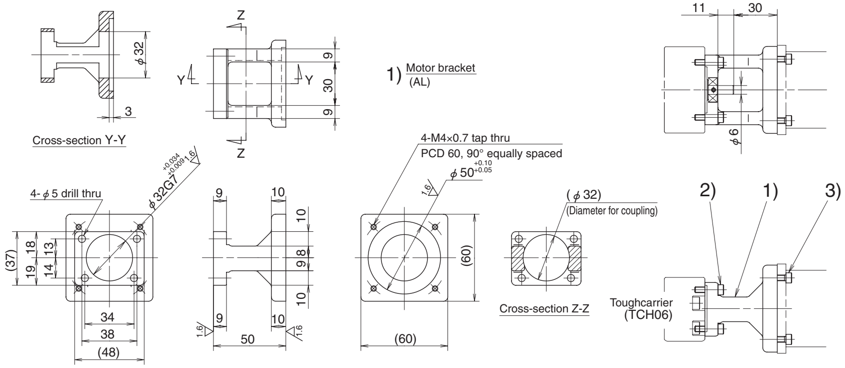
3) Hexagon socket head cap screw (M3, length 12)

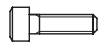
Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Serise	Motor models(Servo motor)
Panasonic Co., Ltd.	–	MAMA01(100W)∗1

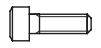
■Reference number

TC-BKH06-160-00





2) Hexagon socket head cap screw (M4, length 16)



3) Hexagon socket head cap screw (M4, length 14)

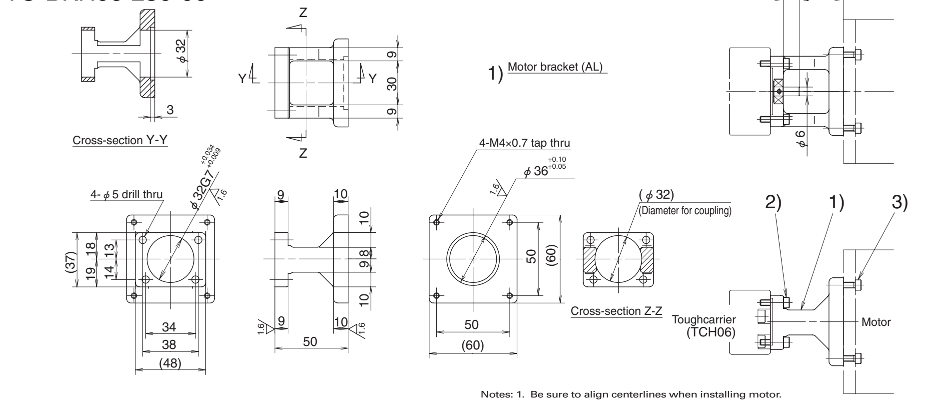
Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Serise	Motor models(Servo motor)
SANYO DENKI Co.,Ltd.	–	P50B05005(50W)∗1 P50B05010(100W)∗1 P50B05020(200W)∗1

∗1 The manufacturer models listed are discontinued motors.

■Reference number

TC-BKH06-250-00



2) Hexagon socket head cap screw (M4, length 16)

3) Hexagon socket head cap screw (M4, length 14)

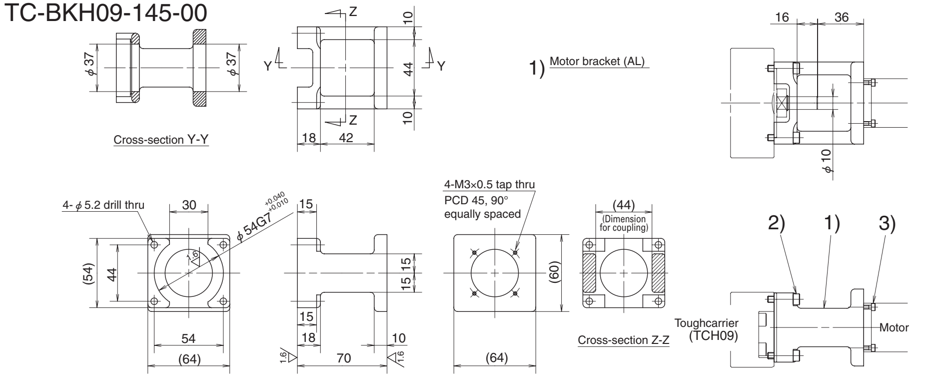
Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor

Maker	Serise	Motor models(stepping motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x, ARL6x, AZ6x
	CRK, CVK, RKⅡ	CRK56x, CVK56x, RKS56x
SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM60x, PB□R60x, PB□P60x

■Reference number

TC-BKH09-145-00



2) Hexagon socket head cap screw (M5, length 20)

3) Hexagon socket head cap screw (M3, length 12)

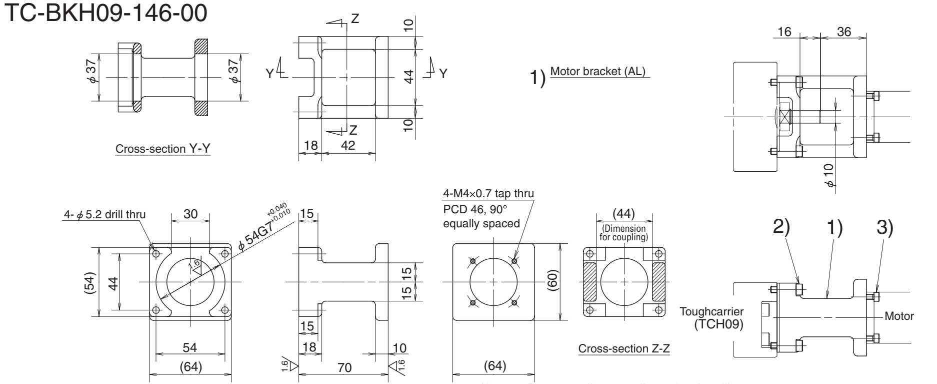
Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor

Maker	Serise	Motor models(Servo motor)
Panasonic Co., Ltd.	MINAS A6	MSMF5A(50W), MSMF01(100W)

■Reference number

TC-BKH09-146-00



2) Hexagon socket head cap screw (M5, length 20)

3) Hexagon socket head cap screw (M4, length 14)

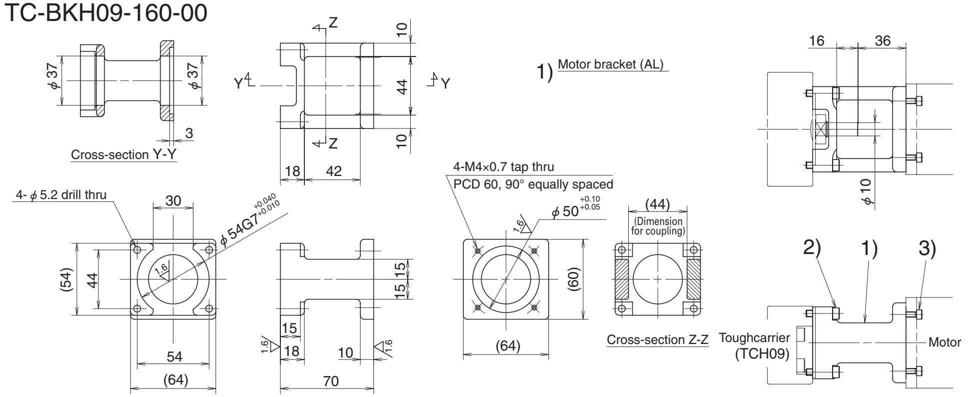
Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor

Maker	Serise	Motor models(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-A5(50W),SGM7A-01(100W),SGM7A-C2(150W) SGM7J-A5(50W),SGM7J-01(100W),SGM7J-C2(150W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR053(50W),HG-MR053(50W), HG-KR13(100W),HG-MR13(100W)
OMRON Corp.	G5	R88M-K05030(50W),R88M-K10030(100W)
SANYO DENKI Co.,Ltd.	SANMOTION R	R2□A04005(50W),R2□A04010(100W)

■Reference number

TC-BKH09-160-00



1) Motor bracket (AL)

2) Hexagon socket head cap screw (M5, length 20)

3) Hexagon socket head cap screw (M4, length 14)

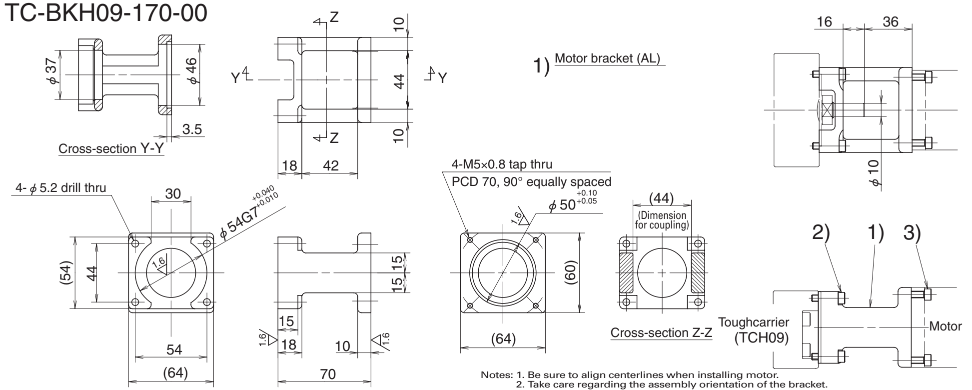
Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor

Maker	Serise	Motor models(Servo motor)
SANYO DENKI Co.,Ltd.	–	P50B05005(50W)∗1 P50B05010(100W)∗1 P50B05020(200W)∗1

■Reference number

TC-BKH09-170-00



1) Motor bracket (AL)

2) Hexagon socket head cap screw (M5, length 20)

3) Hexagon socket head cap screw (M5, length 14)

Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

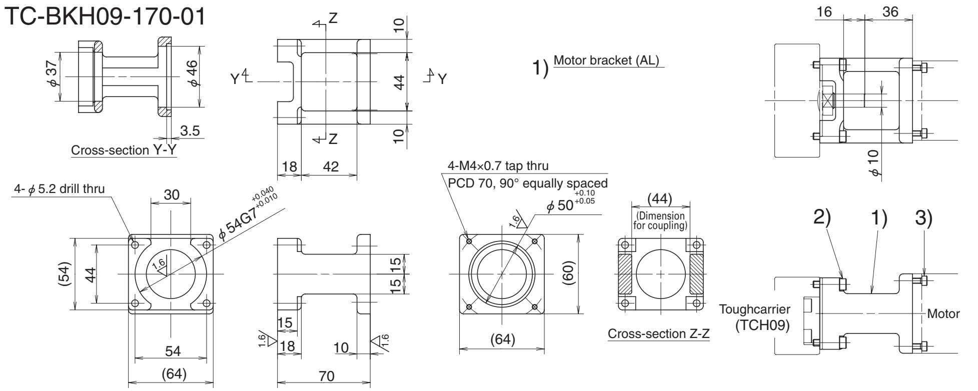
Compatible motor

Maker	Serise	Motor models(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-02A(200W), SGM7J-02(200W) SGM7A-04A(400W), SGM7J-04(400W) SGM7A-06A(600W), SGM7J-06(600W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR23(200W), HG-MR023(200W) HG-KR43(400W), HG-MR43(400W)
SANYO DENKI Co.,Ltd.	SANMOTION R	R2□A06020(200W), R2□A06040(400W)

∗1 The manufacturer models listed are discontinued motors.

■Reference number

TC-BKH09-170-01



1) Motor bracket (AL)

2) Hexagon socket head cap screw (M5, length 20)

3) Hexagon socket head cap screw (M4, length 14)

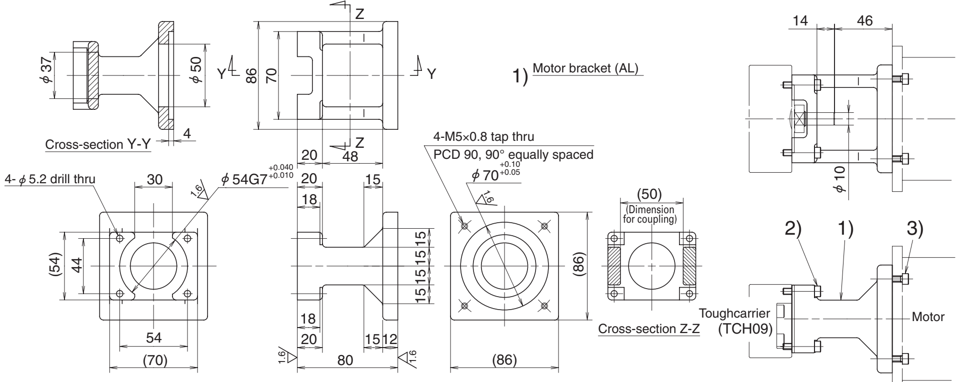
Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor

Maker	Serise	Motor models(Servo motor)
Panasonic Co., Ltd.	MINAS A6	MSMF02(200W),MSMF04(400W)
OMRON Corp.	G5	R88M-K20030(200W),R88M-K40030(400W)

■Reference number

TC-BKH09-190-00



1) Motor bracket (AL)

2) Hexagon socket head cap screw (M5, length 25)

3) Hexagon socket head cap screw (M5, length 16)

Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

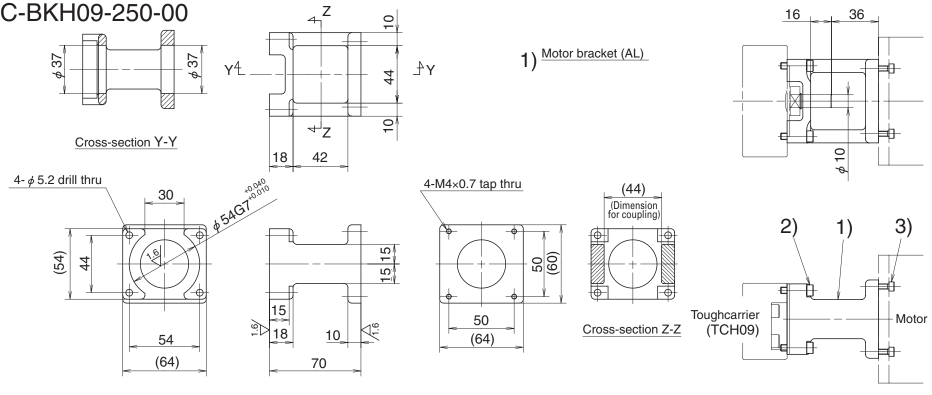
Compatible motor

Maker	Serise	Motor models(Servo motor)
SANYO DENKI Co.,Ltd.	–	P50B07020∗1(200W)
		P50B07030∗1(300W)
		P50B07040∗1(400W)

∗1 The manufacturer models listed are discontinued motors.

■Reference number

TC-BKH09-250-00



2) Hexagon socket head cap screw (M5, length 20)

3) Hexagon socket head cap screw (M4, length 14)

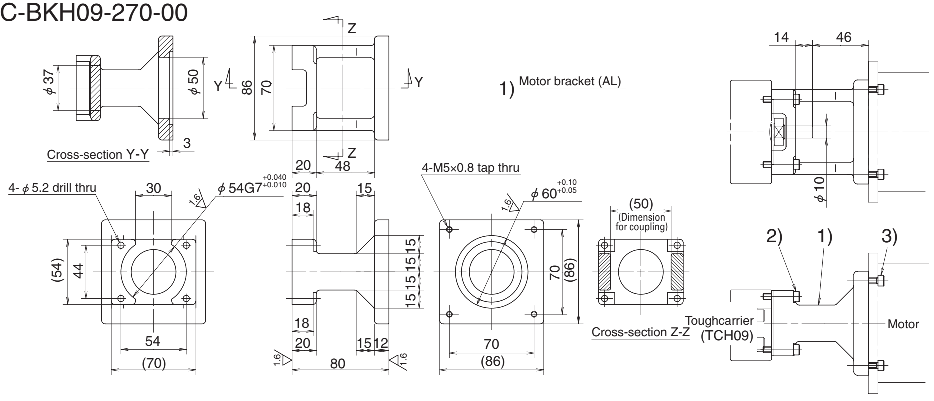
Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor

Maker	Serise	Motor models(stepping motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x, ARL6x, AZ6x
	CRK, CVK, RKⅡ	CRK56x, CVK56x, RKS56x
SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM60x, PB□R60x, PB□P60x

■Reference number

TC-BKH09-270-00



2) Hexagon socket head cap screw (M5, length 25)

3) Hexagon socket head cap screw (M5, length 16)

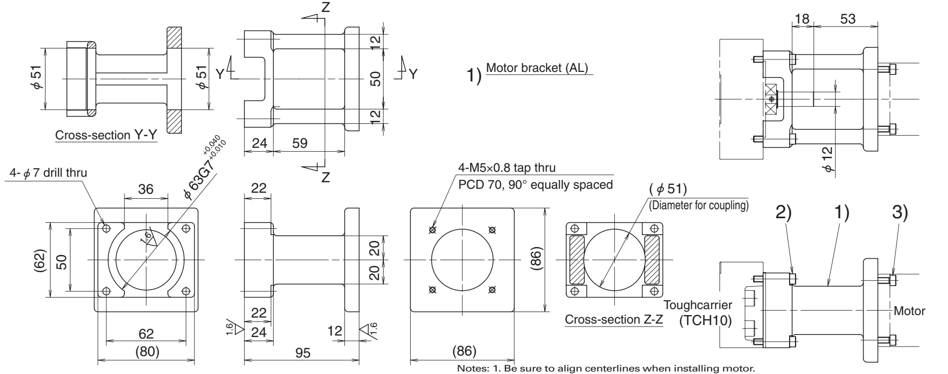
Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

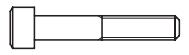
Compatible motor

Maker	Serise	Motor models(stepping motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR9x, ARL9x, AZ9x
	RKⅡ	RKS59x

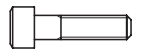
■Reference number

TC-BKH10-170-00





2) Hexagon socket head cap screw (M6, length 30)



3) Hexagon socket head cap screw (M5, length 20)

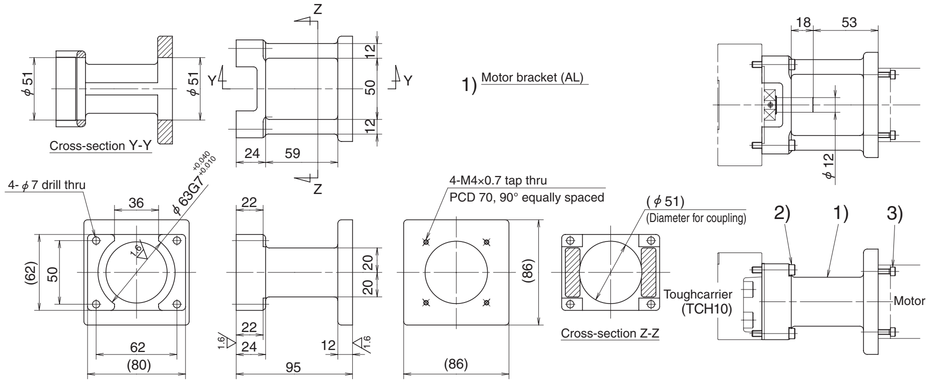
Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

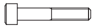
Compatible motor

Maker	Serise	Motor models(Servo motor)
YASKAWA Electric Corp.	Σ-7	SGM7A-02A(200W),SGM7A-04A(400W),SGM7A-06A(600W) SGM7J-02(200W),SGM7J-04(400W),SGM7J-06(600W)
Mitsubishi Electric Corp.	MELSERVO-J4	HG-KR23(200W),HG-MR23(200W) HG-KR43(400W),HG-MR43(400W)
SANYO DENKI Co.,Ltd.	SANMOTION R	R2□A06020(200W)R2□A06040(400W)

■Reference number

TC-BKH10-170-01





2) Hexagon socket head cap screw (M6, length 30)

3) Hexagon socket head cap screw (M4, length 16)

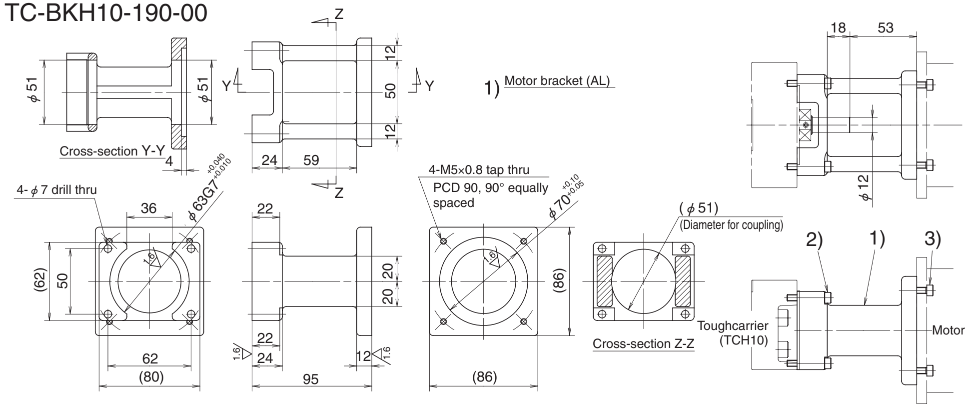
Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

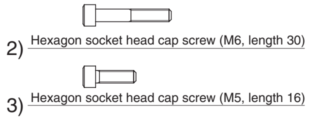
Compatible motor

Maker	Serise	Motor models(Servo motor)
Panasonic Co., Ltd.	MINAS A6	MSMF02(200W),MSMF04(400W)
OMRON Corp.	G5	R88M-K20030(200W) R88M-K40030(400W)

■Reference number

TC-BKH10-190-00



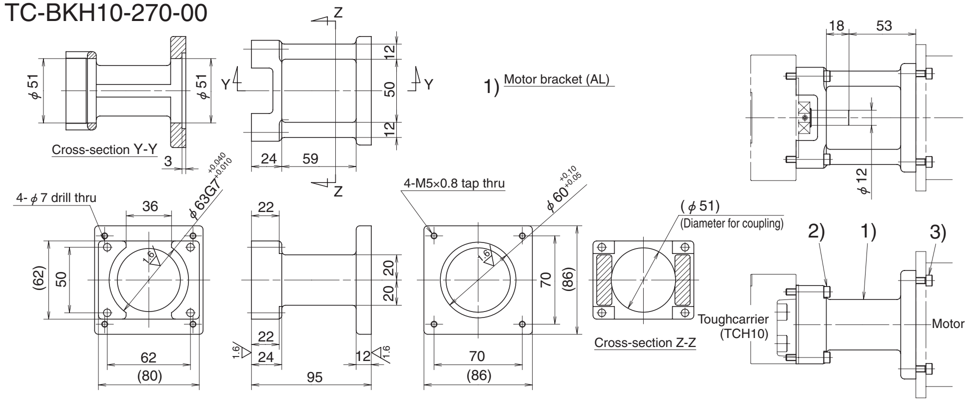


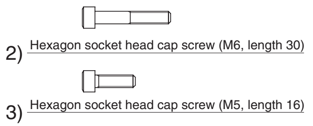
Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Serise	Motor models(Servo motor)
Panasonic Co., Ltd.	MINAS A6	MSMF08(750W)
OMRON Corp.	G5	R88M-K75030(750W)

■Reference number

TC-BKH10-270-00





Notes: 1. Be sure to align centerlines when installing motor.
2. Take care regarding the assembly orientation of the bracket.
3. Because the bracket is made by sand casting, note that external dimensions are reference values.

Compatible motor		
Maker	Serise	Motor models(stepping motor)
ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR9x, ARL9x, AZ9x
	RKⅡ	RKS59x

C-2-7 Motor Bracket Compatibility

Model No	Motor bracket reference No.	Moter manufacturer	Serise	Stepper motor model No.	Wattage of AC servo motor									
					30	50	60	100	150	200	300	400	600	750
TCH06	TC-BKH06-145-00	Panasonic Co., Ltd.	MINAS A6			MSMF5A		MSMF01						
	TC-BKH06-146-00	YASKAWA Electric Corp.	Σ-7			SGM7A-A5 SGM7J-A5		SGM7A-01 SGM7J-01	SGM7A-C2 SGM7J-C2					
		Mitsubishi Electric Corp.	MELSERVO-J4			HG-KR053 HG-MR053		HG-KR13 HG-MR13						
		OMRON Corp.	G5			R88M-K05030		R88M-K10030						
		SANYO DENKI Co.,Ltd.	SANMOTION R			R2□A04005		R2□A04010						
	TC-BKH06-148-00∗1	Panasonic Co., Ltd.	–					MAMA01∗1						
	TC-BKH06-160-00∗1	SANYO DENKI Co.,Ltd.	–			P50B05005∗1		P50B05010∗1		P50B05020∗1				
	TC-BKH06-250-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x, ARL6x, AZ6x										
			CRK, CVK, RKⅡ	CRK56x, CVK56x, RKS56x										
		SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM60x, PB□R60x, PB□P60x										
TCH09	TC-BKH09-145-00	Panasonic Co., Ltd.	MINAS A6			MSMF5A		MSMF01						
	TC-BKH09-146-00	YASKAWA Electric Corp.	Σ-7			SGM7A-A5 SGM7J-A5		SGM7A-01 SGM7J-01	SGM7A-C2 SGM7J-C2					
		Mitsubishi Electric Corp.	MELSERVO-J4			HG-KR053 HG-MR053		HG-KR13 HG-MR13						
		OMRON Corp.	G5			R88M-K05030		R88M-K10030						
		SANYO DENKI Co.,Ltd.	SANMOTION R			R2□A04005		R2□A04010						
	TC-BKH09-160-00∗1	SANYO DENKI Co.,Ltd.	–			P50B05005∗1		P50B05010∗1		P50B05020∗1				
	TC-BKH09-170-00	YASKAWA Electric Corp.	Σ-7							SGM7A-02A SGM7J-02		SGM7A-04A SGM7J-04	SGM7A-06A SGM7J-06	
		Mitsubishi Electric Corp.	MELSERVO-J4							HG-KR23 HG-MR23		HG-KR43 HG-MR43		
		SANYO DENKI Co.,Ltd.	SANMOTION R							R2□A06020		R2□A06040		
	TC-BKH09-170-01	Panasonic Co., Ltd.	MINAS A6							MSMF02		MSMF04		
		OMRON Corp.	G5							R88M-K20030		R88M-K40030		
	TC-BKH09-190-00∗1	SANYO DENKI Co.,Ltd.	–							P50B07020∗1	P50B07030∗1	P50B07040∗1		
	TC-BKH09-250-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR6x, ARL6x, AZ6x										
			CRK, CVK, RKⅡ	CRK56x, CVK56x, RKS56x										
		SANYO DENKI Co.,Ltd.	SANMOTION Model No.PB	PBDM60x, PB□R60x, PB□P60x										
	TC-BKH09-270-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR9x, ARL9x, AZ9x										
			RKⅡ	RKS59x										
TCH10	TC-BKH10-170-00	YASKAWA Electric Corp.	Σ-7							SGM7A-02A SGM7J-02		SGM7A-04A SGM7J-04	SGM7A-06A SGM7J-06	
		Mitsubishi Electric Corp.	MELSERVO-J4							HG-KR23 HG-MR23		HG-KR43 HG-MR43		
		SANYO DENKI Co.,Ltd.	SANMOTION R							R2□A06020		R2□A06040		
	TC-BKH10-170-01	Panasonic Co., Ltd.	MINAS A6							MSMF02		MSMF04		
		OMRON Corp.	G5							R88M-K20030		R88M-K40030		
	TC-BKH10-190-00	Panasonic Co., Ltd.	MINAS A6											MSMF08
		OMRON Corp.	G5											R88M-K75030
	TC-BKH10-270-00	ORIENTAL MOTOR Co.,Ltd.	αSTEP	AR9x, ARL9x, AZ9x										
			RKⅡ	RKS59x										

∗1 The manufacturer models listed are discontinued motors.

C-2-8 Sensor Rail and Top Cover Unit Combinations

Model No.	Reference number	Rail length (L_2)	Sensor rail reference number	Cover unit reference number
TCH06	TCH06005H05K00	150	TC-SRL6-0150	TC-HV06005K00
	TCH06005H10K00			
	TCH06005H20K00			
	TCH06007H05A00			TC-HV06007A00
	TCH06007H10A00			
	TCH06010H05K00	200	TC-SRL6-0200	TC-HV06010K00
	TCH06010H10K00			
	TCH06010H20K00			
	TCH06012H05A00			TC-HV06012A00
	TCH06012H10A00			
	TCH06020H05K00	300	TC-SRL6-0300	TC-HV06020K00
	TCH06020H10K00			
	TCH06020H20K00			
	TCH06013H05D00			TC-HV06013D00
	TCH06013H10D00			
	TCH06022H05A00			TC-HV06022A00
	TCH06022H10A00			
	TCH06017H05B00			TC-HV06017B00
	TCH06017H10B00			
	TCH06030H05K00	400	TC-SRL6-0400	TC-HV06030K00
	TCH06030H10K00			
	TCH06030H20K00			
	TCH06023H05D00			TC-HV06023D00
	TCH06023H10D00			
	TCH06032H05A00			TC-HV06032A00
	TCH06032H10A00			
	TCH06027H05B00			TC-HV06027B00
	TCH06027H10B00			
	TCH06040H05K00	500	TC-SRL6-0500	TC-HV06040K00
	TCH06040H10K00			
	TCH06040H20K00			
	TCH06033H05D00			TC-HV06033D00
	TCH06033H10D00			
	TCH06042H05A00			TC-HV06042A00
	TCH06042H10A00			
	TCH06037H05B00			TC-HV06037B00
	TCH06037H10B00			
	TCH06050H05K00	600	TC-SRL6-0600	TC-HV06050K00
	TCH06050H10K00			
	TCH06050H20K00			
	TCH06043H10D00			TC-HV06043D00
	TCH06043H20D00			
	TCH06052H05A00			TC-HV06052A00
	TCH06052H10A00			
	TCH06047H10B00			TC-HV06047B00

- Sensor rail reference numbers are determined according to the rail length. Select a sensor rail appropriate for your requirements.
- Shapes and numbers of spacer plates for cover units are selected according to slider specifications.

Model No.	Reference number	Rail length (L_2)	Sensor rail reference number	Cover unit reference number
TCH09	TCH09010H05K00	240	TC-SRL9-0240	TC-HV09010K00
	TCH09010H10K00			
	TCH09010H20K00			
	TCH09014H05A00			TC-HV09014A00
	TCH09014H10A00			
	TCH09014H20A00			
	TCH09020H05K00	340	TC-SRL9-0340	TC-HV09020K00
	TCH09020H10K00			
	TCH09020H20K00			
	TCH09024H05A00			TC-HV09024A00
	TCH09024H10A00			
	TCH09024H20A00			
	TCH09030H05K00	440	TC-SRL9-0440	TC-HV09030K00
	TCH09030H10K00			
	TCH09030H20K00			
	TCH09017H05D00			TC-HV09017D00
	TCH09017H10D00			
	TCH09034H05A00			TC-HV09034A00
	TCH09034H10A00			
	TCH09034H20A00			
	TCH09025H05B00			TC-HV09025B00
	TCH09025H10B00			
	TCH09040H05K00	540	TC-SRL9-0540	TC-HV09040K00
	TCH09040H10K00			
	TCH09040H20K00			
	TCH09027H05D00			TC-HV09027D00
	TCH09027H10D00			
	TCH09044H05A00			TC-HV09044A00
	TCH09044H10A00			
	TCH09044H20A00			
	TCH09035H05B00			TC-HV09035B00
	TCH09035H10B00			
	TCH09050H05K00	640	TC-SRL9-0640	TC-HV09050K00
	TCH09050H10K00			
	TCH09050H20K00			
	TCH09037H05D00			TC-HV09037D00
	TCH09037H10D00			
	TCH09054H05A00			TC-HV09054A00
	TCH09054H10A00			
	TCH09054H20A00			
	TCH09045H05B00			TC-HV09045B00
	TCH09045H10B00			
	TCH09060H05K00	740	TC-SRL9-0740	TC-HV09060K00
	TCH09060H10K00			
	TCH09060H20K00			
	TCH09047H10D00			TC-HV09047D00
	TCH09047H20D00			
	TCH09064H05A00			TC-HV09064A00
	TCH09064H10A00			
	TCH09064H20A00			
	TCH09055H10B00			TC-HV09055B00
	TCH09055H20B00			
	TCH09070H05K00	840	TC-SRL9-0840	TC-HV09070K00
	TCH09070H10K00			
	TCH09070H20K00			
	TCH09074H05A00			TC-HV09074A00
	TCH09074H10A00			
	TCH09074H20A00			
	TCH09080H05K00	940	TC-SRL9-0940	TC-HV09080K00
	TCH09080H10K00			
	TCH09080H20K00			
	TCH09067H10D00			TC-HV09067D00
	TCH09067H20D00			
	TCH09084H05A00			TC-HV09084A00
	TCH09084H10A00			
	TCH09084H20A00			
	TCH09075H10B00			TC-HV09075B00
	TCH09075H20B00			

- Sensor rail reference numbers are determined according to the rail length. Select a sensor rail appropriate for your requirements.
- Shapes and numbers of spacer plates for cover units are selected according to slider specifications.

Model No.	Reference number	Rail length (L_2)	Sensor rail reference number	Cover unit reference number
TCH10	TCH10010H10K00	280	TC-SRL1-0280	TC-HV10010K00
	TCH10010H20K00			
	TCH10016H10A00			TC-HV10016A00
	TCH10016H20A00			
	TCH10020H10K00	380	TC-SRL1-0380	TC-HV10020K00
	TCH10020H20K00			
	TCH10026H10A00			TC-HV10026A00
	TCH10026H20A00			
	TCH10030H10K00	480	TC-SRL1-0480	TC-HV10030K00
	TCH10030H20K00			
	TCH10036H10A00			TC-HV10036A00
	TCH10036H20A00			
	TCH10040H10K00	580	TC-SRL1-0580	TC-HV10040K00
	TCH10040H20K00			
	TCH10027H10D00			TC-HV10027D00
	TCH10027H20D00			
	TCH10046H10A00			TC-HV10046A00
	TCH10046H20A00			
	TCH10036H10B00			TC-HV10036B00
	TCH10036H20B00			
	TCH10050H10K00	680	TC-SRL1-0680	TC-HV10050K00
	TCH10050H20K00			
	TCH10037H10D00			TC-HV10037D00
	TCH10037H20D00			
	TCH10056H10A00			TC-HV10056A00
	TCH10056H20A00			
	TCH10046H10B00			TC-HV10046B00
	TCH10046H20B00			
	TCH10060H10K00	780	TC-SRL1-0780	TC-HV10060K00
	TCH10060H20K00			
	TCH10047H10D00			TC-HV10047D00
	TCH10047H20D00			
	TCH10066H10A00			TC-HV10066A00
	TCH10066H20A00			
	TCH10056H10B00			TC-HV10056B00
	TCH10056H20B00			
	TCH10070H10K00	880	TC-SRL1-0880	TC-HV10070K00
	TCH10070H20K00			
	TCH10057H10D00			TC-HV10057D00
	TCH10057H20D00			
	TCH10076H10A00			TC-HV10076A00
	TCH10076H20A00			
	TCH10066H10B00			TC-HV10066B00
	TCH10066H20B00			
	TCH10080H10K00	980	TC-SRL1-0980	TC-HV10080K00
	TCH10080H20K00			
	TCH10067H10D00			TC-HV10067D00
	TCH10067H20D00			
	TCH10086H10A00			TC-HV10086A00
	TCH10086H20A00			
	TCH10076H10B00			TC-HV10076B00
	TCH10076H20B00			
	TCH10090H10K00	1 080	TC-SRL1-1080	TC-HV10090K00
	TCH10090H20K00			
	TCH10077H20D00			TC-HV10077D00
	TCH10096H10A00			TC-HV10096A00
	TCH10096H20A00			
	TCH10086H20B00			TC-HV10086B00
	TCH10100H10K00	1 180	TC-SRL1-1180	TC-HV10100K00
	TCH10100H20K00			
	TCH10087H20D00			TC-HV10087D00
	TCH10106H10A00			TC-HV10106A00
	TCH10106H20A00			
	TCH10096H20B00			TC-HV10096B00
	TCH10110H10K00	1 280	TC-SRL1-1280	TC-HV10110K00
	TCH10110H20K00			
	TCH10097H20D00			TC-HV10097D00
	TCH10116H10A00			TC-HV10116A00
	TCH10116H20A00			
	TCH10106H20B00			TC-HV10106B00
	TCH10120H10K00	1 380	TC-SRL1-1380	TC-HV10120K00
	TCH10120H20K00			
	TCH10107H20D00			TC-HV10107D00
	TCH10126H10A00			TC-HV10126A00
	TCH10126H20A00			
	TCH10116H20B00			TC-HV10116B00

- Sensor rail reference numbers are determined according to the rail length. Select a sensor rail appropriate for your requirements.
- Shapes and numbers of spacer plates for cover units are selected according to slider specifications.

C-2-9 Toughcarrier High-Thrust Model (Special product)

◆ Specifications

The life of the feeding system is improved by use of higher load capacity ball screw and support bearings for standard Toughcarriers.

		TCH06	TCH09		TCH10	
Ball screw	Shaft diameter (mm)	12	20		25	
	Lead (mm)	10	10	20	20	25
	Basic dynamic load rating Ca (N)	4 260	13 400	10 100	11 400	11 400
	Basic static load rating Coa (N)	6 260	25 400	18 700	23 600	23 600
Linear guide	Basic dynamic load rating C (N)	20 900	44 900		62 400	
	Basic static load rating Co (N)	45 000	96 900		132 000	
Support bearings	Basic dynamic load rating (N)	7 450	25 100		27 600	
	Load limit (N)	3 500*	18 600*		26 600*	

*Permissible axial load is 0.7 times the limiting axial load.

1) Only compatible with standard sliders.

2) Applicable strokes are as follows.

TCH06: Stroke 500 mm
TCH09: Stroke 800 mm
TCH10: Stroke 1 200 mm

3) High and precision grades are available for accuracy.

◆ Features

1) Mounting dimensions are the same as Monocarrier MCH Models and standard Toughcarrier actuators. (Interchangeable)

2) Permissible rotational speed is faster than standard Toughcarrier actuators due to a different ball recirculation system.

C-3 Technical Materials

C-3 Technical Materials

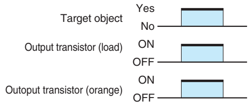
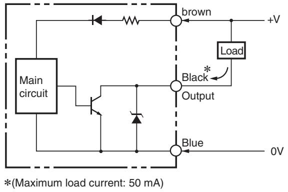
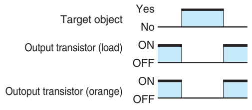
C-3-1 Sensor Specifications

C-3-1. 1 Proximity Switch

Use of OMRON E2S-W13 and E2S-W14

Item	E2S–W13 type	E2S–W14 type
Setting surface	Front face	
Sensing distance	1.6 mm ±15%	
Setting distance	0 to 1.2 mm	
Differential travel	10% max. of sensing distance	
Detectable objects	Ferrous metal	
Standard sensing object	Iron,12 × 12 × 1 mm	
Response frequency	1 kHz min.	
Power supply voltage (operating voltage range)	12 to 24 VDC; ripple (p--p), 10% max (10 to 30 VDC)	
Current consumption	13 mA max. at 24 VDC with no load	
Control output (Switching Capacity)	NPN open collector output, 50 mA max. (30 VDC max.)	
Control output (Residual voltage)	1.0 V max. with a load current of 50 mA and a cable length of 1 m	
Indicator	Operation indicator (orange)	
Operating status (with sensing object approaching)	NO (Normally open contact)	NC (Normally close contact)
Wire lead length	1 000 mm	

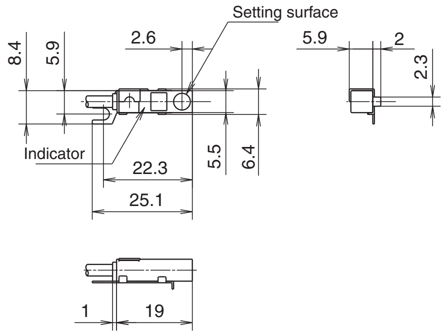
Notes: 1) Take care to avoid errors with sensor wiring.
2) Please contact NSK for PNP output type.

Movement mode	Output type	Type	Time chart	Output circuit
NO	NPN	E2S-W13		
NC		E2S-W14		

E2S-W13 (Normally open contact)

E2S-W14 (Normally close contact)

The external appearances are the same.

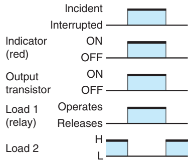
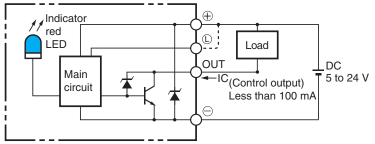
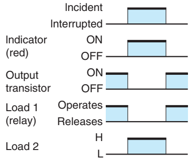


C-3-1. 2 Photo Sensor

Use of OMRON EE-SX674

Item	EE-SX674 type
Slot width	5 mm
Standard reference object	Opaque, 2 × 0.8 mm
Differential distance	0.025 mm
Light source	GaAs infrared LED with peak wavelength of 940 nm
Indicator (without detecting object)	ON GaP red LED (peak emission wavelength, 690 nm)
Supply voltage	5 to 24 VDC ±10%; ripple (p--p), 10% max.
Current consumption	35 mA max.
Control output	NPN open collector output models, 5 to 24 VDC, 100 mA load current
Response frequency	1 kHz max. (3 kHz typ.)
Ambient illumination	Fluorescent light, 1 000 lx max.
Ambient temperature	-25°C to 55°C (-13°F to 131°F) (for operating); -30°C to 80°C (-22°F to 176°F) (for storing)
Ambient humidity	5 to 85% RH (for operating); 5 to 95% RH (for storing)
Connecting method	EE-1001/1006 Connectors, soldering terminals

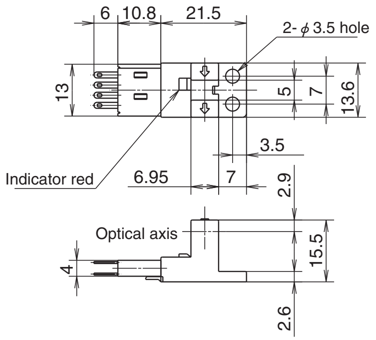
Notes: 1) Take care to avoid errors with sensor wiring.
2) Please contact NSK for PNP output type.

Type	Movement mode	Time chart	Connection terminal	Output circuit
EE-SX674	Light-ON		When terminals L and ⊕ are short circuited	
	Dark-ON		When terminals L and ⊕ are open circuited	

EE-SX674 (Sensor)

EE-1001 (Connector)

A connector is mounted to the sensor in the right figure.



C-3-2 Characteristics and Evaluation Methods

C-3-2. 1 Positioning Accuracy

Perform successive positioning from the reference position in a specific direction. Measure the difference between the actual and desired travel distances for each point from the reference position. Repeat this measurement seven times to determine the average value. Measure such average values over the entire travel distance at the intervals specified for each model and take the maximum difference of the average values determined at respective positions as the measured value.

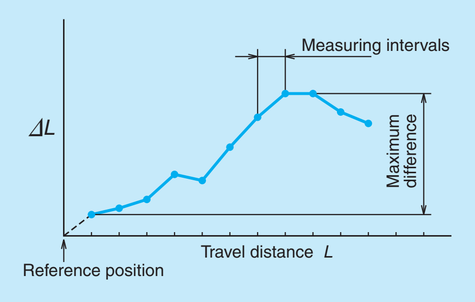


Fig. 1

C-3-2. 2 Repeatability

Repeat positioning at any point seven times from the same direction to measure the stopping position and determine one half of the maximum difference of readings. Repeat this measurement over the entire travel distance at the intervals specified for each model. Take the maximum difference of the determined values as the measured value. Express one half of the maximum difference with a plus-or-minus (±) sign.

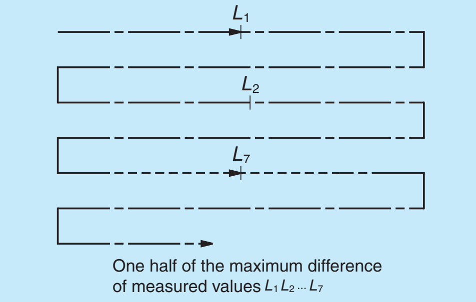


Fig. 2

C-3-2. 3 Running Parallelism (Vertical direction)

We specify the parallelism of slider to the datum bottom surface of rail. An indicator is moved in the axial slider making its stylus slightly touch the rail bottom surface. The slider is moved in the axial direction for the check. We define the total indicator reading as the running parallelism. During the check, the rail is not fixed to the table base. Please be aware that, in general applications, the rail is fixed to the machine base, and thus wobbly rolling error will be added to the running parallelism.

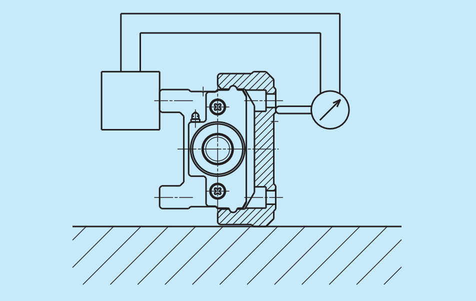


Fig. 3 Setting of indicator

C-3-3 Special Specifications

Please consult NSK if standard products do not meet your requirements.

(1) Surface Treatment

- Fluoride low temperature chrome plating

Note: Ball screw parts (including low temperature chrome plating.)

(2) Special Machining (Processing)

i) Shaft end processing
- Key way processing
- One flat or two flats processing

ii) Pin hole processing
- Slider
- Rail

Note: Due to interference with the internal construction, the position of pin holes is limited. Please consult with NSK about pin positions.

(3) Motor Bracket and Intermediate Plate for Motor Mounting

- We provide motor mounting brackets and intermediate plates that are not listed in the catalog.
- We assemble motors upon request if the motor is provided in advance.

Note: Motion check of the motor is unavailable.

(4) Reversed Motor Mount

A reversed motor mount is available. Please consult NSK.

Notes: 1) We do not check motor running condition.
2) Please refer to the bottom of page C89 to C91 for the configuration of reversed motor mounting for the MCH model.

(5) Right and Left Turn Thread

Right and left turn ball screws are available. Please consult with NSK for available leads.

(6) Ball-Screw-Less Specification (Only Linear Guide Part)

A ball-screw-less rail part with the same cross section of standard Monocarriers is available for a driven linear guide. It will lessen height adjustment work compared with a construction with two standard Monocarriers.

Note: Height grinding adjustment of the two-axis assembly is not available.

C-3-4 Maintenance

C-3-4.1 Maintenance Method

1. For standard Monocarrier actuators we pack grease in the slider, linear guides, and ball screw.
2. Monocarrier actuators are equipped with NSK K1 Lubrication Unit as a standard feature, therefore, you may use it for 5 years or 10 000 km depending on your application, whichever comes first, without maintenance. However, replenishment of grease may extend life substantially.
3. The NSK K1 Lubrication Unit is ideal in environments where oily dust exists. However, the life may be shorter than described in Clause 2 above. Such cases require increasing the frequency of replenishment.
4. A Nozzle for the NSK grease pump for MCH Monocarrier actuators is available as an option. NSK reference number: NSK HGP NZ8

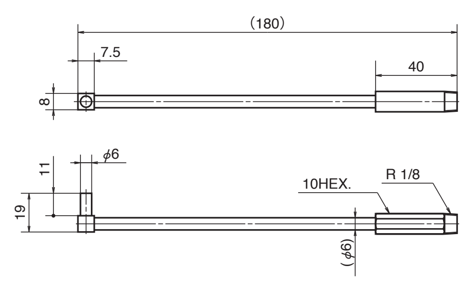


Fig. 4 NSK HGP NZ8

Precautions for handling

1. Please consult with NSK when the motor is coupled to the ball screw using a pulley because there is a restriction on allowable load to the end of ball screw shaft.
2. To extend high performance of NSK K1 lubrication unit, please observe the following.

1. Temperature range	Ambient temperature: 50˚C Max. instantaneous temperature: 80˚C
2. Use of chemicals	Never leave a Monocarrier actuators in close proximity of grease removing organic solvents such as hexane or thinner. Never immerse it in an antirust solvent that contains kerosene.

Note: Other oils, such as water-based and oil based cutting oil, and grease do not cause any problems.

C-3-4. 2 NSK K1™ Lubricant Unit

NSK K1 lubrication units exhibit outstanding features, confirmed by abundant experimental data, along with proven performance of linear guides and ball screws equipped with NSK K1.

(1) High-Speed Durability Test of Linear Guides without Lubricant

Results of high-speed durability testing of a linear guide without lubricant are shown in **Fig. 5** While the linear guide cannot be operated without lubricant for even short periods without damage, installation of the NSK K1 permits the linear guide to run over 25 000 km without any problems.

Conditions	Test piece: LH30AN (Preload Z1)
	Speed: 3.3 m/s
	Stroke: 1 800 mm
No lubricant	All grease removed
NSK K1	All grease removed + NSK K1

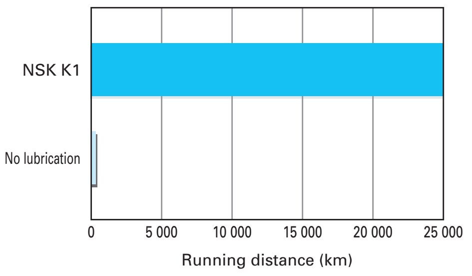


Fig. 5 Results of high-speed durability test of linear guides without lubricant

(2) High-Speed Durability Test of Ball Screws without Lubricant

Results of high-speed durability testing of a ball screw without lubrication are shown in **Fig. 6** While the ball screw cannot be operated without lubricant at 8.5 km without damage, the installation of the NSK K1 permits the ball screw to run over 10 000 km without any problems.

Conditions	Test piece: BS2020 (Ball screw)
	Shaft diameter: 20 mm
	Lead: 20 mm
	Load: none
	Speed: 1.3 m/s (4 000 min^{-1})
	Stroke: 600 mm
No lubricant	All grease removed
NSK K1	All grease removed + NSK K1

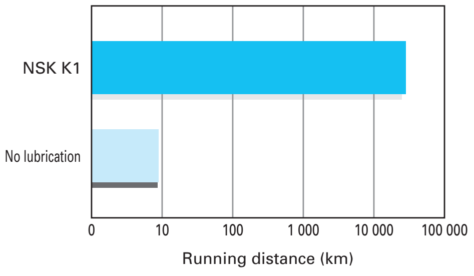


Fig. 6 Results of high-speed durability test of ball screws without lubricant

●NSK K1 Lubrication Units for food processing and medical devices are available.

For safe food processing and medical care, NSK provides Monocarrier actuators equipped with special NSK K1 Lubrication Units made of materials approved by the FDA.

Dimensions are the same as the standard NSK K1 Lubrication Unit, and special handling is not required.

C-3-5 NSK Clean Grease LG2 Specification

● Features

This grease was developed by NSK to be exclusively used for linear guides and ball screws in cleanrooms. Compared to fluoride grease commonly used in clean rooms, LG2 has several advantages such as: higher lubrication function, longer lubrication life, more stable torque (resistant to wear), and higher rust prevention.

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

● Applications

LG2 is lubrication grease for rolling contact machine components such as linear guides and ball screws for processing equipment for semiconductors and flat panel display which require highly clean environments at normal pressure in normal temperatures. It cannot be used in a vacuum environment.

● 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 plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.8% (100°C, 24 hr)
Base oil kinematic Viscosity	32 mm²/s (40°C)

Other

Other

1 Special Environments

1.1 Specifications for Special Environments

1. Linear guide

Table 1.1 Linear guide specifications

Environment	Condition	NSK linear guide specifications				Technical Explanation Page No.
		Rail, slide	Steel balls/rollers	Ball recirculation component	Lubrication/surface treatment	
Cleanroom	Atmosphere, normal temperature	Standard material	Standard material	Standard material	LG2, LGU Grease	D8
					NSK K1-L/K1 lubrication unit	A58
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	LG2, LGU Grease	D8
					NSK K1-L/K1 lubrication unit	A58
					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
Corrosive	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		
		Martensitic stainless steel	Martensitic stainless steel			
	Acid, alkali, clean				Fluoride low temperature chrome plating	D5
					LG2, 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	
Radioactive	Atmosphere	Standard material	Standard material	Standard material	Radiation resistant grease	
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		
Foreign matter	Fine particles, wooden chips	Standard material	Standard material	Standard material	NSK K1-L/K1 lubrication unit	A58
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		
	Water, under water		Standard material	Standard material		
			Martensitic stainless steel	Austenitic stainless steel		

2. Ball screw

Table 1.2 Ball screw specifications

Environment	Condition	NSK Ball screw specification				Technical Explanation Page No.
		Screw shaft, ball nut	Steel balls	Ball Recirculation component	Lubrication/surface treatment	
Cleanroom	Atmosphere, normal temperature	Standard material	Standard material	Standard material	LG2, LGU Grease	D8
					NSK K1 lubrication unit	B559
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	LG2, LGU Grease	D8
					NSK K1 lubrication unit	B559
					Fluoride low temperature chrome plating	D5
	Atmosphere-Vacuum, normal temperature				Fluoride grease	
	Atmosphere-Vacuum up to 200°C					
	Atmosphere-Vacuum up to 200°C, Corrosion resistant	Ceramic	Ceramic	Ceramic	Fluoride grease	
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
Corrosive	Acid, alkali, clean	Standard material	Standard material	Austenitic stainless steel	Fluoride low temperature chrome plating	D5
		Martensitic stainless steel	Martensitic stainless steel			
		Precipitation hardening stainless steel	Precipitation hardening stainless steel		Fluoride grease	
	Strong acid, strong alkali, clean, nonmagnetic	Ceramic	Ceramic			
Nonmagnetic	Atmosphere-Vacuum, clean	Special austenitic stainless steel	Ceramic	Austenitic stainless steel	Fluoride grease	
	Atmosphere-Vacuum, up to 200°C, clean	Ceramic			Fluoroplastic	
High temperature	Atmosphere up to 200°C	Standard material	Standard material	Austenitic stainless steel	Fluoride grease	
	Atmosphere up to 200°C	Martensitic stainless steel	Martensitic stainless steel		Fluoride low temperature chrome plating	D5
	Atmosphere up to 500°C, corrosion resistance	Ceramic	Ceramic		Fluoride grease	
Low temperature	-273°C and higher	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Solid lubricant	
Radioactive	Atmosphere	Standard material	Standard material	Standard material	Radiation resistant grease	
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		
Foreign matter	Fine particles, wooden chips	Standard material	Standard material	Standard material	NSK K1 lubrication unit	B559
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		
	Water, under water					

1.2 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.

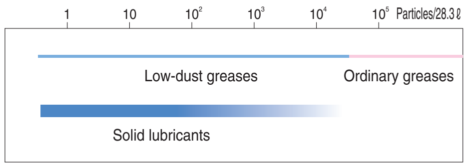


Fig. 2.1 Lubrication in clean environment

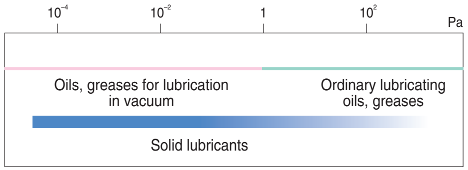


Fig. 2.2 Lubrication in vacuum

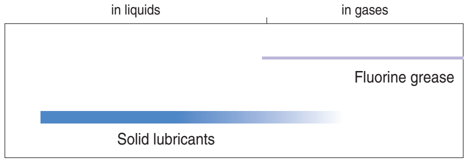


Fig. 2.3 Lubrication in corrosive environment

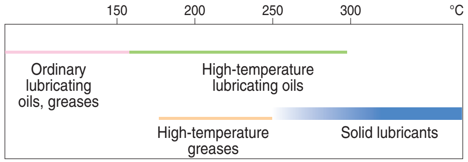


Fig. 2.4 Lubrication in high temperature

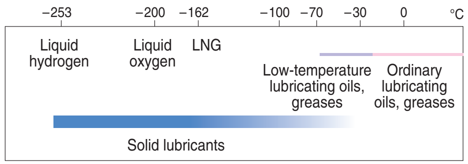


Fig. 2.5 Lubrication in low temperature

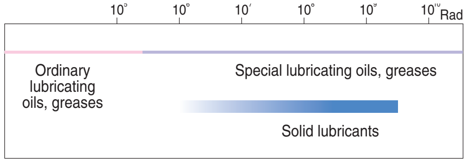


Fig. 2.6 Lubrication in radioactive environment

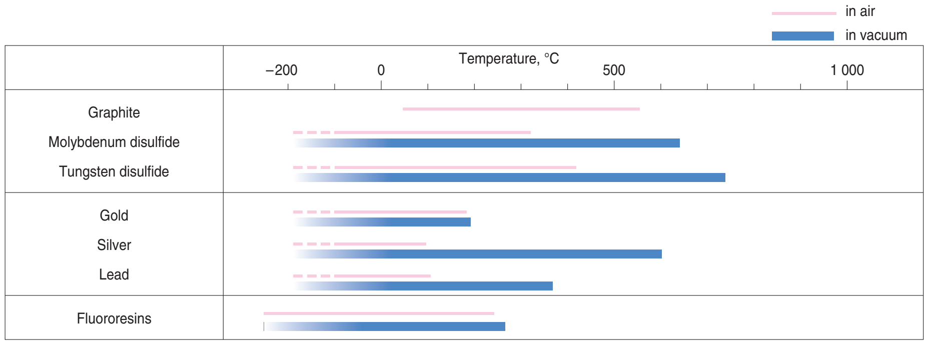


Fig. 2.7 Temperature range for using solid lubricants

2. Materials

Iron 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 2.1 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 hardening 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.

1.3 Rust Prevention and Surface Treatment

1. Fluoride low temperature chrome plating

NSK linear guides, ball screws, and Monocarrier/Toughcarrier actuators are used in various applications and environments, from industrial machinery to semiconductor/FPD manufacturing and aerospace equipment. Preventing rust from developing in these applications is crucial, particularly for machines around water such as part/device washers and for semiconductor/FPD manufacturing equipment involved in chemical wet processing. NSK applies a fluororesin coating to an electrolytic black plating (fluoride low-temperature chrome plating) on these products for optimal rust resistance.

● What is "Fluoride low temperature chrome plating?"

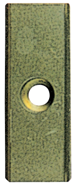
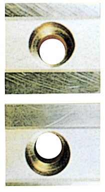
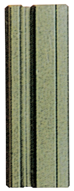
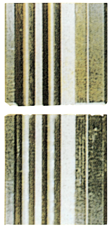
This type of black chrome plating forms a black film (1 to 2 μm in thickness) on the metal surface. Fluoroplastic coating is added to the film to increase corrosion resistance.

- 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.

Do not use organic solvent because it adversely affects antirust property of the plating.

● Humidity chamber test

Table 3.1 Results of the humidity test

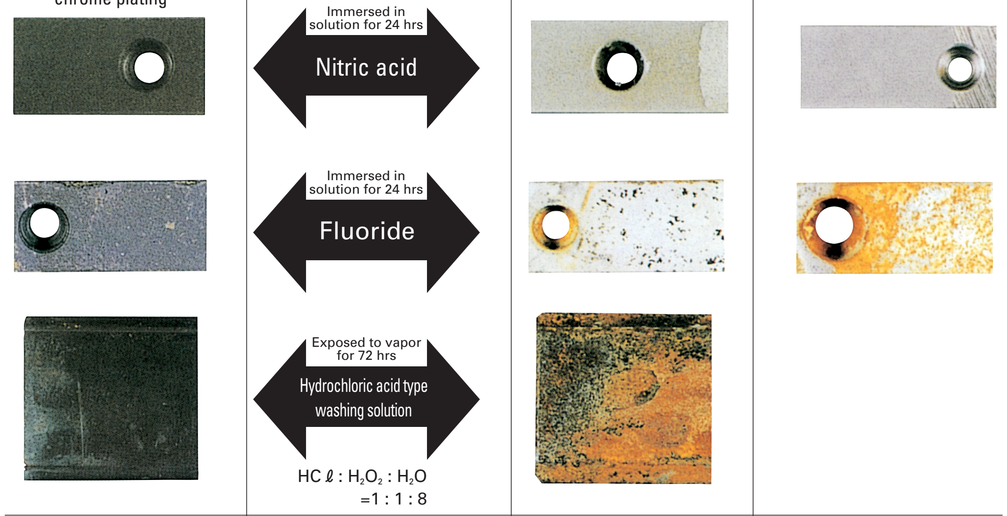
Test sample Characteristic			Fluoride low temperature chrome plating (recommended)	Hard chrome plating (reference)	Electroless nickel plating (reference)	Equivalent to SUS440C material	Standard steel
Corrosion-resistant property	Rusting	Top	(Ground) B	(Ground) B	(Ground) A	(Ground) C	(Ground) D
		Side	(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" condition of the temperature and the humidity conditions 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 3.2 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	None surface treatment
○	Hydrochloric acid (immersed)	○	▲
○	Sulfuric acid (immersed)	○	X
○	Ammonia or sodium hydroxide	○	△

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

● Surface treatment durability test

Peeling resistamce of surface treatment

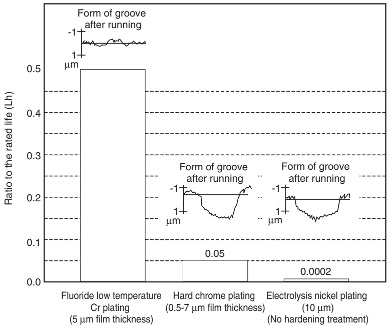


Fig. 3.1 Results of durability test

● Total evaluation

Table 3.3 Evaluation

	Available length	Rust prevention ability	Quality stability	Durability	Cost
Fluoride low temperature chrome plating	◎ (4 m)	◎	○	◎	◎
Hard chrome plating	△ (2 m)	○	X	△	△
Electroless nickel plating	◎ (4 m)	◎	△	X	△
Material equivalent to SUS440C	○ (3.5 m)	○	◎	◎	△

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

1.4 Measures Against Special Environments

1. In vacuum

● Silver-film plated ball screw

Ball screws that are plated by soft metal (special silver film) as a solid lubricant are developed the application for vacuum environment such as semiconductor manufacturing equipment and surface modification systems.

● Durability test in high vacuum

Test equipment and conditions

Table 4.1 shows ball screw specifications. **Fig. 4.1** is a schematic of the testing system in vacuum chamber. **Table 4.2** shows testing conditions.

Table 4.1 Ball screw specifications

Shaft diameter		12 mm
Lead		4 mm
Steel ball diameter		2.381 mm
Numbers of circuit of balls		2.5 turns, 1 circuit
Axis load (preload)		29.4 N
Maximum surface pressure (preload volume)		about 690 MPa
Material	Shaft	SUS630
	Nut	SUS440C
	Ball tube	SUS304
	Steel balls	SUS440C
Solid lubricant		Special silver film

Table 4.2 Testing conditions

Rotational speed	300 min^{-1}
Vacuum chamber pressure	1.3×10^{-5} – 1.3×10^{-6} Pa
Stroke	160 mm

Evaluation method

It is understood that the rolling bearing with solid lubrication reaches end of life when the lubrication film deteriorates, resulting in sudden rise of friction torque. In this test, ball screw rotation torque was constantly measured to study durability and operation. Results were then evaluated.

Test results

Fig. 4.2 shows two distinctive examples obtained in the torque characteristic test.

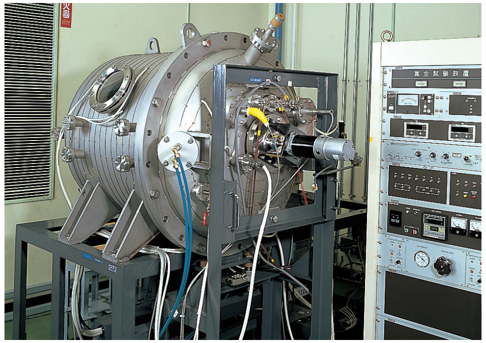


Photo 4.1 Vacuum testing system

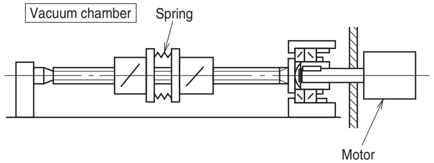


Fig. 4.1 Schematic of the testing system

Test results of the ball screw (a)

The torque tendency was stable until about 1×10^7 rev. Then the torque characteristics slightly deteriorated. At about 1.35×10^7 rev, the torque suddenly rose. At this point, it was determined that the ball screw reached the end of its life.

Test results of the ball screw (b)

Torque value is a little higher in the test (a). The value is also little unstable. The torque momentarily soared several times during the test (some 10 N·cm). It is thought this is attributable to the repeated peeling/sticking of the surface film made of soft metal (silver, etc.).

When the torque finally soared at 1.13×10^7 rev., it was determined that the ball screw reached the end of its life.

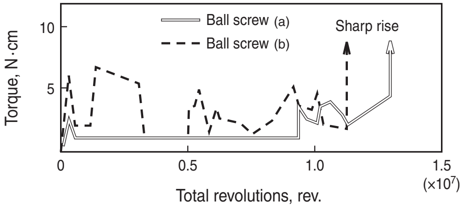


Fig. 4.2 Torque variation

Table 4.3 Ball screw durability

Classification		Ball screw (a)	Ball screw (b)
Life	Total revolutions (rev.)	1.35×10^7	1.13×10^7
	Total traveling distance (km)	54.0	45.2
	Total traveling hours* (h)	750	628

*) Total traveling hours when operated constantly at 300 min^{-1}

Conclusion

Table 4.3 explains results of the two ball screw durability tests.

From these results and other findings, it is estimated that a life of more than 1×10^7 rev. is possible with a load of about 29.4 N.

Torque may soar momentarily before the ball screw reaches its final life due to peeling/sticking of the surface film made of soft metal like silver. For this reason, it is recommendable to select a drive motor with extra torque capacity.

2. Clean environment

● NSK Clean Grease LG2 and LGU

LG2 and LGU "clean" greases are utilized for low-dust specifications of NSK products such as linear guides, ball screws, Monocarriers, Megatorque Motors, XY modules and XY tables. These greases are excellent for cleanrooms thanks to their lower particle emissions and better resistance to corrosion than fluorine greases. Their proven track record makes them particularly suitable for semiconductor production equipment.

Features

- ● **Remarkably low dust emission**
- ● **Long life -- More than ten times longer than fluoride greases, and equivalent to ordinary greases.**
- ● **Excellent rust prevention -- Significantly higher capacity than fluorine greases.**
- ● **Low and stable torque -- 20% or less than that of fluorine greases**

Table 4.4 Nature of Clean Grease LG2 and LGU

Name	Thickener	Base oil	Base oil kinematic viscosity mm²/s (40°C)	Consistency	Dropping point °C
Clean Grease LG2	Lithium soap	Synthetic hydrocarbon oil + mineral oil	32	199	201
Clean Grease LGU	Diurea	Synthetic hydrocarbon oil	95.8	201	260

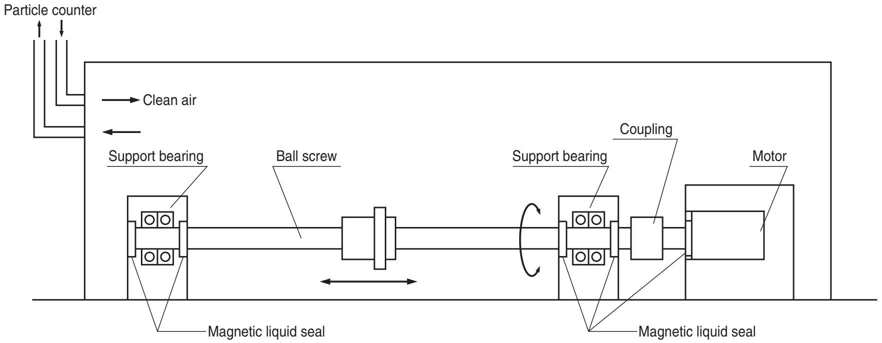


Fig. 4.3 Setting to measure dust generated by ball screw

● Feature 1: Remarkably low dust emission

Compared with fluoride greases, dust emission by LG2 is low and stable for long period of time.

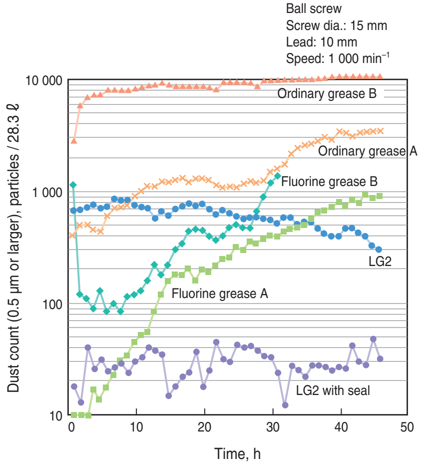


Fig. 4.4 Comparison in dust emission characteristics

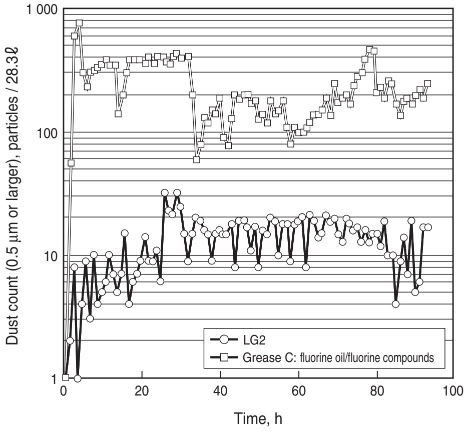


Fig. 4.5 Dust emission from linear guide (Linear guide: LU09)

● Feature 2: Long life

Life is ten times or longer than fluorine greases, and equivalent to ordinary greases. This stretches maintenance intervals.

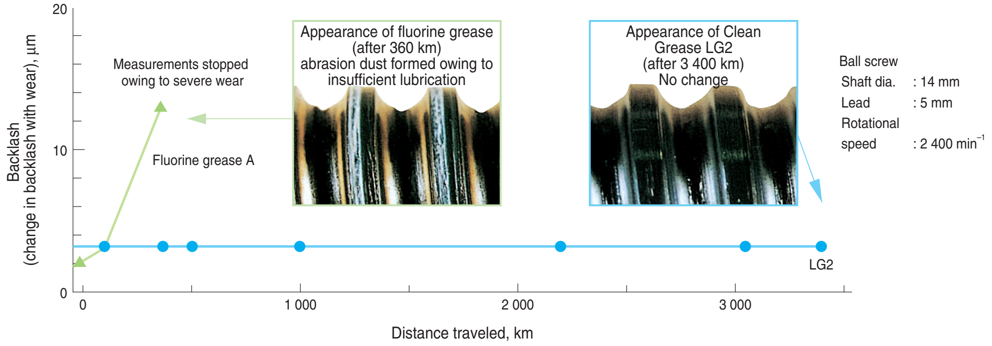
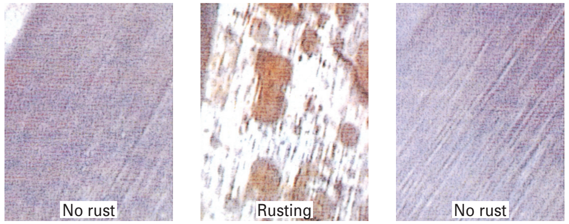


Fig. 4.6 Results of ball screw durability test

●Feature 3: Excellent rust prevention capacity

The rust prevention capacity is significantly higher than fluoride greases. Handling and preparation for operation are easy.

Ball screw rust prevention test (test conditions: 96 hr at humidity 95%, temperature 70°C)



Clean Grease LG2 Fluorine grease A Ordinary grease A

Photo 4.2

Table 4.5 Rust prevention test on bearing

Type	Rusting after 7 days
NSK Clean Grease LG2	No rust
Fluorine grease B	Rusted

Test conditions : 19 mg is sealed in ball bearing 695

: Temp. 90°C, Humidity 60%

Evaluation : Studied by microscope

● Feature 4: Stable torque

Torque is 20% or lower than fluorine greases.

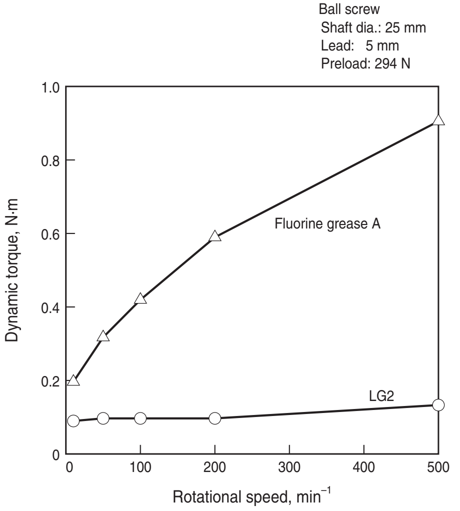


Fig. 4.7 Comparison of torque characteristics

● Total evaluation

Table 4.6 Evaluation

Characteristic	LG2	Fluorine grease	General grease
Dust generation	○	○ – △	△ – X
Torque	○	X	○ – △
Durability	○	△ – X	○
Rust prevention ability	○	△ – X	○

○: Suitable △: Not very suitable X: Problem in use

3. Environment with foreign matters

● NSK Linear Guides Dust-resistant VH model

High-performance end seals with a multi-lip structure prevent the entry of various kinds of foreign matter. The VH model is equipped with the NSK K1-L™ lubrication unit as standard. The outstanding lubrication support provided by NSK K1-L units further improves resistance to dust and durability.
For NSK Linear Guides dust-resistant VH model, refer to page A127. For NSK Linear Guides dust-resistant DV model, refer to page A203.

And For lubrication unit NSK K1-L, refer to the catalog "NSK Linear Guides™ NSK K1-L Lubrication Unit" (CAT No.E3335).

● RA model: Specification with highly dust-resistant V1 seals

RA25, RA30, RA35, RA45, RA55, and RA65 have specifications featuring dust-resistant V1 end seals with enhanced abrasion resistance. Refer to the catalog "NSK Linear Guides Roller Guide with highly dust-resistant V1 seals and V1 bottom seals" (CAT No.E3334).

1.5 Comptability With Special Environments

1. Linear guides

Model	Model No.	Special environment which linear guide can tolerate					
		Cleanroom	Vacuum	Corrosive	High-temperature	Hygienic	Dust-contaminated
NH	NH15	○		○		○	
	NH20	○	○	○	○	○	
	NH25	○	○	○	○	○	
	NH30	○	○	○	○	○	
	NH35	○		○	○	○	
	NH45	○		○	○		
	NH55	○		○			
	NH65	○		○			
VH	VH15	○		○			○
	VH20	○		○			○
	VH25	○		○			○
	VH30	○		○			○
	VH35	○		○			○
	VH45	○		○			○
	VH55	○		○			○
NS	NS15	○	○	○	○	○	
	NS20	○	○	○	○	○	
	NS25	○	○	○	○	○	
	NS30	○	○	○	○*	○	
	NS35	○		○		○	
LW	LW17	○		○	○*	○	
	LW21	○		○	○*	○	
	LW27	○		○	○	○	
	LW35	○		○		○	
	LW50	○		○			
DH	DH15	○		○		○	
	DH20	○		○		○	
	DH25	○		○		○	
	DH30	○		○		○	
	DH35	○		○		○	
	DH45	○		○			
	DH55	○		○			
	DH65	○		○			
DV	DV15	○		○			○
	DV20	○		○			○
	DV25	○		○			○
	DV30	○		○			○
	DV35	○		○			○
	DV45	○		○			○
	DV55	○		○			○
DS	DS15	○		○		○	
	DS20	○		○		○	
	DS25	○		○		○	
	DS30	○		○		○	
	DS35	○		○		○	

*) Dust-resistant parts for these models are not compatible with high temperatures.

Model	Model No.	Special environment which linear guide can tolerate					
		Cleanroom	Vacuum	Corrosive	High-temperature	Hygienic	Dust-contaminated
PU	PU09	○		○		○	
	PU12	○		○		○	
	PU15	○		○		○	
LU	LU05	○		○			
	LU07	○		○			
	LU09_L	○	○	○	○	○	
	LU09_R	○		○		○	
	LU12_L	○	○	○	○	○	
	LU12_R	○		○		○	
	LU15	○	○	○	○*	○	
PE	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	○		○			
RB	RB30	○		○			
	RB35	○		○			
	RB45	○		○			
	RB55	○		○			
	RB65	○		○			
LA	LA25	○		○			
	LA30	○		○			
	LA35	○		○			
	LA45	○		○			
	LA55	○		○			
	LA65	○		○			
HA	HA25	○		○			
	HA30	○		○			
	HA35	○		○			
	HA45	○		○			
	HA55	○		○			
HS	HS15	○		○			
	HS20	○		○			
	HS25	○		○			
	HS30	○		○			
	HS35	○		○			

2. Ball screws

Model	Special environment				
	Clean	Vacuum	Rust prevention	High temp.	Foreign matter
KA Model	○	○	○		
For Contaminated environments VSS Type					○
Made-to-order ball screw	○*	○*	○*	○*	○*

*Available for made-to-order ball screws.
Please consult NSK.

3. Monocarriers

Please consult with NSK for special environmental use.

1.6 Precautions for Handling

Please observe the following precautions to maintain ball screw and linear guide perfomance in special environments over a long period.

- 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 ball slide (interchangeable linear guide) and ball nut (R model ball screw) in a clean, air-tight container such as desiccater with desiccating agent (e.g. silica gel). Do not apply rust preventive oil or paper or product that vaporizes rust preventive agents.
- Wear plastic gloves and handle products in clean place.

2. Lubrication

There are two types of lubricating methods -- grease and oil -- for NSK linear products.

Use a lubricant agent and method most suitable to condition requirements and purpose to optimize the functions of the ball screw, linear guide, or Monocarrier. Note that Monocarriers typically use grease.

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, low speeds, and high temperatures.

The following provides more details on grease and oil lubrication methods.

2.1 Grease Lubrication

Grease lubrication is widely used because it does not require a special oil supply system or piping. Grease lubricants made by NSK include:

- Various types of grease in bellows tubes that can be instantly attached to a grease pump;
- NSK Grease Units that consist of a hand grease pump and various nozzles. They are compact and easy to use.

1. NSK grease lubricants

Table 1.1 shows the marketed general grease widely used for linear guides, ball screws and monocarrier for specific uses, conditions and purposes.

Table 1.1 Grease lubricant for linear guides, ball screws, and monocarriers

Type	Thickener	Base oil	Base oil kinematic viscosity mm^2/s (40°C)	Range of use temperature (°C)	Purpose
AS2	Lithium	Mineral oil	130	–10 to 110	For general use at high load
PS2	Lithium	Synthetic oil + synthetic hydrocarbon oil	15.9	–50 to 110	For low temperature and high frequency operation
LR3	Lithium	Synthetic oil	30	–30 to 130	For high speed, medium load
LG2	Lithium	Mineral oil + synthetic hydrocarbon oil	32	–20 to 70	For claeanroom environments
LGU	Diurea	Synthetic hydrocarbon oil	95.8	–30 to 120	For claeanroom environments
NF2	Urea	Synthetic hydrocarbon oil	26	–40 to 100	For fretting resistance

(1) NSK Grease AS2

● Features

An environmentally friendly and widely used grease for high load applications. AS2 is a mineral oil based grease containing lithium thickener and several additives. It is superb in load resistance as well as stable against 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, AS2 resists softening and grease loss.

● Application

AS2 is a standard grease for general NSK linear guides, ball screws and monocarriers. It is prevalently used in many applications because of its high base oil viscosity, high load resistance, and stability against 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 plate 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 LR3

● Features

LR3 contains a special synthetic oil for high temperatures and stability, and a carefully selected anti-oxidation agent. This grease dramatically increases lubrication life under high temperature conditions. It is used for high speed and medium loads. Lubrication life exceeded 2 000 hours in the endurance test at 150°C. Its rust prevention capacity in severe conditions such as water and moist environments is further strengthened.

● Application

LR3 is a standard grease for PSS model (shaft dia. 15 mm or over), FSS model, FA model (except shaft dia. 10 mm with lead of 4 mm and shaft dia. 12 mm with lead of 5 mm) and VFA model ball screws. It is ideal for operation with medium load at high speeds such as positioning in high tact material handling equipment.

● Nature

Thickener	Lithium soap base
Base oil	Synthetic oil
Consistency	228
Dropping point	208°C
Volume of evaporation	0.58% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	1.9% (100°C, 24 hr)
Base oil kinematic viscosity	30 mm^2/s (40°C)

(3) NSK Grease PS2

● Features

The major base oil component is synthetic oil with mineral oil. PS2 is excellent for low-temperature operation and suits high-speed and light-load applications.

● Application

PS2 is a standard grease for NSK miniature linear guides and ball screws. 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 plate 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)

(4) NSK Grease LG2

● Features

This grease was developed by NSK to be exclusively used for linear guides, ball screws, and Monocarriers in cleanrooms. Compared to fluorine grease which are commonly used in cleanrooms, LG2 has several advantages such as:

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

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

● Application

LG2 is a lubrication grease for rolling element products such as linear guides, ball screws, and Monocarriers for semiconductor and flat panel display (FPD) processing equipment which require a highly clean environment. Because LG2 is exclusively for cleanroom environments at normal temperatures, however, it cannot be used in a vacuum environment. Refer to "Special environment" on page D8 for detailed data on the 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 plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.8% (100°C, 24 hr)
Base oil kinematic viscosity	32 mm²/s (40°C)

(5) NSK Grease LGU

● Features

This is a proprietary urea base grease of NSK featuring low dust emissions exclusively for linear guides, ball screws, and Monocarriers used in cleanrooms.

In comparison with fluorine base grease, which has been used commonly in cleanrooms, LGU has better lubricating properties, longer duration of lubricant, better torque variation, much better anti-rust properties, and equivalent or better dust emissions. 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 fewer metallic elements compared to LG2 grease. It can be used in high temperature environments.

● Application

This is exclusive lubrication grease for linear guides, ball screws, and Monocarriers installed in equipment that requires cleanliness like LG2 grease, and it can be used in temperatures –30 to 120°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 plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.6% (100°C, 24 hr)
Base oil kinematic viscosity	95.8 mm²/s (40°C)

(6) NSK Grease NF2

● Features

NF2 uses high-grade synthetic oil as the base oil and urea base organic compound as the thickener. It has remarkable anti-fretting properties. It can be used in a wide temperature range and has superior lubrication life.

● Application

This grease is suitable for ball screws and linear guides applications with oscillating operations. Allowable temperature range is –40 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 plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.5% (100°C, 24 hr)
Base oil kinematic viscosity	26 mm²/s (40°C)

● Precautions for handling

- Wash the linear guides and ball screws to remove oil prior to applying Clean Grease LG2 or LGU, so the grease functions are fully utilized.
- Clean grease is exclusively used for cleanroom environments at normal temperatures.

Note) Refer to NSK Grease Unit Catalog (CAT. No.3317) for details of NSK Grease.

2. Before use of NSK Precision Products

Wipe off the rust preventive oil before use.

If grease is not applied, apply grease, and move ball slide or ball nut a few strokes so the grease permeates into the ball slide and inside the nut. (Move the ball slide or the ball nut 5 to 10 times with full stroke.)

Then wipe off the excess grease.

3. How to replenish grease and volume of grease to be replenished

Use a grease fitting if an exclusive grease supply component is not used. Supply the required amount through grease fitting by a grease pump.

Wipe off old grease and accumulated dust before supplying new grease. If grease fitting is not used or there is no oil filler due to size limitations, apply grease directly to the rail or to the ball groove of the screw shaft. Remove the seal if possible, move a ball slide or ball nut a few strokes so that the grease permeates into the ball slide, nut and inside the slide.

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 replenishing using a grease pump:

Use a grease pump and fill the inside of ball slide, ball nut and monocarrier slider with grease. Supply grease until it comes out from the ball slide, ball nut or monocarrier slider area. Move ball slide, ball nut or monocarrier slider by hand while filling them with grease, so the grease permeates all areas. Do not operate the machine immediately after replenishing. Always try the system a few times to spread the grease throughout the system and to remove excess grease. Trial operations are necessary because the resistance to sliding force and screw torque greatly increases immediately after replenishment (full-pack state) and may cause problems. The agitating resistance of grease is responsible for this phenomenon. Wipe off excess grease that accumulates at end of rail and screw shaft after trial runs so the grease does not move to other areas.

* 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 ball slide or the internal space of the ball nut. This method eliminates waste of grease and is efficient.

Tables 1.2, **1.3** and **1.4** show internal spaces of ball slide, ball nut and monocarrier slider for reference.

Table 1.2 Internal space of the slide of linear guide

NH, DH Models

Unit: cm^3

Model	NH, DH	
Model No.	High-load type	Super-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

PU, LU Models

Unit: cm^3

Model	PU		LU	
Model No.	Standard type	High-load type	Standard type	High-load type
05	–	–	0.1	–
07	–	–	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

VH, DV Models

Unit: cm^3

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

PE, LE Models

Unit: cm^3

Model	PE		LE		
Model No.	Standard type	High-load type	Medium-load type	Standard type	High-load type
05	–	–	0.1	0.1	–
07	–	–	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

NS, DS Models

Unit: cm^3

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

Miniature LH Model

Unit: cm^3

Model Model No.	LH
08	0.2
10	0.4
12	1.2

LW Model

Unit: cm^3

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

RA Model

Unit: cm^3

Model	RA	
Model No.	High-load type	Super-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

RB Model

Unit: cm^3

Model	RB	
Model No.	High-load type	Super-high-load type
30	5	6
35	6	8
45	10	13
55	15	20
65	33	42

LA Model

Unit: cm^3

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

HA, HS Models

Unit: cm^3

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

Table 1.3 Inside space of ball nut

Tube recirculation (single nut)

Unit: cm^3

Nut model	Inside space
1004 – 2.5	0.8
1205 – 2.5	1.2
1210 – 2.5	1.4
1405 – 2.5	2.2
1408 – 2.5	2.1
1510 – 2.5	2.3
1605 – 2.5	2.6
1616 – 1.5	2.1
2004 – 5	2.7
2005 – 5	4.3
2010 – 2.5	4.7
2020 – 1.5	4.2
2504 – 5	3.2
2505 – 5	5
2506 – 5	7
2510 – 3	9.5
2520 – 2.5	12
2525 – 1.5	7.5
2805 – 5	6
2805 – 10	9
2806 – 5	6
2806 – 10	9.5
3205 – 5	7
3206 – 5	9.5
3210 – 5	22
3225 – 2.5	17
3232 – 1.5	15
3610 – 5	32
4005 – 10	14
4010 – 5	30
4012 – 5	34
4510 – 5	34
5010 – 5	37
5010 – 10	59

Deflector (bridge) recirculation (single nut)

Unit: cm^3

Nut model	Inside space
2505 – 6	6.5
2510 – 4	10
3205 – 8	9.5
3210 – 6	28
4010 – 8	42
5010 – 8	52

End cap recirculation

Unit: cm^3

Nut model	Inside space
1520 – 1.5	1.9
1632 – 1	2
2040 – 1	2.8
2550 – 1	4.2

Note:

Nut model: shaft diameter, lead, total ball turns

Please consult NSK for other specifications.

Refer to B110 to B146 for Compact FA Model.

Table 1.4 Monocarrier slide internal space

MCM Model

Unit: cm^3

Model No.	Lead (mm)	Internal Space
MCM02	1	0.3
	2	0.3
MCM03	1	1
	2	0.9
	10	1.8
	12	1.7
MCM05	5	4.2
	10	4
	20	2.1
	30	2.0

Unit: cm^3

Model No.	Lead (mm)	Internal Space
MCM06	5	8.3
	10	6.5
	20	5.5
MCM08	5	11.6
	10	9.8
	20	8.7
	30	4.3
MCM10	10	19.4
	20	17.4
	30	8.8

MCH Model

Unit: cm^3

Model No.	Lead (mm)	Internal Space
MCH06 MCL06	5	2.8
	10	2.7
	20	2.7
MCH09	5	5.8
	10	5.8
	20	5.6
MCH10	10	10.9
	20	10.1

4. Intervals of checks and replenishments

Even high-quality grease gradually deteriorates and loses its lubricating functionality. Additionally, grease in the slide and ball nut is gradually removed by stroke movement. In some environments, the grease may become dirty and foreign matter may enter the slide and the ball nut. New grease should be supplied depending on the frequency of use. The following is a guide of intervals of grease replenishment for linear guides and ball screws.

Table 1.5 Intervals of checks and replenishments for grease lubrication

Intervals of checks	Items to check	Intervals of replenishments
3-6 months	Dirt, foreign matters such as cutting chips	Usually once per year. Every 3 000 km for material handling system that travels more than 3 000 km per year. Replenish if check results warrant it necessary.

Notes: 1) As a general rule, do not mix greases of different brands.
2) Grease viscosity varies by temperature. Viscosity is particularly high in winter due to low temperatures. Pay attention to increases in linear guide and monocarrier sliding resistance and ball screw and monocarrier torque in such conditions.
3) When the ambient temperature is low, or in Winter, if it is difficult to pump out the grease from the container, wait until the grease is softened.
4) In locations where coolant is dispersed or scattered, emulsification of lubricants and rinsing with water may significantly deteriorate the integrity of the lubricant and efficiency of the grease. Protect the grease unit from coolant by shielding it with a cover, etc.

5. NSK Grease Unit

Easily supply grease to NSK linear products with this manual grease pump by simply attaching a bellows tube filled with grease. We offer several types of grease (80 g) to suit your needs.

Grease in bellows tube

(1) Composition of NSK Grease Unit

Components and grease types are shown below.

NSK Grease Unit	Name	(Tube color)	Reference number
NSK Grease (80 g in a bellows tube)	NSK Grease AS2	(Brown)	NSK GRS AS2
	NSK Grease PS2	(Orange)	NSK GRS PS2
	NSK Grease LR3	(Green)	NSK GRS LR3
	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 hand pump.)		NSK HGP
	Grease nozzle (used with hand grease pump)		
	NSK straight nozzle		NSK HGP NZ1
	NSK chuck nozzle		NSK HGP NZ2
	NSK drive-in 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
	NSK nozzle for MCH		NSK HGP NZ8

(2) NSK Grease (80 g in bellows tube)

Refer to pages D14 and D15 for characteristics and other details.

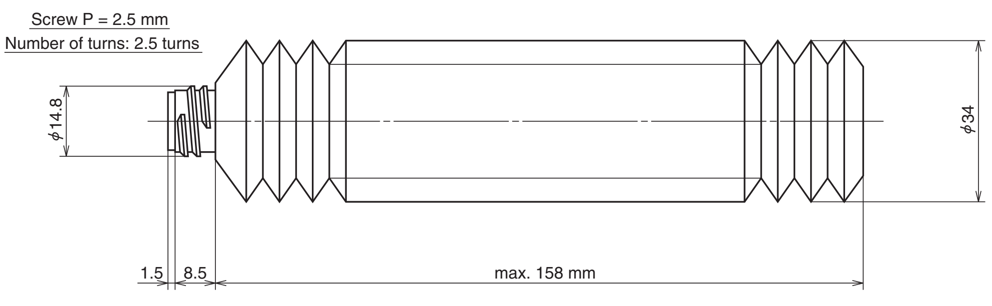


Fig. 1.1 Bellows tube

(3) NSK Manual Grease Pump Unit

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

● **Features**

- Light-weight ·········· Can be operated by one hand, 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 ······ Six types of nozzles to choose from.

● **Specifications**

- Discharge pressure ·· 15 Mpa
- Spout volume ········ 0.35 cc/shot
- Mass of main body ···Without nozzle 240 g
  Provided nozzle 90 g
- Grease tube outer diameter ϕ38.1
- Accessory·············· Several nozzles for unique applications can be attached

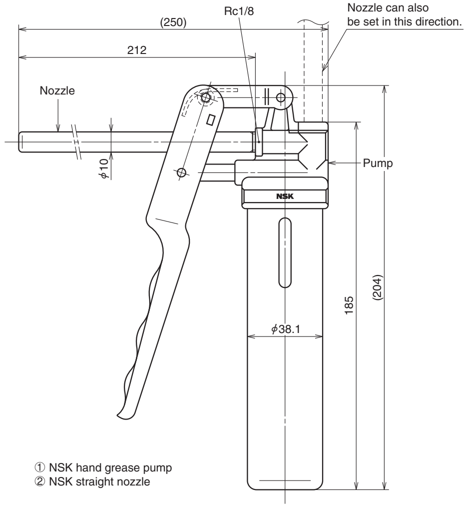
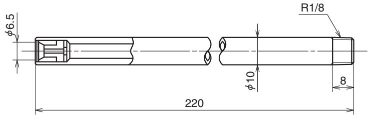
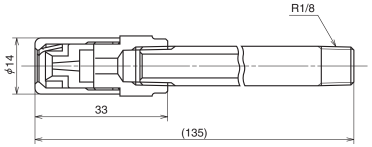
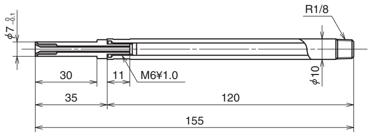
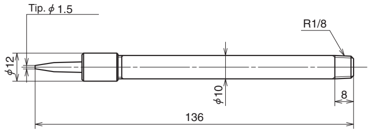
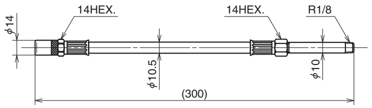
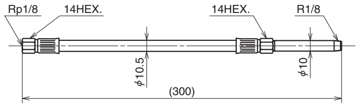
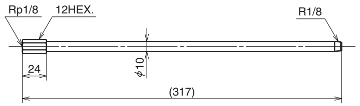
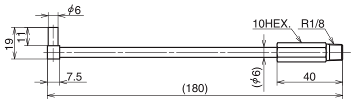


Fig. 1.2 NSK Hand Grease Pump with NSK straight nozzle

*Unopened bellows tubes contain a small amount of air that may take several dozen pumps to flush out. Be sure to pump out all air from the bellows tube before use.

b) Nozzles

Table 1.6 Nozzles that can be attached to NSK Hand Grease Pumps

Name	Designation code	Use	Dimensions
NSK straight nozzle	NSK HGP NZ1	Application Used with grease fittings A, B, and C under the JIS B1575 standard.	
NSK chuck nozzle	NSK HGP NZ2	Same as above except the nozzle and fitting are coupled by a chucking mechanism at the tip that makes pressing the pump unnecessary.	
NSK drive-in fitting nozzle	NSK HGP NZ3	Exclusively used with the -φ3 drive-in grease fitting.	
NSK point nozzle	NSK HGP NZ4	Used for linear guides that do not have a grease fitting. Supplies grease directly to the ball grooves or to the inside through an opening in the slide.	
NSK flexible nozzle	NSK HGP NZ5	Features a flexible chuck nozzle. Used where straight nozzles can't be used.	
NSK flexible extension pipe	NSK HGP NZ6	Used for longer reach. A flexible extension pipe connects the grease pump and nozzle.	
NSK straight extension pipe	NSK HGP NZ7	Used for longer reach. A straight extension pipe connects the grease pump and nozzle.	
NSK nozzle for MCH	NSK HGP NZ8	For MCH Model grease replenishment	

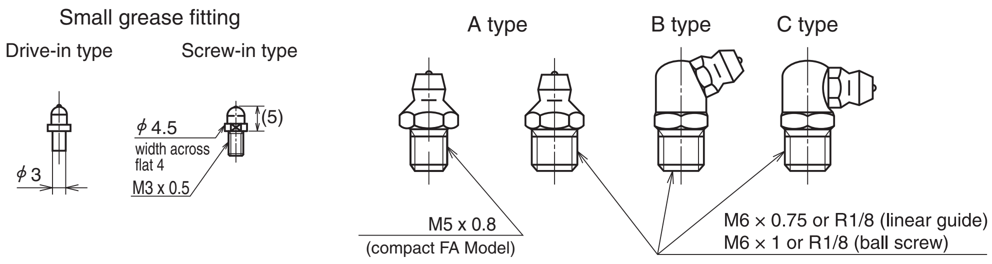


Fig. 1.3 Grease fittings

Table 1.7 Grease fittings used for NSK linear guides

Model	Model number	Tap hole for grease fitting	Standard grease fitting	Straight nozzle NZ1	Chuck nozzles NZ2	Drive-in fitting nozzle NZ3	Point nozzle NZ4	Flexible nozzle NZ5
NH	NH15	φ3	Drive-in type			○		
	NH20, 25, 30, 35*	M6×0.75	B type	○	○			○
	NH45, 55, 65	Rc1/8	B type	○	○			○
VH	VH15	φ3	Drive-in type			○		
	VH20, 25, 30, 35*	M6×0.75	B type	○	○			○
	VH45, 55	Rc1/8	B type	○	○			○
NS	NS15	φ3	Drive-in type			○		
	NS20, 25, 30, 35*	M6×0.75	B type	○	○			○
LW	LW17	φ3	Drive-in type			○		
	LW21, 27, 35*	M6×0.75	B type	○	○			○
	LW50	Rc1/8	B type	○	○			○
DH	DH15	φ3	Drive-in type			○		
	DH20, 25, 30, 35*	M6×0.75	B type	○	○			○
	DH45, 55, 65	Rc1/8	B type	○	○			○
DV	DV15	φ3	Drive-in type			○		
	DV20, 25, 30, 35*	M6×0.75	B type	○	○			○
	DV45, 55	Rc1/8	B type	○	○			○
DS	DS15	φ3	Drive-in type			○		
	DS20, 25, 30, 35*	M6×0.75	B type	○	○			○
PU	PU09, 12	–	–				○	
	PU15	φ3	Drive-in type			○		
LU	LU05, 07, 09, 12, 15	–	–				○	
PE	PE09, 12	–	–				○	
	PE15	φ3	Drive-in type			○		
LE	LE05, 07, 09, 12, 15	–	–				○	
Miniature LH	LH08, 10	–	–				○	
	LH12	φ3	Drive-in type			○		
RA	RA15, 20	φ3	Drive-in type			○		
	RA25, 30, 35*	M6×0.75	B type	○	○			○
	RA45, 55, 65	Rc1/8	B type	○	○			○
RB	RB30	φ3	Drive-in type			○		
	RB35, 45	M6×0.75	B type	○	○			○
	RB55, 65	Rc1/8	B type	○	○			○
LA	LA25, 30, 35*	M6×0.75	B type	○	○			○
	LA45, 55, 65	Rc1/8	B type	○	○			○
HA	HA25, 30, 35*	M6×0.75	B type	○	○			○
	HA45, 55	Rc1/8	B type	○	○			○
HS	HS15	φ3	Drive-in type			○		
	HS20, 25, 30, 35*	M6×0.75	B type	○	○			○

*) If using a chuck nozzle, avoid interference with table and rail.

Note: 1) Use a point nozzle to apply grease directly to the ball groove etc. of PU, LU, PE, LE, and Miniature LH models.

2) A long threaded grease fitting is required for dust-resistant parts. Please refer to the sections pertaining to the lubrication and dust-resistant parts of each model.

Table 1.8 Applicable grease nozzles for ball screws

Category	Type/Application		Model		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
Finished shaft end	Compact FA	High-accuracy, clean	USS		M5×0.8	A type	○	○		○	○
		General	PSS			A type	○*1	○*1		○	○*1
		Transfer equipment	FSS			A type	○*1	○*1		○	○*1
	Miniature, fine lead		MA	Shaft dia. 12 or less	–	–				○	
				Shaft dia. 16 or over	M6×1	–				○	
	Small equipment		FA		M6×1	–	○*2	○*2		○	○*2
	Machine tools		SA	Shaft dia. 36 or less	M6×1	–	○	○		○	○
				Shaft dia. 40 or over	Rc1/8	–	○	○		○	○
	Stainless steel		KA	Shaft dia. 12 or less and lead 2 or less	M3×0.5	–			○	○	
				except above	M6×1	–	○*2	○*2		○	○*2
	Transfer equipment		VFA	Shaft dia. 12 or less	ϕ 2.7	–				○	
				Shaft dia. 15 or over	ϕ 3.5	–				○	
			RMA		–	–				○	
Blank shaft end	Miniature, fine lead		MS	Shaft dia. 12 or less	–	–				○	
				Shaft dia. 16 or over	M6×1	–				○	
	Small equipment		FS		M6×1	–	○*2	○*2		○	○*2
	Machine tools		SS	Shaft dia. 36 or less	M6×1	–	○	○		○	○
				Shaft dia. 40 or over	Rc1/8	–	○	○		○	○
			HSS		M6×1	–	○	○		○	○
	Transfer equipment		RMS		–	–				○	
			RNFTL	Shaft dia. 12 or less	M3×0.5	–			○	○	
				Shaft dia. 14 or over	M6×1	–	○	○		○	○
			RNFBL	Shaft dia. 12 or less	M3×0.5	–			○	○	
				Shaft dia. 14 or over	M6×1	–	○	○		○	○
			RNCT		–	–				○	
			RNFCL	Shaft dia. 12 or less	M3×0.5	–			○	○	
				Shaft dia. 15 or over	M6×1	–	○	○		○	○
			RNSTL		M6×1	–	○	○		○	○

*1 Unavailable for shaft dia. 25 mm *2 Installation of nozzle may not be possible with A-type grease fitting.

Notes: 1) NSK ball screws are not normally equipped with grease fittings excluding the Compact FA model. Tap holes are provided for users to install grease fittings as necessary.

2) Small (screw-in) fittings are available for M3 x 0.5 tap holes. Please contact NSK.

3) VFA models do not support grease fittings. Apply grease directly inside the nut through the oil hole using a point nozzle.

4) MA, RMA, MS, RMS, and RNCT models have no tap hole, apply grease directly to the screw shaft and ball grooves using a point nozzle.

Table 1.9 Applicable grease nozzles for Monocarriers

Model	Model No.	Tap hole for grease fitting	Standard grease fitting	Straight nozzle NZ1	Chuck nozzles NZ2	Drive-in fitting nozzle NZ3	Flexible nozzle NZ5	MCH-exclusive fitting nozzle NZ8
MCM	MCM02	–	–					
	MCM03,05,08,10	ϕ 3	Drive-in type			○		○*
	MCM06	M6×0.75	A type	○	○		○	
MCH	MCH06,09,10	ϕ 3	Drive-in type					○

*) Use of NZ3 is recommended.

2.2 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 grease lubrication. However, oil mist lubricating system supplies air as well as oil, raising the inner pressure of the ball 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 to 68 for the oil mist lubrication system.

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

For ball-type linear guides excluding the LA model:

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

For LA, RA, and RB models:

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

n: Linear guide code

e.g. When NH45 is used,

$n = 45$

Therefore,

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

Similarly, approximate oil supply volume Q to ball screw can be obtained by the following formula.

$Q = d/15$ (cm^3/hr)

d: Nominal shaft diameter of the ball screw

e.g. When the shaft diameter is 50,

$d = 50$

Therefore,

$Q = 50/15 = 3.3$ cm^3/hr

For oil lubrication by gravity drip, the oil supply position and installation position of the ball slide or ball nut 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. For ball screw lubrication as well, oil does not spread if the oil orifice is installed at the bottom, causing insufficient lubrication. Please consult NSK to correct such situations prior to use. NSK has internal design which allows oil lubricant to flow throughout the system. **Table 2.1** shows the criterion of intervals of oil checks and replenishments.

Table 2.1 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 and ball screw are made of plastic. Avoid using an oil that adversely affects synthetic resin.

3) When using oil mist lubricating systems, please confirm oil supply amounts at each outlet part.

3. RoHS Compliance

Please contact NSK for country-specific details on RoHS compliance.

APPENDICES

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BLOCK

Appendices

1. Conversion from International System of Units (SI)

Comparison of SI, CGS, and engineering system units

Items / System of units	Length	Mass	Time	Temperature	Acceleration	Force	Stress	Pressure	Energy	Power
SI	m	kg	s	K, °C	m/s²	N	Pa	Pa	J	W
CGS system	cm	g	s	°C	Gal	dyn	dyn/cm²	dyn/cm²	erg	erg/s
Engineering system	m	kgf • s²/m	s	°C	m/s²	kgf	kgf/m²	kgf/m²	kgf • m	kgf • m/s

Prefixes for SI units

Powers of 10	Prefix Name	Prefix Code	Powers of 10	Prefix Name	Prefix Code
10^{18}	exa	E	10^{-1}	deci	d
10^{15}	peta	P	10^{-2}	centi	c
10^{12}	tera	T	10^{-3}	milli	m
10^{9}	giga	G	10^{-6}	micro	μ
10^{6}	mega	M	10^{-9}	nano	n
10^{3}	kilo	k	10^{-12}	pico	p
10^{2}	hecto	h	10^{-15}	femto	f
10^{1}	deca	da	10^{-18}	atto	a

Conversion factors from SI units

Item	SI unit		Units other than SI units		Conversion factor from SI unit
	Name of unit	Abbreviation	Name of unit	Abbreviation	
Angle	Radian	rad	Degree	°	180/π
			Minute	'	10 800/π
			Second	''	648 000/π
Length	Meter	m	Micron	μ	10^{6}
			Angstrom	Å	10^{10}
Area	Square meter	m²	Are	a	10^{-2}
			Hectare	ha	10^{-4}
Volume	Cubic meter	m³	Liter	l, L	10^{3}
			Deciliter	dl, dL	10^{4}
Time	Second	s	Minute	min	1/60
			Hour	h	1/3 600
			Day	d	1/86 400
Numbers of vibration numbers of frequency	Hertz	Hz	Cycle	s^{-1}	1
Rotational speed	Times per second	s^{-1}	Times per minute	rpm	60
Velocity	Meter per second	m/s	Kilometer per hour	km/h	3 600/1 000
			Knot	kn	3 600/1 852
Acceleration	Meter per square second	m/s²	Gal	Gal	10^{2}
			G	G	1/9.806 65
Mass	Kilogram	kg	Ton	t	10^{-3}
Force	Newton	N	Weight kilogram	kgf	1/9.806 65
			Weight ton	tf	1/(9.806 65×10³)
			Dyne	dyn	10^{5}
Torque and moment of force	Newton meter	N • m	Weight kilogram meter	kgf • m	1/9.806 65
Stress	Pascal	Pa	Weight kilogram per square centimeter	kgf/cm²	1/(9.806 65×10⁴)
	(Newtons per square meter)	(N/m²)	Weight kilogram per square millimeter	kgf/mm²	1/(9.806 65×10⁶)

Conversion factors from SI units (continued from previous page)

Item	SI unit		Units other than SI units		Conversion factor from SI unit
	Name of unit	Abbreviation	Name of unit	Abbreviation	
Pressure	Pascal	Pa	Weight kilogram per square meter	kgf/m²	1/9.806 65
	(newton per square meter)	(N/m²)	Water column meter	mH_2O	1/(9.806 65×10³)
			Mercurial column millimeter	mmHg	760/(1.013 25×10⁵)
			Torr	Torr	760/(1.013 25×10⁵)
			Bar	bar	10^{-5}
			Atmosphere	atm	1/(1.013 25×10⁵)
Energy	Joule	J	Erg	erg	10^{7}
	(newton meter)	(N • m)	Calorie (international)	cal_{IT}	1/4.186 8
			Weight kilogram meter	kgf • m	1/9.806 65
			Kilowatt hour	kW • h	1/(3.6×10⁶)
			Metric horsepower/hour	PS • h	≈3.776 72×10⁻⁷
Electric power, power	Watt	W	Weight kilogram meter per second	kgf • m/s	1/9.806 65
	(joules per second)	(J/s)	Kilo calorie per hour	kcal/h	1/1.163
			Metric horsepower	PS	≈1/735.498 8
Viscosity, Viscosity index	Pascal second	Pa • s	Poise	P	10
Kinematic viscosity, Kinematic viscosity index	Square meter per second	m²/s	Stokes	St	10^{4}
			Centistokes	cSt	10^{6}
Temperature, Difference in temperature	Kelvin, Celsius degrees	K, °C	Degree	°C	[See Note (1)]
Electrical current, magnetomotive force	Ampere	A	Ampere	A	1
Electrical power, electromotive force	Volt	V	(Watt per ampere)	(W/A)	1
Magnetic field intensity	Ampere per meter	A/m	Oersted	Oe	4π/10³
Magnetic flux density	Tesla	T	Gauss	Gs	10^{4}
			Gamma	γ	10^{9}
Electrical resistance	Ohm	Ω	(Volt per ampere)	(V/A)	1

Note (1) Conversion from *TK* to θ °C is : $\theta = T - 273.15$. To indicate temperature difference: $\mathit{\Delta}T = \mathit{\Delta}\theta$. $\mathit{\Delta}T$ and $\mathit{\Delta}\theta$ indicate temperature differences measured by Kelvin and Celsius respectively.

Remarks: Names and abbreviations of the unit in parentheses indicate the definition of the unit shown above the parentheses or left to the parentheses.

Conversion example 1 N = 1/9.806 65 kgf

2. N-kgf Force conversion table

[Using this table]
To convert between units, find the figure in the shaded column that corresponds to the number in the unit you wish to convert. Then, look to the appropriate column on the right or left in the same row for the converted value, For example, from this table:
10 N = 1.0197 kgf, while 10 kgf = 98.066 N.

1 N = 0.1019716 kgf
1 kgf = 9.80665 N

N		kgf	N		kgf	N		kgf
9.8066	1	0.1020	333.43	34	3.4670	657.05	67	6.8321
19.613	2	0.2039	343.23	35	3.5690	666.85	68	6.9341
29.420	3	0.3059	353.04	36	3.6710	676.66	69	7.0360
39.227	4	0.4079	362.85	37	3.7729	686.47	70	7.1380
49.033	5	0.5099	372.65	38	3.8749	696.27	71	7.2400
58.840	6	0.6118	382.46	39	3.9769	706.08	72	7.3420
68.647	7	0.7138	392.27	40	4.0789	715.89	73	7.4439
78.453	8	0.8158	402.07	41	4.1808	725.69	74	7.5459
88.260	9	0.9177	411.88	42	4.2828	735.50	75	7.6479
98.066	10	1.0197	421.69	43	4.3848	745.31	76	7.7498
107.87	11	1.1217	431.49	44	4.4868	755.11	77	7.8518
117.68	12	1.2237	441.30	45	4.5887	764.92	78	7.9538
127.49	13	1.3256	451.11	46	4.6907	774.73	79	8.0558
137.29	14	1.4279	460.91	47	4.7927	784.53	80	8.1577
147.10	15	1.5296	470.72	48	4.8946	794.34	81	8.2597
156.91	16	1.6315	480.53	49	4.9966	804.15	82	8.3617
166.71	17	1.7335	490.33	50	5.0986	813.95	83	8.4636
176.52	18	1.8355	500.14	51	5.2006	823.76	84	8.5656
186.33	19	1.9375	509.95	52	5.3025	833.57	85	8.6676
196.13	20	2.0394	519.75	53	5.4045	843.37	86	8.7696
205.94	21	2.1414	529.56	54	5.5065	853.18	87	8.8715
215.75	22	2.2434	539.37	55	5.6084	862.99	88	8.9735
225.55	23	2.3453	549.17	56	5.7104	872.79	89	9.0755
235.36	24	2.4473	558.98	57	5.8124	882.60	90	9.1774
245.17	25	2.5493	568.79	58	5.9144	892.41	91	9.2794
254.97	26	2.6513	578.59	59	6.0163	902.21	92	9.3814
264.78	27	2.7532	588.40	60	6.1183	912.02	93	9.4834
274.59	28	2.8552	598.21	61	6.2203	921.83	94	9.5853
284.39	29	2.9572	608.01	62	6.3222	931.63	95	9.6873
294.20	30	3.0591	617.82	63	6.4242	941.44	96	9.7893
304.01	31	3.1611	627.63	64	6.5262	951.25	97	9.8912
313.81	32	3.2631	637.43	65	6.6282	961.05	98	9.9932
323.62	33	3.3651	647.24	66	6.7301	970.86	99	10.095

3. kg-lb Mass conversion table

[Using this table]
To convert between units, find the figure in the shaded column that corresponds to the number in the unit you wish to convert. Then, look to the appropriate column on the right or left in the same row for the converted value, For example, from this table 10 kg = 22.046 lb, while 10 lb = 4.536 kg.

1 kg = 2.2046226 lb
1 lb = 0.45359237 kg

kg		lb	kg		lb	kg		lb
0.454	1	2.205	15.422	34	74.957	30.391	67	147.71
0.907	2	4.409	15.876	35	77.162	30.844	68	149.91
1.361	3	6.614	16.329	36	79.366	31.298	69	152.12
1.814	4	8.818	16.783	37	81.571	31.751	70	154.32
2.268	5	11.023	17.237	38	83.776	32.205	71	156.53
2.722	6	13.228	17.690	39	85.980	32.659	72	158.73
3.175	7	15.432	18.144	40	88.185	33.112	73	160.94
3.629	8	17.637	18.597	41	90.390	33.566	74	163.14
4.082	9	19.842	19.051	42	92.594	34.019	75	165.35
4.536	10	22.046	19.504	43	94.799	34.473	76	167.55
4.990	11	24.251	19.958	44	97.003	34.927	77	169.76
5.443	12	26.455	20.412	45	99.208	35.380	78	171.96
5.897	13	28.660	20.865	46	101.41	35.834	79	174.17
6.350	14	30.865	21.319	47	103.62	36.287	80	176.37
6.804	15	33.069	21.772	48	105.82	36.741	81	178.57
7.257	16	35.274	22.226	49	108.03	37.195	82	180.78
7.711	17	37.479	22.680	50	110.23	37.648	83	182.98
8.165	18	39.683	23.133	51	112.44	38.102	84	185.19
8.618	19	41.888	23.587	52	114.64	38.555	85	187.39
9.072	20	44.092	24.040	53	116.84	39.009	86	189.60
9.525	21	46.297	24.494	54	119.05	39.463	87	191.80
9.979	22	48.502	24.948	55	121.25	39.916	88	194.01
10.433	23	50.706	25.401	56	123.46	40.370	89	196.21
10.886	24	52.911	25.855	57	125.66	40.823	90	198.42
11.340	25	55.116	26.308	58	127.87	41.277	91	200.62
11.793	26	57.320	26.762	59	130.07	41.730	92	202.83
12.247	27	59.525	27.216	60	132.28	42.184	93	205.03
12.701	28	61.729	27.669	61	134.48	42.638	94	207.23
13.154	29	63.934	28.123	62	136.69	43.091	95	209.44
13.608	30	66.139	28.576	63	138.89	43.545	96	211.64
14.061	31	68.343	29.030	64	141.10	43.998	97	213.85
14.515	32	70.548	29.484	65	143.30	44.452	98	216.05
14.969	33	72.753	29.937	66	145.51	44.906	99	218.26

4. Hardness conversion table

Rockwell C Scale hardness (1 471 N)	Vickers hardness	Brinell hardness		Rockwell hardness		Shore hardness
		Standard ball	Tungsten carbide ball	A Scale Load 588.4 N Brale indenter	B Scale Load 980.7 N Diameter 1.5888 mm {1/16 in} sphere	
68	940	—	—	85.6	—	97
67	900	—	—	85.0	—	95
66	865	—	—	84.5	—	92
65	832	—	739	83.9	—	91
64	800	—	722	83.4	—	88
63	772	—	705	82.8	—	87
62	746	—	688	82.3	—	85
61	720	—	670	81.8	—	83
60	697	—	654	81.2	—	81
59	674	—	634	80.7	—	80
58	653	—	615	80.1	—	78
57	633	—	595	79.6	—	76
56	613	—	577	79.0	—	75
55	595	—	560	78.5	—	74
54	577	—	543	78.0	—	72
53	560	—	525	77.4	—	71
52	544	500	512	76.8	—	69
51	528	487	496	76.3	—	68
50	513	475	481	75.9	—	67
49	498	464	469	75.2	—	66
48	484	451	455	74.7	—	64
47	471	442	443	74.1	—	63
46	458	432	432	73.6	—	62
45	446	421	421	73.1	—	60
44	434	409	409	72.5	—	58
43	423	400	400	72.0	—	57
42	412	390	390	71.5	—	56
41	402	381	381	70.9	—	55
40	392	371	371	70.4	—	54
39	382	362	362	69.9	—	52
38	372	353	353	69.4	—	51
37	363	344	344	68.9	—	50
36	354	336	336	68.4	(109.0)	49
35	345	327	327	67.9	(108.5)	48
34	336	319	319	67.4	(108.0)	47
33	327	311	311	66.8	(107.5)	46
32	318	301	301	66.3	(107.0)	44
31	310	294	294	65.8	(106.0)	43
30	302	286	286	65.3	(105.5)	42
29	294	279	279	64.7	(104.5)	41
28	286	271	271	64.3	(104.0)	41
27	279	264	264	63.8	(103.0)	40
26	272	258	258	63.3	(102.5)	38
25	266	253	253	62.8	(101.5)	38
24	260	247	247	62.4	(101.0)	37
23	254	243	243	62.0	100.0	36
22	248	237	237	61.5	99.0	35
21	243	231	231	61.0	98.5	35
20	238	226	226	60.5	97.8	34
(18)	230	219	219	—	96.7	33
(16)	222	212	212	—	95.5	32
(14)	213	203	203	—	93.9	31
(12)	204	194	194	—	92.3	29
(10)	196	187	187	—	90.7	28
(8)	188	179	179	—	89.5	27
(6)	180	171	171	—	87.1	26
(4)	173	165	165	—	85.5	25
(2)	166	158	158	—	83.5	24
(0)	160	152	152	—	81.7	24

5. Tolerances for Shaft Diameters

Classification of diameter (mm)		d6	e6	f6	g5	g6	h5	h6	h7	h8	h9	h10	js5	js6
Over	or less													
—	3	−20 −26	−14 −20	−6 −12	−2 −6	−2 −8	0 −4	0 −6	0 −10	0 −14	0 −25	0 −40	±2	±3
3	6	−30 −38	−20 −28	−10 −18	−4 −9	−4 −12	0 −5	0 −8	0 −12	0 −18	0 −30	0 −48	±2.5	±4
6	10	−40 −49	−25 −34	−13 −22	−5 −11	−5 −14	0 −6	0 −9	0 −15	0 −22	0 −36	0 −58	±3	±4.5
10	18	−50 −61	−32 −43	−16 −27	−6 −14	−6 −17	0 −8	0 −11	0 −18	0 −27	0 −43	0 −70	±4	±5.5
18	30	−65 −78	−40 −53	−20 −33	−7 −16	−7 −20	0 −9	0 −13	0 −21	0 −33	0 −52	0 −84	±4.5	±6.5
30	50	−80 −96	−50 −66	−25 −41	−9 −20	−9 −25	0 −11	0 −16	0 −25	0 −39	0 −62	0 −100	±5.5	±8
50	80	−100 −119	−60 −79	−30 −49	−10 −23	−10 −29	0 −13	0 −19	0 −30	0 −46	0 −74	0 −120	±6.5	±9.5
80	120	−120 −142	−72 −94	−36 −58	−12 −27	−12 −34	0 −15	0 −22	0 −35	0 −54	0 −87	0 −140	±7.5	±11
120	180	−145 −170	−85 −110	−43 −68	−14 −32	−14 −39	0 −18	0 −25	0 −40	0 −63	0 −100	0 −160	±9	±12.5
180	250	−170 −199	−100 −129	−50 −79	−15 −35	−15 −44	0 −20	0 −29	0 −46	0 −72	0 −115	0 −185	±10	±14.5
250	315	−190 −222	−110 −142	−56 −88	−17 −40	−17 −49	0 −23	0 −32	0 −52	0 −81	0 −130	0 −210	±11.5	±16
315	400	−210 −246	−125 −161	−62 −98	−18 −43	−18 −54	0 −25	0 −36	0 −57	0 −89	0 −140	0 −230	±12.5	±18
400	500	−230 −270	−135 −175	−68 −108	−20 −47	−20 −60	0 −27	0 −40	0 −63	0 −97	0 −155	0 −250	±13.5	±20
500	630	−260 −304	−145 −189	−76 −120	—	−22 −66	—	0 −44	0 −70	0 −110	0 −175	0 −280	—	±22
630	800	−290 −340	−160 −210	−80 −130	—	−24 −74	—	0 −50	0 −80	0 −125	0 −200	0 −320	—	±25
800	1 000	−320 −376	−170 −226	−86 −142	—	−26 −82	—	0 −56	0 −90	0 −140	0 −230	0 −360	—	±28
1 000	1 250	−350 −416	−195 −261	−98 −164	—	−28 −94	—	0 −66	0 −105	0 −165	0 −260	0 −420	—	±33
1 250	1 600	−390 −468	−220 −298	−110 −188	—	−30 −108	—	0 −78	0 −125	0 −195	0 −310	0 −500	—	±39
1 600	2 000	−430 −522	−240 −332	−120 −212	—	−32 −124	—	0 −92	0 −150	0 −230	0 −370	0 −600	—	±46

Unit: μm

j5	j6	j7	k5	k6	k7	m5	m6	n6	p6	r6	r7	Classification of diameter (mm)	
												Over	or less
±2	+4 −2	+6 −4	+4 0	+6 0	+10 0	+6 +2	+8 +2	+10 +4	+12 +6	+16 +10	+20 +10	—	3
+3 −2	+6 −2	+8 −4	+6 +1	+9 +1	+13 +1	+9 +4	+12 +4	+16 +8	+20 +12	+23 +15	+27 +15	3	6
+4 −2	+7 −2	+10 −5	+7 +1	+10 +1	+16 +1	+12 +6	+15 +6	+19 +10	+24 +15	+28 +19	+34 +19	6	10
+5 −3	+8 −3	+12 −6	+9 +1	+12 +1	+19 +1	+15 +7	+18 +7	+23 +12	+29 +18	+34 +23	+41 +23	10	18
+5 −4	+9 −4	+13 −8	+11 +2	+15 +2	+23 +2	+17 +8	+21 +8	+28 +15	+35 +22	+41 +28	+49 +28	18	30
+6 −5	+11 −5	+15 −10	+13 +2	+18 +2	+27 +2	+20 +9	+25 +9	+33 +17	+42 +26	+50 +34	+59 +34	30	50
+6 −7	+12 −7	+18 −12	+15 +2	+21 +2	+32 +2	+24 +11	+30 +11	+39 +20	+51 +32	+60 +41	+71 +41	50	65
										+62 +43	+73 +43	65	80
+6 −9	+13 −9	+20 −15	+18 +3	+25 +3	+38 +3	+28 +13	+35 +13	+45 +23	+59 +37	+73 +51	+86 +51	80	100
										+76 +54	+89 +54	100	120
+7 −11	+14 −11	+22 −18	+21 +3	+28 +3	+43 +3	+33 +15	+40 +15	+52 +27	+68 +43	+88 +63	+103 +63	120	140
										+90 +65	+105 +65	140	160
										+93 +68	+108 +68	160	180
+7 −13	+16 −13	+25 −21	+24 +4	+33 +4	+50 +4	+37 +17	+46 +17	+60 +31	+79 +50	+106 +77	+123 +77	180	200
										+109 +80	+126 +80	200	225
										+113 +84	+130 +84	225	250
+7 −16	±16	±26	+27 +4	+36 +4	+56 +4	+43 +20	+52 +20	+66 +34	+88 +56	+126 +94	+146 +94	250	280
										+130 +98	+150 +98	280	315
+7 −18	±18	+29 −28	+29 +4	+40 +4	+61 +4	+46 +21	+57 +21	+73 +37	+98 +62	+144 +108	+165 +108	315	355
										+150 +114	+171 +114	355	400
+7 −20	±20	+31 −32	+32 +5	+45 +5	+68 +5	+50 +23	+63 +23	+80 +40	+108 +68	+166 +126	+189 +126	400	450
										+172 +132	+195 +132	450	500
—	—	—	—	+44 0	+70 0	—	+70 +26	+88 +44	+122 +78	+194 +150	+220 +150	500	560
										+199 +155	+225 +155	560	630
—	—	—	—	+50 0	+80 0	—	+80 +30	+100 +50	+138 +88	+225 +175	+255 +175	630	710
										+235 +185	+265 +185	710	800
—	—	—	—	+56 0	+90 0	—	+90 +34	+112 +56	+156 +100	+266 +210	+300 +210	800	900
										+276 +220	+310 +220	900	1 000
—	—	—	—	+66 0	+105 0	—	+106 +40	+132 +66	+186 +120	+316 +250	+355 +250	1 000	1 120
										+326 +260	+365 +260	1 120	1 250
—	—	—	—	+78 0	+125 0	—	+126 +48	+156 +78	+218 +140	+378 +300	+425 +300	1 250	1 400
										+408 +330	+455 +330	1 400	1 600
—	—	—	—	+92 0	+150 0	—	+150 +58	+184 +92	+262 +170	+462 +370	+520 +370	1 600	1 800
										+492 +400	+550 +400	1 800	2 000

6. Toelrances for Housing Bore Diameters

Unit: μm

Classification of diameter (mm)		E6	F6	F7	G6	G7	H6	H7	H8	J6	J7	JS6	JS7
Over	or less												
—	3	+20 +14	+12 +6	+16 +6	+8 +2	+12 +2	+6 0	+10 0	+14 0	+2 −4	+4 −6	±3	±5
3	6	+28 +20	+18 +10	+22 +10	+12 +4	+16 +4	+8 0	+12 0	+18 0	+5 −3	±6	±4	±6
6	10	+34 +25	+22 +13	+28 +13	+14 +5	+20 +5	+9 0	+15 0	+22 0	+5 −4	+8 −7	±4.5	±7.5
10	18	+43 +32	+27 +16	+34 +16	+17 +6	+24 +6	+11 0	+18 0	+27 0	+6 −5	+10 −8	±5.5	±9
18	30	+53 +40	+33 +20	+41 +20	+20 +7	+28 +7	+13 0	+21 0	+33 0	+8 −5	+12 −9	±6.5	±10.5
30	50	+66 +50	+41 +25	+50 +25	+25 +9	+34 +9	+16 0	+25 0	+39 0	+10 −6	+14 −11	±8	±12.5
50	80	+79 +60	+49 +30	+60 +30	+29 +10	+40 +10	+19 0	+30 0	+46 0	+13 −6	+18 −12	±9.5	±15
80	120	+94 +72	+58 +36	+71 +36	+34 +12	+47 +12	+22 0	+35 0	+54 0	+16 −6	+22 −13	±11	±17.5
120	180	+110 +85	+68 +43	+83 +43	+39 +14	+54 +14	+25 0	+40 0	+63 0	+18 −7	+26 −14	±12.5	±20
180	250	+129 +100	+79 +50	+96 +50	+44 +15	+61 +15	+29 0	+46 0	+72 0	+22 −7	+30 −16	±14.5	±23
250	315	+142 +110	+88 +56	+108 +56	+49 +17	+69 +17	+32 0	+52 0	+81 0	+25 −7	+36 −16	±16	±26
315	400	+161 +125	+98 +62	+119 +62	+54 +18	+75 +18	+36 0	+57 0	+89 0	+29 −7	+39 −18	±18	±28.5
400	500	+175 +135	+108 +68	+131 +68	+60 +20	+83 +20	+40 0	+63 0	+97 0	+33 −7	+43 −20	±20	±31.5
500	630	+189 +145	+120 +76	+146 +76	+66 +22	+92 +22	+44 0	+70 0	+110 0	—	—	±22	±35
630	800	+210 +160	+130 +80	+160 +80	+74 +24	+104 +24	+50 0	+80 0	+125 0	—	—	±25	±40
800	1 000	+226 +170	+142 +86	+176 +86	+82 +26	+116 +26	+56 0	+90 0	+140 0	—	—	±28	±45
1 000	1 250	+261 +195	+164 +98	+203 +98	+94 +28	+133 +28	+66 0	+105 0	+165 0	—	—	±33	±52.5
1 250	1 600	+298 +220	+188 +110	+235 +110	+108 +30	+155 +30	+78 0	+125 0	+195 0	—	—	±39	±62.5
1 600	2 000	+332 +240	+212 +120	+270 +120	+124 +32	+182 +32	+92 0	+150 0	+230 0	—	—	±46	±75

K5	K6	K7	M5	M6	M7	N5	N6	N7	P6	P7	Classification of diameter (mm)	
											Over	or less
0 −4	0 −6	0 −10	−2 −6	−2 −8	−2 −12	−4 −8	−4 −10	−4 −14	−6 −12	−6 −16	—	3
0 −5	+2 −6	+3 −9	−3 −8	−1 −9	0 −12	−7 −12	−5 −13	−4 −16	−9 −17	−8 −20	3	6
+1 −5	+2 −7	+5 −10	−4 −10	−3 −12	0 −15	−8 −14	−7 −16	−4 −19	−12 −21	−9 −24	6	10
+2 −6	+2 −9	+6 −12	−4 −12	−4 −15	0 −18	−9 −17	−9 −20	−5 −23	−15 −26	−11 −29	10	18
+1 −8	+2 −11	+6 −15	−5 −14	−4 −17	0 −21	−12 −21	−11 −24	−7 −28	−18 −31	−14 −35	18	30
+2 −9	+3 −13	+7 −18	−5 −16	−4 −20	0 −25	−13 −24	−12 −28	−8 −33	−21 −37	−17 −42	30	50
+3 −10	+4 −15	+9 −21	−6 −19	−5 −24	0 −30	−15 −28	−14 −33	−9 −39	−26 −45	−21 −51	50	80
+2 −13	+4 −18	+10 −25	−8 −23	−6 −28	0 −35	−18 −33	−16 −38	−10 −45	−30 −52	−24 −59	80	120
+3 −15	+4 −21	+12 −28	−9 −27	−8 −33	0 −40	−21 −39	−20 −45	−12 −52	−36 −61	−28 −68	120	180
+2 −18	+5 −24	+13 −33	−11 −31	−8 −37	0 −46	−25 −45	−22 −51	−14 −60	−41 −70	−33 −79	180	250
+3 −20	+5 −27	+16 −36	−13 −36	−9 −41	0 −52	−27 −50	−25 −57	−14 −66	−47 −79	−36 −88	250	315
+3 −22	+7 −29	+17 −40	−14 −39	−10 −46	0 −57	−30 −55	−26 −62	−16 −73	−51 −87	−41 −98	315	400
+2 −25	+8 −32	+18 −45	−16 −43	−10 −50	0 −63	−33 −60	−27 −67	−17 −80	−55 −95	−45 −108	400	500
—	0 −44	0 −70	—	−26 −70	−26 −96	—	−44 −88	−44 −114	−78 −122	−78 −148	500	630
—	0 −50	0 −80	—	−30 −80	−30 −110	—	−50 −100	−50 −130	−88 −138	−88 −168	630	800
—	0 −56	0 −90	—	−34 −90	−34 −124	—	−56 −112	−56 −146	−100 −156	−100 −190	800	1 000
—	0 −66	0 −105	—	−40 −106	−40 −145	—	−66 −132	−66 −171	−120 −186	−120 −225	1 000	1 250
—	0 −78	0 −125	—	−48 −126	−48 −173	—	−78 −156	−78 −203	−140 −218	−140 −265	1 250	1 600
—	0 −92	0 −150	—	−58 −150	−58 −208	—	−92 −184	−92 −242	−170 −262	−170 −320	1 600	2 000

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