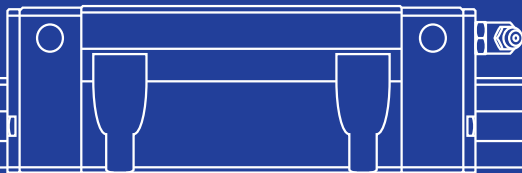
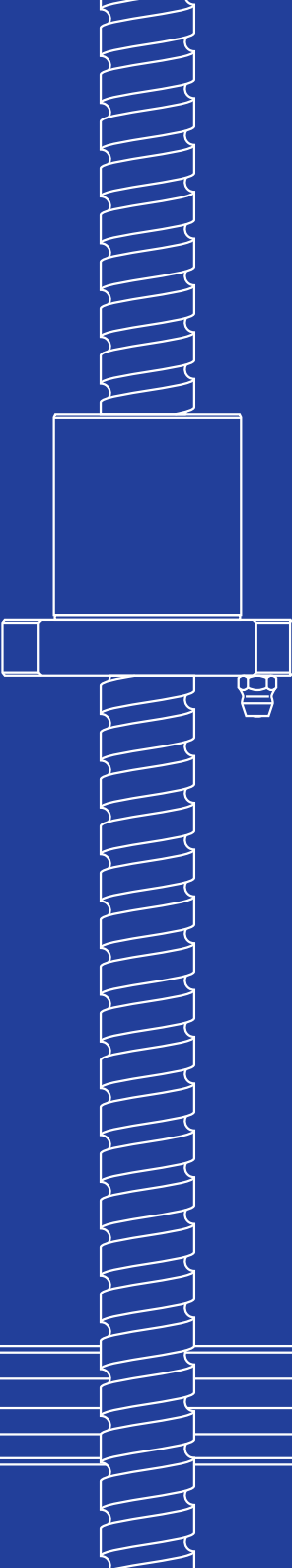


MOTION & CONTROL™

**NSK**

# Precision Machine Components

NSK Linear Guides™  
Ball Screws  
Monocarriers™



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**A. NSK Linear Rolling Guide Product**

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A1  
–  
A397

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**B. Ball Screws**

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B1  
–  
B526

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**C. Monocarrier™**

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C1  
–  
C80

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**D. Other**

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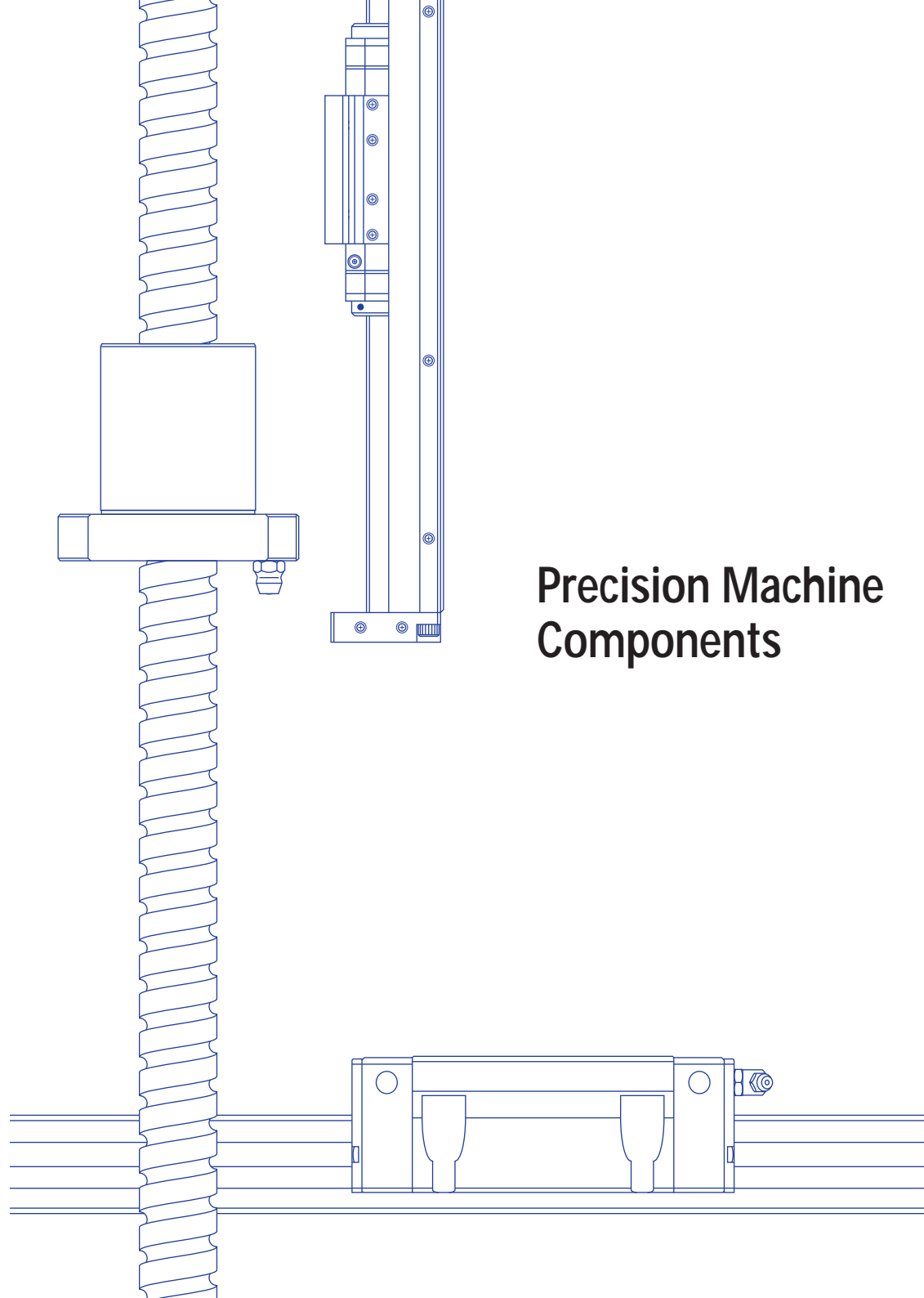
D1  
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**E. Appendices**

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E1  
–  
E10



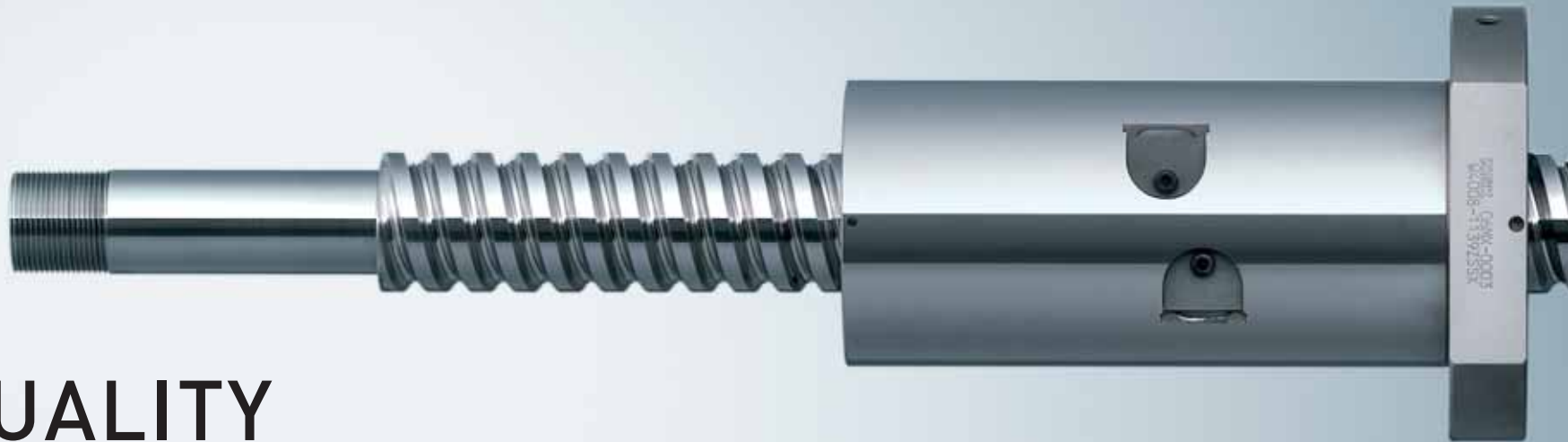
# Precision Machine Components

# GLOBAL BRAND

NSK products are known and used all over the world

Since 1916, when it was the first company in Japan to produce ball bearings, NSK has contributed to industrial growth both domestically and overseas for 90 years. Now, the company's accumulated technology in bearings has been applied to precision products in order to support core components used in a variety of machinery. Precision products marketed under the trusted NSK brand, such as Ball Screws, Linear Guides, Monocarriers, mechatronic products, and Spindles are found in every corner of the globe.

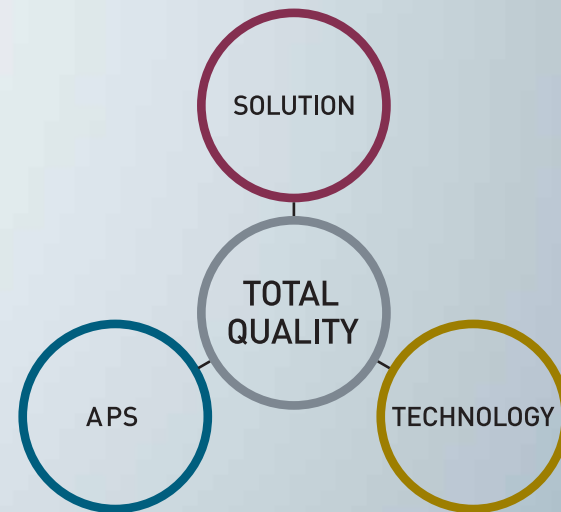




# TOTAL QUALITY

Focus on customers' total quality

Product quality is essential for manufacturers. NSK builds on its solid foundation of quality to enhance its ability to offer solutions that add value for customers, taking advantage of capabilities afforded by supply chain management (APS: Advanced Production System), and further extending its technical expertise based on four core technologies. Quality is the objective in all our business processes toward becoming "No. 1 in Total Quality."

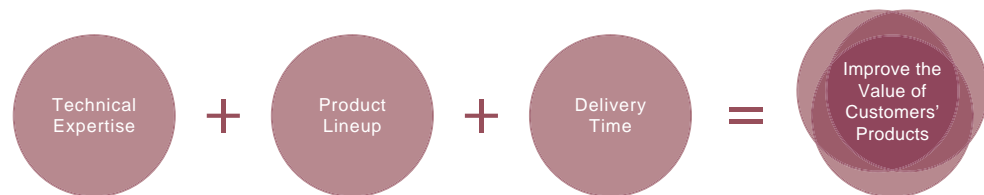




# SOLUTIONS

Improvement of customers' product value by technical support

Solutions only NSK can propose are contributing to the advancement of manufacturing for a new era.

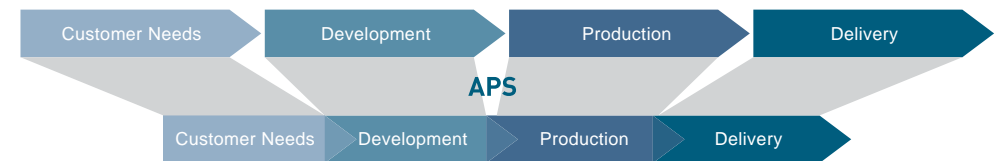


With its Technology Center as the cornerstone, NSK is able to provide technical support worldwide and quickly offer innovative solutions. We are able to more rapidly deliver the required products by combining a global production system with a broad lineup that includes precision products and bearings. These detailed solutions and technical support efforts enable us to enhance the value of our customers' products and thereby deepen our partnerships with those customers.

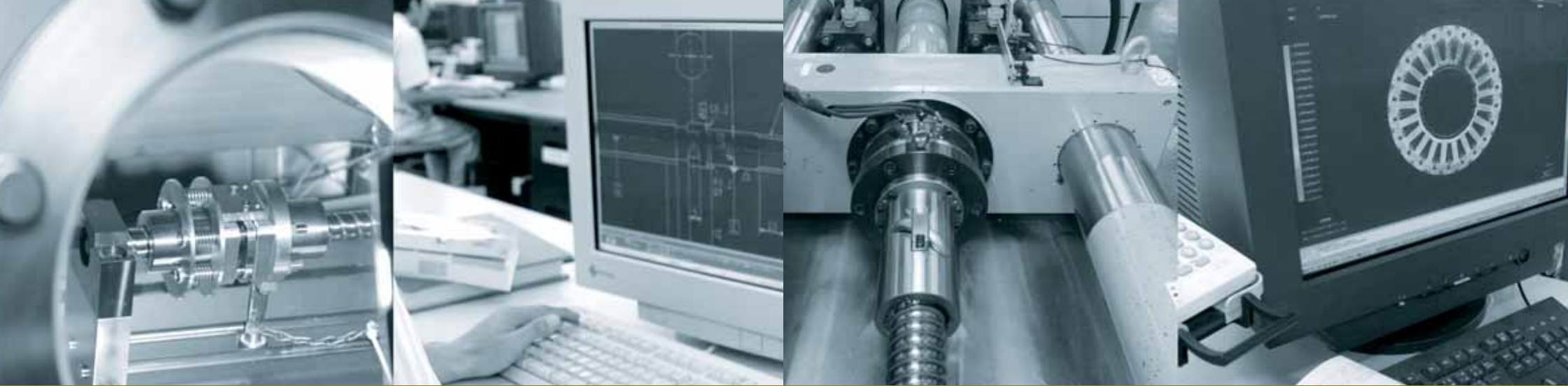
# APS

Advanced production system for speed, quality and global supply chain management

NSK has streamlined operations to cut lead times and achieve faster delivery.

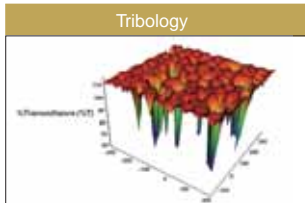


To more effectively respond to customer needs, NSK implemented APS (Advanced Production System) encompassing sales, development, design, manufacturing and distribution. Under our APS, we established a project for streamlining operations to shorten lead times. As a result, the system has boosted supply capacity and directly addressed customer demand.



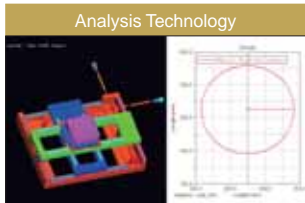
# TECHNOLOGY

Developing innovative technologies and products by our four core technologies



Tribology

Precision products with rotational and linear movement require lubrication that supports high speed, low noise operation, load capacity, durability, and other desirable functionality. NSK has applied, and provided to customers, advanced tribology (friction control technology) to such areas as grease, solid lubricants, and surface processing methods for precision products.



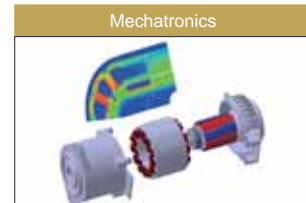
Analysis Technology

NSK utilizes computer simulations to conduct virtual experiments that require high precision or are difficult to run under actual machine operating conditions. Further improvements in analysis technology have accelerated product development.



Materials Technology

We are aggressively striving to advance material technology through material design, thermal treatment, performance evaluation, and analysis as the cornerstone for improving product performance and durability as well as for reducing costs and boosting productivity.



Mechatronics

Our mechatronics, which integrate mechanical and electronic elements, incorporates state-of-the-art advances in high-performance motors along with control and sensor technology.

## Environmental Initiatives

### Approach and Basic Policy for Development and Design

In its Environmental Code of Conduct, the NSK Group aims to develop technology and create products that reduce environmental impact. NSK Group products are incorporated into various machines and devices and have the ability to control friction and reduce the amount of energy consumed. In the product development and design stage, importance is placed on comfort, preservation of natural resources, and energy conservation at the end-user stage, as well as on reducing the environmental impact of the manufacturing process. Therefore, initiatives are being promoted to utilize the environmental features of NSK products. In fiscal 2001, a basic policy affecting all technical departments was established in order to steadily implement these goals.

### Green Procurement Policy

The NSK Group actively procures products, parts, and materials based on environmental considerations. By managing environmentally harmful substances with its suppliers, NSK is strengthening its environmental quality assurance system for its products.

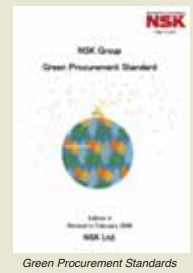
### Green Procurement Standards

The NSK Group must deliver products that ensure satisfaction and meet the ever-stricter requirements of customers and European regulations. Therefore, NSK has established standards for procurement such as the Master Purchase Agreement and the *Green Procurement Standards*, based on the idea that ecological considerations for parts and material procurement are indispensable to environmental protection. The company has asked its suppliers to cooperate in this effort.

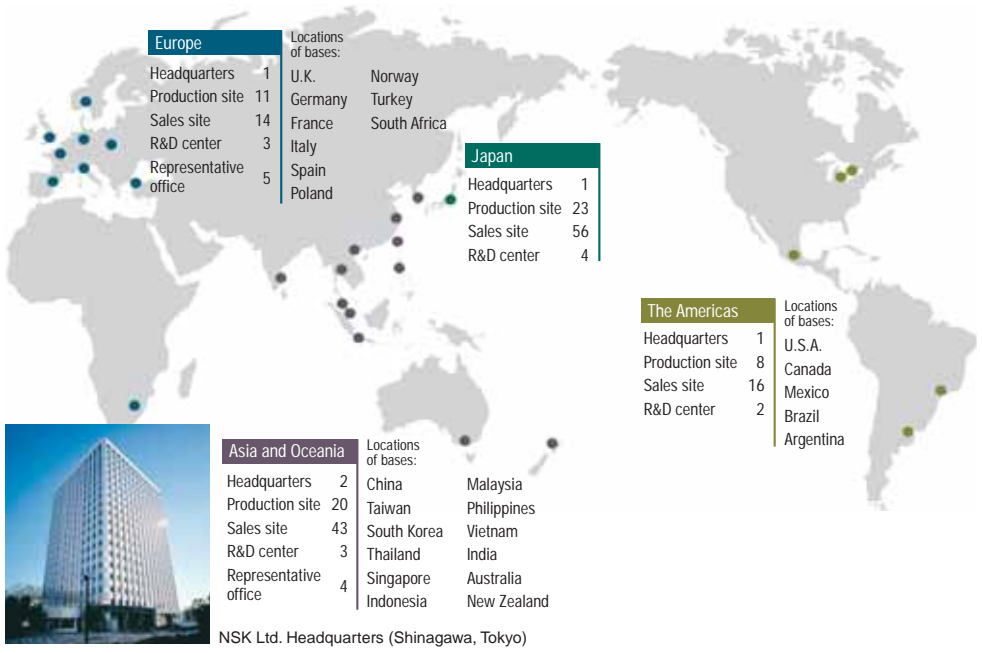
### Basic Policy for the Development of Environmentally Friendly Products

The NSK Group will minimize the environmental impact of its products at every stage—from R&D and design, to production, usage, and disposal—by upholding the following standards:

1. Each product should contribute toward the energy and resource conservation by the machine in which it is installed.
2. The amount of energy and resources required during product manufacturing should be minimal.
3. Environmentally harmful substances should not be used in products or manufacturing processes.
4. Products should contribute to the health and safety of end-users by having low emissions of vibration, noise, and dust.



**NSK Global Network** NSK provides the best products all over the world by our global network.



**Research & Development** NSK's research system takes full advantage of knowledge on technology shared through its information network.



**Precision Machinery and Parts Technology Center**  
Maebashi, Gunma

The Precision Machinery and Parts Technology Center plays a vital role in developing next-generation precision products in cooperation with NSK's Research and Development Center. For new products or those used for special purposes, reliability testing is essential. Each technology division has introduced instruments developed by NSK to evaluate the various aspects of product performance. Experiments conducted by the Center are designed according to specific application conditions, such as operating life and durability. The Center also undertakes vacuum environment testing for semiconductor and LCD manufacturing equipment as well as sound and vibration testing. In addition, accumulated test data is stored in a database, which has proved to be a valuable resource. The Center is constantly striving to develop new industry-leading products.



**Fujisawa Research and Development Center**  
Fujisawa, Kanagawa

The Fujisawa Research and Development Center supports the future of NSK by conducting research and development into innovative technologies, such as tribology, analysis technology, materials technology, and mechatronics. This Center develops high added-value, next-generation products by broadly disseminating data and exchanging information with the Precision Machinery and Parts Technology Center and R&D centers in the Americas, Europe and Asia.

**Manufacturing Bases** Global manufacturing bases assist in maintaining the high-quality "NSK brand."



**NSK Precision Co., Ltd. Maebashi Precision Machinery and Parts Plant**  
Maebashi, Gunma

As a production base for precision machinery components, the Maebashi Precision Machinery and Parts Plant manufactures world-class products, including large Ball Screws and Monocarriers, by fully applying state-of-the-art techniques based on the highest level super-precision technologies. NSK's own production methods ensure meticulous quality control throughout the entire production process.  
Products: Ball Screws, Monocarriers, XY Tables, Support Units



**NSK Precision Co., Ltd. Saitama Precision Machinery and Parts Plant**  
Hanyu, Saitama

The Saitama Precision Machinery and Parts Plant manufactures Linear Guides that are widely used in machine tools, transportation systems, and other applications. With its ground-breaking processing technology and thorough factory automation, the plant contributes to enhancing customer satisfaction by producing high-quality products.  
Products: Linear Guides



**NSK Kyushu Co., Ltd.**  
Ukiha, Fukuoka

As the world's No. 1 production base for small precision Ball Screws, NSK Kyushu Co., Ltd. is striving to realize unsurpassed QCD (quality, cost, delivery) and earn customer trust. NSK Kyushu Co., Ltd. endeavors to shorten delivery time with NSK's proprietary production management system.  
Products: Ball Screws



**NSK Precision America, Inc. Franklin Plant**  
Indiana, U.S.A.

Established in 1993, this plant serves as a production base for Ball Screws. It actively supplies Linear Guides and mechatronic products to meet a wide range of market needs in such areas as machine tools, semiconductors, medical equipment and general industrial applications. The plant also promotes various projects and advanced production system (APS) activities in concert with other plants in Japan to achieve further advances toward even faster delivery systems to meet the demands of a broader market.  
Products: Ball Screws, XY Tables



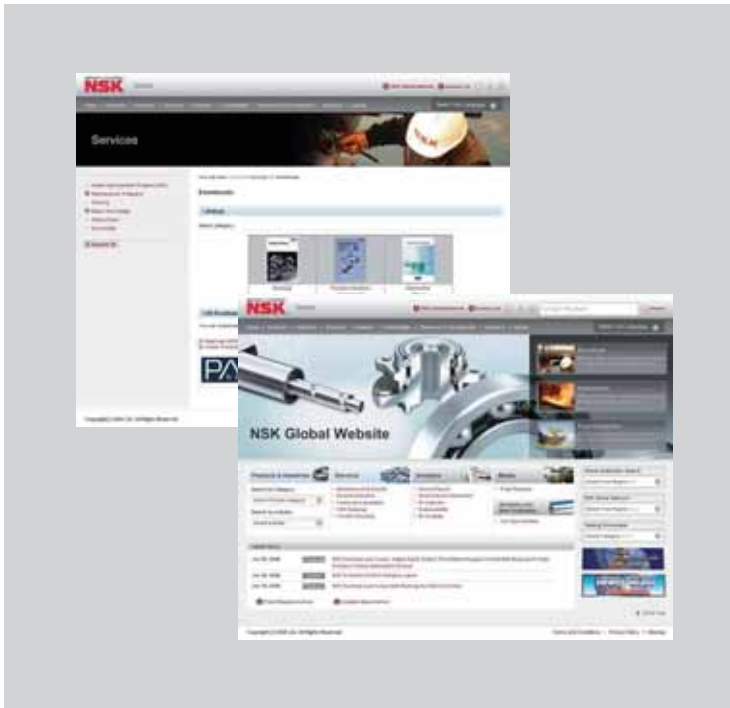
**NSK Precision UK, Ltd. Newark Plant**  
Nottinghamshire, U.K.

The Newark Plant was established in 1998 as a Linear Guide production base that supports short-term delivery along with a European warehouse, a sales base in Europe, and a workshop. The plant is part of a system that covers not only major markets in Europe but also general industrial markets in Eastern Europe and the Middle East. It also pursues streamlining in accordance with globalization and plays an active role as a global sourcing facility by supplying products to the Americas.  
Products: Linear Guides



**For other machine components, technical data, and CAD drawing data, visit the NSK's website at <http://www.nsk.com>.**

<http://www.nsk.com>



NSK Ltd. has a basic policy not to export any products or technology designated as controlled items by export-related laws. When exporting the products in this brochure, the laws of the exporting country must be observed. Specifications are subject to change without notice and without any obligation on the part of the manufacturer. Every care has been taken to ensure the accuracy of the data contained in this brochure, but no liability can be accepted for any loss or damage suffered through errors or omissions. We will gratefully acknowledge any additions or corrections.

# Preface

It is our pleasure to announce the publication of a new catalog which contains all NSK linear motion products. We believe this publication is one way to show our deep appreciation of your patronage.

Market demand for more sophisticated and diversified machines and equipment is rapidly escalating. NSK precision products are not only used widely in these machines, but also are crucial elements.

In response to this trend, ball screws, NSK linear guides, and Monocarriers, which are crucial mechanical components of these machines, are required to be highly reliable, maintenance-free, smaller in size and lightweight. They also are expected to heighten efficiency and satisfy uses in special environment.

Publishing a catalog to introduce our entire product line is especially meaningful under such circumstances.

This is an improved version of the previous catalog; products are categorized, and each product category has two sections. The first section contains an explanation of products for selection and a technical explanation including results of the latest experiments and research to assist thorough technological discussion. The second half is dimension tables. Last, "Other," whose pages are in color, explains special environments and lubrications such as grease, which are general issues for NSK precision products.

We hope abundant NSK products in the new catalog will be your aide in selecting the most suitable products for your purpose. We solicit your continued patronage.

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- (4) Available length of rail
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- (5) Installation
- (6) Lubrication components
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- (2) Ball slide shape
- (3) Accuracy and preload
- (4) Available length of rail
- (5) Installation
- (6) Lubrication components
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- (3) Accuracy and preload
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- (7) Dust proof components
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- (3) Accuracy and preload

- (4) Available length of rail
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- (7) Dust proof components
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- (2) Ball slide shape
- (3) Accuracy and preload
- (4) Available length of rail
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- (7) Dust proof components
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- (3) Accuracy and preload
- (4) Available length of rail
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- (7) Dust proof components
- (8) Reference number
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- (3) Accuracy and preload
- (4) Available length of rail
- (5) Reference number
- (6) Dimensions

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- (3) Accuracy and preload
- (4) Available length of rail
- (5) Installation
- (6) Lubrication components
- (7) Dust proof components
- (8) Reference number
- (9) Dimensions

##### A-5-4.2 HS Series ..... A355

- (1) Features
- (2) Ball slide shape
- (3) Accuracy and preload
- (4) Available length of rail
- (5) Installation
- (6) Lubrication components
- (7) Dust proof components
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#### A-6 Other Linear Rolling Guide Products

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##### A-6-3 Roller Pack ..... A386

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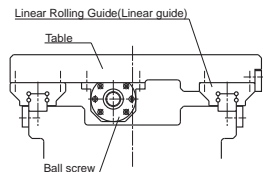
# A-1 Characteristics of NSK Linear Rolling Guides

## Characteristics of the NSK linear rolling guides are:

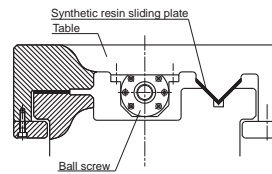
- Designs are simple and economic. This contributes to highly accurate and low cost machines.
- Low friction coefficient facilitates a compact and low cost driving mechanism.
- Ultra-high purity of materials and superb processing technology provide long-term highly reliable operation.
- Prompt delivery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

## A-1-1 Comparison of Rolling Guides and Sliding Guides

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



Example of rolling guide



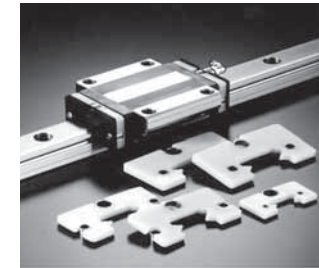
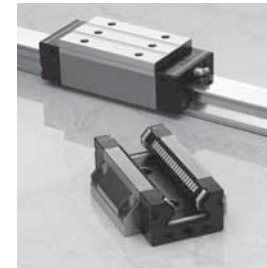
Example of sliding guide

### Comparative characteristics of rolling and sliding guide way

Function	Rolling guide	Sliding guide
Friction	<ul style="list-style-type: none"> <li>• Friction coefficient: 0.01 or lower</li> <li>• Difference between static and dynamic friction is small.</li> <li>• Change by speed is slight.</li> </ul>	<ul style="list-style-type: none"> <li>• Friction is great.</li> <li>• The difference between static and dynamic friction coefficient is great.</li> </ul>
Positioning accuracy	<ul style="list-style-type: none"> <li>• Lost motion is slight.</li> <li>• Stick-slip is slight.</li> <li>• Easy to achieve sub-micron positioning</li> </ul>	<ul style="list-style-type: none"> <li>• Lost motion is great.</li> <li>• Stick-slip at low speed is great.</li> <li>• Difficult to achieve sub-micron positioning</li> </ul>
Life	<ul style="list-style-type: none"> <li>• Possible to estimate useful life</li> </ul>	<ul style="list-style-type: none"> <li>• Difficult to estimate useful life</li> </ul>
Static rigidity	<ul style="list-style-type: none"> <li>• Generally high</li> <li>• No play because of preload</li> <li>• Easy to estimate rigidity</li> </ul>	<ul style="list-style-type: none"> <li>• Rigidity is great against load from a particular direction.</li> <li>• There is mechanical play.</li> <li>• Difficult to estimate rigidity</li> </ul>
Speed	<ul style="list-style-type: none"> <li>• Wide range of use from low to high speed</li> </ul>	<ul style="list-style-type: none"> <li>• Unsuitable for extremely low or high speed</li> </ul>
Maintenance, reliability	<ul style="list-style-type: none"> <li>• Long life through simple maintenance</li> </ul>	<ul style="list-style-type: none"> <li>• Precision is lost greatly by deteriorated guide surface.</li> </ul>

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

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



### (1) Structure of NSK Linear Guides

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

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

### (2) Characteristics of NSK Linear Guides

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

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

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

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

#### 1 High precision and quality

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

#### 2 High reliability and durability

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

#### 3 Abundant in type for any purpose

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

#### 4 Development of random-matching parts for short delivery time

- The adoption of the Gothic arch groove which makes measuring easy, and a reliable quality control method has made random-matching of the rails and the ball 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 contact surfaces which usually do not come into contact in ball type. This increases shock resistance (Fig. 5).

#### 6 Lineup of extremely high-load capacity series

- The LA series provides a top class high-load capacity for the ball linear guides through a unique load carrying configuration with three ball recirculation circuits on the one side.

By installing rollers that are the largest possible diameter and length, the NSK roller linear guides have realized the world highest load capacity, far superior to the roller linear guides of other companies.

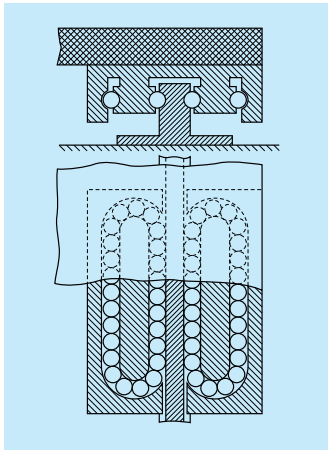


Fig. 1 • French Patent in 1932.  
• Inventor : Gretsh (German)

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

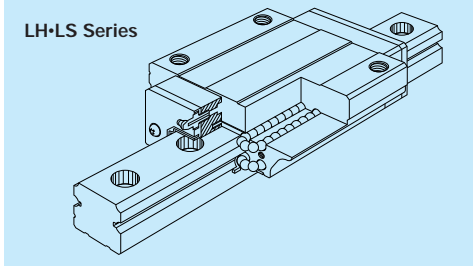
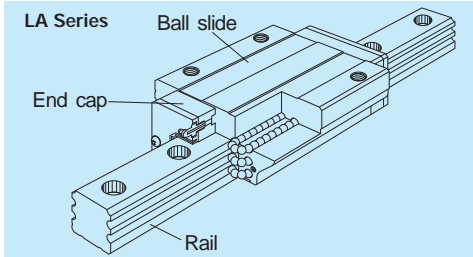
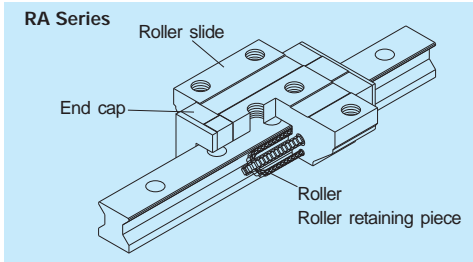


Fig. 2 Structure of NSK linear guides

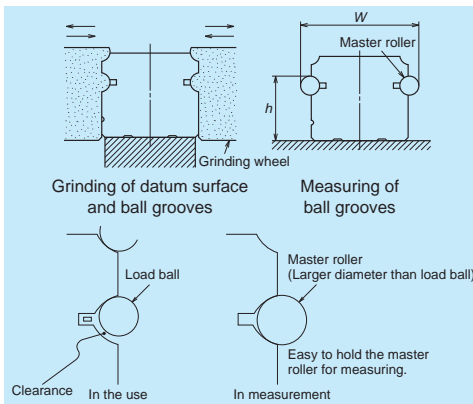


Fig. 4 Processing and measuring grooves

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

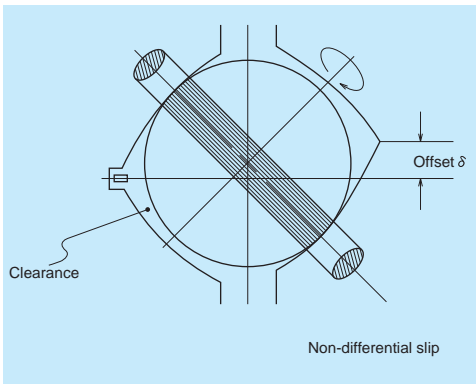


Fig. 3 Two contact point at offset Gothic arch groove

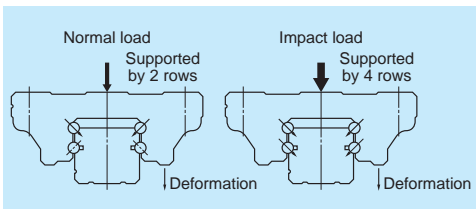
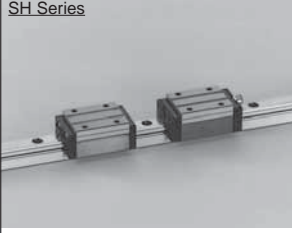
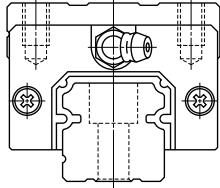
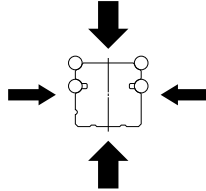
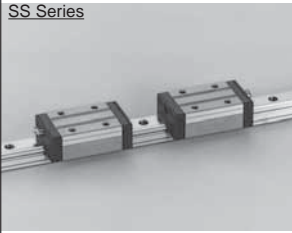
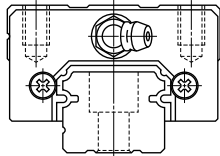
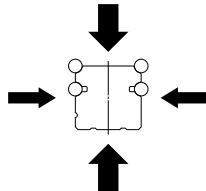
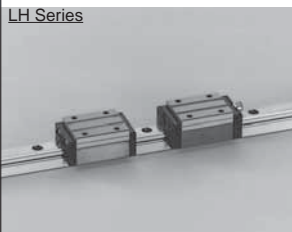
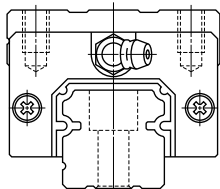
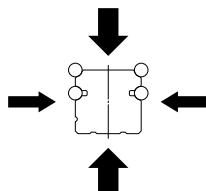
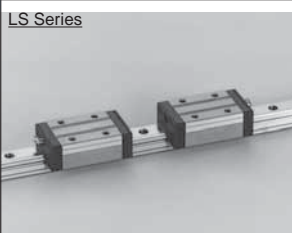
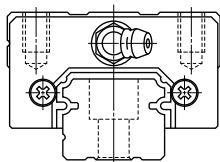
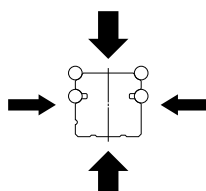


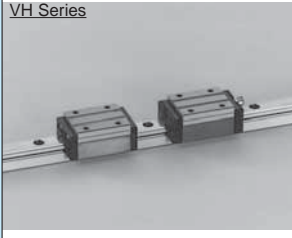
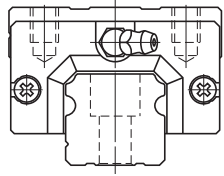
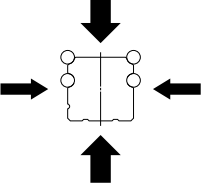

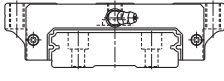
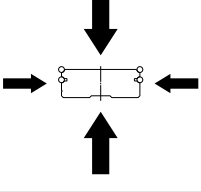

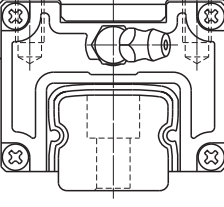
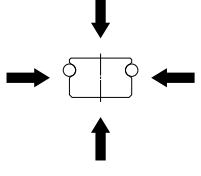

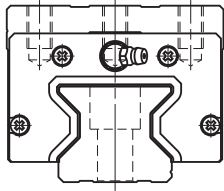
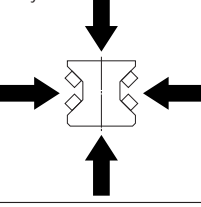
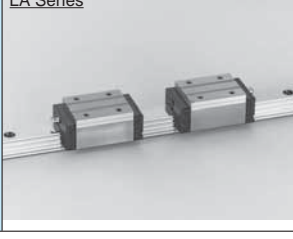
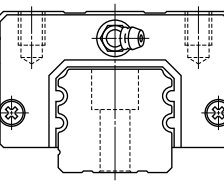
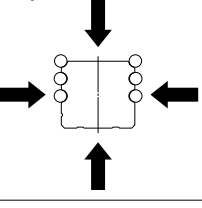
Fig. 5 Shock-resistance
















# A-2 Types of NSK Linear Rolling Guides

Product	Appearance	Shape	Rolling element	Load capability
NSK Linear Guides	SH Series 		Ball	High vertical load carrying capacity 
	SS Series 		Ball	High vertical load carrying capacity 
	LH Series 		Ball	High vertical load carrying capacity 
	LS Series 		Ball	High vertical load carrying capacity 


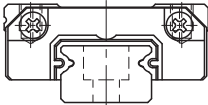
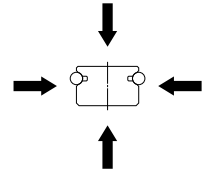

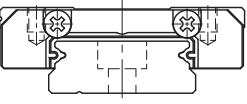
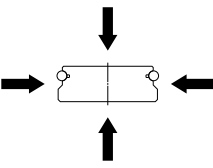
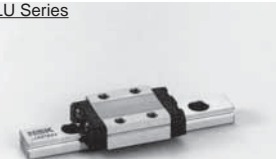
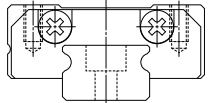
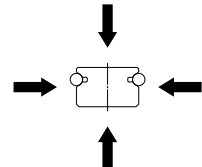
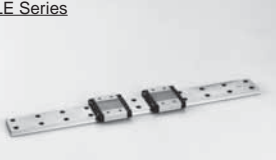
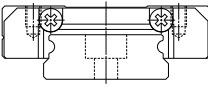
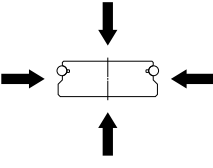
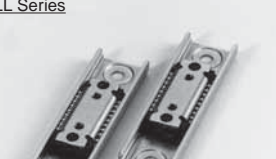
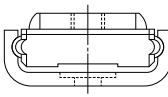
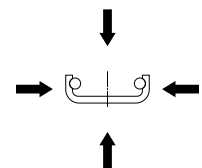
Rigidity ; ☆ : Extremely high ◎ : High ◉ : Medium ○ : Low  
 Friction characteristic ; ◎ : Low ○ : Normal  
 Mounting ; ◎ : Good ○ : Fair
















Rigidity	Friction characteristic	Mounting	Major applications	Page
◎	◎	◎	<ul style="list-style-type: none"> <li>Industrial robots</li> <li>Materials handling</li> <li>Semiconductor manufacturing equipment</li> <li>Laser processing machines</li> <li>Electric discharge machines</li> <li>Packaging/packing machines</li> </ul>	A115
◎	◎	◎	<ul style="list-style-type: none"> <li>Industrial robots</li> <li>Materials handling</li> <li>Electric discharge machines</li> <li>Semiconductor manufacturing equipment</li> <li>Packaging/packing machines</li> <li>Pneumatic components</li> </ul>	A139
◎	◎	◎	<ul style="list-style-type: none"> <li>Industrial robots</li> <li>Materials handling</li> <li>Semiconductor manufacturing equipment</li> <li>Woodworking machines</li> <li>Laser processing machines</li> <li>Electric discharge machines</li> <li>Packaging/packing machines</li> </ul>	A161
◎	◎	◎	<ul style="list-style-type: none"> <li>Industrial robots</li> <li>Materials handling</li> <li>Electric discharge machines</li> <li>Woodworking machines</li> <li>Semiconductor manufacturing equipment</li> <li>Packaging/packing machines</li> <li>Pneumatic components</li> </ul>	A185


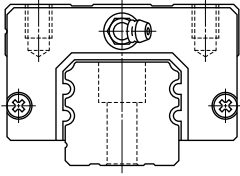
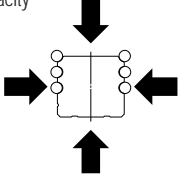

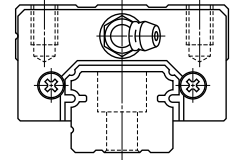
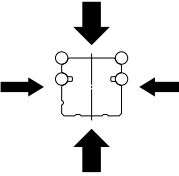

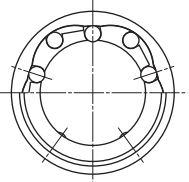
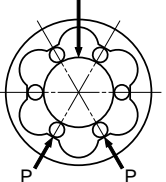

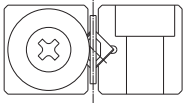
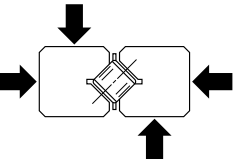

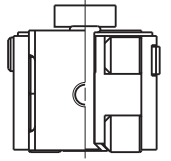
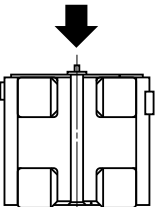
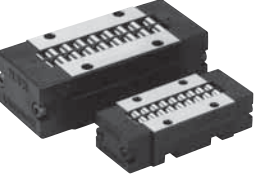
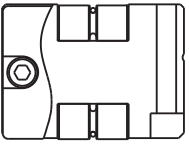
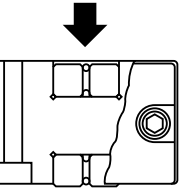
Product	Appearance	Shape	Rolling element	Load capability
NSK Linear Guides	VH Series 		Ball	High vertical load carrying capacity 
	LW Series 		Ball	High vertical load carrying capacity 
	TS Series 		Ball	Four-directional iso-load carrying capacity 
	RA Series 		Roller	Four-directional iso-load carrying capacity 
	LA Series 		Ball	Four-directional iso-load carrying capacity 



















Rigidity	Friction characteristic	Mounting	Major applications	Page
			<ul style="list-style-type: none"> <li>Industrial robots</li> <li>Materials handling</li> <li>Woodworking machines</li> <li>Laser processing machines</li> <li>Electric discharge machines</li> <li>Packaging/packing machines</li> </ul>	A207
			<ul style="list-style-type: none"> <li>Industrial robots</li> <li>Materials handling</li> <li>Electric discharge machines</li> <li>Woodworking machines</li> <li>Semiconductor manufacturing equipment</li> <li>Packaging/packing machines</li> <li>Pneumatic components</li> </ul>	A229
			<ul style="list-style-type: none"> <li>Industrial robots</li> <li>Materials handling</li> <li>Woodworking machines</li> <li>Laser processing machines</li> <li>Electric discharge machines</li> <li>Packaging/packing machines</li> </ul>	A243
			<ul style="list-style-type: none"> <li>Machining centers</li> <li>NC lathes</li> <li>Heavy cutting machine tools</li> <li>Grinders</li> <li>Gear cutting machines</li> <li>Press</li> <li>Electric discharge machines</li> </ul>	A251
			<ul style="list-style-type: none"> <li>Machining centers</li> <li>NC lathes</li> <li>Heavy cutting machine tools</li> <li>Grinders</li> <li>Gear cutting machines</li> <li>Press</li> <li>Electric discharge machines</li> </ul>	A269



Product	Appearance	Shape	Rolling element	Load capability
NSK Linear Guides	<p>PU Series</p> 		Ball	<p>Four-directional iso-load carrying capacity</p> 
	<p>PE Series</p> 		Ball	<p>Four-directional iso-load carrying capacity</p> 
	<p>LU Series</p> 		Ball	<p>Four-directional iso-load carrying capacity</p> 
	<p>LE Series</p> 		Ball	<p>Four-directional iso-load carrying capacity</p> 
	<p>LL Series</p> 		Ball	<p>Four-directional iso-load carrying capacity</p> 

Rigidity	Friction characteristic	Mounting	Major applications	Page
			<ul style="list-style-type: none"> <li>• Semiconductor manufacturing equipment</li> <li>• Liquid crystal display manufacturing equipment</li> <li>• Medical equipment</li> <li>• Optical stage</li> <li>• Microscope XY stage</li> <li>• Small robots</li> <li>• Pneumatic equipment</li> <li>• Computer peripheral equipment</li> </ul>	A289
			<ul style="list-style-type: none"> <li>• Semiconductor manufacturing equipment</li> <li>• Liquid crystal display manufacturing equipment</li> <li>• Medical equipment</li> <li>• Optical stage</li> <li>• Microscope XY stage</li> <li>• Small robots</li> <li>• Pneumatic equipment</li> <li>• Computer peripheral equipment</li> </ul>	A299
			<ul style="list-style-type: none"> <li>• Semiconductor manufacturing equipment</li> <li>• Liquid crystal display manufacturing equipment</li> <li>• Medical equipment</li> <li>• Optical stage</li> <li>• Microscope XY stage</li> <li>• Small robots</li> <li>• Pneumatic equipment</li> <li>• Computer peripheral equipment</li> </ul>	A309
			<ul style="list-style-type: none"> <li>• Semiconductor manufacturing equipment</li> <li>• Liquid crystal display manufacturing equipment</li> <li>• Medical equipment</li> <li>• Optical stage</li> <li>• Microscope XY stage</li> <li>• Small robots</li> <li>• Pneumatic equipment</li> <li>• Computer peripheral equipment</li> </ul>	A321
			<ul style="list-style-type: none"> <li>• Knitting machines</li> <li>• Computer peripheral equipment</li> <li>• Pneumatic equipment</li> <li>• Office equipment</li> </ul>	A335

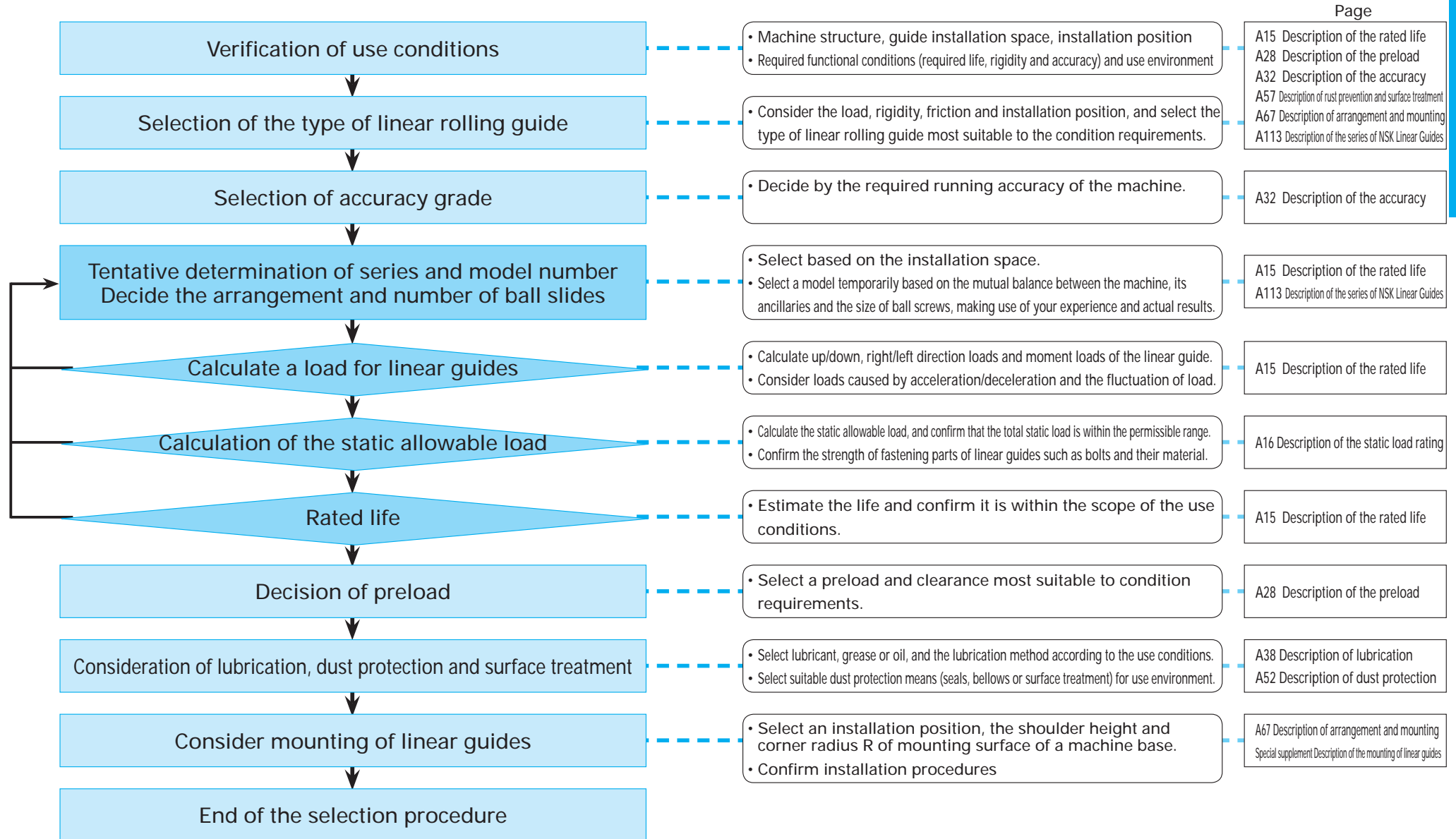
Product	Appearance	Shape	Rolling element	Load capability
NSK Linear Guides	HA Series 		Ball	Four-directional iso-load carrying capacity 
	HS Series 		Ball	High vertical load carrying capacity 
Linear rolling bushing			Ball	
Crossed roller guide			Roller	
Roller pack			Roller	
Linear roller bearing			Roller	

Rigidity	Friction characteristic	Mounting	Major applications	Page
			<ul style="list-style-type: none"> <li>• Machining centers</li> <li>• Precision lathes</li> <li>• Grinders</li> <li>• Electric discharge machines</li> <li>• Optical stage</li> <li>• Liquid crystal display manufacturing equipment</li> <li>• Die and mold tooling machine</li> <li>• Precision measuring equipment</li> </ul>	A341
			<ul style="list-style-type: none"> <li>• Machining centers</li> <li>• Precision lathes</li> <li>• Grinders</li> <li>• Electric discharge machines</li> <li>• Optical stage</li> <li>• Liquid crystal display manufacturing equipment</li> <li>• Precision measuring equipment</li> </ul>	A355
			<ul style="list-style-type: none"> <li>• Materials handling</li> <li>• Packaging/packing machines</li> <li>• Medical equipment</li> <li>• Pneumatic components</li> <li>• Office equipment</li> <li>• Assembling machines</li> </ul>	A369
			<ul style="list-style-type: none"> <li>• Precision stage</li> <li>• Measuring equipment</li> <li>• Test equipment</li> <li>• Printed circuit board assembly</li> </ul>	A380
			<ul style="list-style-type: none"> <li>• Large machine tools</li> <li>• Conveyor system for heavy objects (guide for heavy load)</li> </ul>	A386
			<ul style="list-style-type: none"> <li>• Large machine tools</li> <li>• Conveyor system for heavy objects (guide for heavy load)</li> </ul>	A393

# A-3 Selection of NSK Linear Rolling Guides

## A-3-1 Selection Flow Chart

Selection flow chart of NSK linear rolling guides



## A-3-2 Rating Life and Basic Load Rating

### A-3-2.1 Life and Basic Load Rating

#### (1) Life

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

#### (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 load. 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. Fatigue life varies significantly even in linear guides produced in the same lot, and even when they are operated under the same conditions. This is attributable to the inherent variation of the fatigue of the material itself.

"Rating fatigue life" is the total running distance which allows 90% of the group of linear guides of the same reference number to run without causing flaking when they are independently run under the same conditions. 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 calculates the basic load rating in compliance with ISO standard.

The basic load rating as listed in "A-5 Linear Guide Dimension Table" comply with the ISO standard.

ISO : International Organization for Standardization

[Basic dynamic load rating]

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

Part 1: Dynamic load ratings and rating life

[Basic static load rating]

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

Part 2: Static load ratings

#### (4) Basic dynamic load rating

- 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 50 km of rating fatigue life.
- In case of linear guide, it is a constant load applied to downward direction to the center of the slide.
- Value of basic dynamic load rating  $C$  is shown in "A-5 Linear Guide Dimension Table."
- NSK defines the basic dynamic load rating as the load that furnishes 50 km of rated fatigue life. However some linear guide manufacturers in Europe and the United States define the load for the basic fatigue life of 100 km as the basic dynamic load ratings.
- The following formula may be used to convert the basic dynamic load rating  $C_{50}$  into the dynamic load rating for 100 km rated fatigue life.

For balls as rolling element :  $C_{100} = C/1.26$  (N)  
 For rollers as rolling element :  $C_{100} = C/1.23$  (N)

#### (5) Calculation of rating fatigue life

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

For balls as rolling element :  $L = 50 \times \left(\frac{C}{F}\right)^3$

For rollers as rolling element :  $L = 50 \times \left(\frac{C}{F}\right)^{\frac{10}{3}}$

$L$  : Rating fatigue life (km)  
 $C$  : Basic dynamic load rating (N) (50 km)  
 $F$  : Load to a slide (N)  
 (dynamic equivalent load)

- The rating fatigue life  $L$  for 100 km can be obtained from the following formulas using the dynamic load rating  $C_{100}$ .

For balls as rolling element :  $L = 100 \times \left(\frac{C_{100}}{F}\right)^3$

For rollers as rolling element :  $L = 100 \times \left(\frac{C_{100}}{F}\right)^{\frac{10}{3}}$

$L$  : Rating fatigue life (km)  
 $C_{100}$  : Dynamic load rating for 100 km (N)  
 $F$  : Load to a slide (dynamic equivalent load) (N)

#### (6) Dynamic equivalent load

- Load applied to the linear guide (slide load) comes from various directions up/down and right/left directions and/or as moment load. Sometimes more than one type of load is applied simultaneously. Sometimes volume and direction of the load may change.
- Varying load cannot be used as it is to calculate life of linear guide. Therefore, it is necessary to use a hypothetical load to slide with a constant volume which would generate a value equivalent to an actual fatigue life. This is called "dynamic equivalent load." For actual calculation, refer to "A-3-2.2 (3)"

#### (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 to the rolling elements and to the rolling contact surface. 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 case of linear guide, 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-5 Linear Guide Dimension Table."

#### (8) Basic static moment load rating

- Generally, NSK linear guide uses a set of two rails and four slides for the guide way of one axis. Under some operating condition, static moment load should be taken into account.
- " $M_0$ ," which is the limit of static moment load, and calculated from permanent deformation in such use is shown in "A-5 Linear Guide Dimension Table."

#### (9) Basic load rating by load direction

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

Table 2.1 Basic load ratings by load direction

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

A-3-2.2 How to Calculate 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, vertical
- Rail combination : Single rail, multiple rail
- Applying loads :  $F_x, F_y$  and  $F_z$  (N)
- Slide span :  $l$  (mm)
- Rail span :  $L$  (mm)
- Position of load action point :  $X, Y, Z$  (mm)
- Center of driving mechanism :  $X_b, Y_b, Z_b$  (mm)
- Operating speed :  $V$  (mm/sec)
- Time in acceleration :  $t$  (sec)
- Operating frequency (duty cycle)

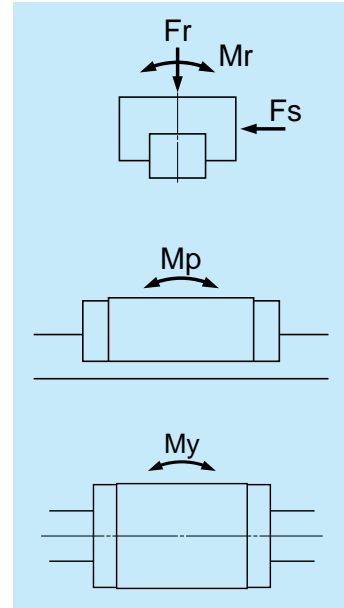


Fig. 2.1

(2) Calculating load to a slide

- Table 2.2 shows a formula to calculate loads that are going to be applied to each assembled slide into a machine.
- The Table shows six typical patterns of linear guide installing structure.

- In the Tables, directions indicated by arrows denote "plus" for the applied loads ( $F_x, F_y, F_z$ ) and the loads which are applied to the slide. ( $F_r, F_s, M_r, M_p, M_y$ ).

- 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 ( $i = 1 - n$ ;  $n$  is the number of loads applied in X direction) (N)
- $F_{yj}$  : Load applied in Y direction ( $j = 1 - n$ ;  $n$  is the number of loads applied in Y direction) (N)
- $F_{zk}$  : Load applied in Z direction ( $k = 1 - n$ ;  $n$  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

Table 2.2 Loads applied to the slides

Pattern	Arrangement of slides	Load to slide and deformation at Point A
1		$F_{r1} = \sum_{k=1}^n F_{zk} \quad , \quad F_{s1} = \sum_{j=1}^n F_{yj}$ $M_{r1} = \sum_{j=1}^n (F_{yj} \cdot Z_{yj}) + \sum_{k=1}^n (F_{zk} \cdot Y_{zk})$ $M_{p1} = \sum_{i=1}^n \{F_{xi} \cdot (Z_{xi} - Z_b)\} + \sum_{k=1}^n (F_{zk} \cdot X_{zk})$ $M_{y1} = -\sum_{i=1}^n \{F_{xi} \cdot (Y_{xi} - Y_b)\} + \sum_{j=1}^n (F_{yj} \cdot X_{yj})$
2		$F_{r1} = \frac{\sum_{k=1}^n F_{zk}}{2} + \frac{M2}{l} \quad , \quad F_{r2} = \frac{\sum_{k=1}^n F_{zk}}{2} - \frac{M2}{l}$ $F_{s1} = \frac{\sum_{j=1}^n F_{yj}}{2} + \frac{M3}{l} \quad , \quad F_{s2} = \frac{\sum_{j=1}^n F_{yj}}{2} - \frac{M3}{l}$ $M_{r1} = \frac{M1}{2} \quad , \quad M_{r2} = \frac{M1}{2}$ $M1 = \sum_{j=1}^n (F_{yj} \cdot Z_{yj}) + \sum_{k=1}^n (F_{zk} \cdot Y_{zk})$ $M2 = \sum_{i=1}^n \{F_{xi} \cdot (Z_{xi} - Z_b)\} + \sum_{k=1}^n (F_{zk} \cdot X_{zk})$ $M3 = -\sum_{i=1}^n \{F_{xi} \cdot (Y_{xi} - Y_b)\} + \sum_{j=1}^n (F_{yj} \cdot X_{yj})$
3		$F_{r1} = \frac{\sum_{k=1}^n F_{zk}}{2} + \frac{M1}{L} \quad , \quad F_{r2} = \frac{\sum_{k=1}^n F_{zk}}{2} - \frac{M1}{L}$ $F_{s1} = F_{s2} = \frac{\sum_{j=1}^n F_{yj}}{2}$ $M_{p1} = M_{p2} = \frac{M2}{2} \quad , \quad M_{y1} = M_{y2} = \frac{M3}{2}$ $M1 = \sum_{j=1}^n (F_{yj} \cdot Z_{yj}) + \sum_{k=1}^n (F_{zk} \cdot Y_{zk})$ $M2 = \sum_{i=1}^n \{F_{xi} \cdot (Z_{xi} - Z_b)\} + \sum_{k=1}^n (F_{zk} \cdot X_{zk})$ $M3 = -\sum_{i=1}^n \{F_{xi} \cdot (Y_{xi} - Y_b)\} + \sum_{j=1}^n (F_{yj} \cdot X_{yj})$

Pattern	Arrangement of slides	Load to slide and deformation at Point A
4	<p>Center of driving mechanism (<math>X_b, Y_b, Z_b</math>)</p>	$Fr_1 = \frac{\sum_{k=1}^n F_{Zk}}{4} + \frac{M_1}{2L} + \frac{M_2}{2l}, \quad Fr_2 = \frac{\sum_{k=1}^n F_{Zk}}{4} + \frac{M_1}{2L} - \frac{M_2}{2l}$ $Fr_3 = \frac{\sum_{k=1}^n F_{Zk}}{4} - \frac{M_1}{2L} + \frac{M_2}{2l}, \quad Fr_4 = \frac{\sum_{k=1}^n F_{Zk}}{4} - \frac{M_1}{2L} - \frac{M_2}{2l}$ $Fs_1 = Fs_3 = \frac{\sum_{j=1}^n F_{Yj}}{4} + \frac{M_3}{2l}, \quad Fs_2 = Fs_4 = \frac{\sum_{j=1}^n F_{Yj}}{4} - \frac{M_3}{2l}$ $M_1 = \sum_{j=1}^n (F_{Yj} \cdot Z_{yj}) + \sum_{k=1}^n (F_{Zk} \cdot Y_{zk})$ $M_2 = \sum_{i=1}^n \{F_{X_i} \cdot (Z_{xi} - Z_b)\} + \sum_{k=1}^n (F_{Zk} \cdot X_{zk})$ $M_3 = -\sum_{i=1}^n \{F_{X_i} \cdot (Y_{xi} - Y_b)\} + \sum_{j=1}^n (F_{Yj} \cdot X_{yj})$ $\delta x = Y_d \cdot \frac{Fs_2 - Fs_1}{l \cdot K_s} + Z_d \cdot \frac{Fr_1 - Fr_2}{l \cdot K_r}$ $\delta y = \frac{\sum_{j=1}^n F_{Yj}}{4 \cdot K_s} + X_d \cdot \frac{Fs_1 - Fs_2}{l \cdot K_s} + Z_d \cdot \frac{Fr_1 - Fr_3}{l \cdot K_r}$ $\delta z = \frac{\sum_{k=1}^n F_{Zk}}{4 \cdot K_r} + X_d \cdot \frac{Fr_1 - Fr_2}{l \cdot K_r} + Y_d \cdot \frac{Fr_1 - Fr_3}{l \cdot K_r}$

5	<p>Center of driving mechanism (<math>X_b, Y_b, Z_b</math>)</p>	$Fr_1 = \frac{\sum_{k=1}^n F_{Zk}}{6} + \frac{M_1}{3L} + \frac{M_2}{2l}, \quad Fr_2 = \frac{\sum_{k=1}^n F_{Zk}}{6} + \frac{M_1}{3L}$ $Fr_3 = \frac{\sum_{k=1}^n F_{Zk}}{6} + \frac{M_1}{3L} - \frac{M_2}{2l}, \quad Fr_4 = \frac{\sum_{k=1}^n F_{Zk}}{6} - \frac{M_1}{3L} + \frac{M_2}{2l}$ $Fr_5 = \frac{\sum_{k=1}^n F_{Zk}}{6} - \frac{M_1}{3L}, \quad Fr_6 = \frac{\sum_{k=1}^n F_{Zk}}{6} - \frac{M_1}{3L} - \frac{M_2}{2l}$ $Fs_1 = Fs_4 = \frac{\sum_{j=1}^n F_{Yj}}{6} + \frac{M_3}{2l}, \quad Fs_2 = Fs_5 = \frac{\sum_{j=1}^n F_{Yj}}{6}$ $Fs_3 = Fs_6 = \frac{\sum_{j=1}^n F_{Yj}}{6} - \frac{M_3}{2l}$ $M_1 = \sum_{j=1}^n (F_{Yj} \cdot Z_{yj}) + \sum_{k=1}^n (F_{Zk} \cdot Y_{zk})$ $M_2 = \sum_{i=1}^n \{F_{X_i} \cdot (Z_{xi} - Z_b)\} + \sum_{k=1}^n (F_{Zk} \cdot X_{zk})$ $M_3 = -\sum_{i=1}^n \{F_{X_i} \cdot (Y_{xi} - Y_b)\} + \sum_{j=1}^n (F_{Yj} \cdot X_{yj})$ $\delta x = Y_d \cdot \frac{Fs_3 - Fs_1}{l \cdot K_s} + Z_d \cdot \frac{Fr_1 - Fr_3}{l \cdot K_r}$ $\delta y = \frac{\sum_{j=1}^n F_{Yj}}{6 \cdot K_s} + X_d \cdot \frac{Fs_1 - Fs_3}{l \cdot K_s} + Z_d \cdot \frac{Fr_1 - Fr_4}{l \cdot K_r}$ $\delta z = \frac{\sum_{k=1}^n F_{Zk}}{6 \cdot K_r} + X_d \cdot \frac{Fr_1 - Fr_3}{l \cdot K_r} + Y_d \cdot \frac{Fr_1 - Fr_4}{l \cdot K_r}$
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Pattern	Arrangement of slides	Load to slide and deformation at Point A
6	<p>Center of driving mechanism (<math>X_b, Y_b, Z_b</math>)</p>	$Fr_1 = \frac{\sum_{k=1}^n F_{Zk}}{8} + \frac{M_1}{4L} + \frac{M_2 \cdot l'}{2 \cdot (l^2 + l'^2)}$ $Fr_2 = \frac{\sum_{k=1}^n F_{Zk}}{8} + \frac{M_1}{4L} + \frac{M_2 \cdot l}{2 \cdot (l^2 + l'^2)}$ $Fr_3 = \frac{\sum_{k=1}^n F_{Zk}}{8} + \frac{M_1}{4L} - \frac{M_2 \cdot l}{2 \cdot (l^2 + l'^2)}$ $Fr_4 = \frac{\sum_{k=1}^n F_{Zk}}{8} + \frac{M_1}{4L} - \frac{M_2 \cdot l'}{2 \cdot (l^2 + l'^2)}$ $Fr_5 = \frac{\sum_{k=1}^n F_{Zk}}{8} - \frac{M_1}{4L} + \frac{M_2 \cdot l'}{2 \cdot (l^2 + l'^2)}$ $Fr_6 = \frac{\sum_{k=1}^n F_{Zk}}{8} - \frac{M_1}{4L} + \frac{M_2 \cdot l}{2 \cdot (l^2 + l'^2)}$ $Fr_7 = \frac{\sum_{k=1}^n F_{Zk}}{8} - \frac{M_1}{4L} - \frac{M_2 \cdot l}{2 \cdot (l^2 + l'^2)}$ $Fr_8 = \frac{\sum_{k=1}^n F_{Zk}}{8} - \frac{M_1}{4L} - \frac{M_2 \cdot l'}{2 \cdot (l^2 + l'^2)}$ $Fs_1 = Fs_5 = \frac{\sum_{j=1}^n F_{Yj}}{8} + \frac{M_3 \cdot l'}{2 \cdot (l^2 + l'^2)}$ $Fs_2 = Fs_6 = \frac{\sum_{j=1}^n F_{Yj}}{8} + \frac{M_3 \cdot l}{2 \cdot (l^2 + l'^2)}$ $Fs_3 = Fs_7 = \frac{\sum_{j=1}^n F_{Yj}}{8} - \frac{M_3 \cdot l}{2 \cdot (l^2 + l'^2)}$ $Fs_4 = Fs_8 = \frac{\sum_{j=1}^n F_{Yj}}{8} - \frac{M_3 \cdot l'}{2 \cdot (l^2 + l'^2)}$ $M_1 = \sum_{j=1}^n (F_{Yj} \cdot Z_{yj}) + \sum_{k=1}^n (F_{Zk} \cdot Y_{zk})$ $M_2 = \sum_{i=1}^n \{F_{X_i} \cdot (Z_{xi} - Z_b)\} + \sum_{k=1}^n (F_{Zk} \cdot X_{zk})$ $M_3 = -\sum_{i=1}^n \{F_{X_i} \cdot (Y_{xi} - Y_b)\} + \sum_{j=1}^n (F_{Yj} \cdot X_{yj})$ $\delta x = Y_d \cdot \frac{Fs_4 - Fs_1}{l_2 \cdot K_s} + Z_d \cdot \frac{Fr_1 - Fr_4}{l_2 \cdot K_r}$ $\delta y = \frac{\sum_{j=1}^n F_{Yj}}{8 \cdot K_s} + X_d \cdot \frac{Fs_1 - Fs_4}{l_2 \cdot K_s} + Z_d \cdot \frac{Fr_1 - Fr_5}{l \cdot K_r}$ $\delta z = \frac{\sum_{k=1}^n F_{Zk}}{8 \cdot K_r} + X_d \cdot \frac{Fr_1 - Fr_4}{l_2 \cdot K_r} + Y_d \cdot \frac{Fr_1 - Fr_5}{l \cdot K_r}$

(3) Calculation of dynamic equivalent load

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

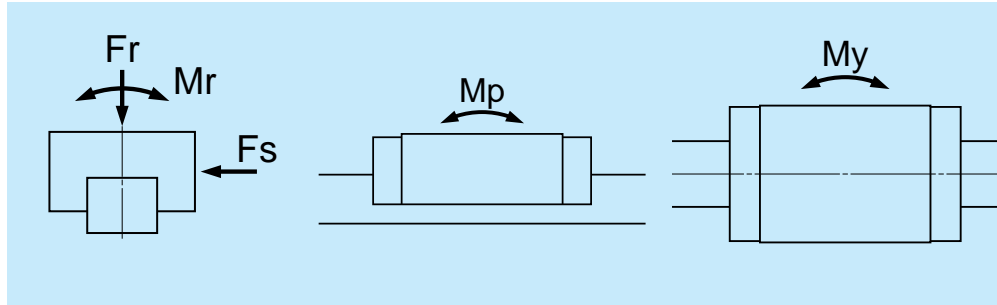


Fig. 2.3

Table 2.3 Loads in the arrangement of linear guides

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

• Use dynamic equivalent coefficient  $\epsilon$  in the table below for easy conversion of moment load to dynamic equivalent load.

• Coefficient of each moment direction is as follows.

- $\epsilon_r$ : Rolling direction
- $\epsilon_p$ : Pitching direction
- $\epsilon_y$ : Yawing direction

Table 2.4 Dynamic equivalent coefficients

Unit: 1/m

Model No.	$\epsilon_r$	$\epsilon_p$	$\epsilon_y$	Model No.	$\epsilon_r$	$\epsilon_p$	$\epsilon_y$	Model No.	$\epsilon_r$	$\epsilon_p$	$\epsilon_y$
SH15	188	112	133	LS35S	76	87	104	PU12	163	204	204
SH15L	188	68	81	VH15	188	111	132	PU12L	163	125	125
SH20	142	82	98	VH15L	188	72	86	PU15	133	174	174
SH20L	142	56	67	VH20	142	81	97	PU15L	133	102	102
SH25	123	66	78	VH20L	142	57	68	PE05	194	277	277
SH25L	123	47	56	VH25	123	68	81	PE07	141	203	203
SH30A	98	74	89	VH25L	123	51	61	PE09	123	161	161
SH30EF	98	60	71	VH30A	98	70	83	PE09L	123	108	108
SH30L	98	42	50	VH30EF	98	58	69	PE12	90	136	136
SH35	78	54	64	VH30L	98	44	52	PE12L	90	90	90
SH35L	78	36	43	VH35	78	51	61	PE15	50	111	111
SH45	60	39	46	VH35L	78	36	43	PE15L	50	72	72
SH45L	60	29	35	VH45	60	38	45	LU05	385	359	359
SH55	51	33	39	VH45L	60	30	36	LU07	286	305	305
SH55L	51	24	29	VH55	51	31	37	LU09	217	242	242
SS15	177	97	115	VH55L	51	25	30	LU09L	217	138	138
SS15S	177	176	210	LW17	66	125	149	LU09R	217	203	203
SS20	127	87	104	LW21	59	108	129	LU12	167	204	204
SS20S	127	138	164	LW27	53	76	91	LU12L	167	116	116
SS25	111	70	83	LW35	32	51	61	LU15	133	174	174
SS25S	111	115	137	LW50	25	38	46	LU15L	133	94	94
SS30	94	57	68	RA15	105	95	95	LE05	196	248	248
SS30S	94	106	126	RA15L	105	70	70	LE05S	196	323	323
SS35	76	42	50	RA20	79	74	74	LE07	141	188	188
SS35S	76	94	112	RA20L	79	55	55	LE07S	141	349	349
LH08	316	269	321	RA25	71	64	64	LE07L	141	122	122
LH10	253	203	242	RA25L	71	50	50	LE09	123	149	149
LH12	223	136	162	RA30	56	58	58	LE09S	123	277	277
LH15	188	111	132	RA30L	56	44	44	LE09L	123	102	102
LH15L	188	72	86	RA35	46	52	52	LE12	90	125	125
LH20	142	81	97	RA35L	46	39	39	LE12S	90	233	233
LH20L	142	57	68	RA45	37	40	40	LE12L	90	86	86
LH25	123	68	81	RA45L	37	30	30	LE15	50	102	102
LH25L	123	51	61	RA55	32	33	33	LE15S	50	174	174
LH30A	98	70	83	RA55L	32	24	24	LE15L	50	68	68
LH30EF	98	58	69	RA65	26	28	28	HA25	122	33	33
LH30L	98	44	52	RA65L	26	19	19	HA30	105	27	27
LH35	78	51	61	LA25	122	76	76	HA35	84	23	23
LH35L	78	36	43	LA25L	122	47	47	HA45	60	20	20
LH45	60	38	45	LA30	105	63	63	HA55	51	16	16
LH45L	60	30	36	LA30L	105	43	43	HS15	177	45	54
LH55	51	31	37	LA35	84	54	54	HS20	127	39	47
LH55L	51	25	30	LA35L	84	37	37	HS25	111	33	39
LH65	43	27	32	LA45	60	41	41	HS30	94	27	32
LH65L	43	20	24	LA45L	60	31	31	HS35	76	23	28
LH85L	33	17	20	LA55	51	33	33	TS15	128	122	122
LS15	177	116	138	LA55L	51	26	26	TS20	97	90	90
LS15S	177	174	208	LA65	43	29	29	TS25	81	77	77
LS20	127	94	112	LA65L	43	20	20	TS30	67	61	61
LS20S	127	136	162	LS25	111	70	83	TS35	55	54	54
LS25	111	70	83	LS25S	111	108	129	PU05	377	431	431
LS25S	111	108	129	LS30	94	63	75	PU07	267	349	349
LS30	94	63	75	LS30S	94	102	121	PU09	215	222	222
LS30S	94	102	121	LS35	76	54	64	PU09L	215	136	136

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

- L : Super-high-load type ; LH45L
- S : Medium load type ; LS25S
- No code: High-load type ; LY45\_
- A : Ball slide shape is square ; LH30A (only LH30 and SH30)
- EF : Ball slide shape is flanged type (EL, FL type) ; LH30EF (only LH30 and SH30)
- R : Miniature Series with ball retainer ; LU09R

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

- When  $F_r$  is the largest load :  $F_e = F_r + 0.5F_{se} + 0.5F_{re} + 0.5F_{pe} + 0.5F_{ye}$
- When  $F_{se}$  is the largest load :  $F_e = 0.5F_r + F_{se} + 0.5F_{re} + 0.5F_{pe} + 0.5F_{ye}$
- When  $F_{re}$  is the largest load :  $F_e = 0.5F_r + 0.5F_{se} + F_{re} + 0.5F_{pe} + 0.5F_{ye}$
- When  $F_{pe}$  is the largest load :  $F_e = 0.5F_r + 0.5F_{se} + 0.5F_{re} + F_{pe} + 0.5F_{ye}$
- When  $F_{ye}$  is the largest load :  $F_e = 0.5F_r + 0.5F_{se} + 0.5F_{re} + 0.5F_{pe} + F_{ye}$

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

**(4) Calculation of mean effective load**

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

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

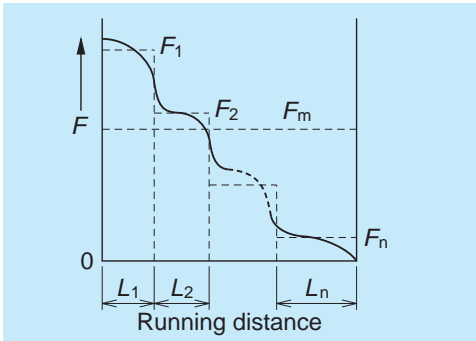


Fig. 2.3 Stepwise load change

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

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

In case of ball  $F_m = \sqrt[3]{\frac{1}{L} (F_1^3 L_1 + F_2^3 L_2 + \dots + F_n^3 L_n)}$       In case of roller  $F_m = \sqrt[10]{\frac{1}{L} (F_1^{10} L_1 + F_2^{10} L_2 + \dots + F_n^{10} L_n)}$

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

$L$  : Running distance ( $\Sigma L_n$ )

② When load changes almost linearly (Fig. 2.4)  
 Approximate mean effective load  $F_m$  can be obtained by the following formula.

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

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

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

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

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

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

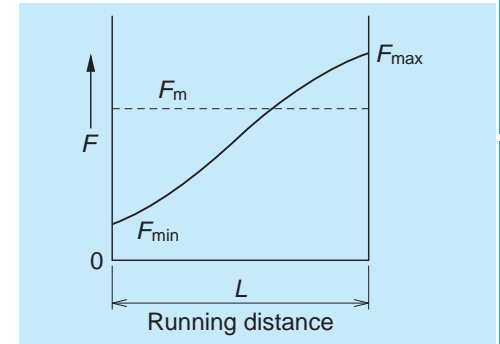


Fig. 2.4 Linear load change

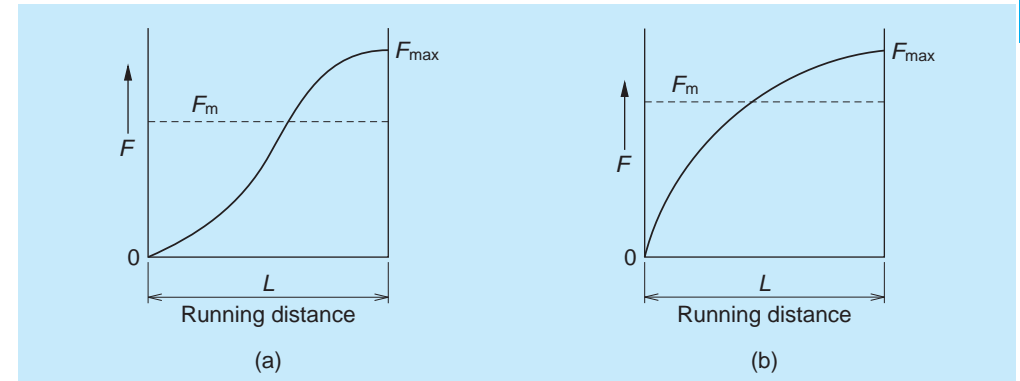


Fig. 2.5 Load that changes in sinusoidal pattern

**(5) Various coefficients**

① Load factors

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

Table 2.5 Load factor  $f_w$

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

$$C_H = f_H \cdot C$$

$$C_{OH} = f_{H'} \cdot C_o$$

- $C_H$ : Basic dynamic load rating adjusted by hardness coefficient
- $f_H$ : Hardness coefficient (Refer to Fig. 2.6)
- $C_{OH}$ : Basic static load rating adjusted by hardness coefficient
- $f_{H'}$ : Static hardness coefficient (Refer to Fig. 2.6)

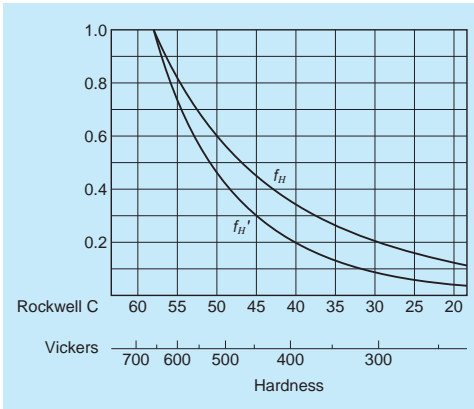


Fig. 2.6 Hardness coefficient

③ Reliability coefficient

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

(6) Calculation of rating life

Life Calculating Formula

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

$$L = 50 \times \left( \frac{f_H \cdot C}{f_w \cdot F_m} \right)^n \text{ (km)}$$

- Ball linear guide bearing which uses balls  $n = 3$
- Roller linear guide bearing which uses rollers  $n = 10/3$
- $f_H$ : Hardness coefficient
- $f_w$ : Load factor
- $F_m$ : Mean effective load

Use basic dynamic load rating  $C$  to calculate the life.

**Note: Do not use basic static load rating  $C_o$ , and basic static moment rating  $M_{Ro}$ ,  $M_{Po}$  or  $M_{Yo}$ .**

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."

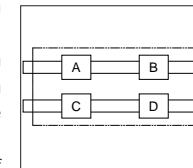


Fig. 2.7 Life of a system

(7) Examination of static load

① Examine from basic static load rating

- Examine static equivalent load  $P_o$ , which is applied to the slide, from basic static load rating  $C_o$  and static permissible load factor  $f_s$ .

$$f_s = \frac{C_o}{P_o}$$

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

For SH, SS, LH, LS, VH, HS and LW Series:

If compressed load and lateral load are combined  
 $P_o = Fr + 1.54Fs$

If tensile load and lateral load are combined

$$P_o = 1.28Fr + 1.54Fs$$

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

$$P_o = Fr + Fs$$

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

Table 2.6

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

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

② Examining from static moment load rating

- Also examine static permissible moment load  $M_o$  from basic static moment load  $M_{Po}$  and static permissible load factor  $f_s$ .

$$f_s = \frac{M_{Po}}{M_o}$$

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

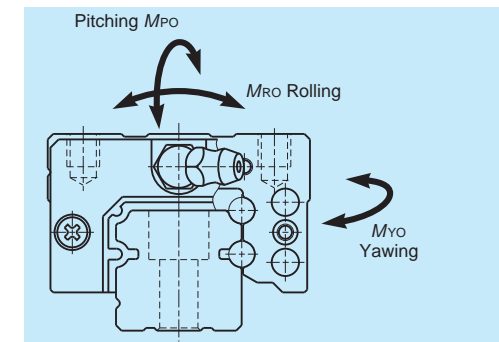


Fig. 2.8 Moment load directions

## (8) Precautions for the design in examining the life

The following points must be heeded in examining the life.



### In case of oscillating stroke

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



### When applying pitching or yawing moment

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



### When an extraordinary large load is applied during stroke

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



### When calculated life is extraordinarily short (Less than 3000 km in calculated life.)

- In such case, the contact pressure to the rolling elements and the rolling contact surface is extraordinarily high.
- Operated under such state continually, the life is significantly affected by the loss of lubrication and the presence of dust, and the actual life becomes shorter than calculated.
- It is necessary to reconsider arrangement, the number of slide, and the type of model in order to reduce the load to the slide.
- It is necessary to consider preload for calculation of rating life, when selecting Z3 (medium preload) or Z4 (heavy preload) as a preload. Please consult NSK.



### Application at high speed

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

## A-3-3 Preload

### (1) Objective of preload

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

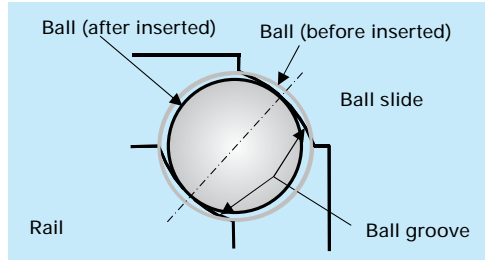


Fig.3.1 Preloading method

### (2) Preload and rigidity

- In NSK linear guides, slight size changes rolling elements, which are going to be inserted in the slide, control clearance and amount of preload.
- In NSK linear guide, rigidity is further increased and elastic deformation is reduced by applying preload.
- In general, a load range of ball guide system in which the preload is effective becomes about 2.8 times of the preload (Fig.3.2). For roller guide system, it becomes about 2.2 times of the preload.
- Fig. 3.3 shows the relationship of ball slide deformation by external vertical load and preload. SH35 is used as a case.
- The following show the definition of linear guide rigidity.

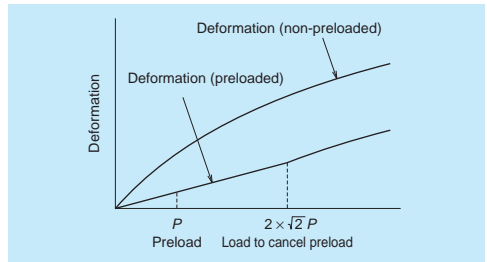


Fig. 3.2 Elastic deformation

- 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).

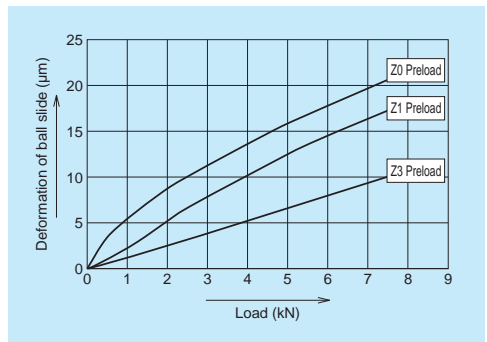


Fig. 3.3 Rigidity of SH35, downward direction load (example)

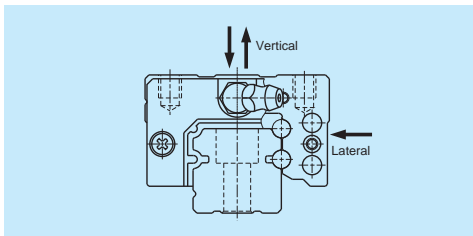


Fig. 3.4 Radial rigidity

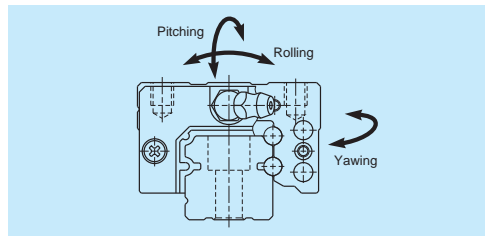


Fig. 3.5 Moment rigidity

- Since two rails and four slides are used in general as a pair, considering only 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.

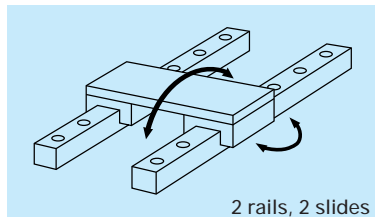


Fig. 3.6 Pitching and yawing direction

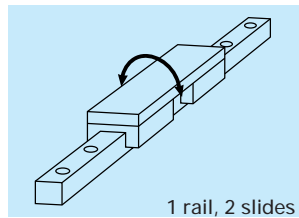


Fig. 3.7 Rolling direction

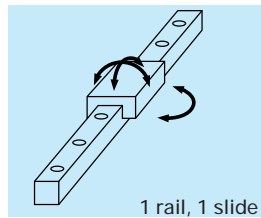


Fig. 3.8 All directions

### (3) Selection of preload types

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

Table 3.1 Classification of preload in each series

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

Table 3.2 Loads

Classification of preload	Use condition	Applications
Z0, ZT, ZS (Fine clearance)	<ul style="list-style-type: none"> <li>• An application in which a set of parallel two linear guides (four ball slides/two rails) is used to sustain a unidirectional load with low vibration and impact.</li> <li>• Application in which the accuracy is not very necessary but a friction force must be minimized.</li> </ul>	Welding machine, Glass processing machine, Packaging/packing machines, Materials handling
Z1, ZZ (Slight preload)	<ul style="list-style-type: none"> <li>• Moment loads are applied.</li> <li>• Application for highly accurate.</li> </ul>	Industrial robot, Inspection/measuring equipment, Laser cutting machine, Electric discharge machine, PCB driller, Moulder
Z3, Z4 (Medium preload, Heavy preload)	<ul style="list-style-type: none"> <li>• Application in which extremely high stiffness is essential.</li> <li>• Application in which vibration and impact load will be applied.</li> </ul>	Machining centers, Lathes, Milling machines, Boring machines, Grinders

### (4) Deformation Calculation

The followings are the relation between load and deformation.

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

When the rolling element is roller
 

- The deformation is proportional to the 9/10 power of the load.

- With preload
  - The deformation is directly proportional to the load.

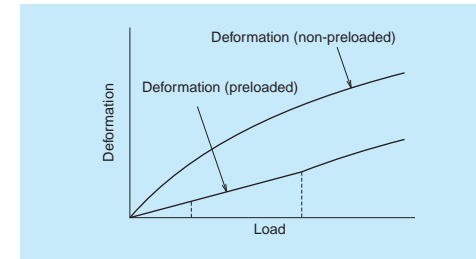


Fig. 3.9 Elastic deformation

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

<Required conditions to calculate deformation>

- Volume of load
- Direction of load
- Point of load application
- Position of deformation calculation
- Arrangement of rail and ball slides
- Position of driving mechanism

Please refer to the calculating formula of deformation for typical table structures on the Pages A18 to A20.

### (5) Application examples of preload

Table 3.3 shows examples of preload of NSK linear guides for specific purposes.

Refer to this table when selecting preload type for your application.

Table 3.3 Examples of preload for specific purpose

Type of machine	Application	Preload			
		Heavy preload Z4	Medium preload Z3	Slight preload Z1, ZZ	Fine clearance Z0, ZT, ZS
Machine tools	• Machining centers	○	○		
	• Grinders	○	○		
	• Lathes	○	○		
	• Milling machines	○	○		
	• Drilling machines	○	○		
	• Boring machines		○		
	• Gear cutters	○	○		
	• Diesinking machine		○	○	
	• Laser cutting machine		○	○	
	• Electric discharge machine		○		
Industrial machines and equipment	• Punch press		○	○	
	• Press machine			○	○
	• Welding machine		○	○	○
	• Painting machine			○	○
	• Textile machine			○	○
	• Coil winder		○	○	
	• Woodworking machine		○	○	○
	• Glass processing machine			○	○
	• Stone cutting machine			○	○
	• Tire forming machine			○	○
	• ATC			○	○
	• Industrial robot		○	○	○
	• Materials handling			○	○
• Packing machine			○	○	
• Construction machine				○	
Semiconductor facilities	• Prober		○		
	• Wire bonder		○	○	
	• PCB driller		○	○	
	• Slicer		○		
	• Dicer		○		
	• Chip moulder		○	○	
Others	• IC handler			○	
	• Scanner			○	
	• Lithographic machine		○	○	
	• Measuring/inspection equipment			○	
	• Three-dimensional measuring equipment		○	○	
Others	• Medical equipment			○	○
	• OA equipment			○	○
	• Railway cars			○	○
	• Stage systems				○
Others	• Pneumatic equipment			○	○

**(6) Load and rating life when the preload is taken into account**

It is necessary to consider preload for calculation of rating life, when the Z3 (medium preload) or the Z4 (heavy preload) preload code is specified. Please consult NSK.

**(7) Calculating Friction Force by Preload**

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

$$F = iP$$

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

Use the following contact coefficient values (*i*).  
 SH, SS, LH, LS, LW, HS Series : 0.004  
 HA, LA Series : 0.010  
 PU, PE, LU, LE Series : 0.026

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

**Calculation example**

In case of LH35AN - Z3  
*i* = 0.004  
*P* = 2350 (N) (refer to LH series preload)  
*F* = *iP*  
 = 0.004 × 2350 = 9.4 (N)

Therefore, the criteria of the dynamic friction force of LH35AN - Z3 is 9.4 N.

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

**A-3-4 Accuracy**

**(1) Accuracy standard**

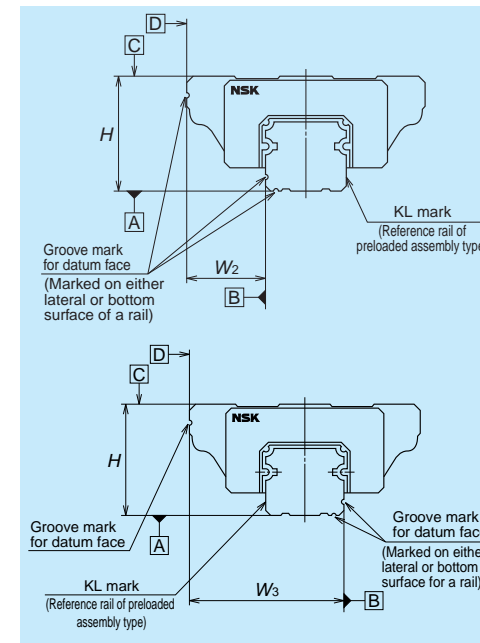
The accuracy characteristics of linear guide are specified to each series in the variations of assembled height, assembled width, and running parallelism. We also specify the mutual variation of a pair of linear guides in the assembled height and assembled width. The accuracy of the table equipped with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

**(2) Definition of Accuracy**

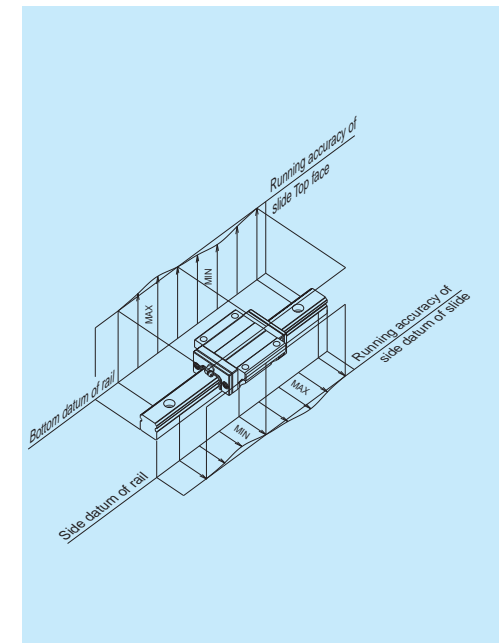
- Table 4.1, Figure 4.1 and Figure 4.2 show accuracy characteristics.

**Table 4.1 Definition of accuracy**

Characteristics	Definition (Figures 4.1 and 4.2)
Mounting height <i>H</i>	Distance from A (rail bottom datum face) to C (slide top face)
Variation of <i>H</i>	Variation of <i>H</i> in slides assembled to the rails of a set of linear guides
Mounting width <i>W<sub>2</sub></i> or <i>W<sub>3</sub></i>	Distance from B (rail side datum face) to D (slide side datum face). Applicable only to the reference linear guide.
Variation of <i>W<sub>2</sub></i> or <i>W<sub>3</sub></i>	Difference of the width ( <i>W<sub>2</sub></i> or <i>W<sub>3</sub></i> ) between the assembled slides which are installed in the same rail. Applicable only to the reference linear guide.
Running parallelism of slide, face C to face A	Variation of C (slide top face) to A (rail bottom datum face) when slide is moving.
Running parallelism of slide, face D to face B	Variation of D (slide side datum face) to B (rail side datum face) 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 faces of the rail and slide on the reference linear guide (indicated as KL on the rail). (Fig. 4.3 and Fig. 4.4)

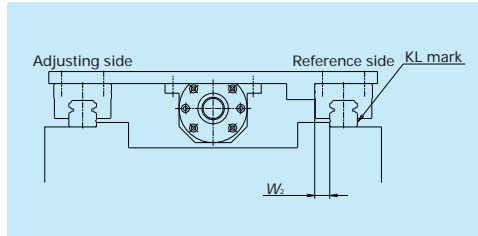


Fig. 4.3 Mounting width  $W_2$

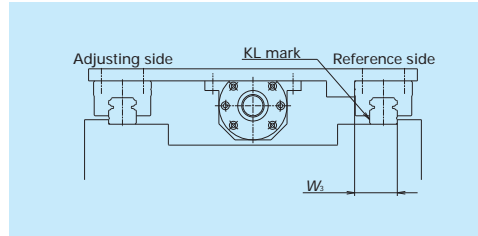


Fig. 4.4 Mounting width  $W_3$

**Running Parallelism of Ball Slide**

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

Table 4.2 Running parallelism of slide

Unit:  $\mu\text{m}$

Accuracy grade	Preloaded assembly (not random matching)						Random-matching type
	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC	
Rail over all length (mm)							
over							
or less							
- 50	2	2	2	4.5	6	6	
50 - 80	2	2	3	5	6	6	
80 - 125	2	2	3.5	5.5	6.5	6.5	
125 - 200	2	2	4	6	7	7	
200 - 250	2	2.5	5	7	8	8	
250 - 315	2	2.5	5	8	9	9	
315 - 400	2	3	6	9	11	11	
400 - 500	2	3	6	10	12	12	
500 - 630	2	3.5	7	12	14	14	
630 - 800	2	4.5 (4)	8	14	16	16	
800 - 1000	2.5	5 (4.5)	9	16	18	18	
1000 - 1250	3	6 (5)	10	17	20	20	
1250 - 1600	4	7 (6)	11	19	23	23	
1600 - 2000	4.5	8 (7)	13	21	26	26	
2000 - 2500	5	10 (8)	15	22	29	29	
2500 - 3150	6	11 (9.5)	17	25	32	32	
3150 - 4000	9	16	23	30	34	34	

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

**(3) Application examples of accuracy grade**

Table 4.3 shows examples of accuracy grade and preload of NSK linear guides for specific purposes.

Refer to this table when selecting accuracy grade and preload type for your application.

Table 4.3 Application examples of accuracy grade and preload

Type of machine	Application	Accuracy grade					Preload			
		Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN, PC	Heavy preload Z4	Medium preload Z3	Slight preload Z1, ZZ	Fine clearance Z0, ZT
Machine tools	• Machining centers		○	○	○		○	○		
	• Grinders	○	○	○			○	○		
	• Lathes		○	○	○		○	○		
	• Milling machines		○	○	○		○	○		
	• Drilling machines			○	○		○	○		
	• Boring machines		○	○	○		○	○		
	• Gear cutters		○	○	○		○	○		
	• Diesinking machine		○	○	○			○	○	
	• Laser cutting machine		○	○	○			○	○	
	• Electric discharge machine	○	○	○			○	○		
Industrial machines and equipment	• Punch press			○	○			○	○	
	• Press machine				○			○	○	○
	• Welding machine				○			○	○	○
	• Painting machine				○			○	○	○
	• Textile machine				○			○	○	○
	• Coil winder				○			○	○	○
	• Woodworking machine			○	○			○	○	○
	• Glass processing machine				○			○	○	○
	• Stone cutting machine				○			○	○	○
	• Tire forming machine				○			○	○	○
	• ATC				○			○	○	○
	• Industrial robot			○	○			○	○	○
	• Materials handling				○			○	○	○
	• Packing machine				○			○	○	○
• Construction machine				○			○	○	○	
Semiconductor facilities	• Prober	○						○	○	
	• Wire bonder		○	○				○	○	
	• PCB driller			○	○			○	○	
	• Slicer	○	○					○	○	
	• Dicer	○	○					○	○	
	• Chip mounter			○	○			○	○	
Others	• IC handler			○	○			○	○	
	• Scanner			○	○			○	○	
	• Lithographic machine	○	○					○	○	
	• Measuring/inspection equipment	○	○	○	○			○	○	
	• Three-dimensional measuring equipment	○	○	○	○			○	○	
	• Medical equipment		○	○	○			○	○	○
	• OA equipment				○			○	○	○
	• Railway cars				○			○	○	○
	• Stage systems				○			○	○	○
	• Pneumatic equipment				○	○		○	○	○

Note: Only "slight preload (Z1, ZZ)" and "fine clearance (Z0, ZT)" are available for "normal grade (PN and PC)".  
 For random-matching type, only accuracy grade "PC," and preload "ZZ" and "ZT" are available.  
 For random-matching RA Series, only accuracy grade "P6" and preload "Z3" are available.

**(4) Combination of accuracy grade and preload**

**① Accuracy grades**

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

**Table 4.4 Accuracy grades and applicable series**

Series	Preloaded assembly (not random matching)					Random-matching type	
	Ultra precision	Super precision	High precision	Precision grade	Normal grade	Precision grade	Normal grade
	P3	P4	P5	P6	PN	P6	PC
LH, SH, VH	○	○	○	○	○		○
LS, SS	○	○	○	○	○		○
LA	○	○	○	○			
LW			○	○	○		○
LE, PE			○	○	○		○
LU, PU		○	○	○	○		○
LL					○		
HA	○	○	○				
HS	○	○	○				
RA	○	○	○	○		○ <sup>*)</sup>	

\*) Only RA25 to 65 are available in random matching.

**② Preload**

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

**Table 4.5 Classification of preload**

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

Note : 1) Z3 preload types for LW Series are LW35 and 50 only.

2) "Z" is omitted from the specification number (refer to each series).

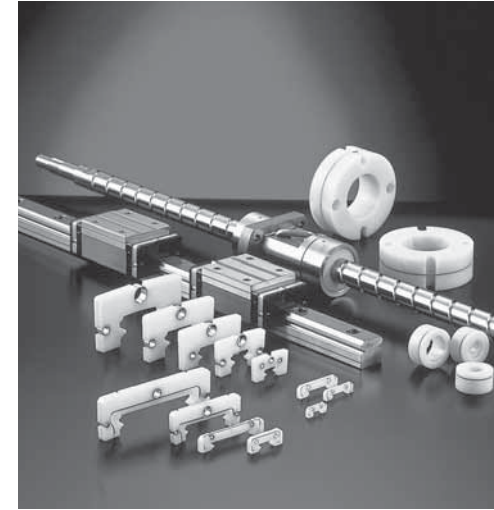
### A-3-5 Lubrication

#### (1) NSK Linear Guides Equipped with "NSK K1™" Lubrication Unit.

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

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

**What is "NSK K1™" Lubrication Unit?**  
"NSK K1™" is a lubrication device which combines oil and resin in a single unit. The porous resin contains a large amount of lubrication oil. Equipped closely to the rail, "NSK K1™" constantly supplies fresh oil which seeps from the resin, lubricating the rail surface.



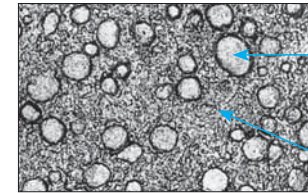
### ③ Combinations of accuracy grade and preload

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

Table 4.6 Combinations of accuracy grade and preload type

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

\*) P6 grade is only for RA 25 to 65, and its preload is Z3. (Preload code is ZZ)



Enlarged surface of "NSK K1" Lubrication Unit  
100µm

**Polyolefin**  
Unlike vinyl chloride products, polyolefin does not produce dioxin. Polyolefin is also gaining use at supermarkets for food wrapping.

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

#### Remarkable capacity with new material: NSK K1™ Lubrication Unit information

- NSK K1 lubrication unit (referred to NSK K1 hereafter) to be equipped with NSK linear guide is outstanding new lubrication material.
- Newly developed "porous synthetic resin" contains large volume of lubricant oil, and it seeps out enhancing lubricating function.
- Simply install NSK K1 inside the standard end seal (rubber).
- We also provide NSK K1 lubrication unit for sanitary environments suited for food processing machinery, medical equipment and their ancillaries for the environment where hygiene control is essential. For details, refer to A-3-8 (3).

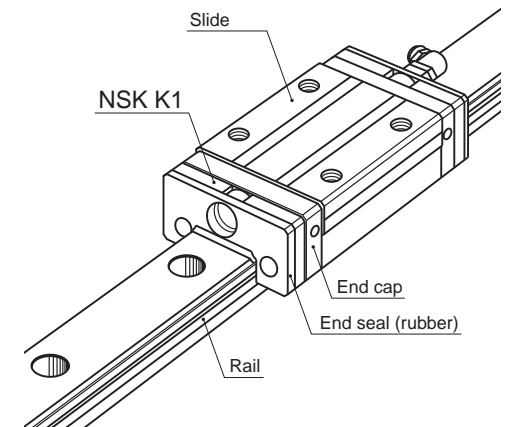


Fig. 5.1



## 1) Features

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

### ① Maintenance is required only infrequently

Used with grease, and maintaining lubrication function for a long period of time. Ideal for systems/ environments which make replenishment difficult.

For automotive component processing lines, etc.

### ② Does not pollute the environment

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

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

We also provide NSK K1 lubrication unit for sanitary environment suited for food processing machinery, medical equipment and their ancillaries for the environment where hygiene control is essential. For details, refer to A-3-8 (3).

## 2) Functions

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

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

Figure 5.2 shows test results under these conditions. The linear guide operated with no lubricant is unable to travel after a short period because breakage occurs. Equipped with NSK K1, the linear guide easily travels 25000 km.

Conditions: Sample ; LH30AN (preload Z1)  
Travel speed ; 200 m/min

### ③ Good for environments where lubricant is washed away

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

Food processing equipment, housing/construction machines, etc.

### ④ Maintains efficiency in dusty environment

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

Woodworking machines, etc.

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

Stroke ; 1800 mm  
No lubricant: Completely degraded, no lubrication  
NSK K1: Completely degraded, no lubrication  
+ NSK K1

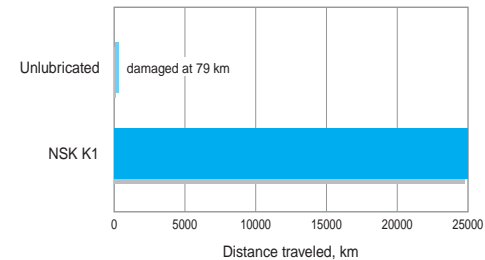


Fig. 5.2 Durability test at high speed, with no lubrication (lubricated by NSK K1 only)

## ② Durability test immersed in water

Figure 5.3 shows test results after the linear guide is immersed in water once per week for 24 hours at a time, then traveled for 2700 km. Without NSK K1, the ball groove surface wore out at an early stage and broke. With NSK K1, the wear was reduced to about 1/3 (Table 5.1). This test proves the effect of NSK K1.

Conditions: Sample ; LS30 Stainless (preload Z1)  
Travel speed ; 24 m/min  
Stroke ; 400 mm  
Load ; 4700 N/Slide  
Lubricant ; Fully packed with dedicated grease (\*) for food machines

Immersing condition:  
Immersed and traveled once per week for 24 hours at a time.

\* Grease made in U.S.A.

Characteristic  
Consistency: 280  
Base oil viscosity: 580 (cSt)

Table 5.1 Comparison in wear of grooves and steel balls (2700 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

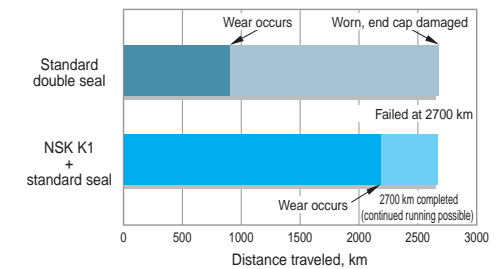


Fig. 5.3 Durability test immersed in water

### ④ Dust emission

Figure 5.5 is a comparison of NSK K1 dust emissions. The combination of NSK K1 and NSK Clean Grease LG2 (low dust grease) generates as little dust as fluorine grease.

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

## ③ Durability test with wood chips

Wood chips absorb lubricant. Maintaining lubrication in such environment is extremely difficult. Figure 5.4 shows that the life when NSK K1 is added to a standard seal is two times longer than the life when two seals are combined (Standard double seal).

Conditions: Sample ; LH30AN (preload Z1)  
Travel speed ; 24 m/min  
Stroke ; 400 mm  
Load ; 490 N/Slide

Seal specifications/lubricant:  
Standard double Seal...Standard double Seal + AS2 Grease  
NSK K1.....NSK K1 + Standard seal + AS2 Grease

Wood chip conditions:  
1.....Large volume of wood chips  
2.....Medium volume of wood chips

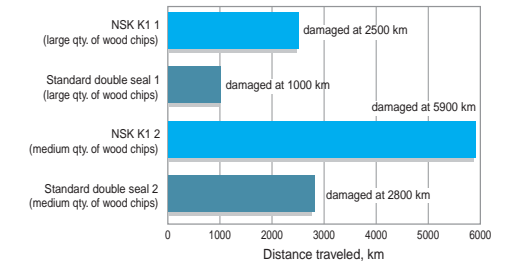


Fig. 5.4 Durability test with wood chips

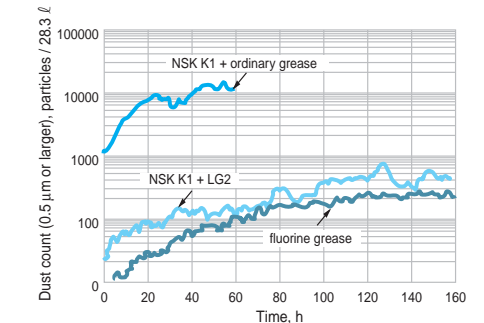


Fig. 5.5 Comparison of dust emission

### 3) Specifications

#### ① Applicable series and sizes

- 1 Can be installed in SH, SS, LH, LS, LW, RA, LA, PU, PE, LU, LE, HA, and HS series. For VH and TS series, NSK K1 is equipped as a standard specification.
- 2 Can be used with stainless steel materials and surface-treated items.

#### ② Standard specifications

- 1 Install NSK K1 between the end seal and end cap.  
For TS series, it is installed inside end cap. (Double-seal specification, and specification with protector are also available on request.)
- 2 NSK standard grease is packed inside the slide.  
(Volume of grease, type of grease on request.)
- 3 Accuracy and preload are the same as standard items.  
(Dynamic friction increases slightly due to NSK K1.)

#### ③ Number of installed NSK K1

Normally, one NSK K1 should be installed on both sides of slides. (two K1s for one slide)  
However, more NSK K1 may be required under more stringent drive and environment. Please consult NSK for details.

#### Precautions for handling

To extend high functions of NSK K1, please observe the following precautions.

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

Note: Water-type cutting oil, oil-type cutting oil, grease such as mineral-type AS2 and ester-type PS2 do not damage NSK K1.

### (2) Lubrication

There are two types of lubricating method, grease and oil, for linear guides.

Use a lubricant agent and method most suitable to condition requirements and purpose to optimize functions of linear guides.

In general, lubricants with low base oil kinematic viscosity are used for high speed operation, in which thermal expansion has large impact, and in low temperatures.

Lubrication with high base oil kinematic viscosity is used for oscillating operations, low speed and high temperature.

The following are lubrication methods by grease and by oil.

#### 1) Grease Lubrication

Grease lubrication is widely used because it does not require special oil supply system or piping. Grease lubricants made by NSK are:

- Various types of grease in bellowed container which can be instantly attached to the grease pump;
- NSK Grease Unit which comprise a hand grease pump and various nozzles. They are compact and easy to use.

#### 1. NSK grease lubricants

Table 5.2 shows the marketed general grease widely used for linear guides, in specific uses, conditions and purposes.

Table 5.2 Grease lubricant for linear guides

Type	Thickener	Base oil	Base oil kinematic viscosity mm <sup>2</sup> /s (40°C)	Range of use temperature (°C)	Purpose
AS2 <sup>*1)</sup>	Lithium type	Mineral oil	130	-10 - 110	For general use at high load
PS2 <sup>*2)</sup>	Lithium type	Synthetic oil + mineral oil	15	-50 - 110	For low temperature and high frequency operation
LG2	Lithium type	Mineral oil + synthetic hydrocarbon oil	30	-20 - 70	For clean environment
LGU	Diurea	Synthetic hydrocarbon oil	100	-30 - 120	For clean environment
NF2	Urea composite type	Synthetic oil + mineral oil	27	-40 - 100	For fretting resistant

\*1) Standard grease of SH, SS, LH, LS, VH, LW, TS, RA, LA, HA, and HS Series.

\*2) Standard grease of PU, PE, LU, and LE Series.

## ① NSK Grease AS2

### • Features

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

### • Application

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

### • Nature

Thickener	Lithium soap base
Base oil	Mineral oil
Consistency	275
Dropping point	185°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 <sup>2</sup> /s (40°C)

## ② NSK Grease PS2

### • Features

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

### • Application

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

### • Nature

Thickener	Lithium soap base
Base oil	Synthetic oil + mineral 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 mm <sup>2</sup> /s (40°C)

## ③ NSK Grease LG2

### • Features

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

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

In dust generation, LG2 is more than equal to 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 linear guides for semiconductor and liquid crystal display (LCD) processing equipment which require a highly clean environment. Because LG2 is exclusively for a clean environment at normal temperatures, however, it cannot be used in a vacuum environment.

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

### • Nature

Thickener	Lithium soap base
Base oil	Mineral oil + Synthetic hydrocarbon oil
Consistency	207
Dropping point	200°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	30 mm <sup>2</sup> /s (40°C)

## ④ NSK Grease LGU

### • Features

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

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

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

### • Application

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

This cannot be used in vacuum.

### • Nature

Thickener	Diurea
Base oil	Synthetic hydrocarbon oil
Consistency	209
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	100 mm <sup>2</sup> /s (40°C)

## ⑤ NSK Grease NF2

### • Features

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

### • Application

This grease is suitable for linear guides of which application include oscillating operations. Allowable temperature range is -40° to 130°C.

### • Nature

Thickener	Diurea
Base oil	Synthetic hydrocarbon oil
Consistency	288
Dropping point	269°C
Volume of evaporation	7.9% (177°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	27 mm <sup>2</sup> /s (40°C)

### • Precautions for handling

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

## 2. How to replenish grease

Use grease fitting to linear guide slide if exclusive grease supply component is not used. Supply required amount to grease fitting by a grease gun (pump).

Wipe off old grease and accumulated dust before supplying new grease. If grease fitting is not used, apply grease directly to the rail. Remove the seal if possible, and move a slide few strokes so the grease permeates into the slide. A hand grease pump, an exclusive and easy lubrication device to linear guides, is available at NSK.

## 3. Volume of grease to be replenished

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

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

criterion is:

All at once, replenish the amount which fills about 50% of the internal space of the slide. This method eliminates waste of grease, and is efficient.

Page A46 shows internal spaces of slide of each series for reference.

- When replenishing using a grease gun:

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

## 4. Intervals of checks and replenishments

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

**Table 5.3 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 chip	Usually once per year. Every 3000 km for material handling system which travels more than 3000 km per year. Replenish if checking results warrant it necessary.

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

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

**Table 5.4 Inside space of the slide**

### SH, SS Series

Model No.	Unit: cm <sup>3</sup>			
	SH		SS	
	High-load type	Ultra-high-load type	Medium-load type	High-load type
15	2	3	1.5	2
20	5	7	3	4
25	9	12	5	7
30	11	17	7	11
35	20	27	11	17
45	42	53	-	-
55	73	93	-	-

### VH Series

Model No.	Unit: cm <sup>3</sup>	
	VH	
	High-load type	Ultra-high-load type
15	3	4
20	6	8
25	9	13
30	13	20
35	22	30
45	47	59
55	80	100

### HA, HS Series

Model No.	Unit: cm <sup>3</sup>	
	HA	HS
	15	-
20	-	9
25	16	16
30	27	25
35	42	40
45	67	-
55	122	-

### LW Series

Model No.	Unit: cm <sup>3</sup>	
	LW	
	17	3
21	3	
27	7	
35	24	
50	52	

### TS Series

Model No.	Unit: cm <sup>3</sup>	
	TS	
	15	2
20	3	
25	6	
30	9	
35	15	

### LH, LS Series

Model No.	Unit: cm <sup>3</sup>			
	LH		LS	
	High-load type	Ultra-high-load type	Medium-load type	High-load type
08	0.2	-	-	-
10	0.4	-	-	-
12	1.2	-	-	-
15	3	4	2	3
20	6	8	3	4
25	9	13	5	8
30	13	20	8	12
35	22	30	12	19
45	47	59	-	-
55	80	100	-	-
65	139	186	-	-
85	-	336	-	-

### RA Series

Model No.	Unit: cm <sup>3</sup>	
	RA	
	High-load type	Ultra-high-load type
15	1	1.5
20	2	2.5
25	3	3.5
30	5	6
35	6	8
45	10	13
55	15	20
65	33	42

### LA Series

Model No.	Unit: cm <sup>3</sup>	
	LA	
	High-load type	Ultra-high-load type
25	8	12
30	14	18
35	21	29
45	38	48
55	68	86
65	130	177

### PE, PU Series

Model No.	Unit: cm <sup>3</sup>			
	PE		PU	
	Standard type	High-load type	Standard type	High-load type
05	0.1	-	0.1	-
07	0.2	-	0.1	-
09	0.4	0.5	0.2	0.3
12	0.5	0.7	0.3	0.4
15	1.2	1.6	0.8	1.1

### LE, LU Series

Model No.	Unit: cm <sup>3</sup>				
	LE			LU	
	Medium-load type	Standard type	High-load type	Standard type	High-load type
05	0.1	0.1	-	0.1	-
07	0.1	0.2	0.3	0.1	-
09	0.2	0.4	0.5	0.2	0.3
12	0.3	0.5	0.7	0.3	0.4
15	0.8	1.2	1.6	0.8	1.1

### 5. NSK Grease Unit

Supply grease to NSK linear guides by a manual type hand grease pump. Install the grease in bellows tube to the pump. Several types of grease (80 g) are available.



Grease in a bellows tube



#### ① Composition of NSK Grease Unit

Components and grease types are shown below.

NSK Grease Unit			
	Name	(Tube type)	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 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 the hand pump.)		NSK HGP
	Grease nozzle (used with the hand grease pump)		
	NSK straight nozzle		NSK HGP NZ1
	NSK chuck nozzle		NSK HGP NZ2
	NSK drive fitting nozzle		NSK HGP NZ3
	NSK point nozzle		NSK HGP NZ4
	NSK flexible nozzle		NSK HGP NZ5
	NSK flexible extension pipe		NSK HGP NZ6
	NSK straight extension pipe		NSK HGP NZ7

#### ② NSK Greases (80 g in a bellows tube)

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

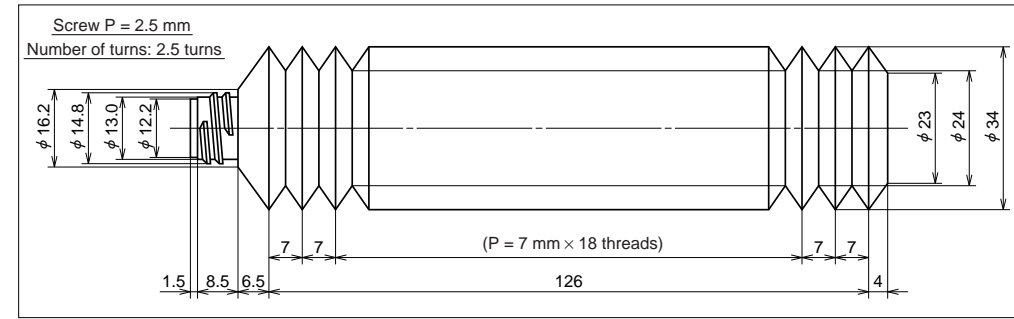


Fig. 5.6 Bellows tube

#### ③ NSK manual Grease Pump Unit

##### a. NSK Hand Grease Pump Unit (Reference number: NSK HGP)

###### ● Features

- Light-weight ..... Can be operated by one hand, yet there is no worry to making 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 the grease in bellows tube.
- Remaining grease ..... Can be confirmed through slit on the tube.
- Several nozzles ..... Five types of nozzles to choose from.

###### ● Specifications

- Spout volume ..... 0.35 g/stroke
- Mass of main body ... 393 g
- Overall length ..... About 200 mm
- Overall width ..... About 200 mm
- Grease tube outer diameter ..  $\phi$  38.1
- Accessory..... Several nozzles for a unique application can be attached

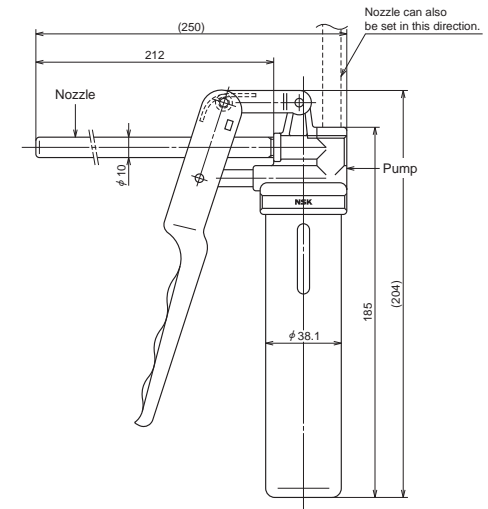


Fig. 5.7 NSK Hand Grease Pump with NSK straight nozzle

b. Nozzles

Table 5.5 Nozzles that can be attached to NSK Hand Grease Pump

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

Table 5.6 Grease fittings used for NSK linear guide

Series	Model No.	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
SH Series	SH15	φ 3	Drive-in type			○		
	SH20, 25, 30, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○
	SH45, 55	Rc1/8	B type	○	○			○
SS Series	SS15	φ 3	Drive-in type			○		
	SS20, 25, 30, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○
LH Series	LH08, 10	-	-				○	
	LH12, 15	φ 3	Drive-in type			○		
	LH20, 25, 30, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○
LS Series	LH45, 55, 65	Rc1/8	B type	○	○			○
	LS15	φ 3	Drive-in type			○		
LS Series	LS20, 25, 30, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○
	VH15	φ 3	Drive-in type			○		
VH Series	LH20, 25, 30, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○
	VH45, 55	Rc1/8	B type	○	○			○
LW Series	LW17	φ 3	Drive-in type			○		
	LW21, 27, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○
LW Series	LW50	Rc1/8	B type	○	○			○
	TS15	φ 3	Drive-in type			○		
TS Series	TS20, 25, 30, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○
	RA15, 20	φ 3	Drive-in type			○		
RA Series	RA25, 30, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○
	RA45, 55, 65	Rc1/8	B type	○	○			○
LA Series	LA25, 30, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○
	LA45, 55, 65	Rc1/8	B type	○	○			○
PU Series	PU05, 07, 09, 12	-	-				○	
	PU15	φ 3	Drive-in type			○		
PE Series	PE05, 07, 09, 12	-	-				○	
	PE15	φ 3	Drive-in type			○		
LU Series	LU05, 07, 09, 12, 15	-	-				○	
LE Series	LE05, 07, 09, 12, 15	-	-				○	
HA Series	HA25, 30, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○
	HA45, 55	Rc1/8	B type	○	○			○
HS Series	HS15	φ 3	Drive-in type			○		
	HS20, 25, 30, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○

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

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

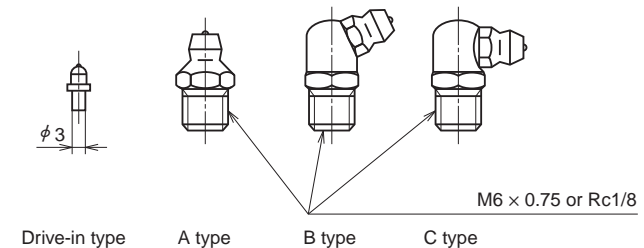


Fig. 5.8 Grease fittings

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

## 2) Oil Lubrication

Required amount of new oil is regularly supplied by:

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

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

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

In case of ball type linear guide except for LA series

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

In case of LA and RA series

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

$n$ : Linear guide code

e.g. When LH45 is used,

$$n = 45,$$

Therefore,

$$Q = 45/150 = 0.3 \text{ cm}^3\text{/hr}$$

For oil lubrication by gravity drip, the oil supply position and installation position of the slide are crucial. In case of linear guide, unless it is installed to a horizontal position, the oil flows only on the down side, and does not spread to all race way surface. This may cause 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 5.7 shows the criterion of intervals of oil checks and replenishments.

**Table 5.7 Intervals of checks and replenishments**

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

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

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

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

## A-3-6 Dust Proof

### (1) Standard Specification

- To keep foreign matters from entering inside the slide, NSK linear guide has an end seal on both ends, an bottom seal at the bottom, and an inner seal inside the slide.
- Table 6.1 shows seals for standard specification for each series.
- Seal friction per standard slide is shown in the dust proof item of each series.

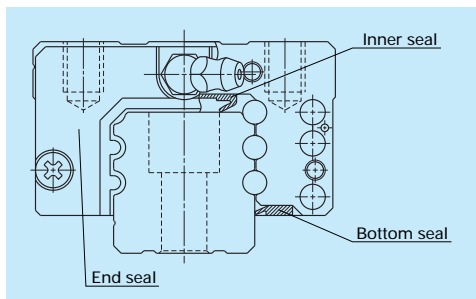


Fig. 6.1

Table 6.1 Standard seals

		End seal	Bottom seal	Inner seal
SH Series	SH15	○	○	-
	SH20, SH25, SH30, SH35, SH45, SH55	○	○	△
SS Series	SS15	○	○	-
	SS20, SS25, SS30, SS35	○	○	△
LH Series	LH08, LH10	○	-	-
	LH12, LH15	○	○	-
	LH20, LH25, LH30, LH35, LH45, LH55, LH65	○	○	△
LS Series	LS15	○	○	-
	LS20, LS25, LS30, LS35	○	○	△
VH Series	VH15	○	○	-
	VH20, VH25, VH30, VH35, VH45, VH55	○	○	△
LW Series	LW17, LW21, LW27, LW35, LW50	○	○	-
TS Series	TS15, TS20, TS25, TS30, TS35	○	○	○
RA Series	RA15, RA20	○	○	△
	RA25, RA30, RA35, RA45, RA55, RA65	○	○	○
LA Series	LA25, LA30, LA35, LA45, LA55, LA65	○	○	△
PU Series	PU05, PU07, PU09, PU12, PU15	○	-	-
PE Series	PE05, PE07, PE09, PE12, PE15	○	-	-
LU Series	LU05, LU07, LU09	△	-	-
	LU12, LU15	○	-	-
LE Series	LE05, LE07, LE09, LE12, LE15	○	-	-
HA Series	HA25, HA30, HA35, HA45, HA55	○	○	○
HS Series	HS15, HS20, HS25, HS30, HS35	○	△	-

○ : Installed as standard

△ : Installed on request



## (2) Dust proof components

- NSK has the following items. Select a suitable type for the operating environment.

Table 6.2 Optional dust proof components

Name	Purpose	Reference page
NSK K1 lubrication unit	Made of oil impregnated resin. Enhances lubricating functions.	A38 – 41
Double seal	Combines two end seals, enhancing sealing function.	A53
Protector	Protect end seal from hot and hard contamination.	A54
Rail cap	Prevents foreign matters such as swarf generated in cutting operation from clogging the rail-mounting hole.	A54
Inner seal	Installed inside a slide, and prevents foreign matters from entering the rolling contact surface.	A55
Bellows	Covers linear guide.	A55
Rail cover *)	Covers top of rail, and prevents foreign matters such as cutting dust from collecting in the rail mounting holes.	A258

\*) Rail cover is applicable to RA25 to 65 of RA series.

### 1. Double seal

- A combination of two end seals to enhance seal function.
- When a double seal is installed, the end seal section becomes thicker than the standard item. Please pay attention to the increase in a slide length when designing the mounting dimension of slide and the table stroke. Please refer to the section of dust proof components for the dimensional increase in the length direction of each series due to fitting of double seal.
- Double-seal set: Can be installed to a completed standard item later on request. It comprises two end seals, a collar, and a screw for installation (Fig. 6.2). The product reference numbers of each series are described on the section of dust proof parts.
- When attaching a grease fitting to the end cap after the double seal is equipped, you require a connector shown in Figure 6.2. Please specify the connector set when ordering linear guides.
- For VH, RA, LA, HA, and HS Series, double-seal set can be installed only before shipping from the factory.

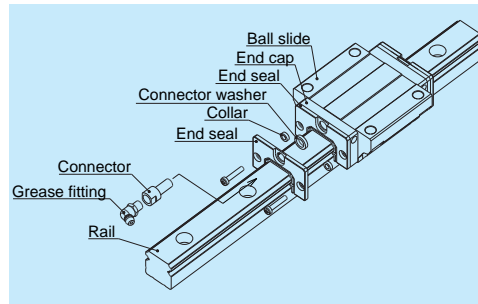


Fig. 6.2 Double seal

### 2. Protector

- A protector is usually installed outside the end seal to prevent high-temperature fine particles such as welding spatter and other hard foreign matters from entering the slide.
- Same as the case with a double seal, when a protector is installed, the slide becomes longer. Please pay attention to the increase in a slide length when designing the mounting dimensions of slide and the table stroke. The dimensional increase in the slide length because of protector is described on the section of dust proof components.
- Protector can be installed to a completed item later. The reference number for order shown in dust proof components of each series.
- When attaching a grease fitting to the end cap after the protector is equipped, you require a connector shown in Figure 6.3. Please specify the connector set when ordering linear guides.
- For VH, RA, LA, HA, and HS Series, protector can be installed only before shipping from the factory.

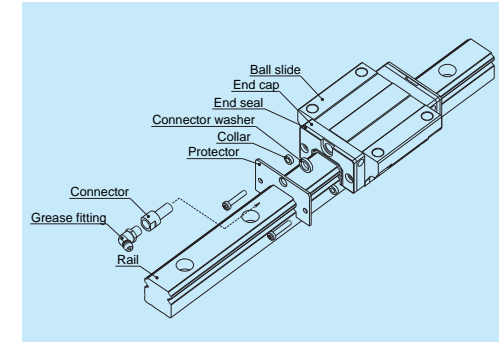


Fig. 6.3 Protector

### 3. Cap to cover the bolt hole for rail mounting

- After the rail is mounted to the machine base, a cap is used to cover the bolt hole to prevent foreign matters from clogging up the hole or from entering into the slide (Fig. 6.4).
- The cap for the bolt hole is made of synthetic resin which is superb in its resistance to oil and wear.
- The size of rail mounting bolts and bolt hole caps are shown on the section of dust proof components in each series.
- To insert a cap into the rail bolt hole, use a flat tool (Fig. 6.5). Pound the cap gradually until its height becomes flush with the rail top face.
- You can reorder extra bolt hole caps. The size of rail mounting bolts and reference numbers of bolt hole caps are shown on the section of dust proof components.

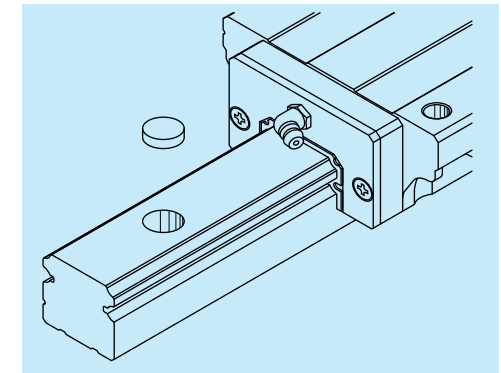


Fig. 6.4

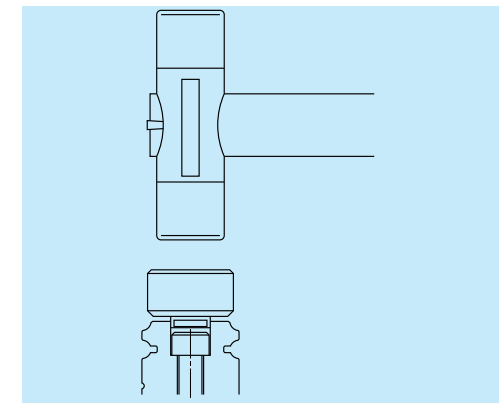


Fig. 6.5

#### 4. Inner seal

- The end seal installed on both ends of the slide cannot arrest entire foreign matters, though the missed amount is negligible. An inner seal protects the rolling contact surface from such foreign matters which entered inside the slide (Fig. 6.6).
- Inner seal is installed inside the slide. Therefore, the appearance in size and the shape are the same as standard slide. (Inner seal is already installed before shipped from the factory.)
- It is strongly recommended to use a bellows and a double seal, along with an inner seal, to maintain precision of the linear guide.
- Refer to Table 6.1 for availability of inner seal.

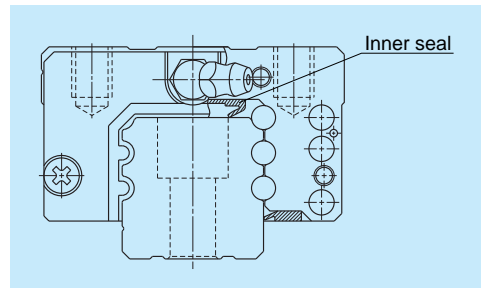


Fig. 6.6 Inner seal when installed

#### 5. Bellows

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

#### ① Installation of bellows SH, SS, LH and LS Series

##### \* Installation in the ball slide (Fig. 6.7)

- Remove two machine screws ( $M_2$ ) which secure the end seals to the end of the slide (Fig. 6.7). For LS15, hold the end cap by hand. Otherwise, the end cap is detached from the ball slide, and the balls inside may spill out.
- Then place a spacer to the hole for securing 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).

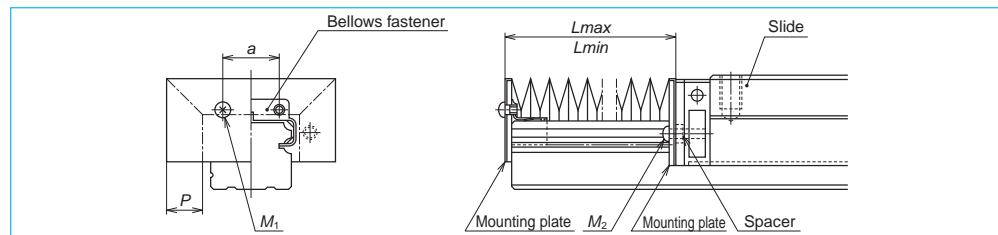


Fig. 6.7

##### \* Installation in the rail

- To install bellows for SH, SS, LH and LS Series, lightly knock a fastener exclusively for bellows to the end of the rail (Fig. 6.7). Then secure the mounting plate at the end of the bellows through the tap hole of the fastener.
- As described above, a bellows can be easily installed in the end of the rail without creating a tap hole on the end of the rail.

#### ② LA and LW Series

##### \* Installation in the ball slide (Fig. 6.8 and Fig. 6.9)

- Remove two machine screws which secure the end seal. (For LW17 and 21, hold the end cap by hand. Otherwise, the end cap is detached from the slide, and the balls inside may spill out.)
- Place a spacer in 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).

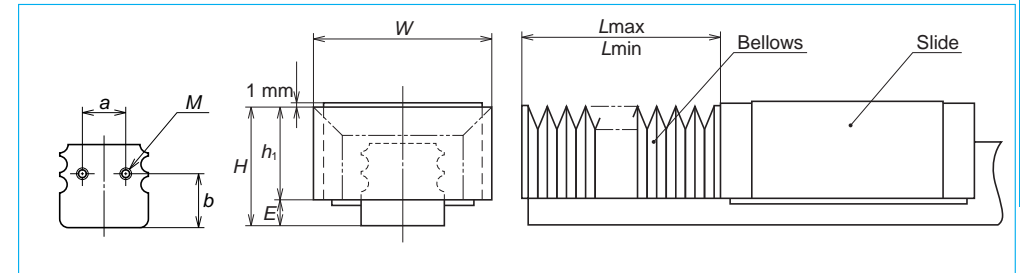


Fig. 6.8

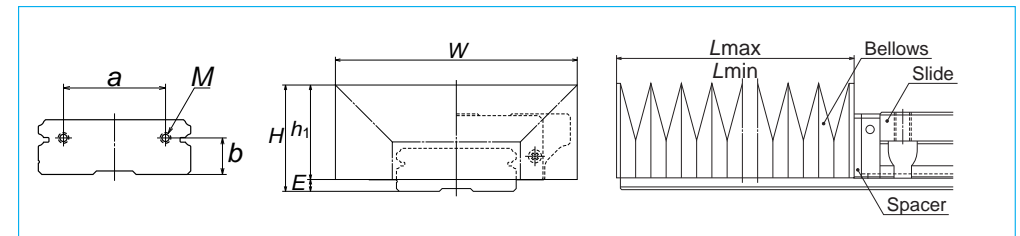


Fig. 6.9

##### Calculating length of bellows

- Formula is as follows.
- A bellows forms one block (BL) with six folds as shown in Fig. 6.10. Stroke is determined by multiplying by an integer of this BL.
- Length when stretched to maximum size :

- Length when contracted to minimum size :  

$$L_{max} = 7 \times P \times \text{Number of BL}$$

$$L_{min} = 17 \times \text{Number of BL}$$
- Stroke :  

$$St = L_{max} - L_{min}$$
- P and the number of BL are shown in bellows dimension table in each series.

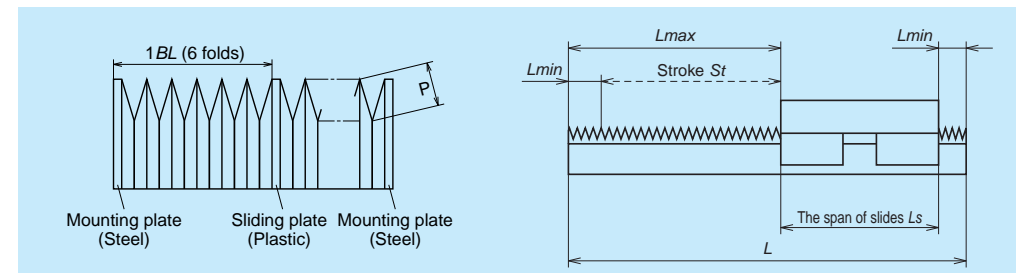


Fig. 6.10

## A-3-7 Rust Prevention (Stainless Steel and Surface Treatment)

### (1) Stainless steel

NSK linear guide is available in stainless steel.

○Stainless steel standard series

PU Series PE Series  
LL Series

○Available in stainless steel

SH Series SS Series  
LH Series LS Series  
LU Series LE Series

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

### (2) Surface Treatment

#### 1) 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 the result of humidity chamber test for antirust characteristics and their cost-effectiveness.

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

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

Please consult NSK for other surface treatment.

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

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

○Fluoride low temperature chrome plating

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

#### 2) Rust prevention of fluoride low temperature chrome plating

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

Among all measures to cope with environment, rust prevention is the most challenging. Such environment includes: Moisture for washers and other equipment; Chemicals used in the wet processing of semiconductor and liquid crystal display manufacturing equipment.

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

#### ● What is "Fluoride low temperature chrome plating ?"

This is a type of black chrome plating which forms a black film (1-2 μm) 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 an 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 by other surface treatment and stainless steel products.

Do not use organic solvent because it adversely affects antirust property of the plating.

### ● Humidity cabinet corrosion resistance test

Table 7.1 Results of the humidity cabinet test

Characteristic		Test sample				
		Fluoride low temperature chrome plating (Recommended)	Hard chrome plating (Reference)	Electroless nickel plating (Reference)	Equivalent to SUS440C material	Standard steel
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
Rust prevention ability	Test conditions ● Testing cabinet: High temperature, highly moist cabinet (made by DABAI ESPEC) ● Temperature: 70 °C ● Relative humidity: 95% ● Testing time: 96 h Time to "reach to" and "falling from" the temperature/humidity conditions Reaching: 5 h Falling: 2 h					
Film thickness		5 μm	0.5 - 7 μm	10 μm	—	—

Rusting A: No rust B: Not rust, but some discoloration  
C: Spotty rust D: Light rusted E: Completely rusted

● Corrosion resistance test against chemicals

Table 7.2 Result of the corrosion resistance test

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

Fluoride low temperature chrome plating		Hard chrome plating (reference)	None surface treatment
	Immersed in solution for 24 hrs Nitric acid		
	Immersed in solution for 24 hrs Fluoride		
	Immersed in solution for 72 hrs Hydrochloric acid type washing solution HCl : H <sub>2</sub> O <sub>2</sub> : H <sub>2</sub> O = 1 : 1 : 8		
○	Hydrochloric acid (immersed)	○	▲
○	Sulfuric acid (immersed)	○	×
○	Ammonia or sodium hydroxide	○	△

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

● Surface treatment durability test

● Total evaluation

Life of surface treatment by peeling

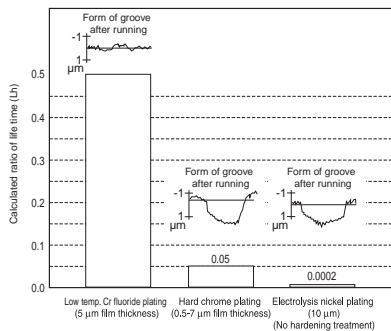


Fig. 7.1 Result of durability test

Table 7.3 Evaluation

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

◎: Excellent ○: Suitable in use  
△: Not very suitable in use ×: Problem in use

A-3-8 Special Environment

(1) Heat-Resistant Specifications

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

Table 8.1 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

- LH Series
- LW Series
- LE Series
- LS Series
- LU Series

(2) Vacuum and Clean Specifications

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

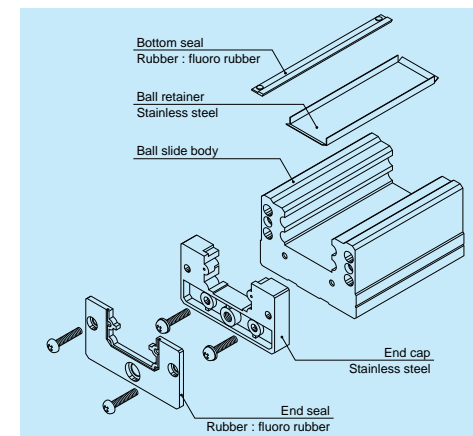
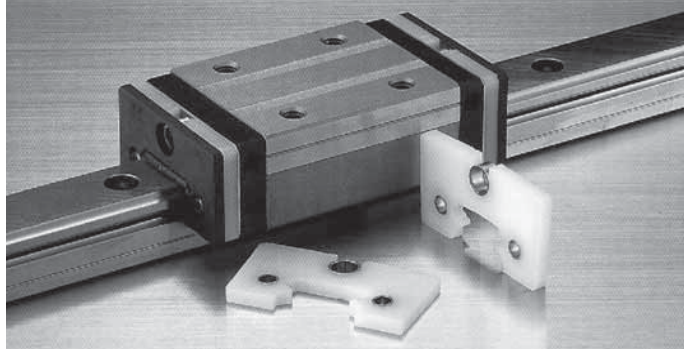


Fig. 8.1

### (3) "NSK Linear Guides for Food Processing Equipment and Medical Devices" for Sanitary Environment

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



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

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

With the basic function of highly praised "NSK K1™" lubrication unit for general industry, more sophisticated materials make it applicable in food and medical equipment. It also offers easy installation, mounted inside the standard end seal.

#### 1. Features

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

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

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

<Features of grease for food processing machines>

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

- Superb water resistance and antirust capability
- Superb wear resistance
- Applicable for a centralized oiling system

◆Appropriate volume of grease

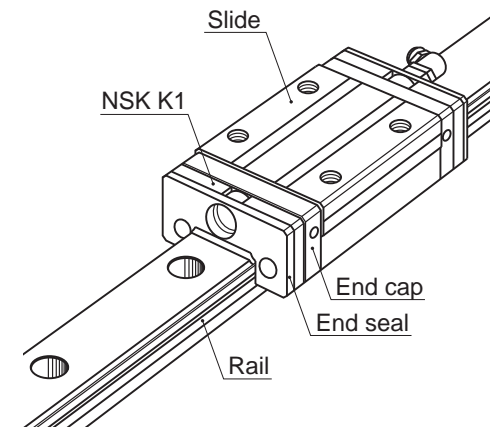
Reduces grease draining and scattering, and maintains a clean environment by supplying appropriate volume of grease.

#### 2. Available models

Table 8.2 shows available models.

Table 8.2

LH Series	LH12, LH15, LH20, LH25, LH30, LH35
LS Series	LS15, LS20, LS25, LS30, LS35
PU Series	PU09, PU12, PU15
PE Series	PE09, PE12, PE15
LU Series	LU09, LU12, LU15
LE Series	LE09, LE12, LE15
LW Series	LW17, LW21, LW27, LW35



#### Precautions for use

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

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

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

(4) Specifications for Special Environments

Table 8.3 Linear guide specifications

Environment	Condition	NSK linear guide specifications				Technical Explanation Page No.
		Rail, slide	Steel balls/rollers	Ball Recirculation component	Lubrication/surface treatment	
Clean	Atmosphere, normal temperature	Standard material	Standard material	Standard material	LG2 Grease, LGU Grease	D8
					NSK K1 lubrication unit	D10
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	LG2 Grease, LGU Grease	D8
					NSK K1 lubrication unit	D10
Atmosphere-Vacuum, normal temperature Atmosphere-Vacuum up to 200°C	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Fluoride low temperature chrome plating	D5	
				Fluoride grease		
Vacuum	Atmosphere-Vacuum, normal temperature Atmosphere-Vacuum up to 200°C Atmosphere-Vacuum up to 300°C High vacuum up to 500°C	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Fluoride grease	
					Molybdenum disulfide	
					Special silver film	D7
Corrosion resistance	Vapor, steam	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		
	Acid, alkali	Standard material	Standard material	Standard material	Fluoride low temperature chrome plating	D5
					Fluoride low temperature chrome plating	D5
	Acid, alkali, clean	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Fluoride low temperature chrome plating	D5
					LG2 Grease, LGU Grease	D8
	Strong acid, strong alkali	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Fluoride low temperature chrome plating	D5
					Fluoride grease	
	Organic solvent					Fluoride grease
High temperature	Atmosphere up to 150°C	Standard material	Standard material		ET150 Grease	
	Atmosphere Up to 200°C	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Fluoride grease	
	Atmosphere Up to 200°C, Corrosion resistant				Fluoride grease	
Low temperature	-273 °C -	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Solid lubricant	
Radiation resistance	Atmosphere	Standard material	Standard material	Standard material	Radiation resistant grease	
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		
Foreign matters	Fine particles, wooden chips	Standard material	Standard material	Standard material	NSK K1 lubrication unit	D10
						Martensitic stainless steel
	Water, under water	Martensitic stainless steel	Standard material	Standard material		D10
						Martensitic stainless steel

(5) Lubrication and Materials

1. Lubrication

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

Fig. 8.2 Lubrication in clean environment

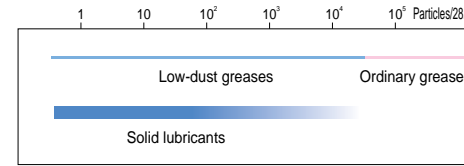


Fig. 8.3 Lubrication in vacuum

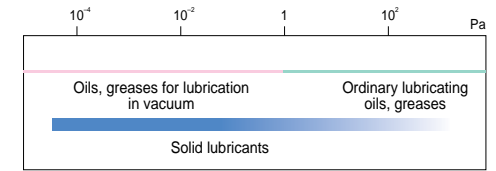


Fig. 8.4 Lubrication in corrosive environment

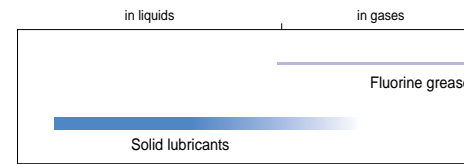


Fig. 8.5 Lubrication in high temperature

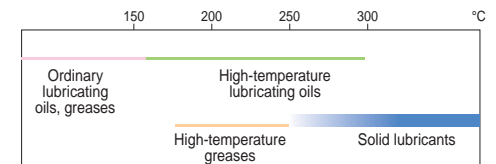


Fig. 8.6 Lubrication in low temperature

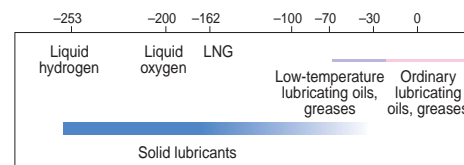


Fig. 8.7 Lubrication in radioactive environment

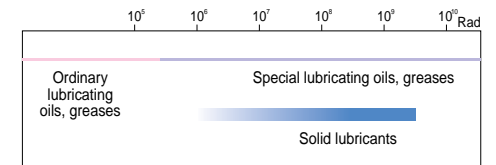
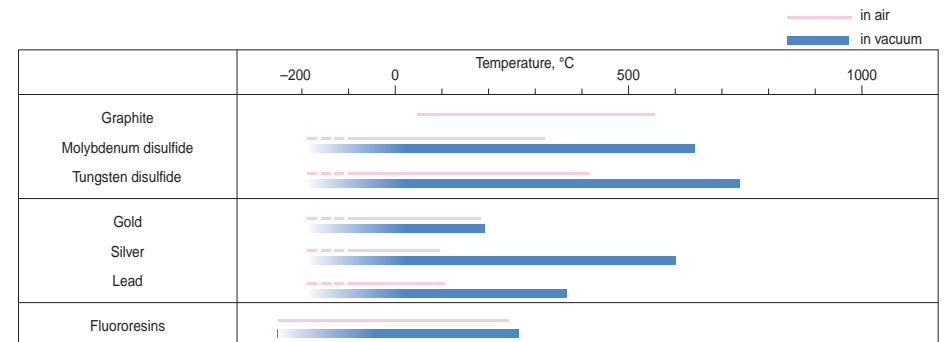


Fig. 8.8 Temperature range for using solid lubricants



## 2. Materials

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

**Table 8.4 Characteristics of metal materials**

Application	Type of steel	Linear expansivity ×10 <sup>-6</sup> /°C	Young's modulus GPa	Hardness <sup>*)</sup> 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.

## 3. Table to Cope With Special Environments

Series	Model No.	Special environment which linear guide can tolerate					
		Clean	Vacuum	Corrosion	High temp.	Hygienic	High dust proofing
SH	SH15	○		○			
	SH20	○		○			
	SH25	○		○			
	SH30	○		○			
	SH35	○		○			
	SH45	○		○			
	SH55	○		○			
	SS15	○		○			
	SS20	○		○			
	SS25	○		○			
SS	SS30	○		○			
	SS35	○		○			
	LH08	○		○			
LH	LH10	○		○			
	LH12	○		○		○	
	LH15	○	○	○	○	○	○
	LH20	○	○	○	○	○	○
	LH25	○	○	○	○	○	○
	LH30	○	○	○	○	○	○
	LH35	○		○		○	
	LH45	○		○		○	
	LH55	○		○		○	
	LH65	○		○		○	
LS	LS15	○	○	○	○	○	
	LS20	○	○	○	○	○	
	LS25	○	○	○	○	○	
	LS30	○	○	○	○	○	
	LS35	○		○		○	
VH	VH15	○		○	○		○
	VH20	○		○	○		○
	VH25	○		○	○		○
	VH30	○		○	○		○
	VH35	○		○			○
	VH45	○		○			○
	VH55	○		○			○
LW	LW17	○		○		○	
	LW21	○		○		○	
	LW27	○		○		○	
	LW35	○		○		○	
	LW50	○		○		○	
TS	TS15	○		○			
	TS20	○		○			
	TS25	○		○			
	TS30	○		○			
	TS35	○		○			
RA	RA15	○		○			
	RA20	○		○			

Series	Model No.	Special environment which linear guide can tolerate					
		Clean	Vacuum	Corrosion	High temp.	Hygienic	High dust proofing
RA	RA25	○		○			
	RA30	○		○			
	RA35	○		○			
	RA45	○		○			
	RA55	○		○			
	RA65	○		○			
LA	LA25	○		○			
	LA30	○		○			
	LA35	○		○			
	LA45	○		○			
	LA55	○		○			
	LA65	○		○			
PU	PU05	○		○			
	PU07	○		○			
	PU09	○		○		○	
	PU12	○		○		○	
	PU15	○		○		○	
PE	PE05	○		○			
	PE07	○		○			
	PE09	○		○		○	
LU	PE12	○		○		○	
	PE15	○		○		○	
	LU05	○		○			
	LU07	○		○			
	LU09_L	○	○	○	○	○	○
	LU09_R	○	○	○	○	○	○
	LU12_L	○	○	○	○	○	○
	LU12_R	○	○	○	○	○	○
	LU15	○	○	○	○	○	○
	LE05	○		○			
LE	LE07	○	○	○	○		
	LE09_L	○	○	○	○	○	
	LE09_R	○	○	○	○	○	
	LE12_L	○	○	○	○	○	
	LE12_R	○	○	○	○	○	
	LE15_L	○	○	○	○	○	
HA	LE15AR	○	○	○	○	○	
	HA25	○		○			
	HA30	○		○			
	HA35	○		○			
	HA45	○		○			
HS	HA55	○		○			
	HS15	○		○			
	HS20	○		○			
	HS25	○		○			
	HS30	○		○			
HS35	○		○				

## 4. Precautions for Handling

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

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

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

## A-3-9 Arrangement and Mounting of Linear Guide

### (1) Arrangement

- For NSK linear guide, the datum face of the rail and of the slide are marked with either a "datum face groove" or with an "arrow."
- In case that two or more linear guides are used together, one linear guide is designated as a reference side guide, and the rest is adjusting side guide(s). The reference side linear guide has its reference number, serial number, and "KL" mark on the opposite side of the datum face (Fig. 9.1).
- When the datum faces of the reference side rail and slides are pressed to their mounting datum faces respectively, the variation of distance (mounting width  $W_2$  or  $W_3$ ) between the datum faces of the rails and that of the slides must be a minimum and therefore, it is specified as the standard. (Fig. 9.2 and 9.3)
- The ways to indicate the datum faces of each series are shown in Table 9.1.

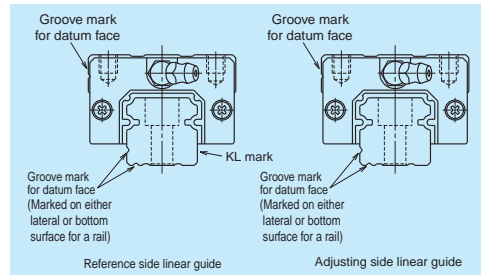


Fig. 9.1 Datum face

Table 9.1 Marks on the rail datum faces in each series

Model No.	Standard	LU05, 07, 09 PU05, 09, 12, 15 LE07, 09, 12	LU12, 15, LH15	PU07, LE05, 15 LE09, 12 (with a ball retainer) PE series LH08, 10, 12 LW17, 21 RA15
Material				
Special high carbon steel				
Stainless steel				

### Example of arrangement

- Arrangement of the linear guide must be determined taking into account the table position, its direction (horizontal, vertical, inclined, hanging from the ceiling), stroke, the size of bed and the table in the equipment as a whole. Table 9.2 shows a common arrangement examples, and features/precautions for each case.

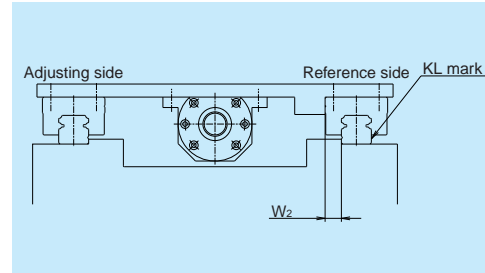


Fig. 9.2 Most common setting of the reference side rail

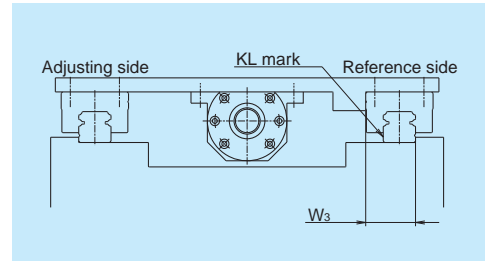


Fig. 9.3 Setting of the reference side rail in certain occasions

Table 9.2 Arrangement example

Arrangement	Features/Precautions
	<ul style="list-style-type: none"> <li>Easy in highly-accurate installation (recommended arrangement)</li> </ul>
	<ul style="list-style-type: none"> <li>Easy in highly-accurate installation</li> <li>Lubricant oil may not be supplied to slide. <u>Precaution is required in the oil supply design.</u></li> </ul>
	<ul style="list-style-type: none"> <li>Slightly difficult for highly-accurate installation</li> <li>Life of linear guide is affected by mounting accuracy.</li> <li>When oil lubricant is used, <u>precaution is required in oil supply design.</u></li> </ul>
	<ul style="list-style-type: none"> <li>Difficult for highly-accurate installation</li> <li>For a linear guide mounted in sideways, <u>precaution is required in oil supply design if oil lubricant is used.</u></li> </ul>
	<ul style="list-style-type: none"> <li>Rather easy in highly-accurate installation</li> <li>When oil lubricant is used, <u>precaution is required in oil supply design.</u></li> </ul>
	<ul style="list-style-type: none"> <li>Easy in highly-accurate installation if the linear guide is installed to the machine base first, then hung upside down along with the machine base.</li> <li>Slide may detach from the rail and fall down if the linear guide is damaged and rolling element in the slide fall out. It is necessary to <u>take preventive measures against the falling of the ball slide.</u></li> </ul>



(2) Mounting Accuracy

1. Accuracy of the mounting base of machine

- 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 face accuracy, reducing the error to about 1/3 in average (Fig. 9.4).

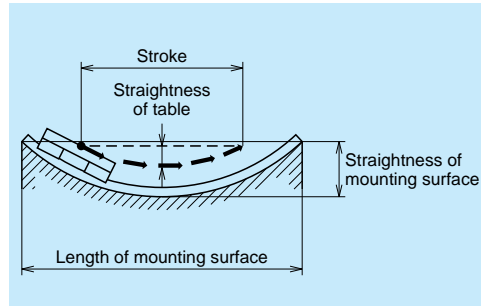
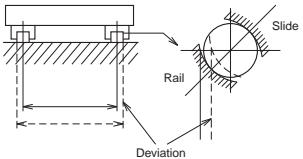
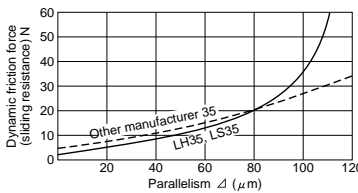
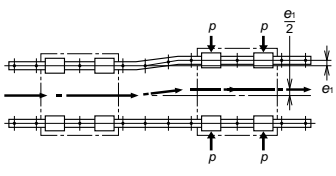


Fig. 9.4

2. Installation error

- Mounting error affects mainly three factors: life, friction and accuracy (Table 9.3).

Table 9.3 Influence of mounting error

Factor	Influence
Life	 <ul style="list-style-type: none"> <li>• Large mounting error generates a force which twists the slide and reduces its life.</li> <li>• It also distorts the contact point of the ball and the groove, and changes contact angle, lowering rigidity.</li> </ul>
Friction	 <ul style="list-style-type: none"> <li>• SH, SS, LH and LS Series are affected very little by mounting error thanks to their small friction. (Self alignment)</li> <li>• However, because of off-set Gothic arch grooves, their friction suddenly soars once the mounting error exceeds a certain level.</li> <li>• Mounting error severely affects friction of LA Series with heavy preload.</li> </ul>
Accuracy	 <ul style="list-style-type: none"> <li>• When rigidity of four slides are equal, the theoretical straightness becomes 1/2 of the installation error <math>e_1</math>.</li> <li>• However, this value becomes slightly larger due to deformation of the rail and the machine base.</li> </ul>

3. Permissible values of mounting error

- Of the three factors; life, friction, and accuracy, which are affected by the mounting error, NSK focuses on life. By the NSK standard, permissible values of mounting error are the values under the following conditions.

For ball guide

- Load volume per ball slide is 10% of the basic dynamic load rating C.
- Rated life is 5000 km or longer.
- Rigidity of the machine base is infinite.

For roller guide

- Load volume per roller slide is 10% of the basic dynamic load rating C.
- Rated life is 10000 km or longer.
- Rigidity of the machine base is infinite.

- Fig. 9.5 and 9.6 are representing the mounting errors. Their permissible values of mounting error are shown in "Installation" of the each series.

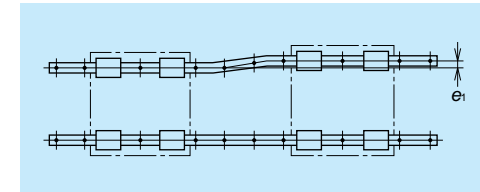


Fig. 9.5

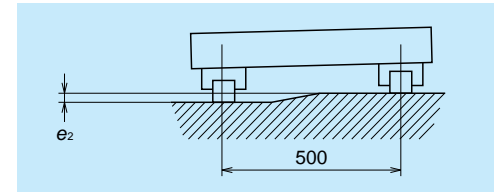


Fig. 9.6

#### 4. Running accuracy and the influence of even-off effect

When installed in a machine base, the linear guide is affected by the flatness of the mounting face of the machine base. However, in the case of two-rails/four-slides 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 stroke, compared to rail length, as well as by interaction between the rails, and slides.

Fig. 9.9 shows an actually measured straightness of the table which uses NSK linear guide. In this case, the final straightness of the table is about 1/5 of the straightness of the mounting face.

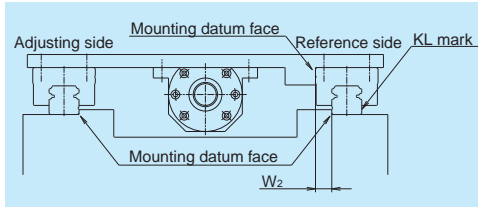


Fig. 9.7

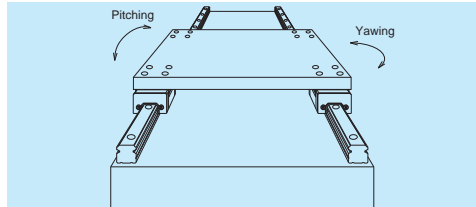


Fig. 9.8

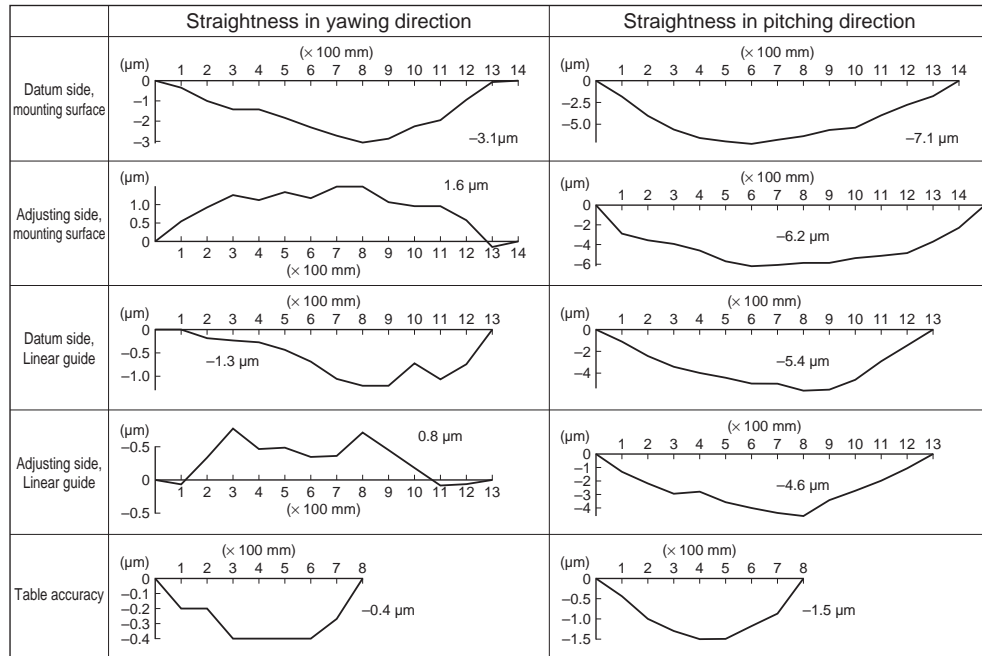


Fig. 9.9 Straightness of the table equipped with linear guide

### (3) Installation

#### 1. Shoulder height of the mounting face of the machine base and corner radius r

- Fig. 9.10 and 9.11, show shoulder height of the mounting face of the machine base and the size of corner r. 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 face begins), and horizontally secured to it. Recommended sizes are shown in "Shoulder height and corner radius r" of each series introduction.
- The shoulder should be thick (wide) enough, so it is not deformed by the pressing force.

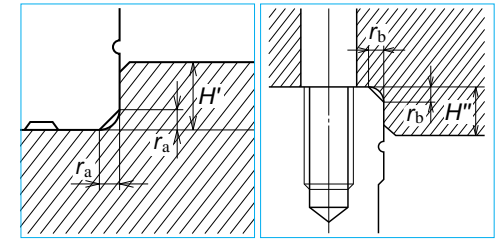


Fig. 9.10 Shoulder for the rail datum face Fig. 9.11 Shoulder for the slide datum face

#### 2. Tightening torque of the bolt

- Table 9.4 shows tightening torque of the bolt when the rail is secured to the fixture of race way interface 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 9.4 Bolt tightening torque (Bolt material: High carbon chromium steel)

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

#### 3. Installation procedures

- There are two installation ways depending on the accuracy requirement.
  - Installation with high accuracy
  - 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 face with an oilstone (Fig. 9.12).
- Apply machine oil or similar oil with low viscosity to the mounting face to increase the rust preventive effect.
- Linear guide is a precision product. Handle with care.

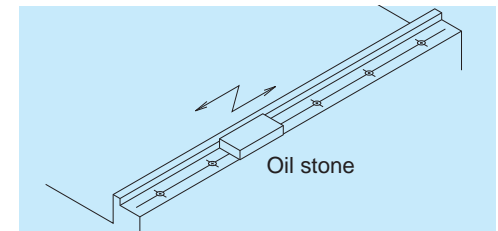


Fig. 9.12

## A Highly accurate installation

### a Rail installation procedures

#### a-1) Machine base has a shoulder on the side where the reference side rail is installed.

① Confirm that the rail is reference side rail, and the datum face of the rail comes face to face with the shoulder of the bed. Keep the slides on the rail, and carefully place the rail on the machine base on its mounting face. Temporarily tighten the bolts.

At this time, press the rail from sideways to make the rail tightly contact to the shoulder of the machine base. Apply tightening torque to the bolt in Table 9.4 when tightening a shoulder plate (Fig. 9.13).

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 face is on the left side as shown in Fig. 9.14, tighten the bolt at the farthest end first, then proceed to near end.

This way, a bolt rotating force 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 face 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 face of the machine base for the adjusting side rail: Secure a measuring table to the slides of the reference side rail (Fig. 9.15). Use this to adjust the parallelism of the adjusting side rail. Check parallelism of the adjusting side rail with a dial gauge from one end of the rail, tightening the bolts one by one.

The measuring table is more stable if secured to two bearings, but one bearing is sufficient. Parallelism between two rails can also be checked by the same method in Fig. 9.15 when there is a shoulder on the face where the adjusting side rail is installed.

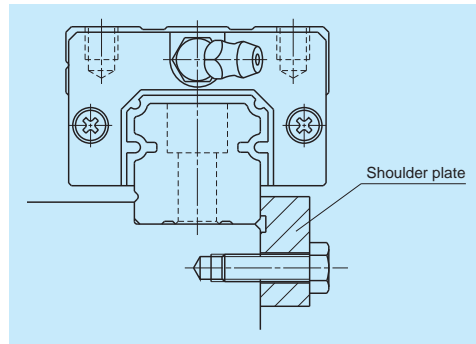


Fig. 9.13 Pressing the rail from sideways

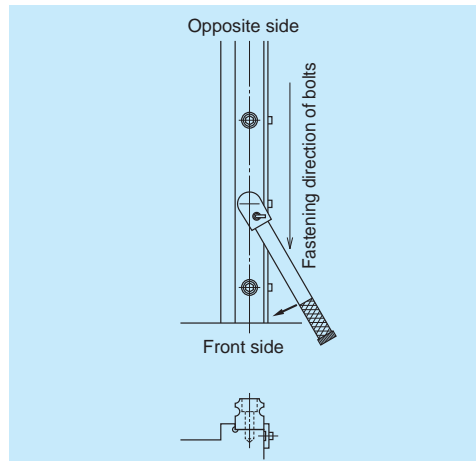


Fig. 9.14 Rail installation

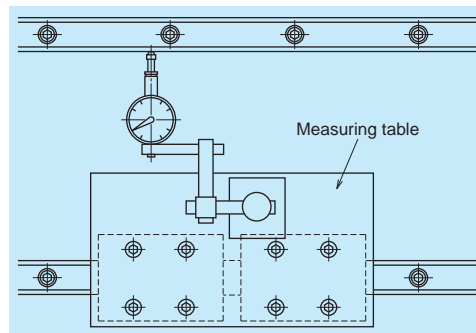


Fig. 9.15 Measuring parallelism

#### a-2) When 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 the machine base on its mounting face. Temporarily 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 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 gauge, 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. 9.16).

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 gauge to measure parallelism.

Other procedures are the same as ① - ④, and the ④ in cases where there is a shoulder on the machine base.

### b) Procedures of slide installation

#### b-1) When 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. Temporarily 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 face 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. 9.17).

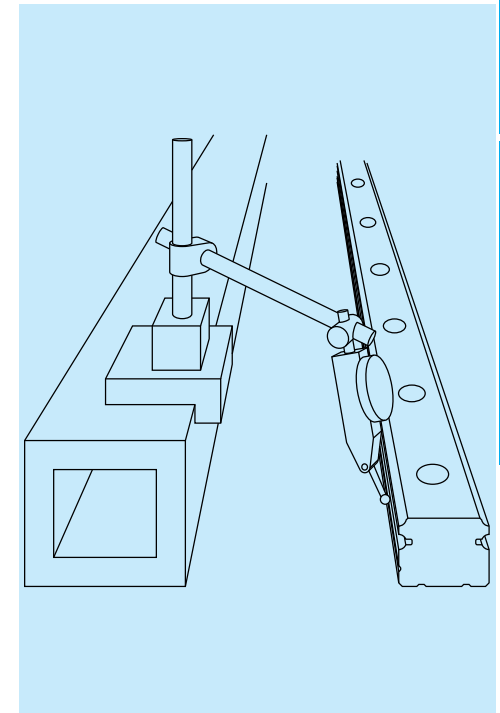


Fig. 9.16

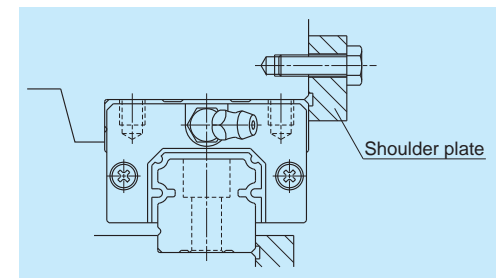


Fig. 9.17 Pressing slide from sideways

- 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-2) 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. Temporarily tighten bolts to secure 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 standard torque.

**B Easy installation**

- ① Carefully place the reference side rail on the machine base. Then tighten the bolts for installation with specified torque.
- ② Temporarily 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 specified torque. Leave the rest of the slide on the adjusting side rail temporarily tightened (Fig. 9.18).
- ④ While moving the table with each pitch of the bolt for rail: With specified torque, tighten the rail mounting bolt which is located immediately adjacent to the slide on the adjusting side rail that had been finally tightened.  
Take this procedure from one end to the other.
- ⑤ Return the table to the original position once. Then with standard torque, tighten the rest of the slides on the adjusting side. Then, by the same procedure as in ④, tighten the rest of the rail mounting bolts with standard torque. Move the table to check any abnormality such as large friction force.

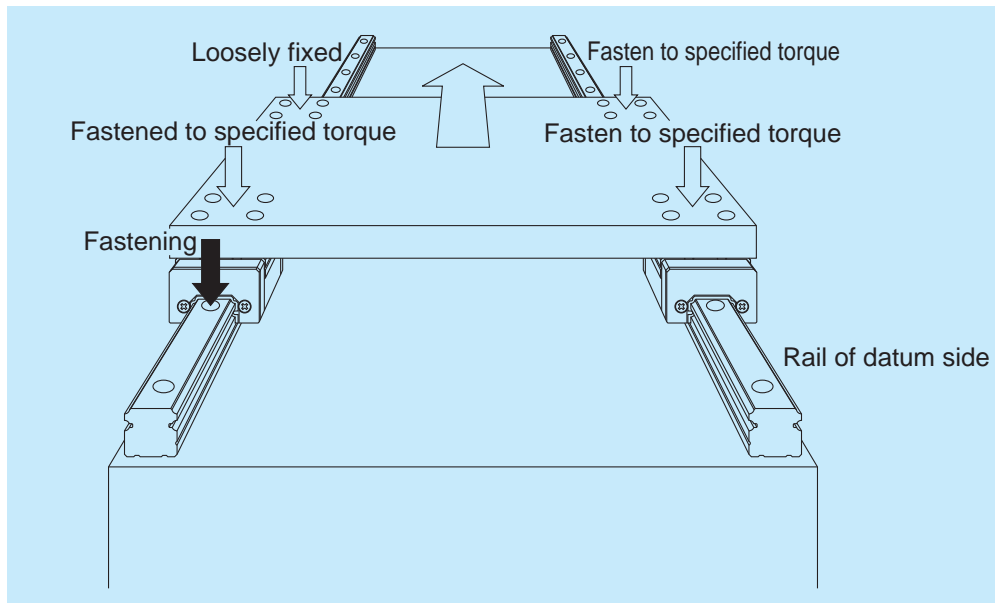


Fig. 9.18 Easy installation

**4. Various methods to press linear guide sideways**

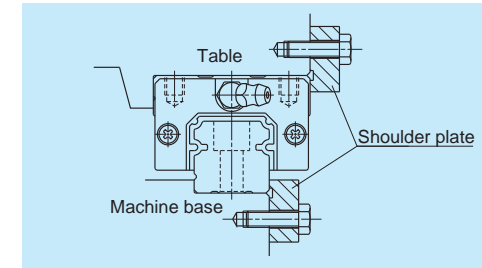


Fig. 9.19 Recommended method

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

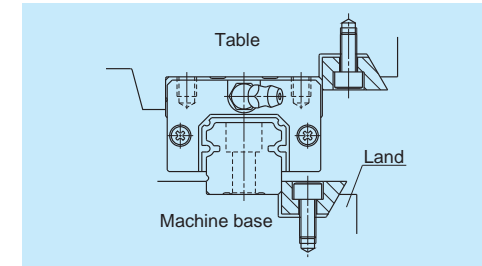


Fig. 9.20 Installation that requires caution

- 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.

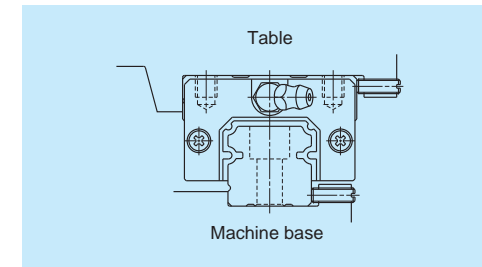


Fig. 9.21

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

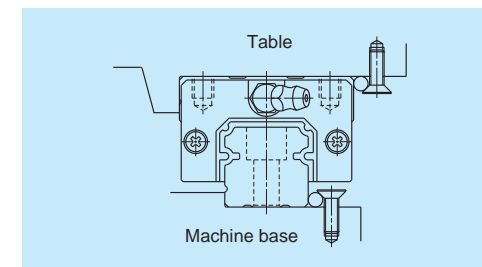


Fig. 9.22

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

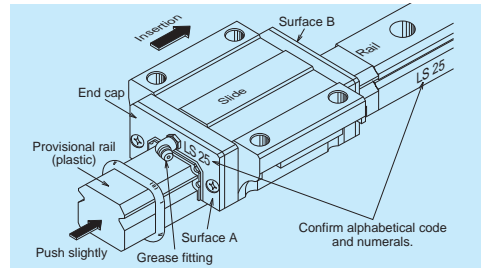
**(4) Assemble Random-Matching Linear Guide**

- Random-matching slide is assembled on a provisional rail (an inserting tool) when it is delivered (Fig. 9.23).
- NSK standard grease is packed into the slide, allowing immediate use.

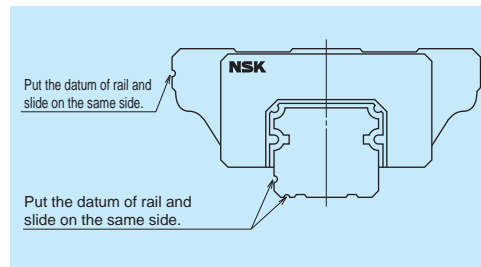
**Assembly procedures of random-matching linear guide**

Follow steps as described below.

- ① Wipe off the rust preventive oil from the rail and slide.
- ② Please match an groove mark for datum face of slide and rail to become an assembling state desired.
- ③ Align the provisional rail to the rail in the bottom and side faces. Press the provisional rail lightly against the rail, and move the slide over the rail (Fig. 9.23).



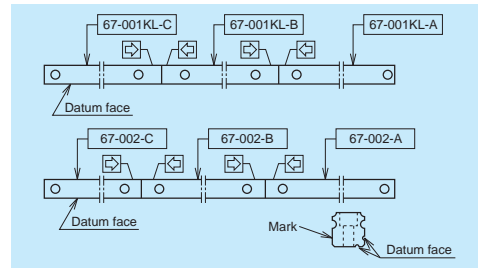
**Fig. 9.23** Inserting slide into the rail



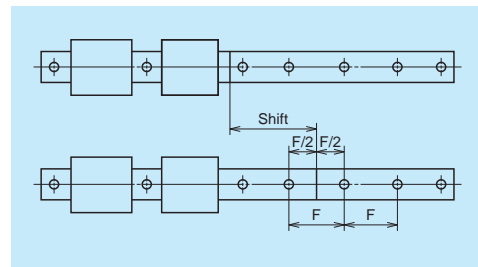
**Fig. 9.24**

**(5) Butting Rail Specification**

- A rail which requires the length that exceeds manufactured maximum length comes in butting specification.
- The rails with butting specification are marked with alphabet (A, B, C ...) and an arrow on the opposite side of the mounting datum face. Use the alphabets and arrows for assembly order and direction of the rail (Fig. 9.25).
- The random-matching rails for butting specification are only marked with the arrows.
- The pitch of the rail mounting hole on the butting section should be as F in Fig. 9.26. When two rails are used in parallel, the butted sections should not align. This is to avoid change in the running accuracy of the table at the butted sections.
- We recommend shifting the butting sections more than the length of a slide. If the higher running accuracy is required, consider installing the slides into the table so that they do not simultaneously pass the butting sections.



**Fig. 9.25**



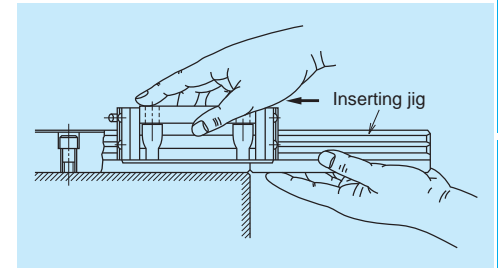
**Fig. 9.26**

**(6) Handling Preloaded Assembly**

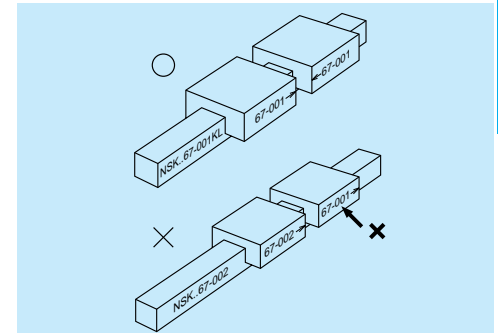
- In case of the preloaded assembly (not random matching), do not remove slides from the rail as a general rule.
- If it is unavoidable to remove slides from the rail, make certain to use a provisional rail (a jig used to insert a slide to the rail) as shown in Fig. 9.27.
- Provisional rail for each model is in stock.
- Pay due attention to the assembly mark when returning the slide back to the rail. Follow the cautions described below.

**Mark for assembling ball slide and rail**

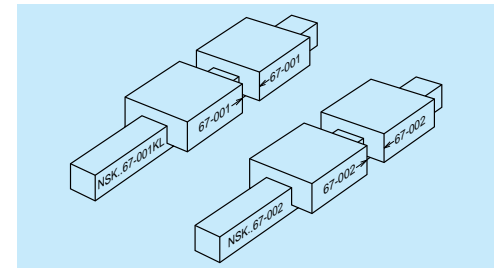
- Rails of preloaded assembly (not random-matching) are marked with a reference number and a serial number on the opposite of the datum face.
- Slide to be combined are also marked with the same serial number (reference number is not marked).
- Furthermore, slides are marked with an arrow. Slides should be positioned with their arrows facing each other.
- In case that the slides had to be removed from the rail, confirm their serial numbers and the directions of arrows for re-assembly (Fig. 9.28).
- 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. 9.29).
- When two or more rails of different reference number are used in a single set, the rails and slides have the same serial number. In this case, when slides are removed from the rail, it is unclear which rail each slide was previously installed on. When removing ball slides from the rail for an unavoidable reason (Fig. 9.30), sufficient precaution is required.



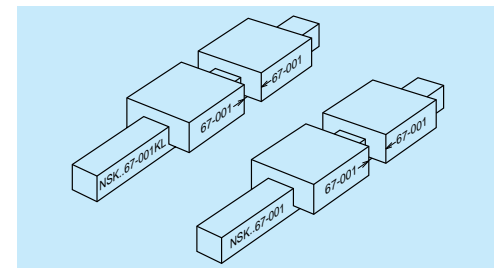
**Fig. 9.27**



**Fig. 9.28**



**Fig. 9.29** When two rails have the same reference number



**Fig. 9.30** When two rails have different reference number

### A-3-10 Drills to Select Linear Guide

#### (1) Single Axis Material Handling System

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

Specification of 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<sub>b</sub> : 100 (mm)  
 Rail span L<sub>r</sub> : 90 (mm)

Load point coordinates from the table center (mm)			
Load	X coordinate	Y coordinate	Z coordinate
W1	30	-20	20
W2	80	-90	120
F	-50	-135	30

Stroke: 1000 mm  
 (1 cycle: 2000 mm)

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

#### (1)-1 Selection of linear guide model

Select a type of linear guide from "A-1-2 Structure and Characteristics of Linear Guide." Since this material handling system has 2 rails and 4 ball slides, LH, LS, and LU Series are suitable.

Here, we temporary select LU15 because of the dimensions of mounting space.

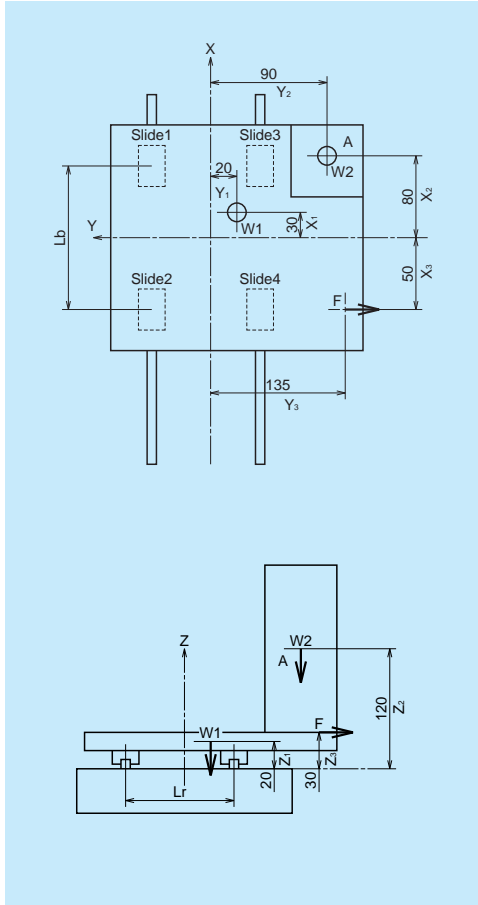


Fig. 10.1 Single axis material handling system

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.

#### (1)-2 Calculating life

Calculate life of the selected LU15AL based on "A-3-2 Rating Life and Basic Load Rating."

Linear guide LU15AL

Basic dynamic load rating : 5550 (N)  
 Basic static load rating : 6600 (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<sub>r</sub> : 90 (mm)  
 Ball slide span L<sub>b</sub> : 100 (mm)

From the time to reach travel speed and the travel speed, the table acceleration is 0.8 m/sec<sup>2</sup>. Therefore, it is not necessary to take into account inertial force brought about by 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 in Table 2.2 (page A19)

There is a work mounted on the table  
 Vertical direction loads

$$M1 = \sum_{j=1}^n (F_{yj} \cdot Z_{yj}) + \sum_{k=1}^n (F_{zk} \cdot Y_{zk})$$

$$= F \cdot Z_3 + W1 \cdot Y_1 + W2 \cdot Y_2$$

$$= -200 \times 30 + 150 \times (-20) + 200 \times (-90)$$

$$= -27000 \text{ (N}\cdot\text{mm)}$$

$$M2 = \sum_{i=1}^n \{F_{xi} \cdot (Z_{xi} - Z_b)\} + \sum_{k=1}^n (F_{zk} \cdot X_{zk})$$

$$= W1 \cdot X_1 + W2 \cdot X_2$$

$$= 150 \times 30 + 200 \times 80$$

$$= 20500 \text{ (N}\cdot\text{mm)}$$

$$F_{r1} = \frac{\sum_{k=1}^n F_{zk}}{4} + \frac{M1}{2 \cdot L} + \frac{M2}{2 \cdot \ell}$$

$$= \frac{W1 + W2}{4} + \frac{M1}{2 \cdot L_r} + \frac{M2}{2 \cdot L_b}$$

$$= \frac{150 + 200}{4} + \frac{-27000}{2 \times 90} + \frac{20500}{2 \times 100}$$

$$= 40 \text{ (N)}$$

Similarly

$$F_{r2} = -165 \text{ (N)}$$

$$F_{r3} = 340 \text{ (N)}$$

$$F_{r4} = 135 \text{ (N)}$$

Lateral direction loads

$$M3 = -\sum_{i=1}^n \{F_{xi} \cdot (Y_{xi} - Y_b)\} + \sum_{j=1}^n (F_{yj} \cdot X_{yj})$$

$$= F \cdot X_3$$

$$= -200 \times (-50)$$

$$= 10000 \text{ (N}\cdot\text{mm)}$$

$$F_{s1} = F_{s3} = \frac{\sum_{j=1}^n F_{yj}}{4} + \frac{M3}{2 \cdot \ell}$$

$$= \frac{F}{4} + \frac{M3}{2 \cdot L_b}$$

$$= \frac{-200}{4} + \frac{10000}{2 \times 100}$$

$$= 0 \text{ (N)}$$

**Lateral direction loads**

$$M3 = -\sum_{i=1}^n \{F_{xi} \cdot (Y_{xi} - Y_b)\} + \sum_{j=1}^n (F_{yj} \cdot X_{yj})$$

$$= F \cdot X_3$$

$$= -200 \times (-50)$$

$$= 10000 \text{ (N·mm)}$$

$$F_{s1} = F_{s3} = \frac{\sum_{j=1}^n F_{yj}}{4} + \frac{M3}{2 \cdot \ell}$$

$$= \frac{F}{4} + \frac{M3}{2 \cdot L_b}$$

$$= \frac{-200}{4} + \frac{10000}{2 \times 100}$$

$$= 0 \text{ (N)}$$

Similarly

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

**No work mounted on the table**

**Vertical direction load**

$$M1 = \sum_{j=1}^n (F_{yj} \cdot Z_{yj}) + \sum_{k=1}^n (F_{zk} \cdot Y_{zk})$$

$$= F \cdot Z_3 + W1 \cdot Y_1$$

$$= -200 \times 30 + 150 \times (-20)$$

$$= -9000 \text{ (N·mm)}$$

Similarly

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

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

$$M2 = \sum_{i=1}^n \{F_{xi} (Z_{xi} - Z_b)\} + \sum_{k=1}^n (F_{zk} \cdot X_{zk})$$

$$= W1 \cdot X_1$$

$$= 150 \times 30$$

$$= 4500 \text{ (N·mm)}$$

$$F_{r1} = \frac{\sum_{k=1}^n F_{zk}}{4} + \frac{M1}{2 \cdot L} + \frac{M2}{2 \cdot \ell}$$

$$= \frac{W1}{4} + \frac{M1}{2 \cdot L_r} + \frac{M2}{2 \cdot L_b}$$

$$= \frac{150}{4} + \frac{-9000}{2 \times 90} + \frac{4500}{2 \times 100}$$

$$= 10 \text{ (N)}$$

Similarly

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

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

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

**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 LU15AL,

**Vertical direction dynamic equivalent load**

$$F_r = F_r$$

**Lateral direction dynamic equivalent load**

$$F_{so} = F_s \cdot \tan \alpha = F_s$$

Use the formula for full dynamic equivalent load (Page A23) to calculate  $F_e$ .

Results are shown in the table below.

Unit: N

Work mounted	Slide1	Slide2	Slide3	Slide4
$F_r (F_{r1} - F_{r4})$	40	-165	340	135
$F_{so} (F_{s1} - F_{s4})$	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
$F_{so} (F_{s1} - F_{s4})$	0	-100	0	-100
$F_e$	10	118	110	133

Based on the results of calculations, a ball slide that bears the maximum dynamic equivalent load shall be taken as the representative of the linear guides for further life calculation. For this case, we take the Slide3.

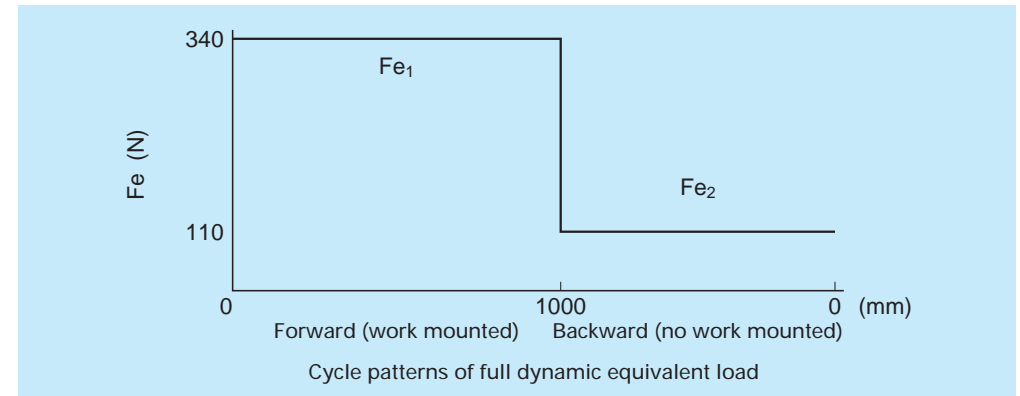
**Calculation of mean effective load**

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

Therefore;

**Work mounted**  $F_{e1} = 340 \text{ (N)}$

**No work mounted**  $F_{e2} = 110 \text{ (N)}$



From the cycle pattern, the mean effective load matches "① **When load and running distance vary by phase.**" Therefore, use the following formula.

Assuming that L is:  $L = L_1 + L_2$ .

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

$$= \sqrt[3]{\frac{1}{2000} (340^3 \times 1000 + 110^3 \times 1000)}$$

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

**Determine various coefficients**

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

**Load factors**

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

**Hardness coefficient**

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

**Calculate rating life**

Use "A-3-2.2 (6) Calculation of rating life."

The basic dynamic load rating (C) of linear guide LU15AL : 5550 (N)

Mean effective load  $F_m$  : 273 (N)

Load factor  $f_w$  : 1.2

Hardness coefficient  $f_H$  : 1

$$\text{Rating fatigue life } L = 50 \times \left( \frac{f_H \cdot C}{f_w \cdot F_m} \right)^3$$

$$= 50 \times \left( \frac{1 \times 5550}{1.2 \times 273} \right)^3$$

$$= \text{approximately } 243110 \text{ (km)}$$

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

Convert the above rating fatigue life into hours:

$$\frac{243110 \times 1000}{12 \times 60 \times 16} = \text{approximately } 21100 \text{ (days)}$$

**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 LU15AL: 6600 (N)

Ball slide No. 3 bears the largest load.

$P_0$  at this time:

$$P_0 = F_r + F_s = 340$$

Therefore, static permissible load coefficient  $f_S$  is:

$$f_S = \frac{C_0}{P_0} = \frac{6600}{340} = 19.4$$

There is no problem at this value.

**(1)-3 Selection of accuracy grade and preload**

Based on "A-1-3.4 (2) Application examples of accuracy," select accuracy grade PN and preload Z1 for material handling system.

**(1)-4 Calculation of deformation**

Calculate deformation by the weight of the mounted work  $W_2$ . From "Rigidity of LU series," the rigidity of linear guide LU15AL with Z1 preload is:

$$K_s = K_r = 45 \text{ (N/}\mu\text{m)} = 45000 \text{ (N/mm)}$$

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

**From Pattern 4 in Table 2.2 (Page A19)**

Work mounted:

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

$$= -90 \times \frac{-100 - 0}{100 \times 45000} + 120 \times \frac{40 - (-165)}{100 \times 45000}$$

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

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

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

**No work mounted:**

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

$$= -90 \times \frac{-100 - 0}{100 \times 45000} + 120 \times \frac{10 - (-35)}{100 \times 45000}$$

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

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

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

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

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

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

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

**(2) Machining Center**

The following is a case calculation for a horizontal type machining center. Arrangements of each axis are shown in Fig. 10.2 and Fig. 10.3.

**Operating conditions**

Dimensions and load conditions are:

X axis column's weight	$W_x$ : 7500 (N)
Y axis spindle head's weight	$W_y$ : 2500 (N)
Z axis table's weight	$W_z$ : 5500 (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	$F_x = F_y = 1000 \text{ (N)}$	
Drilling process	$F_z = 3000 \text{ (N)}$	



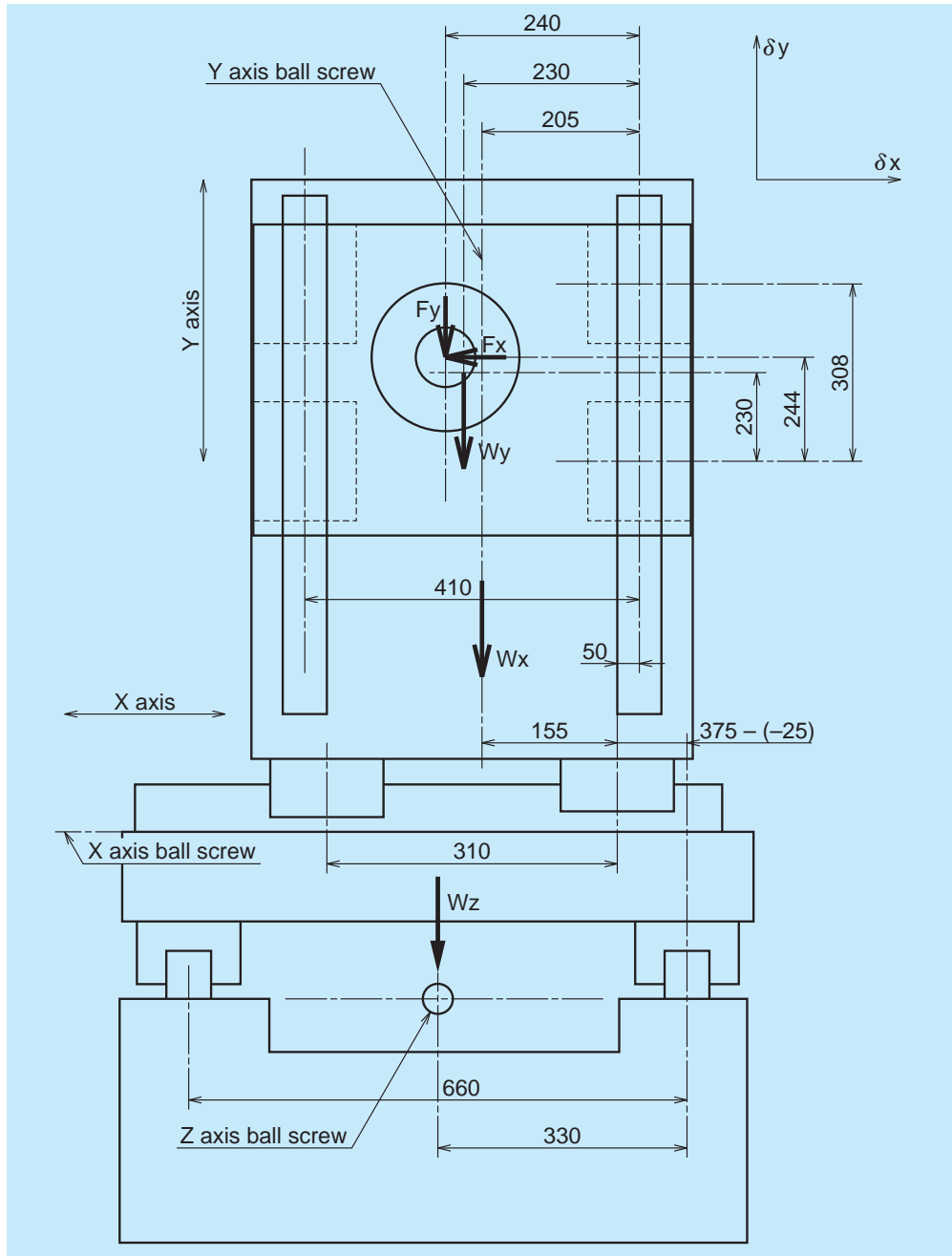


Fig. 10.2 Machining center (front view)

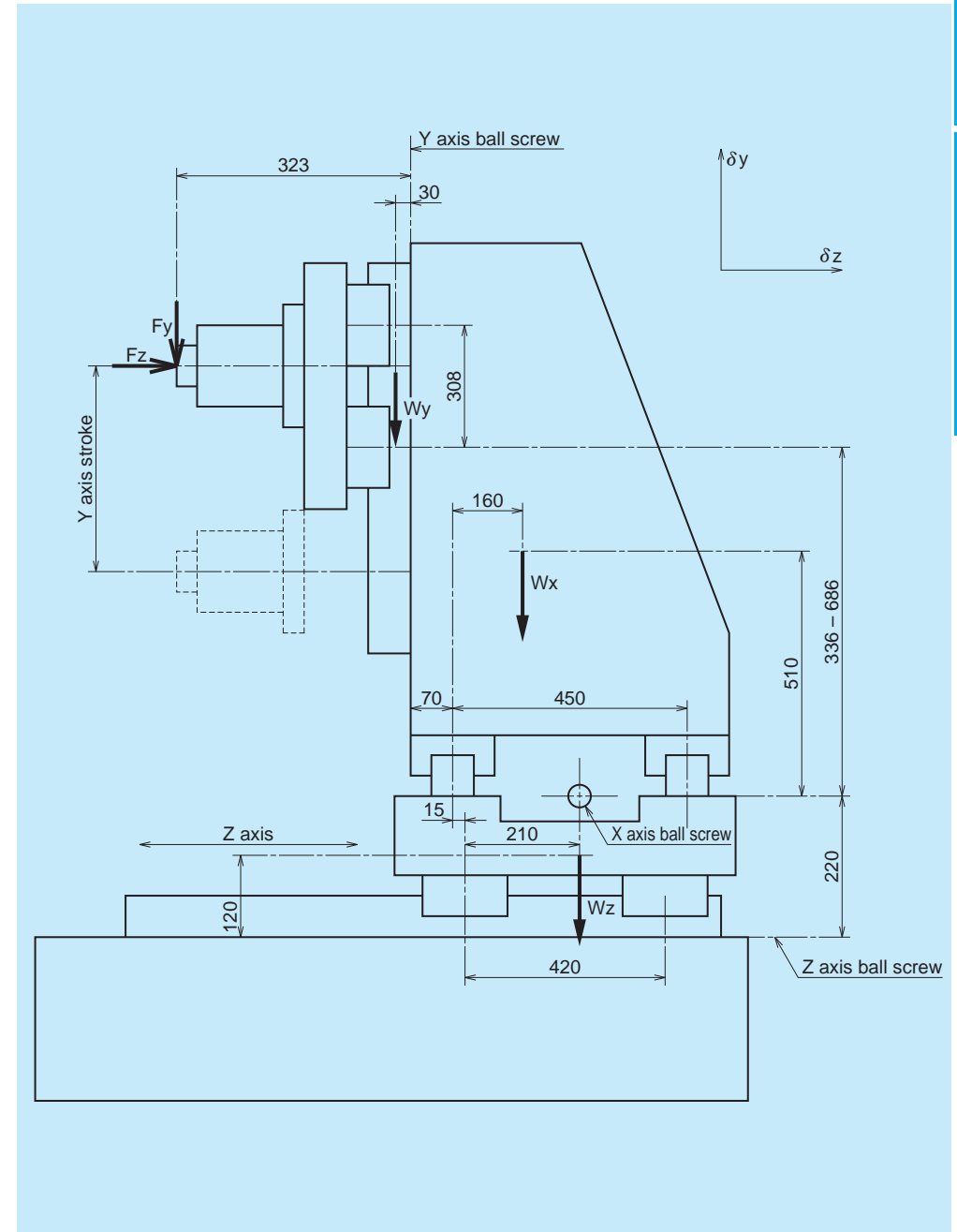


Fig. 10.3 Machining center (side view)

**(2)-1 Selection of linear guide model**

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

Select below temporarily from shaft diameter of ball screw:

- X axis LA55
- Y axis LA35
- Z axis LA65

**(2)-2 Calculation of life expectation**

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

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

Calculation of the loads that apply to the ball slide

In case of no cutting load:  $F_x = F_y = F_z = 0$

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 consider  $W_x$  and  $W_y$

Y axis: Loads to consider  $W_y$

Z axis: Loads to consider  $W_x, W_y,$  and  $W_z$

Unit: N

Axis	Load direction	Slide1	Slide2	Slide3	Slide4
X axis	Vertical direction $F_r$	1156	955	4045	3844
	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	3860	3890	6985
	Lateral direction $F_s$	0	0	0	0

**In case of milling process:  $F_x = F_y = 1000$  (N)**

Similarly,

X axis: Loads to consider  $W_x, W_y, F_x,$  and  $F_y$

Y axis: Loads to consider  $W_y, F_x,$  and  $F_y$

Z axis: Loads to consider  $W_x, W_y, W_z, F_x,$  and  $F_y$

$F_y$

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

Unit: N

Axis	Load direction	Slide1	Slide2	Slide3	Slide4
X axis	Vertical direction $F_r$	2277	-1039	6539	3224
	Lateral direction $F_s$	997	-997	997	-997
Y axis	Vertical direction $F_r$	252	-1040	1040	-252
	Lateral direction $F_s$	54	-554	54	-554
Z axis	Vertical direction $F_r$	-771	3796	4453	9020
	Lateral direction $F_s$	486	-986	486	-986

**In case of drilling process:  $F_z = 3000$  (N)**

X axis: Loads to consider  $W_x, W_y,$  and  $F_z$

Y axis: Loads to consider  $W_y$  and  $F_z$

Z axis: Loads to consider  $W_x, W_y, W_z,$  and  $F_z$

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

Unit: N

Axis	Load direction	Slide1	Slide2	Slide3	Slide4
X axis	Vertical direction $F_r$	4256	4055	945	744
	Lateral direction $F_s$	919	581	919	581
Y axis	Vertical direction $F_r$	305	938	561	1195
	Lateral direction $F_s$	102	-102	102	-102
Z axis	Vertical direction $F_r$	4872	-247	7997	2878
	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," necessary load  $F_r$  and  $F_{se}$  are, as the linear guide model is LA Series, obtained as follows.

**Vertical dynamic equivalent load**

$$F_r = F_r$$

**Lateral dynamic equivalent load**

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

From above, calculate  $F_e$  using formulas for full dynamic equivalent loads shown in Page A23. From calculation, the largest full dynamic equivalent loads are as follows.

Largest full dynamic equivalent load  $F_e$  (N)

Axis	Largest full dynamic equivalent load $F_e$ (N)		
	No cutting load	For milling process	For drilling process
X axis	4045	7038	4716
Y axis	173	1317	1246
Z axis	6985	9513	8417

**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 at 70% of the largest full dynamic equivalent load in all processes.

Therefore,

**X axis:**  $7038 \times 0.7 = 4927$  (N)

**Y axis:**  $1317 \times 0.7 = 922$  (N)

**Z axis:**  $9513 \times 0.7 = 6659$  (N)

**Determine various coefficients**

Determine based on "A-3-2.2 (5) Various coefficients."

In this occasion,  
Load coefficient  $f_w$ : 1.5  
Hardness coefficient  $f_H$ : 1

**Calculation of rating life**

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

**Basic dynamic load rating C**

(X axis linear guide LA55): 139000 (N)

**Basic dynamic load rating C**

(Y axis linear guide LA35): 61500 (N)

**Basic dynamic load rating C**

(Z axis linear guide LA65): 260000 (N)

Load coefficient  $f_w$ : 1.5

Hardness coefficient  $f_H$ : 1

Rating fatigue life  $L = 50 \times \left( \frac{f_H \cdot C}{f_w \cdot F_m} \right)^3$

From this,

In case of X axis  $L_x = 332650$  (km)

In case of Y axis  $L_y = 4396720$  (km)

In case of Z axis  $L_z = 881830$  (km)

In case of roller, shown in A-3-2.2 (6)

"Calculation of rating life" (Page A26)

**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:

$\delta x = -17.9 - (-3.4) = -14.5$  (μm)

$\delta y = -13.3 - (-9.1) = -4.2$  (μm)

$\delta z = -14.2 - (-9.3) = -4.9$  (μm)

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

Basic static load rating  $C_0$

(X axis linear guide LA55): 215000 (N)

Basic static load rating  $C_0$

(Y axis linear guide LA35): 98000 (N)

Basic static load rating  $C_0$

(Z axis linear guide LA65): 420000 (N)

Examine for milling process with large load.

X axis  $f_s = \frac{C_0}{P_0} = \frac{C_0}{(F_T + F_s)} = \frac{215000}{(6539 + 997)} = 28.5$

Similarly,

Y axis  $f_s = 61.5$

Z axis  $f_s = 42.0$

Therefore, there is no problem.

**(2)-3 Selection of accuracy grade and preload**

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

**(2)-4 Calculation of deformation**

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

Rigidity of X axis linear guide LA55Z3 : 1400 (N/μm)

Rigidity of Y axis linear guide LA35Z3 : 825 (N/μm)

Rigidity of Z axis linear guide LA65Z3 : 1730 (N/μm)

Deformation at processing points at time of milling:

$\delta x = -5.8 - (-3.4) = -2.4$  (μm)

$\delta y = 5.0 - (-9.1) = 14.1$  (μm)

$\delta z = 14.3 - (-9.3) = 23.6$  (μm)

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

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

**A-3-11 Reference**

The articles in "Motion & Control (NSK Technical Journals)" which refer to NSK linear guides are listed in the table below for user convenience.

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

For inquiries and orders of "Motion & Controls," please contact your local NSK sales offices, or representatives.

**Table 11.1 Motion & Control (NSK Technical Journal): Articles relating to linear guides (1997 -)**

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

# A-4 NSK Linear Guides™

## (1) Structure of NSK Linear Guides

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

## (2) Characteristics of NSK Linear Guides

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

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

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

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

### 1. High precision and quality

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

### 2. High reliability and durability

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

### 3. Abundant in type for any purpose

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

### 4. Development of random-matching parts for short delivery time

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

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

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

### 6. Lineup of extremely high-load capacity series

• The LA series provides a top class high-load capacity for the ball linear guides through a unique load carrying configuration with three ball recirculation circuits on the one side.

By installing rollers that are the largest possible diameter and length, the NSK roller linear guides have realized the world highest load capacity, far superior to the roller linear guides of other companies.

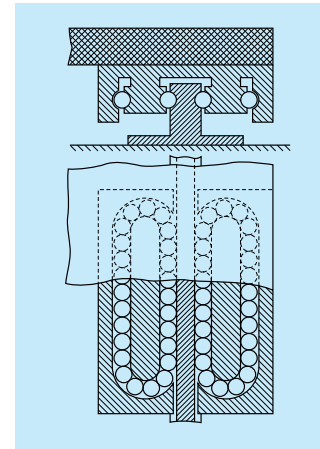


Fig. 1 • French Patent in 1932.  
• Inventor : Gretsh (German)

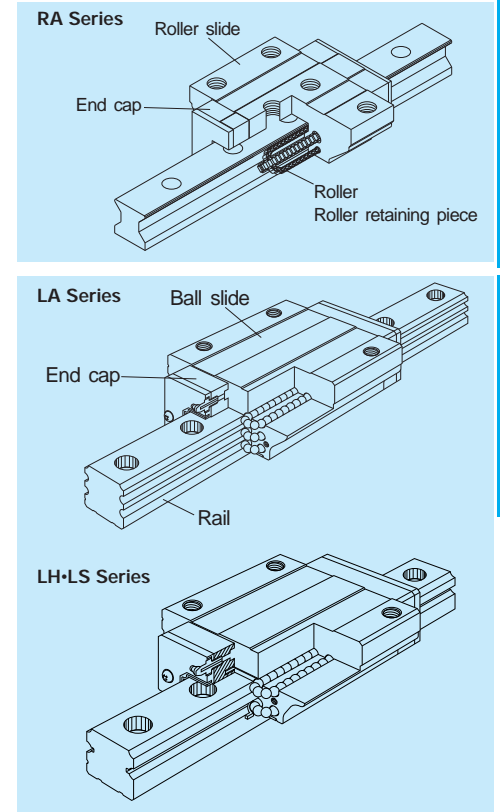


Fig. 2 Structure of NSK linear guides

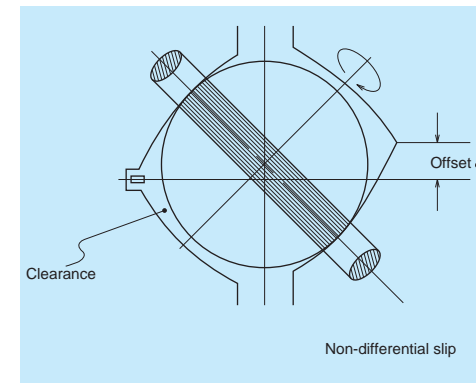


Fig. 3 Two contact point at offset Gothic arch groove

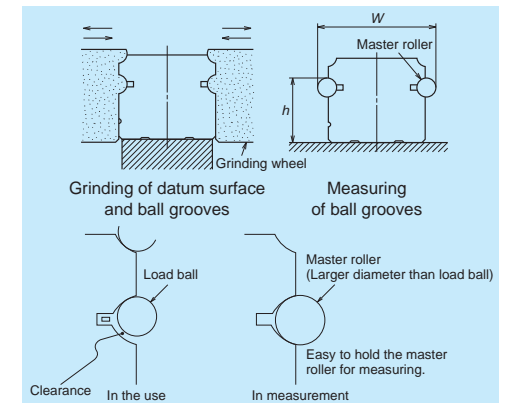


Fig. 4 Processing and measuring grooves

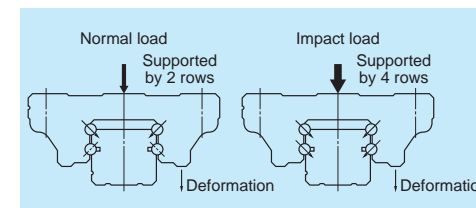


Fig. 5 Shock-resistance

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

### (3) Types and Characteristics of NSK Linear Guides

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

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

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

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

Category	Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	
High vertical load carrying capacity type	Self-aligning type	LH	AN BN			
			AL BL			
			EL GL			
			FL HL			
			EM GM			
			High-load type	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>AL, AN</p> </div> <div style="text-align: center;"> <p>EL, FL, EM</p> </div> </div>		

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

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

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



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

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

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

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

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

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

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

Characteristics	Applications	Page
<p>The HA Series ball guide with high-precision and high-load carrying capacity, featuring high-motion accuracy equivalent to hydrostatic bearings.</p> <ul style="list-style-type: none"> <li>● Ball passage vibration has been reduced to one-third of conventional models by ultra-long ball slides and specification of new design.</li> <li>● 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.</li> <li>● High motion accuracy is realized by super-finished ball groove feature (option).</li> <li>● End seal, bottom seal, and inner seal of high dust proof specification are available as a standard.</li> <li>● Best for high-grade working machine.</li> </ul>	<ul style="list-style-type: none"> <li>• Die and mold tooling machine center</li> <li>• Precision processing machine</li> <li>• Heavy cutting machine tools</li> <li>• Gear cutters</li> <li>• Press machines</li> <li>• Grinders</li> </ul>	A341
<p>The HS Series ball guide with high-precision featuring high-motion accuracy equivalent to hydrostatic bearings.</p> <ul style="list-style-type: none"> <li>● Ball passage vibration has been reduced to one-third of conventional models by ultra-long ball slides and specification of new design.</li> <li>● The contact angle between the ball and the raceway is set at 50 degrees. The load carrying capacity against vertical directions, which is prevalent in most operations, increases by this design.</li> <li>● The DF contact structure greatly absorbs the error in the perpendicular direction of rail at time of installation.</li> <li>● Thanks to the offset Gothic arch groove, balls make contacts at two points. This keeps friction small.</li> </ul>	<ul style="list-style-type: none"> <li>• Precision processing machine</li> <li>• Electric discharge machines</li> <li>• Grinders</li> <li>• Liquid crystal display manufacturing equipment</li> </ul>	A355

## (4) Guide to Technical Services

### CAD drawing data

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

NSK website

<http://www.nsk.com>

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

### Data offered by CAD

#### NSK linear guides

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

## (2) Telephone consultation with NSK engineers

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

## (5) Linear Guides: Handling Precautions

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

### 1. Lubrication



Confirm lubrication.

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

### 2. Handling



Handle with care.



Do not disassemble.



Do not drop.



Do not give impact.

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

### 3. Precautions in use



Do not contaminate.



Temperature limitation.



Do not hang upside down.

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

### 4. Storage



Store in the correct position.

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

## (6) Design Precautions

The following points must be heeded in examining the life.



### In case of oscillating stroke

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



### When applying pitching or yawing moment

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



### When an extraordinary large load is applied during stroke

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



### When calculated life is extraordinarily short (Less than 3000 km in calculated life.)

- In such case, the contact pressure to the balls or rollers and the rolling contact surface is extraordinarily high.
- Operated under such state continually, the life is significantly affected by the loss of lubrication and the presence of dust, and the actual life becomes shorter than calculated.
- It is necessary to reconsider arrangement, the number of slide, and the type of model in order to reduce the load to the slide.
- It is necessary to consider preload for calculation of rating life, when selecting Z3 (medium preload) or Z4 (heavy preload) as a preload. Please consult NSK.



### Application at high speed

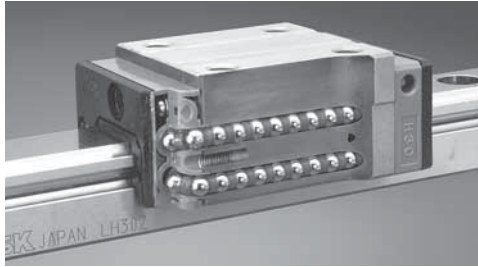
- The standard maximum allowable speed of a linear guide under normal conditions is 100 m/min. However, the maximum allowable speed can be affected by accuracy of installation, temperature, external loading etc.
- The end cap with high speed specification must be used when operating speed exceeds the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

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

1. SH Series	A115
2. SS Series	A139
3. LH Series	A161
4. LS Series	A185
5. VH Series	A207
6. LW Series	A229
7. TS Series	A243

### A-5-1 General Industrial Use

## A-5-1.1 SH Series



## (1) Features

## 1. Lower noise and gentler tone

Incorporating a retainer piece and optimizing the circulation path enables steel ball circulation stability and the prevention of ball collision, resulting in noise reduction.

## 2. Smoother motion

Improved steel ball circulation stability, free of interference between the balls improves dynamic friction characteristics, resulting in smooth and stable motion, which is especially effective for low speed motion.

## 3. Low dust generation

A resin retaining piece, which prevents steel balls collision, features effective low dust generation characteristics compared to conventional products.

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

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

## 5. High load carrying capacity to vertical direction

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

## 6. High resistance against impact load

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

## 7. High accuracy

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

## 8. Fast delivery

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

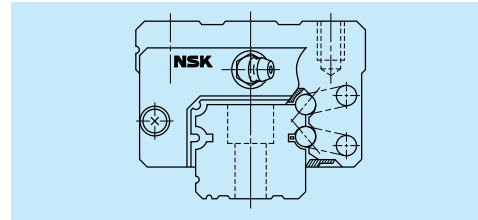


Fig. 1 SH Series

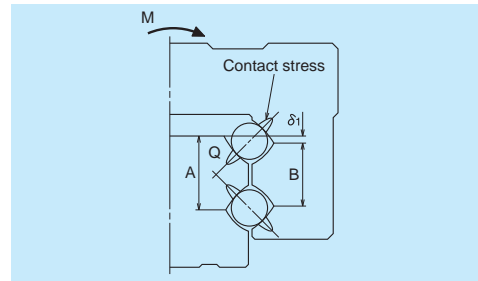


Fig. 2 Enlarged illustration of the offset Gothic arch groove

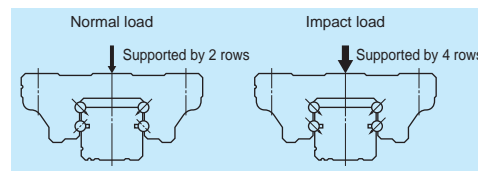


Fig. 3 When load is applied

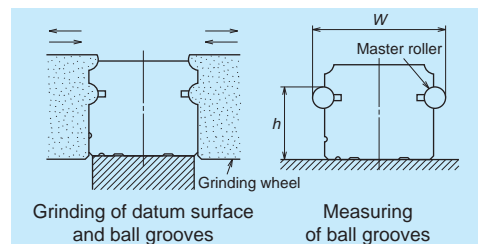


Fig. 4 Rail grinding and measuring

## (2) Ball slide shape

Ball slide Model	Shape/installation method	Type	
		High-load type	Super-high-load type
AN BN		AN 	BN 
AL BL		AL 	BL 
EL GL		EL 	GL 
FL HL		FL 	HL 
EM GM		EM 	GM 



## (3) Accuracy and preload

## 1. Running parallelism of ball slide

Table 1

Unit:  $\mu\text{m}$ 

Rail over all length (mm) over or less	Preloaded assembly (not random matching)						Random-matching type
	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC	
- 50	2	2	2	4.5	6	6	
50 - 80	2	2	3	5	6	6	
80 - 125	2	2	3.5	5.5	6.5	6.5	
125 - 200	2	2	4	6	7	7	
200 - 250	2	2.5	5	7	8	8	
250 - 315	2	2.5	5	8	9	9	
315 - 400	2	3	6	9	11	11	
400 - 500	2	3	6	10	12	12	
500 - 630	2	3.5	7	12	14	14	
630 - 800	2	4.5	8	14	16	16	
800 - 1000	2.5	5	9	16	18	18	
1000 - 1250	3	6	10	17	20	20	
1250 - 1600	4	7	11	19	23	23	
1600 - 2000	4.5	8	13	21	26	26	
2000 - 2500	5	10	15	22	29	29	
2500 - 3150	6	11	17	25	32	32	
3150 - 4000	9	16	23	30	34	34	

## 2. Accuracy standard

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

## • Tolerance of preloaded assembly

Table 2

Unit:  $\mu\text{m}$ 

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

## • Tolerance of random-matching type; Normal grade, PC

Table 3

Unit:  $\mu\text{m}$ 

Characteristics	Model No.	SH15, 20, 25, 30, 35	SH45, 55
Mounting height $H$		$\pm 20$	$\pm 30$
Variation of mounting height $H$		15 <sup>①</sup> 30 <sup>②</sup>	20 <sup>①</sup> 35 <sup>②</sup>
Mounting width $W_2$ or $W_3$		$\pm 30$	$\pm 35$
Variation of mounting width $W_2$ or $W_3$		25	30
Running parallelism of face C to face A	See Table 1, Fig. 5 and Fig. 6		
Running parallelism of face D to face 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
Without NSK K1 lubrication unit		P3	P4	P5	P6	PN	PC
With NSK K1 lubrication unit		K3	K4	K5	K6	KN	KC
Preload	Fine clearance Z0	○	○	○	○	○	—
	Slight preload Z1	○	○	○	○	○	—
	Medium preload Z3	○	○	○	○	—	—
	Random-matching type with slight preload ZZ	—	—	—	—	—	○

## 4. Assembled accuracy

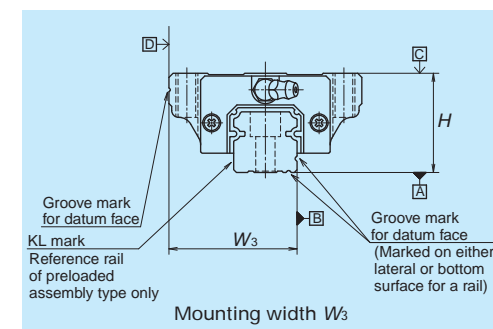
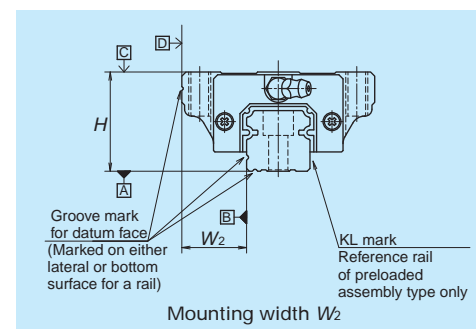


Fig. 5 Special high carbon steel

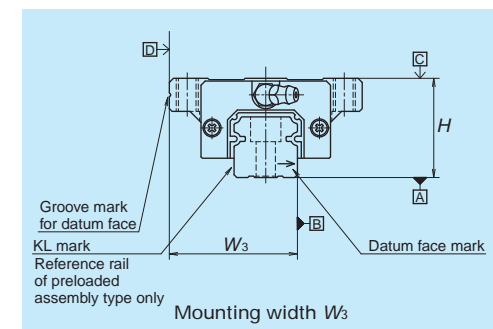
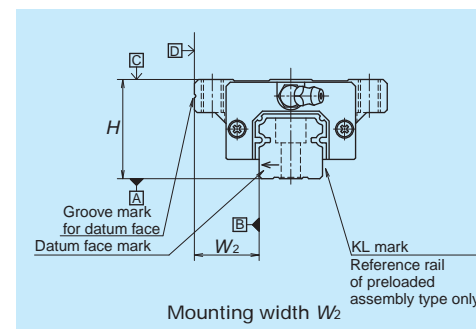


Fig. 6 Stainless steel

## 5. Preload and rigidity

We offer four levels of preload: slight preload Z1, medium preload Z3 and fine clearance Z0, along with random-matching type of slight preload ZZ. Values for preload and rigidity of the preloaded assembly are shown in Table 5. Rigidities are for the median of the preload range.

### • Preload and rigidity of preloaded assembly

Table 5

Model No.	Preload (N)		Rigidity (N/ $\mu$ m)				
	Slight preload (Z1)	Medium preload (Z3)	Vertical direction		Lateral direction		
			Slight preload (Z1)	Medium preload (Z3)	Slight preload (Z1)	Medium preload (Z3)	
High-load type	SH15 AN, EL, FL, EM	78	441	127	215	88	166
	SH20 AN, EL, FL, EM	147	784	157	274	127	225
	SH25 AN, AL, EL, FL, EM	196	1180	186	343	137	255
	SH30 AN, AL	245	1470	196	363	137	265
	SH30 EL, FL, EM	294	1670	245	441	176	323
	SH35 AN, AL, EL, FL, EM	390	2160	294	529	205	382
	SH45 AN, AL, EL, FL, EM	635	3700	397	727	283	529
Super-high-load type	SH55 AN, AL, EL, FL, EM	930	5600	482	891	336	635
	SH15 BN, GL, HL, GM	98	637	186	333	137	264
	SH20 BN, GL, HL, GM	196	1080	235	421	186	343
	SH25 BN, BL, GL, HL, GM	245	1570	284	529	196	382
	SH30 BN, BL, GL, HL, GM	343	2160	333	627	235	451
	SH35 BN, BL, GL, HL, GM	490	2840	411	755	284	529
	SH45 BN, BL, GL, HL, GM	785	4600	515	944	367	686
	SH55 BN, BL, GL, HL, GM	1180	6750	631	1148	440	817

Note: Clearance for fine clearance Z0 is 0 to 3  $\mu$ m. Therefore, preload is zero.  
However, Z0 of PN grade is 0 to 15  $\mu$ m.

### • Clearance and preload of random-matching type

Table 6

unit:  $\mu$ m

Model No.	Slight preload ZZ
SH15	-4 - 0
SH20	-5 - 0
SH25	-5 - 0
SH30	-7 - 0
SH35	-7 - 0
SH45	-7 - 0
SH55	-8 - 0

## (4) Available length of rail

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

Table 7 Length limitation of rails

Unit : mm

Series	Size Material	15	20	25	30	35	45	55
		SH	Special high carbon steel	2000	3960	3960	4000	4000
	Stainless steel	1800	3500	3500	3500			

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

## (5) Installation

### 1. Permissible values of mounting error

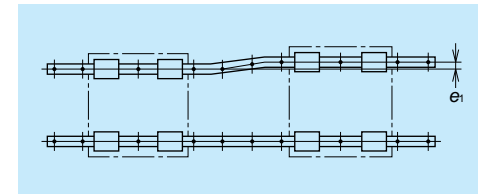


Fig. 7

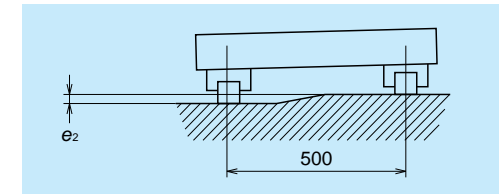


Fig. 8

Table 8

Unit :  $\mu$ m

Value	Preload	Model No.						
		SH15	SH20	SH25	SH30	SH35	SH45	SH55
Permissible values of parallelism in two rails $e_1$	Z0, ZT	22	30	40	45	55	65	80
	Z1, ZZ	18	20	25	30	35	45	55
	Z3	13	15	20	25	30	40	45
Permissible values of parallelism (height) in two rails $e_2$	Z0, ZT	375 $\mu$ m/500 mm						
	Z1, ZZ, Z3	330 $\mu$ m/500 mm						

### 2. Shoulder height of the mounting face and corner radius

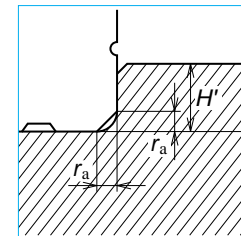


Fig. 9 Shoulder for the rail datum face

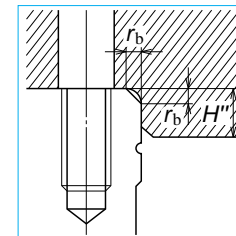


Fig. 10 Shoulder for the ball slide datum face

Table 9

Unit : mm

Model No.	Corner radius (maximum)		Shoulder height	
	$r_a$	$r_b$	$H'$	$H''$
SH 15	0.5	0.5	4	4
SH 20	0.5	0.5	4.5	5
SH 25	0.5	0.5	5	5
SH 30	0.5	0.5	6	6
SH 35	0.5	0.5	6	6
SH 45	0.7	0.7	8	8
SH 55	0.7	0.7	10	10

## (6) Lubrication components

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

### 1. Types of lubrication accessories

Figure 11 and Table 10 show grease fittings and tube fittings.

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

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

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

Please ask NSK for stainless lubrication accessories.

### 2. Mounting position of lubrication accessories

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

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

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

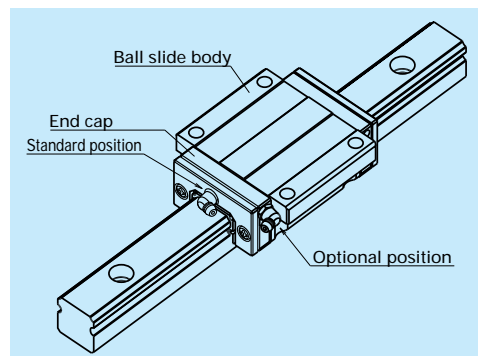


Fig. 12 Mounting position of lubrication accessories

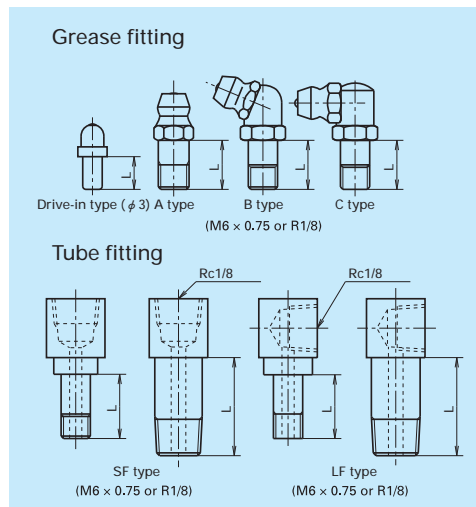


Fig. 11 Grease fitting and tube fitting

Model No.	Dust proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
SH15	Standard	5	-
	With NSK K1	10	-
	Double seal	*	-
	Protector	*	-
SH20	Standard	5	-
	With NSK K1	12	-
	Double seal	10	-
	Protector	10	-
SH25	Standard	5	6**
	With NSK K1	12	11**
	Double seal	10	9**
	Protector	10	9**
SH30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
SH35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
SH45	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
SH55	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17

\*) Please contact NSK as a connector is required.  
 \*\*) Only available for AN and BN type ball slides.

## (7) Dust proof components

### 1. Standard specification

To keep foreign matters from entering inside the ball slide, SH Series has an end seal on both ends, and bottom seals at the bottom.

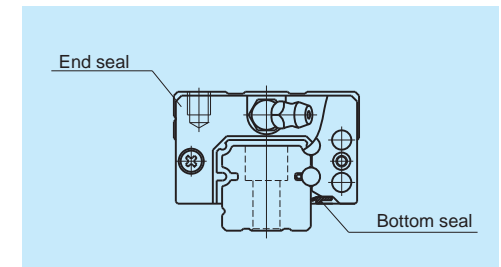


Fig. 13

Table 11 Seal friction per ball slide (maximum value)

Series	Size	Unit : N						
		15	20	25	30	35	45	55
SH		8	9	10	10	12	17	22

### 2. NSK K1™

Table 12 shows the dimension of linear guides equipped with the NSK K1.

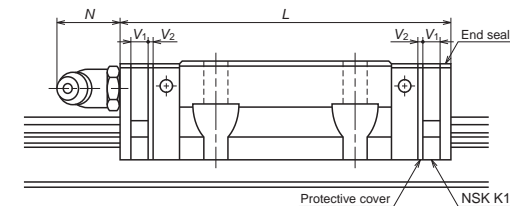


Table 12

Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness $V_1$	Protective cover thickness $V_2$	Protruding area of the grease fitting $N$
SH15	Standard	AN, EL, FL, EM	55	65.6	4.5	0.8	(5)
	Long	BN, GL, HL, GM	74	84.6			
SH20	Standard	AN, EL, FL, EM	69.8	80.4	4.5	0.8	(14)
	Long	BN, GL, HL, GM	91.8	102.4			
SH25	Standard	AN, AL, EL, FL, EM	79.0	90.6	5.0	0.8	(14)
	Long	BN, BL, GL, HL, GM	107	118.6			
SH30	Standard	AN, AL	85.6	97.6	5.0	1.0	(14)
	Flange type	EL, FL, EM	98.6	110.6			
SH35	Standard	AN, BL, GL, HL, GM	124.6	136.6	5.5	1.0	(14)
	Long	BN, BL, GL, HL, GM	143	156			
SH45	Standard	AN, AL, EL, FL, EM	139	154	6.5	1.0	(15)
	Long	BN, BL, GL, HL, GM	171	186			
SH55	Standard	AN, AL, EL, FL, EM	163	178	6.5	1.0	(15)
	Long	BN, BL, GL, HL, GM	201	216			

Note: Ball slide length equipped with NSK K1 = (Standard ball slide length) + (Thickness of NSK K1,  $V_1 \times$  Number of NSK K1) + (Thickness of the protective cover,  $V_2 \times 2$ )

### 3. Double seal

Use a double seal set as showing in Table 13, when installing an extra seal to completed standard products. (Fig. 14)

When installing a grease fitting after the installation of double seals, a connector is required.

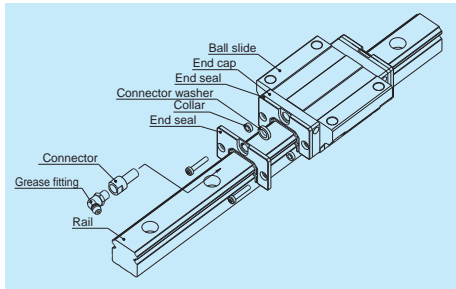


Fig. 14 Double seal

Table 13 Double-seal set

Model No.	Reference No.		Increased thickness $V_1$
	Without connector	With connector	
SH15	LH15WS-01	*	2.5
SH20	LH20WS-01	LH20WSC-01	2.5
SH25	LH25WS-01	LH25WSC-01	2.8
SH30	LH30WS-01	LH30WSC-01	3.6
SH35	LH35WS-01	LH35WSC-01	3.6
SH45	LH45WS-01	LH45WSC-01	4.3
SH55	LH55WS-01	LH55WSC-01	4.3

### 4. Protector

Use a protector set as showing Table 14, when installing a protector to completed standard products. (Fig.15)

When installing a grease fitting after the installation of protectors, a connector is required.

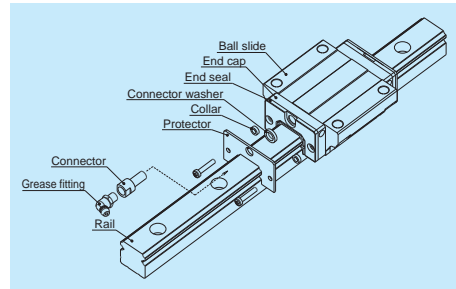


Fig. 15 Protector

Table 14 Protector set

Model No.	Reference No.		Increased thickness $V_2$
	Without connector	With connector	
SH15	LH15PT-01	*	2.7
SH20	LH20PT-01	LH20PTC-01	2.9
SH25	LH25PT-01	LH25PTC-01	3.2
SH30	LH30PT-01	LH30PTC-01	4.2
SH35	LH35PT-01	LH35PTC-01	4.2
SH45	LH45PT-01	LH45PTC-01	4.9
SH55	LH55PT-01	LH55PTC-01	4.9

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

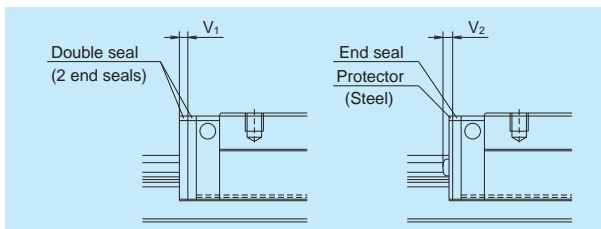


Fig. 16

### 5. Cap to cover the bolt hole for rail mounting

Table 15 Caps to cover rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
SH15	M4	LG-CAP/M4	20
SH20	M5	LG-CAP/M5	20
SH25	M6	LG-CAP/M6	20
SH30, SH35	M8	LG-CAP/M8	20
SH45	M12	LG-CAP/M12	20
SH55	M14	LG-CAP/M14	20

### 7. Bellows

Use a bellows fastener kit as showing Table 17, when installing bellows to completed standard products. A bellows fastener kit is supplied with one of bellows fastener, two of M1 set screws, two of M2 set screws, and two collars for M2 set screw.

### 6. Inner seal

Inner seal can be manufactured for models shown below.

Table 16

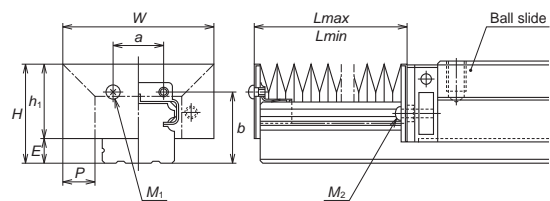
Series	Model No.
SH	SH20, SH25, SH30, SH35, SH45, SH55

Table 17 Bellows fastener kit reference No.

Model No.	Kit reference No.
SH20	LH20FS-01
SH25	LH25FS-01
SH30	LH30FS-01
SH35	LH35FS-01
SH45	LH45FS-01
SH55	LH55FS-01

## Dimension tables of bellows

### SH Series



#### Bellows reference number

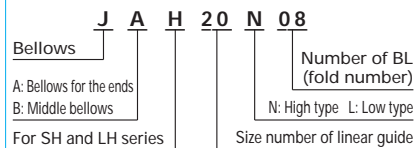


Fig. 17 Dimensions of bellows

Table 18 Dimensions of bellows

Unit: mm

Model No.	H	h <sub>1</sub>	E	W	P	a	b	BL minimum length	M <sub>1</sub> Tap x depth	M <sub>2</sub> Tap 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					

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
		L <sub>min</sub>	34	68	102	136	170	204	238	272	306
JAH20N	Stroke	106	212	318	424	530	636	742	848	954	1060
	L <sub>max</sub>	140	280	420	560	700	840	980	1120	1260	1400
JAH25L	Stroke	106	212	318	424	530	636	742	848	954	1060
	L <sub>max</sub>	140	280	420	560	700	840	980	1120	1260	1400
JAH25N	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
	L <sub>max</sub>	210	420	630	840	1050	1260	1470	1680	1890	2100
JAH30L	Stroke	134	268	402	536	670	804	938	1072	1206	1340
	L <sub>max</sub>	168	336	504	672	840	1008	1176	1344	1512	1680
JAH30N	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
	L <sub>max</sub>	210	420	630	840	1050	1260	1470	1680	1890	2100
JAH35L	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
	L <sub>max</sub>	210	420	630	840	1050	1260	1470	1680	1890	2100
JAH35N	Stroke	246	492	738	984	1230	1476	1722	1968	2214	2460
	L <sub>max</sub>	280	560	840	1120	1400	1680	1960	2240	2520	2800
JAH45L	Stroke	176	352	528	704	880	1058	1232	1408	1584	1760
	L <sub>max</sub>	210	420	630	840	1050	1260	1470	1680	1890	2100
JAH45N	Stroke	316	632	948	1264	1580	1896	2212	2528	2844	3160
	L <sub>max</sub>	350	700	1050	1400	1750	2100	2450	2800	3150	3500
JAH55L	Stroke	246	492	738	984	1230	1476	1722	1968	2214	2460
	L <sub>max</sub>	280	560	840	1120	1400	1680	1960	2240	2520	2800
JAH55N	Stroke	386	772	1158	1544	1930	2316	2702	3088	3474	3860
	L <sub>max</sub>	420	840	1260	1680	2100	2520	2940	3360	3780	4200

Remarks: Values of odd numbers BL (3, 5, 7, ...) can be obtained by adding two values of even number BLs on both sides, then dividing the sum by two.

Note: We recommend using SH Series in a clean environment in order to utilize their full range of capabilities.

SH Series

(8) Reference number

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.

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

1. Reference number for preloaded assembly

**SH 30 1000 ANC 2 -\*\* P5 3**

Series name							
Size							Preload code (See page A118)
Rail length (mm)							Accuracy code (See Table 21)
Ball slide shape code (See page A116)							Design serial number
Material/surface treatment code (See Table 20)							Added to the reference number.
							Number of ball slides per rail

2. Reference number for random-matching type

**SAH 30 ANC -\*\*PCZ**

Random-matching ball slide series code							
SAH : SH Series random-matching ball slide							Preload code
Size							Z: Slight preload only (See page A118)
Ball slide shape code (See page A116)							Accuracy code : PC
Material/surface treatment code (See Table 20)							PC: Normal grade is only available
							Design serial number
							Added to the reference number.

**Rail L1H30 1200 LCN -\*\* PC Z**

Random-matching rail series code							
L1H : LH/SH Series random-matching rail							Preload code
Size							Z: Slight preload only (See page A118)
Rail length (mm)							Accuracy code : PC
Rail shape code: L							PC: Normal grade is only available
L : Standard							Design serial number
Material/surface treatment code (See Table 20)							Added to the reference number.
							*Butting rail specification
							N: Non-butting. L: Butting specification

\*Please consult with NSK for butting rail specification.

Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is slight preload "Z" (Refer to page A118).

Table 20 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
K	Stainless steel (SH15 to SH30 only)
D	Special high carbon steel with surface treatment
H	Stainless steel with surface treatment
Z	Other, special

Table 21 Accuracy code

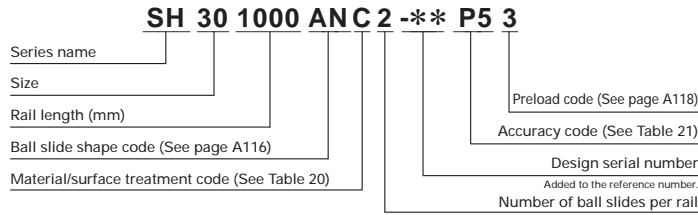
Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5
Precision grade	P6	K6
Normal grade	PN	KN
Normal grade (random-matching type)	PC	KC

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

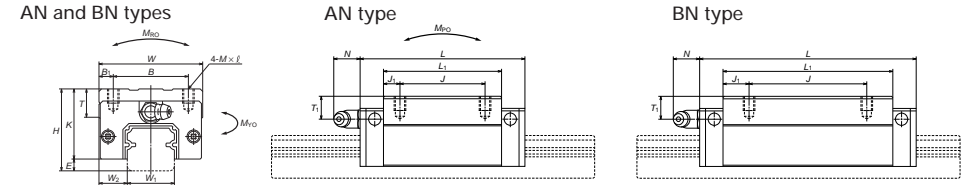
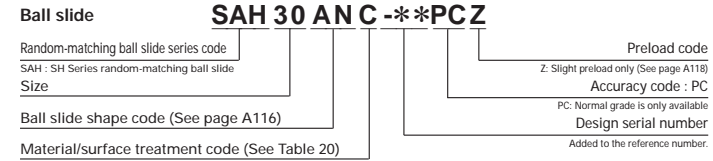
(9) Dimensions

SH-AN (High-load type)

SH-BN (Super-high-load type)

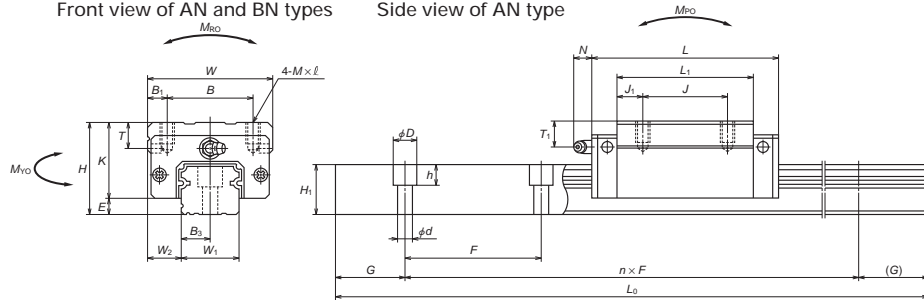


Reference number for ball slide of random-matching type

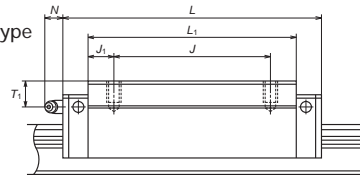


Front view of AN and BN types

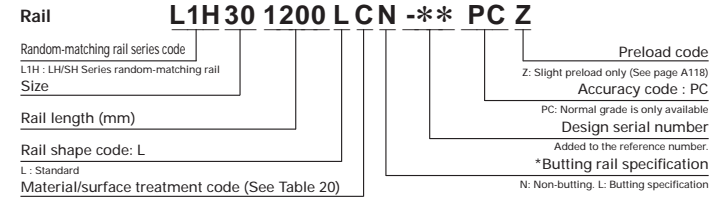
Side view of AN type



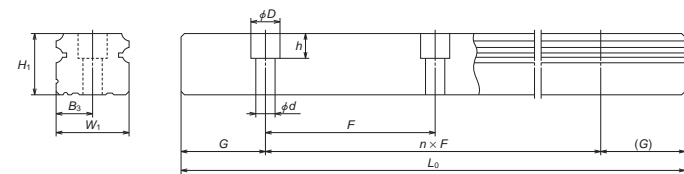
Side view of BN type



Reference number for rail of random-matching type



\*Please consult with NSK for butting rail specification.



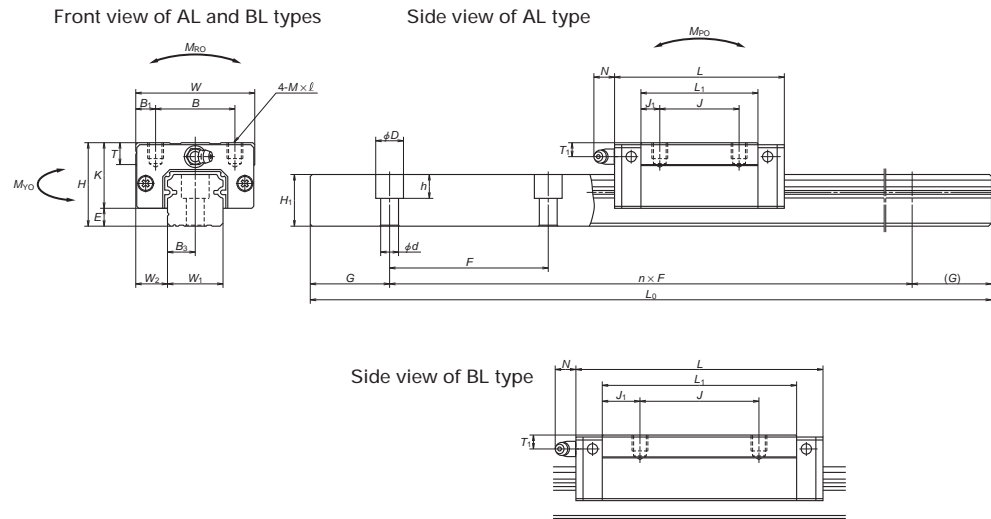
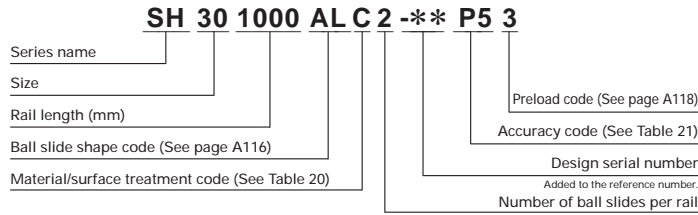
Model No.	Assembly				Ball slide											
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole			B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Grease fitting		
						B	J	Mxpitchxℓ						Hole size	T <sub>1</sub>	N
SH15AN SH15BN	28	4.6	9.5	34	55 74	26	26	M4x0.7x6	4	39 58	6.5 16	23.4	8	φ 3	8.5	3.3
SH20AN SH20BN	30	5	12	44	69.8 91.8	32	36 50	M5x0.8x6	6	59 72	7 11	25	12	M6x0.75	5	11
SH25AN SH25BN	40	7	12.5	48	79 107	35	35 50	M6x1x9	6.5	58 86	11.5 18	33	12	M6x0.75	10	11
SH30AN SH30BN	45	9	16	60	85.6 124.6	40	40 60	M8x1.25x10	10	59 98	9.5 19	36	14	M6x0.75	10	11
SH35AN SH35BN	55	9.5	18	70	109 143	50	50 72	M8x1.25x12	10	80 114	15 21	45.5	15	M6x0.75	15	11
SH45AN SH45BN	70	14	20.5	86	139 171	60	60 80	M10x1.5x17	13	105 137	22.5 28.5	56	17	Rc1/8	20	13
SH55AN SH55BN	80	15	23.5	100	163 201	75	75 95	M12x1.75x18	12.5	126 164	25.5 34.5	65	18	Rc1/8	21	13

Remarks: 1) The external appearance of stainless steel ball slides differs from those of standard material ball slide.  
 A129

Rail													Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole	G	Max. length	Dynamic	Static	Static moment			D <sub>w</sub>	Ball slide (kg)	Rail (kg/m)							
W <sub>1</sub>	H <sub>1</sub>	F	d x D x h	B <sub>3</sub> (reference)	L <sub>max</sub> ( ) for stainless	C (N)	C <sub>0</sub> (N)	M <sub>ro</sub> (N·m)	M <sub>po</sub> (N·m)	M <sub>vo</sub> (N·m)										
15	15	60	4.5x7.5x5.3	7.5	2 000 (1 800)	10 100 13 400	18 800 28 200	98 147	87 193	73 162	3.175	0.18 0.26	1.6							
20	18	60	6x9.5x8.5	10	3 960 (3 500)	16 300 21 600	29 600 44 500	199 298	167 360	141 305	3.968	0.33 0.48	2.6							
23	22	60	7x11x9	11.5	3 960 (3 500)	22 400 32 000	37 500 62 500	295 490	246 615	207 515	4.762	0.55 0.82	3.6							
28	26	80	9x14x12	14	4 000 (3 500)	31 000 46 000	51 500 91 500	490 870	365 1 060	305 885	5.556	0.77 1.3	5.2							
34	29	80	9x14x12	17	4 000	47 500 61 500	80 500 117 000	950 1 380	780 1 600	655 1 340	6.35	1.5 2.1	7.2							
45	38	105	14x20x17	22.5	3990	76 500 94 500	128 000 175 000	1 970 2 680	1 550 2 760	1 300 2 320	7.937	3.0 3.9	12.3							
53	44	120	16x23x20	26.5	3960	113 000 140 000	181 000 247 000	3 300 4 550	2 640 4 800	2 210 4 050	9.525	4.7 6.1	16.9							

2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.  
 A130

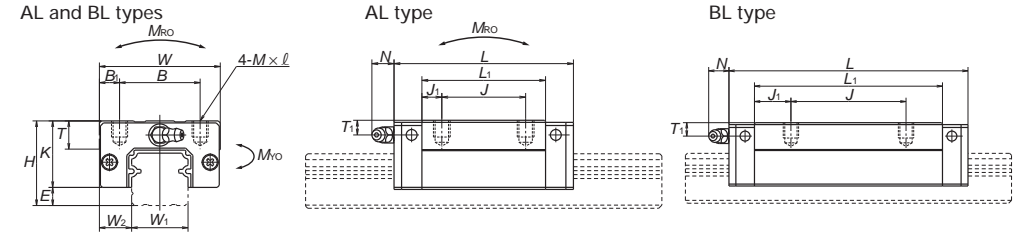
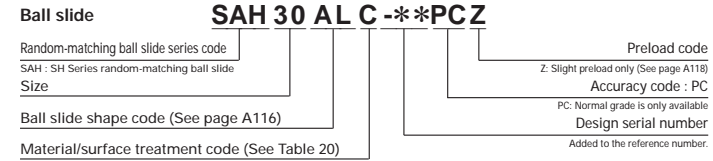
SH-AL (High-load type)  
SH-BL (Super-high-load type)



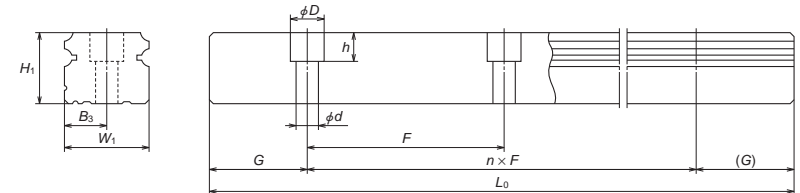
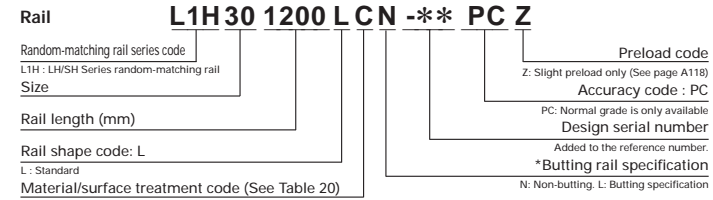
Model No.	Assembly			Ball slide												
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole						Grease fitting				
						B	J	M×pitch×ℓ	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Hole size	T <sub>1</sub>	N
SH25AL SH25BL	36	7	12.5	48	79 107	35	35 50	M6×1×6	6.5	58 86	11.5 18	29	12	M6×0.75	6	11
SH30AL SH30BL	42	9	16	60	85.6 124.6	40	40 60	M8×1.25×8	10	59 98	9.5 19	33	14	M6×0.75	7	11
SH35AL SH35BL	48	9.5	18	70	109 143	50	50 72	M8×1.25×8	10	80 114	15 21	38.5	15	M6×0.75	8	11
SH45AL SH45BL	60	14	20.5	86	139 171	60	60 80	M10×1.5×10	13	105 137	22.5 28.5	46	17	Rc1/8	10	13
SH55AL SH55BL	70	15	23.5	100	163 201	75	75 95	M12×1.75×13	12.5	126 164	25.5 34.5	55	15	Rc1/8	11	13

Remarks: 1) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Reference number for ball slide of random-matching type



Reference number for rail of random-matching type



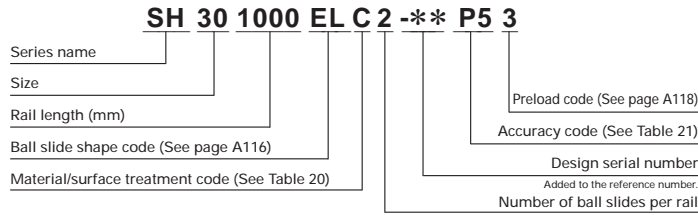
\*Please consult with NSK for butting rail specification.

Rail							Basic load rating					Ball dia.	Weight	
Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Mounting bolt hole d×D×h	B <sub>3</sub>	G (reference)	Max. length L <sub>max</sub> ( ) for stainless	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment			D <sub>w</sub>	Ball slide (kg)	Rail (kg/m)
									M <sub>Ro</sub>	M <sub>Po</sub>	M <sub>Vo</sub>			
23	22	60	7×11×9	11.5	20	3 960 (3 500)	22 400 32 000	37 500 62 500	295 490	246 615	207 515	4.762	0.46 0.69	3.6
28	26	80	9×14×12	14	20	4 000 (3 500)	31 000 46 000	51 500 91 500	490 870	365 1 060	305 885	5.556	0.69 1.16	5.2
34	29	80	9×14×12	17	20	4 000	47 500 61 500	80 500 117 000	950 1 380	780 1 600	655 1 340	6.35	1.2 1.7	7.2
45	38	105	14×20×17	22.5	22.5	3990	76 500 94 500	128 000 175 000	1 970 2 680	1 550 2 760	1 300 2 320	7.937	3.0 3.9	12.3
53	44	120	16×23×20	26.5	30	3960	113 000 140 000	181 000 247 000	3 300 4 550	2 640 4 800	2 210 4 050	9.525	4.7 6.1	16.9

2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.

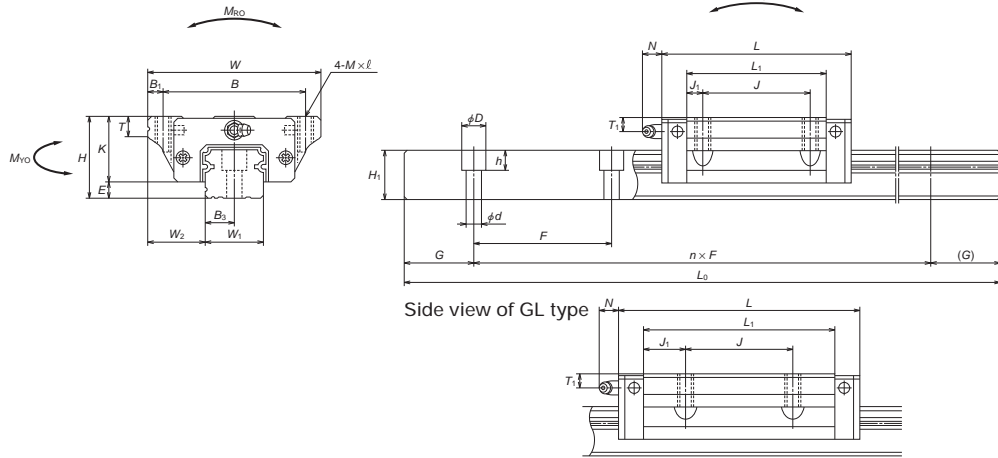


SH-EL (High-load type)  
SH-GL (Super-high-load type)

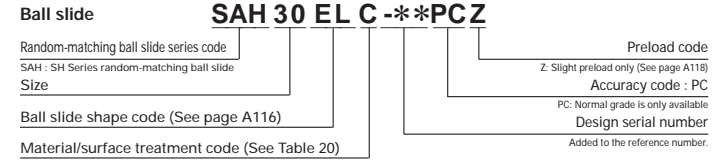


Front view of EL and GL types

Side view of EL type



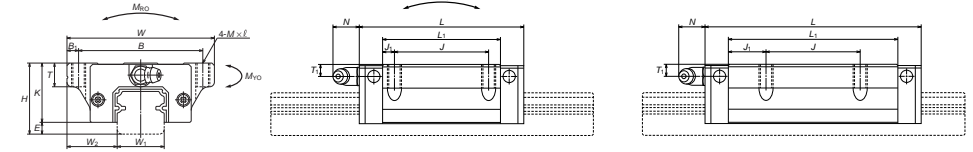
Reference number for ball slide of random-matching type



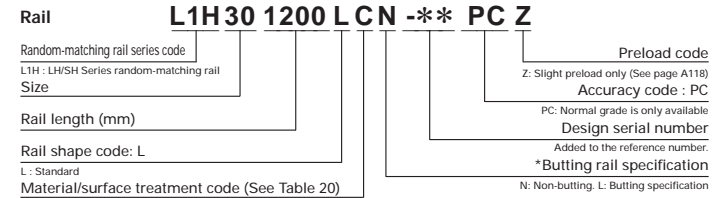
EL and GL types

EL type

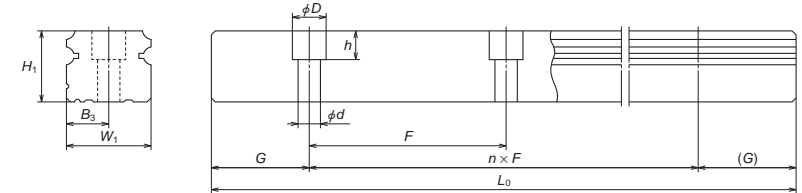
GL type



Reference number for rail of random-matching type



\*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide												
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole								Grease fitting		
						B	J	Mxpitchxℓ	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Hole size	T <sub>1</sub>	N
SH15EL SH15GL	24	4.6	16	47	55 74	38	30	M5x0.8x8	4.5	39 58	4.5 14	19.4	8	φ 3	4.5	3.3
SH20EL SH20GL	30	5	21.5	63	69.8 91.8	53	40	M6x1x10	5	50 72	5 16	25	10	M6x0.75	5	11
SH25EL SH25GL	36	7	23.5	70	79 107	57	45	M8x1.25x16 (M8x1.25x12)	6.5	58 86	6.5 20.5	29	11 (12)	M6x0.75	6	11
SH30EL SH30GL	42	9	31	90	98.6 124.6	72	52	M10x1.5x18 (M10x1.5x15)	9	72 98	10 23	33	11 (15)	M6x0.75	7	11
SH35EL SH35GL	48	9.5	33	100	109 143	82	62	M10x1.5x20	9	80 114	9 26	38.5	12	M6x0.75	8	11
SH45EL SH45GL	60	14	37.5	120	139 171	100	80	M12x1.75x24	10	105 137	12.5 28.5	46	13	Rc1/8	10	13
SH55EL SH55GL	70	15	43.5	140	163 201	116	95	M14x2x28	12	126 164	15.5 34.5	55	15	Rc1/8	11	13

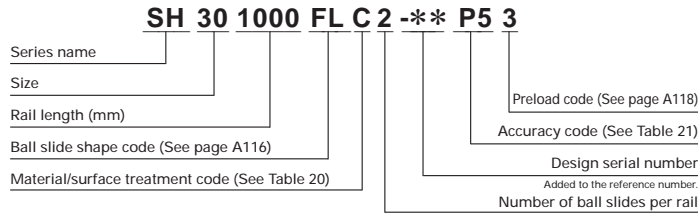
Remarks: 1) Parenthesized dimensions are applicable to stainless steel products.

2) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

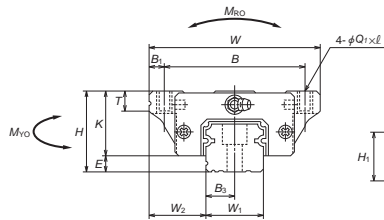
Rail				Basic load rating						Ball dia. D <sub>w</sub>	Weight			
Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Mounting bolt hole d x D x h	G	Max. length L <sub>max</sub> ( ) for stainless	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment M <sub>ro</sub> (N·m) M <sub>po</sub> (N·m) M <sub>vo</sub> (N·m)			Ball slide (kg)	Rail (kg/m)		
15	15	60	4.5x7.5x5.3	7.5	20	2 000 (1 800)	10 100 13 400	18 800 28 200	98 147	87 193	73 162	3.175	0.17 0.25	1.6
20	18	60	6x9.5x8.5	10	20	3 960 (3 500)	16 300 21 600	29 600 44 500	199 298	167 360	141 305	3.968	0.45 0.65	2.6
23	22	60	7x11x9	11.5	20	3 960 (3 500)	22 400 32 000	37 500 62 500	295 490	246 615	207 515	4.762	0.63 0.93	3.6
28	26	80	9x14x12	14	20	4 000 (3 500)	35 500 46 000	63 000 91 500	600 870	540 1 060	450 885	5.556	1.2 1.6	5.2
34	29	80	9x14x12	17	20	4 000	47 500 61 500	80 500 117 000	950 1 380	780 1 600	655 1 340	6.35	1.7 2.4	7.2
45	38	105	14x20x17	22.5	22.5	3 990	76 500 94 500	128 000 175 000	1 970 2 680	1 550 2 760	1 300 2 320	7.937	3.0 3.9	12.3
53	44	120	16x23x20	26.5	30	3 960	113 000 140 000	181 000 247 000	3 300 4 550	2 640 4 800	2 210 4 050	9.525	5.0 6.5	16.9

3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.

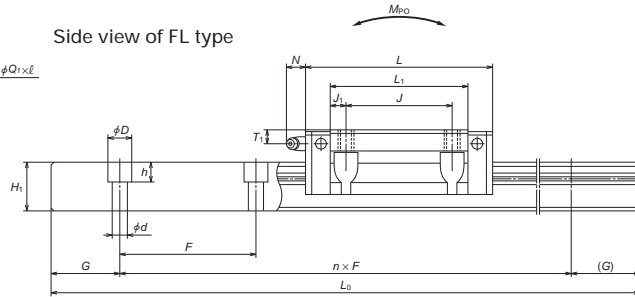
SH-FL (High-load type)  
SH-HL (Super-high-load type)



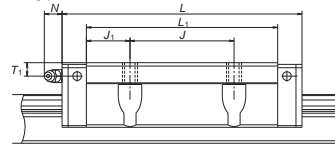
Front view of FL and HL types



Side view of FL type



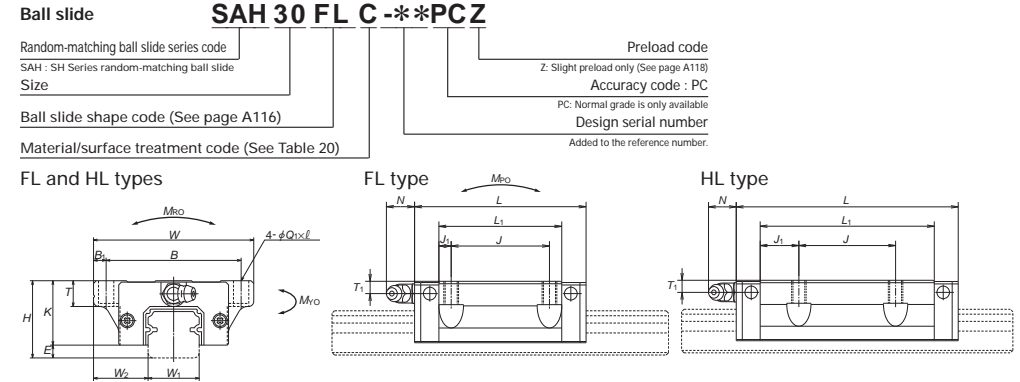
Side view of HL type



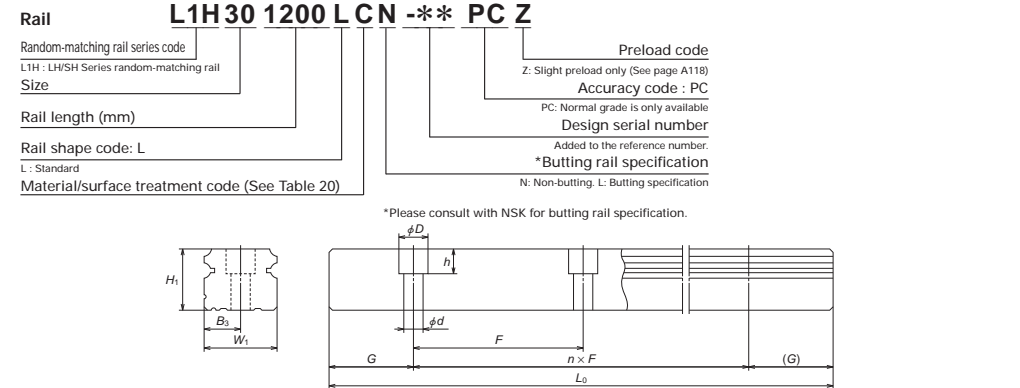
Model No.	Assembly				Ball slide											
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole			B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Grease fitting		
						B	J	Q <sub>1</sub> ×ℓ						Hole size	T <sub>1</sub>	N
SH15FL SH15HL	24	4.6	16	47	55 74	38	30	4.5×7	4.5	39 58	4.5 14	19.4	8	φ 3	4.5	3.3
SH20FL SH20HL	30	5	21.5	63	69.8 91.8	53	40	6×9.5	5	50 72	5 16	25	10	M6×0.75	5	11
SH25FL SH25HL	36	7	23.5	70	79 107	57	45	7×10(7×11.5)	6.5	58 86	6.5 20.5	29	11 (12)	M6×0.75	6	11
SH30FL SH30HL	42	9	31	90	98.6 124.6	72	52	9×12(9×14.5)	9	72 98	10 23	33	11 (15)	M6×0.75	7	11
SH35FL SH35HL	48	9.5	33	100	109 143	82	62	9×13	9	80 114	9 26	38.5	12	M6×0.75	8	11
SH45FL SH45HL	60	14	37.5	120	139 171	100	80	11×15	10	105 137	12.5 28.5	46	13	Rc1/8	10	13
SH55FL SH55HL	70	15	43.5	140	163 201	116	95	14×18	12	126 164	15.5 34.5	55	15	Rc1/8	11	13

Remarks: 1) Parenthesized dimensions are applicable to stainless steel products.  
2) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Reference number for ball slide of random-matching type



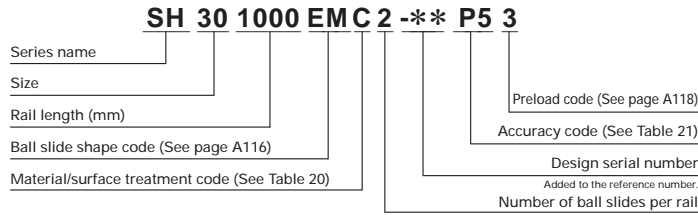
Reference number for rail of random-matching type



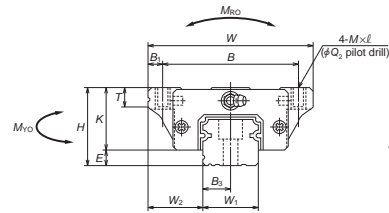
Rail							Basic load rating					Ball dia. D <sub>w</sub>	Weight	
Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Mounting bolt hole d×D×h	B <sub>3</sub>	G (reference)	Max. length L <sub>0max</sub> ( ) for stainless	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment M <sub>RO</sub> M <sub>PO</sub> M <sub>VO</sub> (N·m) (N·m) (N·m)				Ball slide (kg)	Rail (kg/m)
15	15	60	4.5×7.5×5.3	7.5	20	2000 (1800)	10100 13400	18800 28200	98 147	87 193	73 162	3.175	0.17 0.25	1.6
20	18	60	6×9.5×8.5	10	20	3960 (3500)	16300 21600	29600 44500	199 298	167 360	141 305	3.968	0.45 0.65	2.6
23	22	60	7×11×9	11.5	20	3960 (3500)	22400 32000	37500 62500	295 490	246 615	207 515	4.762	0.63 0.93	3.6
28	26	80	9×14×12	14	20	4000 (3500)	35500 46000	63000 91500	600 870	540 1060	450 885	5.556	1.2 1.6	5.2
34	29	80	9×14×12	17	20	4000	47500 61500	80500 117000	950 1380	780 1600	655 1340	6.35	1.7 2.4	7.2
45	38	105	14×20×17	22.5	22.5	3990	76500 94500	128000 175000	1970 2680	1550 2760	1300 2320	7.937	3 3.9	12.3
53	44	120	16×23×20	26.5	30	3960	113000 140000	181000 247000	3300 4550	2640 4800	2210 4050	9.525	5 6.5	16.9

3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.

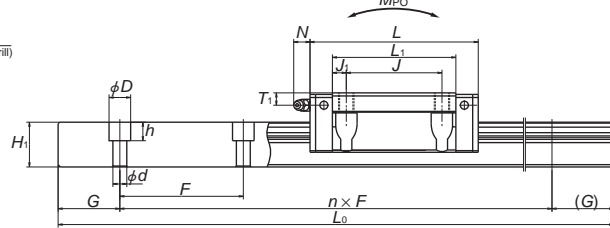
SH-EM (High-load type)  
SH-GM (Super-high-load type)



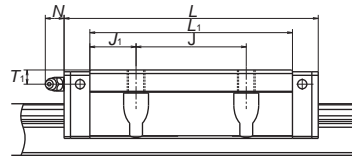
Front view of EM and GM types



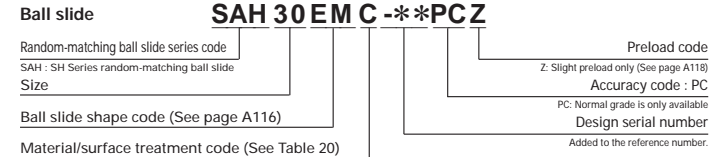
Side view of EM type



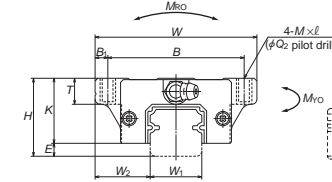
Side view of GM type



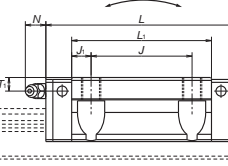
Reference number for ball slide of random-matching type



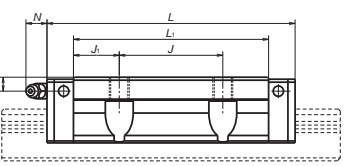
EM and GM types



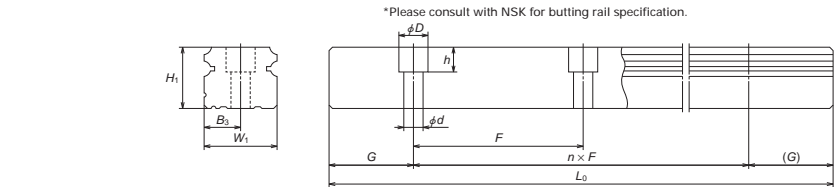
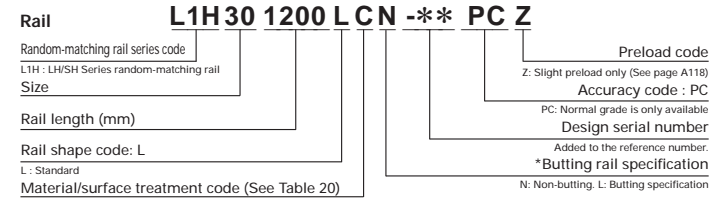
EM type



GM type



Reference number for rail of random-matching type



Model No.	Assembly				Ball slide												
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole						Grease fitting					
						B	J	Mxpitchxℓ	Q <sub>2</sub>	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Hole size	T <sub>1</sub>	N
SH15EM SH15GM	24	4.6	16	47	55 74	38	30	M5x0.8x7	4.4	4.5	39 58	4.5 14	19.4	8	φ 3	4.5	3.3
SH20EM SH20GM	30	5	21.5	63	69.8 91.8	53	40	M6x1x9.5	5.3	5	50 72	5 16	25	10	M6x0.75	5	11
SH25EM SH25GM	36	7	23.5	70	79 107	57	45	M8x1.25x10 (M8x1.25x11.5)	6.8	6.5	58 86	6.5 20.5	29	11 (12)	M6x0.75	6	11
SH30EM SH30GM	42	9	31	90	98.6 124.6	72	52	M10x1.5x12 (M10x1.5x14.5)	8.6	9	72 98	10 23	33	11 (15)	M6x0.75	7	11
SH35EM SH35GM	48	9.5	33	100	109 143	82	62	M10x1.5x13	8.6	9	80 114	9 26	38.5	12	M6x0.75	8	11
SH45EM SH45GM	60	14	37.5	120	139 171	100	80	M12x1.75x15	10.5	10	105 137	12.5 28.5	46	13	Rc1/8	10	13
SH55EM SH55GM	70	15	43.5	140	163 201	116	95	M14x2x18	12.5	12	126 164	15.5 34.5	55	15	Rc1/8	11	13

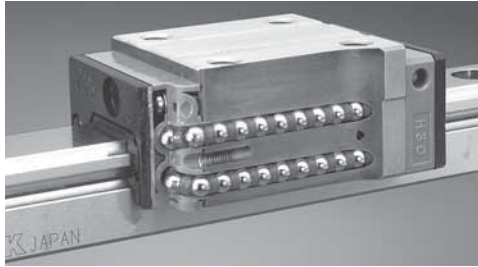
Remarks: 1) Parenthesized dimensions are applicable to stainless steel products.  
2) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Unit: mm

Rail							Basic load rating					Ball dia. D <sub>w</sub>	Weight	
Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Mounting bolt hole d x D x h	B <sub>3</sub>	G (reference)	Max. length L <sub>0max</sub> ( ) for stainless	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment				Ball slide (kg)	Rail (kg/m)
							C	C <sub>0</sub>	M <sub>RO</sub>	M <sub>PO</sub>	M <sub>VO</sub>			
15	15	60	4.5x7.5x5.3	7.5	20	2000 (1800)	10100 13400	18800 28200	98 147	87 193	73 162	3.175	0.17 0.25	1.6
20	18	60	6x9.5x8.5	10	20	3960 (3500)	16300 21600	29600 44500	199 298	167 360	141 305	3.968	0.45 0.65	2.6
23	22	60	7x11x9	11.5	20	3960 (3500)	22400 32000	37500 62500	295 490	246 615	207 515	4.762	0.63 0.93	3.6
28	26	80	9x14x12	14	20	4000 (3500)	35500 46000	63000 91500	600 870	540 1060	450 885	5.556	1.2 1.6	5.2
34	29	80	9x14x12	17	20	4000	47500 61500	80500 117000	950 1380	780 1600	655 1340	6.35	1.7 2.4	7.2
45	38	105	14x20x17	22.5	22.5	3990	76500 94500	128000 175000	1970 2680	1550 2760	1300 2320	7.937	3 3.9	12.3
53	44	120	16x23x20	26.5	30	3960	113000 140000	181000 247000	3300 4550	2640 4800	2210 4050	9.525	5 6.5	16.9

3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.

A-5-1.2 SS Series



(1) Features

1. Lower noise and gentler tone

Incorporating a retainer piece and optimizing the circulation path enables steel ball circulation stability and the prevention of ball collision, resulting in noise reduction.

2. Smoother motion

Improved steel ball circulation stability, free of interference between the balls improves dynamic friction characteristics, resulting in smooth and stable motion, which is especially effective for low speed motion.

3. Low dust generation

A resin retaining piece, which prevents steel balls collision, features effective low dust generation characteristics compared to conventional products.

4. High self-aligning capability (rolling direction)

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

5. High load carrying capacity to vertical direction

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

6. High resistance against impact load

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

7. High accuracy

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

8. Fast delivery

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

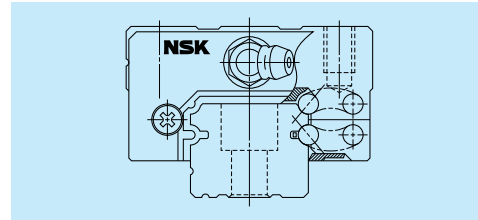


Fig. 1 SS Series

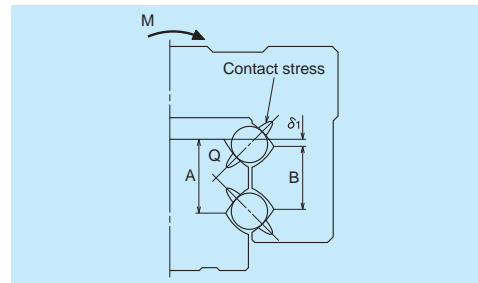


Fig. 2 Enlarged illustration of the offset Gothic arch groove

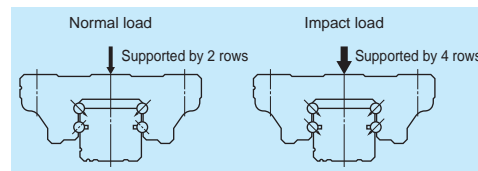


Fig. 3 When load is applied

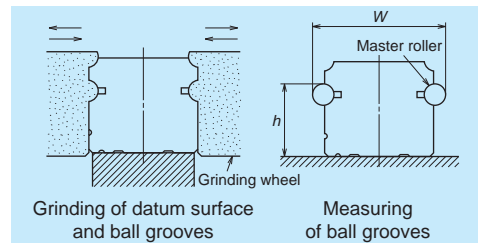


Fig. 4 Rail grinding and measuring

(2) Ball slide shape

Ball slide Model	Shape/installation method	Type	
		Medium-load type	High-load type
AL CL		CL 	AL 
EL JL		JL 	EL 
FL KL		KL 	FL 
EM JM		JM 	EM 

(3) Accuracy and preload

1. Running parallelism of ball slide

Table 1

Unit:  $\mu\text{m}$

Rail over all length (mm) over or less	Preloaded assembly (not random matching)						Random-matching type
	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC	
- 50	2	2	2	4.5	6	6	
50 - 80	2	2	3	5	6	6	
80 - 125	2	2	3.5	5.5	6.5	6.5	
125 - 200	2	2	4	6	7	7	
200 - 250	2	2.5	5	7	8	8	
250 - 315	2	2.5	5	8	9	9	
315 - 400	2	3	6	9	11	11	
400 - 500	2	3	6	10	12	12	
500 - 630	2	3.5	7	12	14	14	
630 - 800	2	4.5	8	14	16	16	
800 - 1000	2.5	5	9	16	18	18	
1000 - 1250	3	6	10	17	20	20	
1250 - 1600	4	7	11	19	23	23	
1600 - 2000	4.5	8	13	21	26	26	
2000 - 2500	5	10	15	22	29	29	
2500 - 3150	6	11	17	25	32	32	
3150 - 4000	9	16	23	30	34	34	

2. Accuracy standard

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

• Tolerance of preloaded assembly

Table 2

Unit:  $\mu\text{m}$

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

• Tolerance of random-matching type; Normal grade PC

Table 3

Unit:  $\mu\text{m}$

Characteristics	Model No.	SS15, 20, 25, 30, 35
Mounting height $H$		$\pm 20$
Variation of mounting height $H$		15 <sup>①</sup> 30 <sup>②</sup>
Mounting width $W_2$ or $W_3$		$\pm 30$
Variation of mounting width $W_2$ or $W_3$		25
Running parallelism of face C to face A	See Table 1, Fig. 5, and Fig. 6	
Running parallelism of face D to face 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
Without NSK K1 lubrication unit		P3	P4	P5	P6	PN	PC
With NSK K1 lubrication unit		K3	K4	K5	K6	KN	KC
Preload	Fine clearance Z0	○	○	○	○	○	—
	Slight preload Z1	○	○	○	○	○	—
	Medium preload Z3	○	○	○	○	—	—
	Random-matching type with slight preload ZZ	—	—	—	—	—	○

4. Assembled accuracy

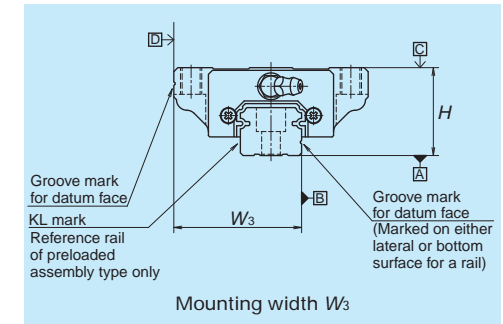
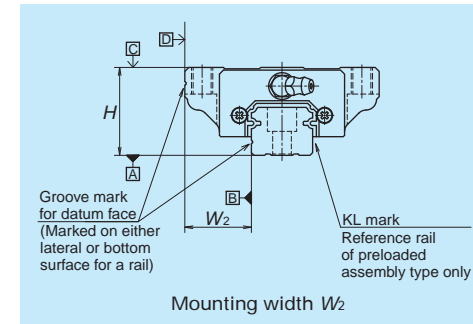


Fig. 5 Special high carbon steel

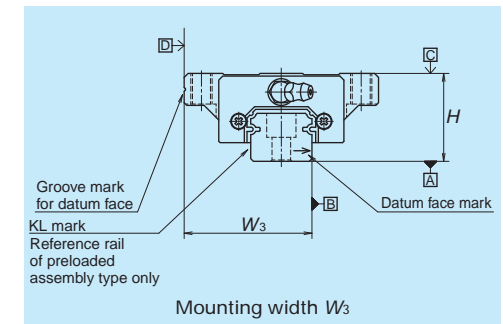
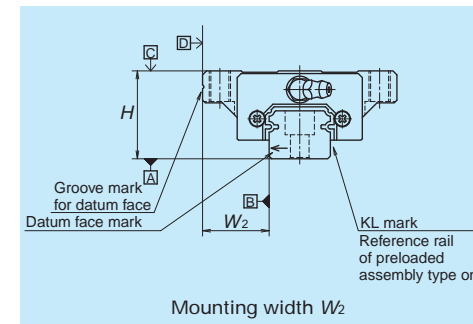


Fig. 6 Stainless steel

### 5. Preload and rigidity

We offer four levels of preload: slight preload Z1, medium preload Z3 and fine clearance Z0, along with random-matching type of slight preload ZZ. Values for preload and rigidity of the preloaded assembly are shown in Table 5. Rigidities are for the median of the preload range.

• Preload and rigidity of preloaded assembly

Table 5

Model No.	Preload (N)		Rigidity (N/μm)				
	Slight preload (Z1)	Medium preload (Z3)	Vertical direction		Lateral direction		
			Slight preload (Z1)	Medium preload (Z3)	Slight preload (Z1)	Medium preload (Z3)	
High-load type	SS15 AL, EL, FL, EM	69	392	118	216	88	157
	SS20 AL, EL, FL, EM	88	490	147	255	108	186
	SS25 AL, EL, FL, EM	147	833	196	353	137	255
	SS30 AL, EL, FL, EM	245	1370	245	441	176	323
	SS35 AL, EL, FL, EM	294	1860	284	539	205	392
Medium-load type	SS15 CL, JL, KL, JM	39	245	69	127	49	88
	SS20 CL, JL, KL, JM	59	343	88	157	59	118
	SS25 CL, JL, KL, JM	98	588	108	206	78	147
	SS30 CL, JL, KL, JM	147	882	127	235	98	176
	SS35 CL, JL, KL, JM	196	1180	166	304	117	225

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.

• Clearance and preload of random-matching type

Table 6 unit: μm

Model No.	Slight preload ZZ
SS15	-4 - 0
SS20	-4 - 0
SS25	-5 - 0
SS30	-5 - 0
SS35	-6 - 0

### (4) Available length of rail

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

Table 7 Length limitation of rails

Unit : mm

Series	Size Material	15	20	25	30	35
		SS	Special high carbon steel	2000	3960	3960
	Stainless steel	1700	3500	3500	3500	3500

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

### (5) Installation

#### 1. Permissible values of mounting error

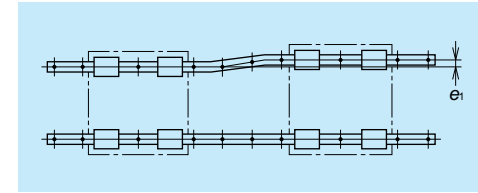


Fig. 7

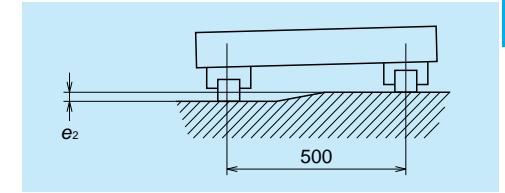


Fig. 8

Table 8

Unit : μm

Value	Preload	Model No.				
		SS15	SS20	SS25	SS30	SS35
Permissible values of parallelism in two rails $e_1$	Z0, ZT	20	22	30	35	40
	Z1, ZZ	15	17	20	25	30
	Z3	12	15	15	20	25
Permissible values of parallelism (height) in two rails $e_2$	Z0, ZT	375 μm/500 mm				
	Z1, ZZ, Z3	330 μm/500 mm				

#### 2. Shoulder height of the mounting face and corner radius r

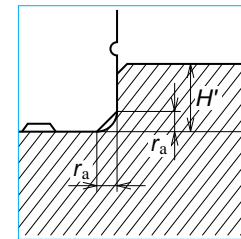


Fig. 9 Shoulder for the rail datum face

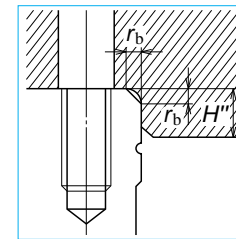


Fig. 10 Shoulder for the ball slide datum face

Table 9

Unit : mm

Model No.	Corner radius (maximum)		Shoulder height	
	$r_a$	$r_b$	$H'$	$H''$
SS 15	0.5	0.5	4	4
SS20	0.5	0.5	4.5	5
SS 25	0.5	0.5	5	5
SS 30	0.5	0.5	6	6
SS 35	0.5	0.5	6	6

### (6) Lubrication components

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

#### 1. Types of lubrication accessories

Figure 11 and Table 10 show grease fittings and tube fittings.

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

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

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

Please ask NSK for stainless lubrication accessories.

#### 2. Mounting position of lubrication accessories

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

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

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

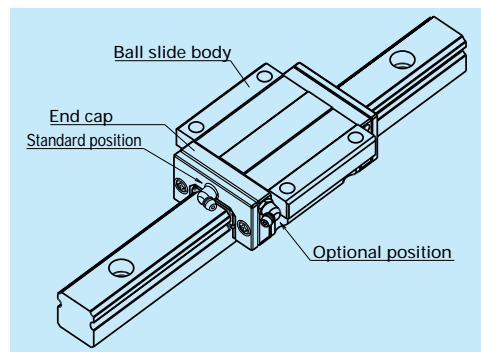


Fig. 12 Mounting position of lubrication accessories

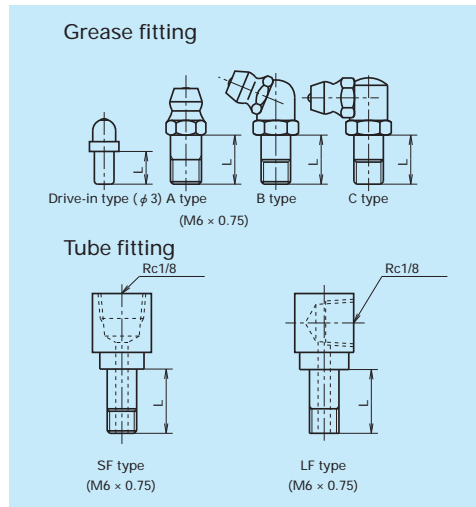


Fig. 11 Grease fitting and tube fitting

Model No.	Dust proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
SS15	Standard	5	-
	With NSK K1	10	-
	Double seal	*	-
	Protector	*	-
SS20	Standard	5	-
	With NSK K1	10	-
	Double seal	8	-
	Protector	8	-
SS25	Standard	5	6
	With NSK K1	12	11
	Double seal	10	9
	Protector	10	9
SS30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
SS35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11

\*) Please contact NSK as a connector is required.

### (7) Dust proof components

#### 1. Standard specification

To keep foreign matters from entering inside the ball slide, SS Series has an end seal on both ends, and bottom seals at the bottom.

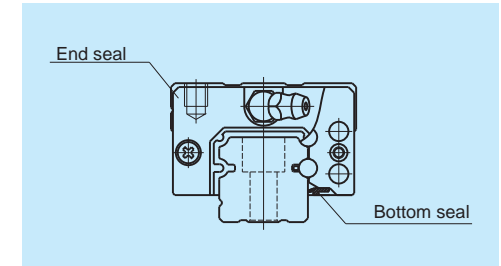


Fig. 13

Table 11 Seal friction per ball slide (maximum value)

Series	Size	Unit : N				
		15	20	25	30	35
SS		8	9	9	9	10

#### 2. NSK K1™

Table 12 shows the dimension of linear guides equipped with the NSK K1.

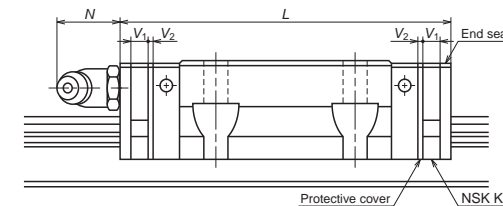


Table 12

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Unit: mm		
					Per NSK K1 thickness V <sub>1</sub>	Protective cover thickness V <sub>2</sub>	Protruding area of the grease fitting N
SS15	Standard	AL, EL, FL, EM	56.8	66.4	4.0	0.8	(5)
	Short	CL, JL, KL, JM	40.4	50			
SS20	Standard	AL, EL, FL, EM	65.2	75.8	4.5	0.8	(14)
	Short	CL, JL, KL, JM	47.2	57.8			
SS25	Standard	AL, EL, FL, EM	81.6	92.2	4.5	0.8	(14)
	Short	CL, JL, KL, JM	59.6	70.2			
SS30	Standard	AL, EL, FL, EM	96.4	108.4	5.0	1.0	(14)
	Short	CL, JL, KL, JM	67.4	79.4			
SS35	Standard	AL, EL, FL, EM	108	121	5.5	1.0	(14)
	Short	CL, JL, KL, JM	77	90			

Note: Ball slide length equipped with NSK K1 = (Standard ball slide length) + (Thickness of NSK K1, V<sub>1</sub> × Number of NSK K1) + (Thickness of the protective cover, V<sub>2</sub> × 2)

### 3. Double seal

Use a double seal set as showing in Table 13, when installing an extra seal to completed standard products. (Fig. 14)

When installing a grease fitting after the installation of double seals, a connector is required.

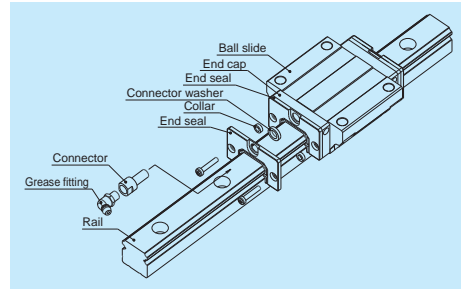


Fig. 14 Double seal

### 4. Protector

Use a protector set as showing Table 14, when installing a protector to completed standard products. (Fig.15)

When installing a grease fitting after the installation of protectors, a connector is required.

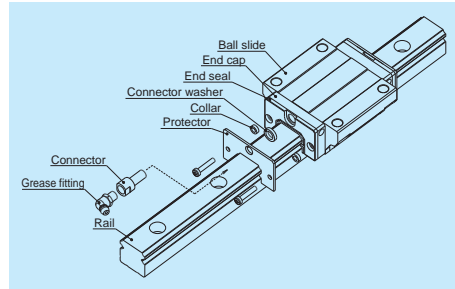


Fig. 15 Protector

Table 13 Double-seal set

Model No.	Reference No.		Increased thickness $V_1$
	Without connector	With connector	
SS15	LS15WS-01	*	2.8
SS20	LS20WS-01	LS20WSC-01	2.5
SS25	LS25WS-01	LS25WSC-01	2.8
SS30	LS30WS-01	LS30WSC-01	3.6
SS35	LS35WS-01	LS35WSC-01	3.6

Table 14 Protector set

Model No.	Reference No.		Increased thickness $V_2$
	Without connector	With connector	
SS15	LS15PT-01	*	3
SS20	LS20PT-01	LS20PTC-01	2.7
SS25	LS25PT-01	LS25PTC-01	3.2
SS30	LS30PT-01	LS30PTC-01	4.2
SS35	LS35PT-01	LS35PTC-01	4.2

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

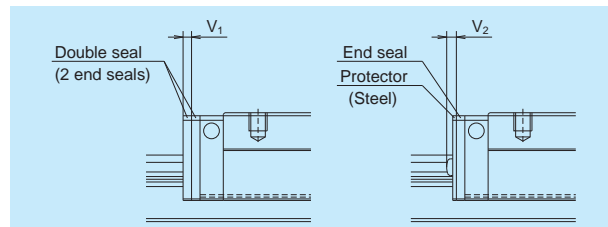


Fig. 16

### 5. Cap to cover the bolt hole for rail mounting

Table 15 Caps to cover rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
SS15	M3	LG-CAP/M3	20
SS15	M4	LG-CAP/M4	20
SS20	M5	LG-CAP/M5	20
SS25, SS30	M6	LG-CAP/M6	20
SS35	M8	LG-CAP/M8	20

### 7. Bellows

Use a bellows fastener kit as showing Table 17, when installing bellows to completed standard products. A bellows fastener kit is supplied with one of bellows fastener, two of M1 set screws, two of M2 set screws, and two collars for M2 set screw.

### 6. Inner seal

Inner seal can be manufactured for models shown below.

Table 16

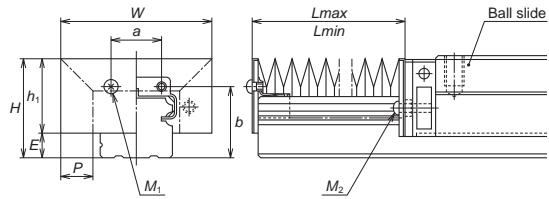
Series	Model No.
SS	SS20, SS25, SS30, SS35

Table 17 Bellows fastner kit reference No.

Model No.	Kit reference No.
SS15	LS15FS-01
SS20	LS20FS-01
SS25	LS25FS-01
SS30	LS30FS-01
SS35	LS35FS-01



Dimension tables of bellows  
SS Series



**Bellows reference number**

**J A S 15 L 08**

Bellows: J (Bellows for the ends), A (Middle bellows), S (For SS and LS series)

Number of BL (fold number): 15

L: Low type

Size number of linear guide: 08

Fig. 17 Dimension of bellows

Table 18 Dimensions of bellows

Unit: mm

Model No.	H	h <sub>1</sub>	E	W	P	a	b	BL minimum length	M <sub>1</sub> Tap x depth	M <sub>2</sub> Tap x depth
JAS15L	23.5	18.9	4.6	43	10	8	16.5	17	M3×5	M3×14
JAS20L	27	21	6	48	10	13	19.7	17	M3×5	M2.5×14
JAS25L	32	25	7	51	10	15	23.2	17	M3×5	M3×18
JAS30L	41	32	9	66	15	16	29	17	M4×6	M4×19
JAS35L	47	36.5	10.5	72	15	22	33.5	17	M4×6	M4×22

Table 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
		L <sub>min</sub>	34	68	102	136	170	204	238	272	306
JAS15L	Stroke	106	212	318	424	530	636	742	848	954	1060
	L <sub>max</sub>	140	280	420	560	700	840	980	1120	1260	1400
JAS20L	Stroke	106	212	318	424	530	636	742	848	954	1060
	L <sub>max</sub>	140	280	420	560	700	840	980	1120	1260	1400
JAS25L	Stroke	106	212	318	424	530	636	742	848	954	1060
	L <sub>max</sub>	140	280	420	560	700	840	980	1120	1260	1400
JAS30L	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
	L <sub>max</sub>	210	420	630	840	1050	1260	1470	1680	1890	2100
JAS35L	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
	L <sub>max</sub>	210	420	630	840	1050	1260	1470	1680	1890	2100

Remarks: Values of odd number BL (3, 5, 7, ...) can be obtained by adding two values of even number BLs on both side, then dividing the sum by two.

Note: We recommend using SS Series in a clean environment in order to utilize their full range of capabilities.

SS Series

(8) Reference number

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.

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

1. Reference number for preloaded assembly

**SS 30 1000 AL C 2 -\*\* P5 3**

Series name	Preload code (See page A142)
Size	Accuracy code (See Table 21)
Rail length (mm)	Design serial number
Ball slide shape code (See page A140)	Added to the reference number.
Material/surface treatment code (See Table 20)	Number of ball slides per rail

2. Reference number for random-matching type

**SAS 30 AL C -\*\*PCZ**

Random-matching ball slide series code	Preload code
SAS : SS Series random-matching ball slide	Z: Slight preload only (See page A142)
Size	Accuracy code : PC
Ball slide shape code (See page A140)	PC: Normal grade is only available
Material/surface treatment code (See Table 20)	Design serial number
	Added to the reference number.

**L1S 30 1200 L CN -\*\* PC Z**

Random-matching rail series code	Preload code
L1S : LS/SS Series random-matching rail	Z: Slight preload only (See page A142)
Size	Accuracy code : PC
Rail length (mm)	PC: Normal grade is only available
Rail shape code	Design serial number
L: Standard, LS15 with mounting hole for M3	Added to the reference number.
T: LS15 with mounting hole for M4	*Butting rail specification
Material/surface treatment code (See Table 20)	N: Non-butting, L: Butting specification

\*Please consult with NSK for butting rail specification.

Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is slight preload "Z" (Refer to page A142).

Table 20 Material/surface treatment code

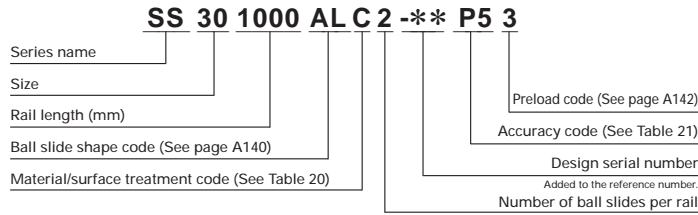
Code	Description
C	Special high carbon steel (NSK standard)
K	Stainless steel
D	Special high carbon steel with surface treatment
H	Stainless steel with surface treatment
Z	Other, special

Table 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
Normal grade	PN	KN
Normal grade (random-matching type)	PC	KC

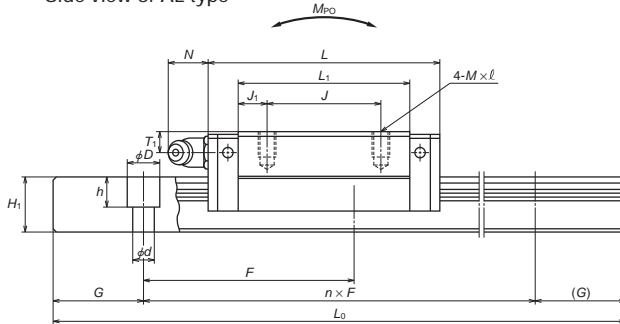
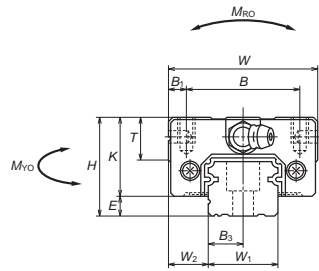
Note: Refer to Page A38 for NSK K1 lubrication unit.

(9) Dimensions  
 SS-CL (Medium-load type)  
 SS-AL (High-load type)

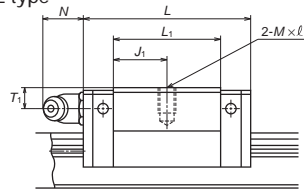


Front view of AL and CL types

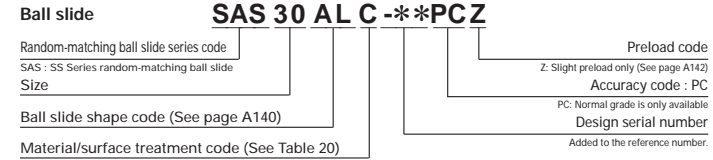
Side view of AL type



Side view of CL type



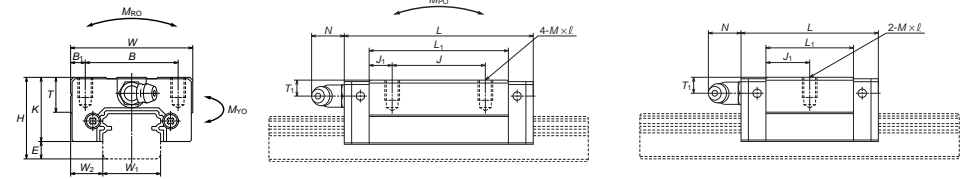
Reference number for ball slide of random-matching type



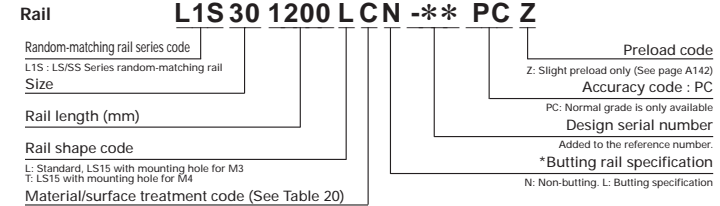
AL and CL types

AL type

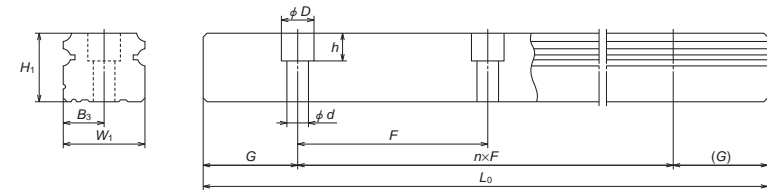
CL type



Reference number for rail of random-matching type



\*Please consult with NSK for butting rail specification.



Model No.	Assembly			Ball slide													
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole						Grease fitting					
						B	J	Mxpitchxℓ	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Hole size	T <sub>1</sub>	N	
SS15CL SS15AL	24	4.6	9.5	34	40.4 56.8	26	- 26	M4x0.7x6	4	23.6 40	11.8 7	19.4	10	φ 3	6	3	
SS20CL SS20AL	28	6	11	42	47.2 65.2	32	- 32	M5x0.8x7	5	30 48	15 8	22	12	M6x0.75	5.5	11	
SS25CL SS25AL	33	7	12.5	48	59.6 81.6	35	- 35	M6x1x9	6.5	38 60	19 12.5	26	12	M6x0.75	7	11	
SS30CL SS30AL	42	9	16	60	67.4 96.4	40	- 40	M8x1.25x12	10	42 71	21 15.5	33	13	M6x0.75	8	11	
SS35CL SS35AL	48	10.5	18	70	77 108	50	- 50	M8x1.25x12	10	49 80	24.5 15	37.5	14	M6x0.75	8.5	11	

Remarks: 1) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Unit: mm

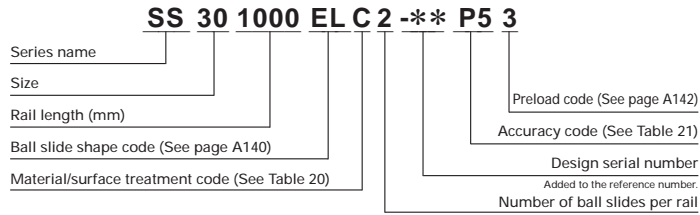
Rail							Basic load rating					Ball dia.		Weight	
Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Mounting bolt hole d x D x h	B <sub>3</sub>	G (reference)	Max. length L <sub>max</sub> (l) for stainless	Static moment					D <sub>w</sub>	Ball slide (kg)	Rail (kg/m)	
							Dynamic C (N)	Static C <sub>0</sub> (N)	M <sub>RO</sub> (N·m)	M <sub>PO</sub> (N·m)	M <sub>VO</sub> (N·m)				
15	12.5	60	*3.5x6x4.5 4.5x7.5x5.3	7.5	20	2 000 (1 700)	4 900 7 900	7 800 15 600	39 78	21.1 73.5	17.7 61.5	2.778	0.14 0.2	1.4	
20	15.5	60	6x9.5x8.5	10	20	3 960 (3 500)	7 250 11 100	11 800 21 800	80 149	40.5 124	34 104	3.175	0.19 0.28	2.3	
23	18	60	7x11x9	11.5	20	3 960 (3 500)	12 700 17 900	20 800 33 500	164 266	96.5 242	81 203	3.968	0.34 0.51	3.1	
28	23	80	7x11x9	14	20	4 000 (3 500)	18 700 27 300	29 600 50 500	282 480	153 415	128 350	4.762	0.58 0.85	4.8	
34	27.5	80	9x14x12	17	20	4 000 (3 500)	26 000 38 000	40 000 68 500	465 800	234 620	196 520	5.556	0.86 1.3	7	

2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.

\* Standard mounting hole of SS15 rail is for M3 bolts (Hole size: 3.5x6x4.5).

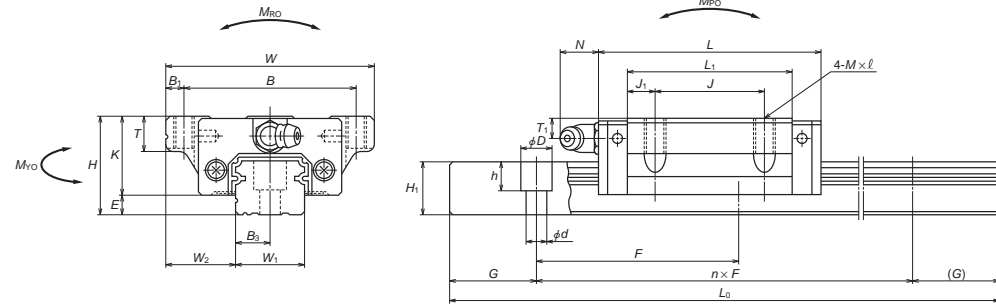
If you require the mounting hole for M4 bolts (Hole size: 4.5x7.5x5.3), please specify it when ordering.

SS-JL (Medium-load type)  
SS-EL (High-load type)

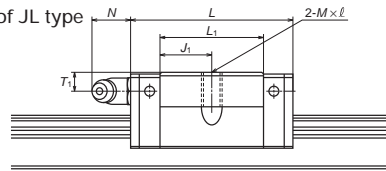


Front view of EL and JL types

Side view of EL type



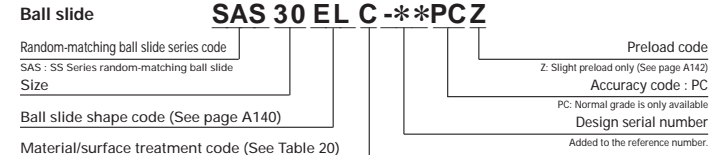
Side view of JL type



Model No.	Assembly			Ball slide											Grease fitting		
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole			B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Hole size	T <sub>1</sub>	N	
						B	J	M×pitch×l									
SS15JL SS15EL	24	4.6	18.5	52	40.4 56.8	41	-	M5×0.8×6	5.5	23.6 40	11.8 7	19.4	8	φ 3	6	3	
SS20JL SS20EL	28	6	19.5	59	47.2 65.2	49	-	M6×1×10	5	30 48	15 8	22	10	M6×0.75	5.5	11	
SS25JL SS25EL	33	7	25	73	59.6 81.6	60	-	M8×1.25×12	6.5	38 60	19 12.5	26	11 (12)	M6×0.75	7	11	
SS30JL SS30EL	42	9	31	90	67.4 96.4	72	-	M10×1.5×18 (M10×1.5×15)	9	42 71	21 15.5	33	11 (15)	M6×0.75	8	11	
SS35JL SS35EL	48	10.5	33	100	77 108	82	-	M10×1.5×20 (M10×1.5×15)	9	49 80	24.5 15	37.5	12 (15)	M6×0.75	8.5	11	

Remarks: 1) Parenthesized dimensions are applicable to stainless steel products.  
2) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

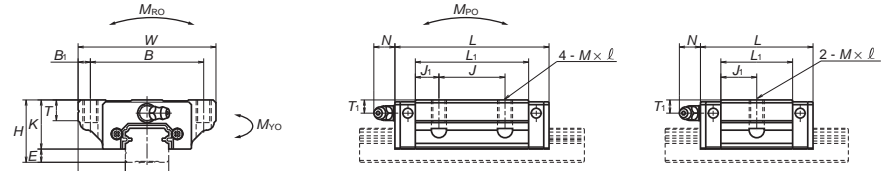
Reference number for ball slide of random-matching type



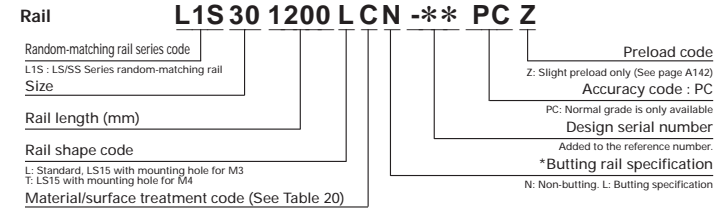
EL and JL types

EL type

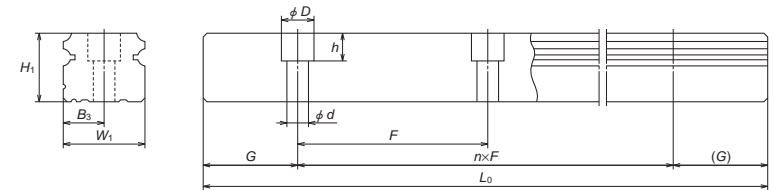
JL type



Reference number for rail of random-matching type



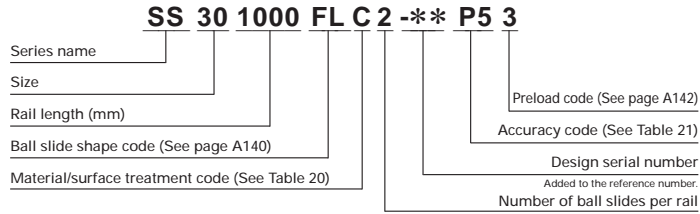
\*Please consult with NSK for butting rail specification.



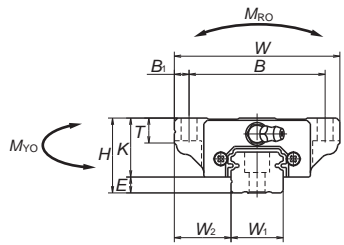
Rail										Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole	B <sub>3</sub>	G	Max. length L <sub>0max</sub>	Dynamic C	Static C <sub>0</sub>	Static moment			D <sub>w</sub>	Ball slide (kg)	Rail (kg/m)			
W <sub>1</sub>	H <sub>1</sub>	F	d×D×h	(reference)	(°) for stainless	(N)	(N)	M <sub>RO</sub>	M <sub>PO</sub>	M <sub>VO</sub>							
15	12.5	60	*3.5×6×4.5 4.5×7.5×5.3	7.5	20	2 000 (1 700)	4 900 7 900	7 800 15 600	39 78	21.1 73.5	17.7 61.5	2.778	0.17 0.26	1.4			
20	15.5	60	6×9.5×8.5	10	20	3 960 (3 500)	7 250 11 100	11 800 21 800	80 149	40.5 124	34 104	3.175	0.24 0.35	2.3			
23	18	60	7×11×9	11.5	20	3 960 (3 500)	12 700 17 900	20 800 33 500	164 266	96.5 242	81 203	3.968	0.44 0.66	3.1			
28	23	80	7×11×9	14	20	4 000 (3 500)	18 700 27 300	29 600 50 500	282 480	153 415	128 350	4.762	0.76 1.2	4.8			
34	27.5	80	9×14×12	17	20	4 000 (3 500)	26 000 38 000	40 000 68 500	465 800	234 620	196 520	5.556	1.2 1.7	7			

3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.  
\* Standard mounting hole of SS15 rail is for M3 bolts (Hole size: 3.5×6×4.5).  
If you require the mounting hole for M4 bolts (Hole size: 4.5×7.5×5.3), please specify it when ordering.

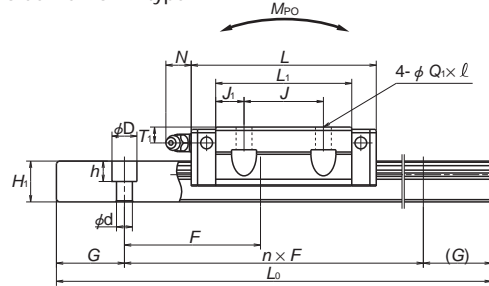
SS-KL (Medium-load type)  
SS-FL (High-load type)



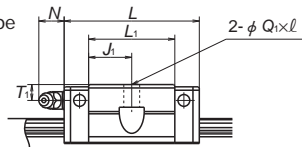
Front view of FL and KL types



Side view of FL type



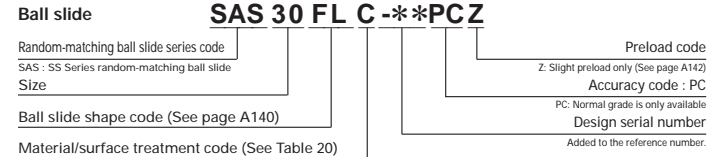
Side view of KL type



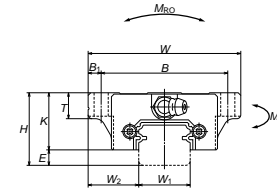
Model No.	Assembly			Ball slide												
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole			B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Grease fitting		
						B	J	Q <sub>1</sub> ×ℓ						Hole size	T <sub>1</sub>	N
SS15KL SS15FL	24	4.6	18.5	52	40.4 56.8	41	- 26	4.5×7	5.5	23.6 40	11.8 7	19.4	8	φ 3	6	3
SS20KL SS20FL	28	6	19.5	59	47.2 65.2	49	- 32	5.5×9(5.5×9.5)	5	30 48	15 8	22	10	M6×0.75	5.5	11
SS25KL SS25FL	33	7	25	73	59.6 81.6	60	- 35	7×10(7×11.5)	6.5	38 60	19 12.5	26	11 (12)	M6×0.75	7	11
SS30KL SS30FL	42	9	31	90	67.4 96.4	72	- 40	9×12(9×14.5)	9	42 71	21 15.5	33	11 (15)	M6×0.75	8	11
SS35KL SS35FL	48	10.5	33	100	77 108	82	- 50	9×13(9×14.5)	9	49 80	24.5 15	37.5	12 (15)	M6×0.75	8.5	11

Remarks: 1) Parenthesized dimensions are applicable to stainless steel products.  
2) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

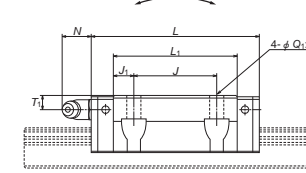
Reference number for ball slide of random-matching type



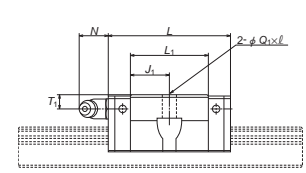
FL and KL types



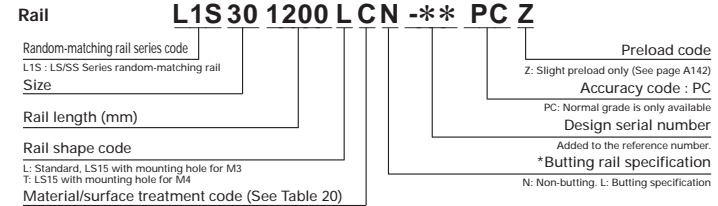
FL type



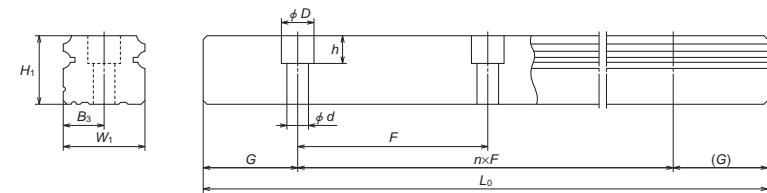
KL type



Reference number for rail of random-matching type



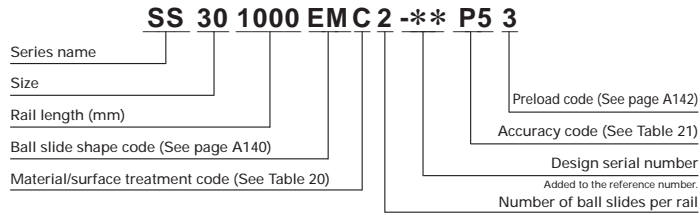
\*Please consult with NSK for butting rail specification.



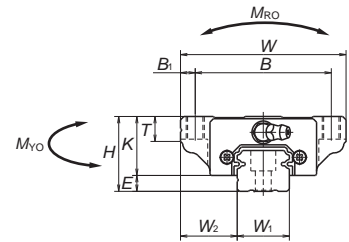
Rail							Basic load rating					Ball dia. D <sub>w</sub>	Weight	
Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Mounting bolt hole d×D×h	B <sub>3</sub>	G (reference)	Max. length L <sub>max</sub> (() for stainless)	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment (N·m)				Ball slide (kg)	Rail (kg/m)
15	12.5	60	* 3.5×6×4.5 4.5×7.5×5.3	7.5	20	2000 (1700)	4900 7900	7800 15600	39 78	21.1 73.5	17.7 61.5	2.778	0.17 0.26	1.4
20	15.5	60	6×9.5×8.5	10	20	3960 (3500)	7250 11100	11800 21800	80 149	40.5 124	34 104	3.175	0.24 0.35	2.3
23	18	60	7×11×9	11.5	20	3960 (3500)	12700 17900	20800 33500	164 266	96.5 242	81 203	3.968	0.44 0.66	3.1
28	23	80	7×11×9	14	20	4000 (3500)	18700 27300	29600 50500	282 480	153 415	128 350	4.762	0.76 1.2	4.8
34	27.5	80	9×14×12	17	20	4000 (3500)	26000 38000	40000 68500	465 800	234 620	196 520	5.556	1.2 1.7	7

3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.  
\* Standard mounting hole of SS15 rail is for M3 bolts (Hole size: 3.5×6×4.5).  
If you require the mounting hole for M4 bolts (Hole size: 4.5×7.5×5.3), please specify it when ordering.

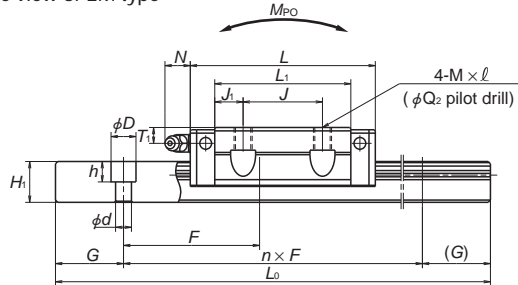
SS-JM (Medium-load type)  
SS-EM (High-load type)



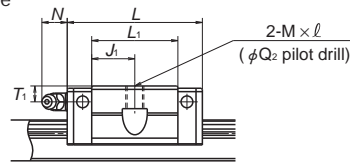
Front view of EM and JM types



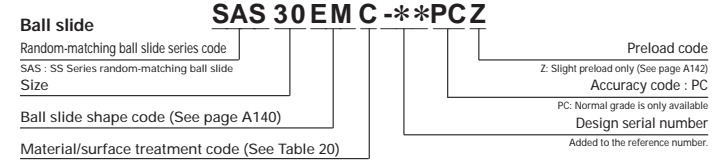
Side view of EM type



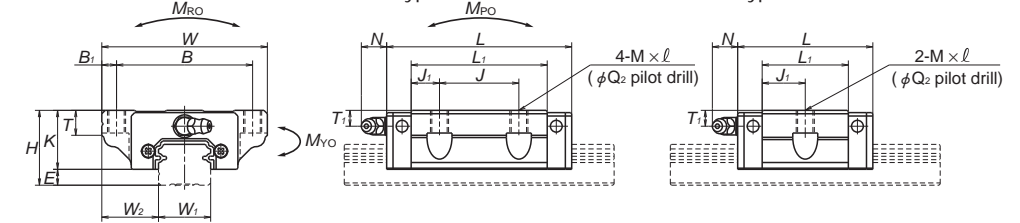
Side view of JM type



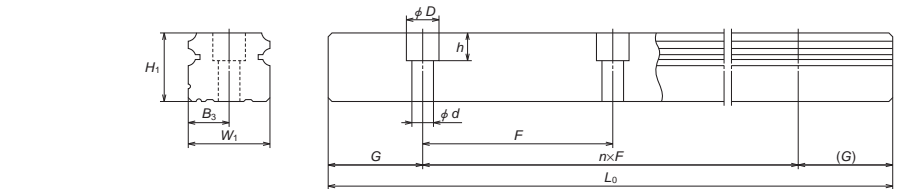
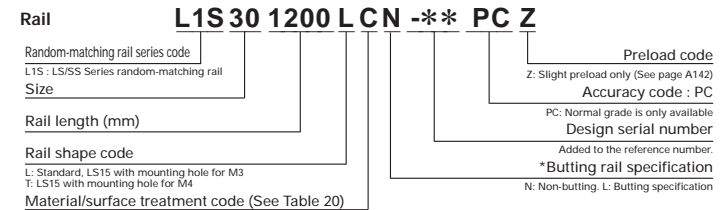
Reference number for ball slide of random-matching type



EM and JM types



Reference number for rail of random-matching type



Model No.	Assembly			Ball slide													
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole					Grease fitting						
						B	J	Mxpitchxℓ	Q <sub>2</sub>	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Hole size	T <sub>1</sub>	N
SS15JM SS15EM	24	4.6	18.5	52	40.4 56.8	41 26	-	M5×0.8×7	4.4	5.5	23.6 40	11.8 7	19.4	8	φ 3	6	3
SS20JM SS20EM	28	6	19.5	59	47.2 65.2	49 32	-	M6×1×9 (M6×1×9.5)	5.3	5	30 48	15 8	22	10	M6×0.75	5.5	11
SS25JM SS25EM	33	7	25	73	59.6 81.6	60 35	-	M8×1.25×10 (M8×1.25×11.5)	6.8	6.5	38 60	19 12.5	26	11 (12)	M6×0.75	7	11
SS30JM SS30EM	42	9	31	90	67.4 96.4	72 40	-	M10×1.5×12 (M10×1.5×14.5)	8.6	9	42 71	21 15.5	33	11 (15)	M6×0.75	8	11
SS35JM SS35EM	48	10.5	33	100	77 108	82 50	-	M10×1.5×13 (M10×1.5×14.5)	8.6	9	49 80	24.5 15	37.5	12 (15)	M6×0.75	8.5	11

Remarks: 1) Parenthesized dimensions are applicable to stainless steel products.  
2) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Rail							Basic load rating					Ball dia.	Weight	
Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Mounting bolt hole d×D×h	B <sub>3</sub>	G (reference)	Max. length L <sub>max</sub> ( ) for stainless	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment M <sub>RO</sub> (N·m) M <sub>PO</sub> (N·m) M <sub>VO</sub> (N·m)			D <sub>w</sub>	Ball slide (kg)	Rail (kg/m)
15	12.5	60	* 3.5×6×4.5 4.5×7.5×5.3	7.5	20	2000 (1700)	4900 7900	7800 15600	39 78	21.1 73.5	17.7 61.5	2.778	0.17 0.26	1.4
20	15.5	60	6×9.5×8.5	10	20	3960 (3500)	7250 11100	11800 21800	80 149	40.5 124	34 104	3.175	0.24 0.35	2.3
23	18	60	7×11×9	11.5	20	3960 (3500)	12700 17900	20800 33500	164 266	96.5 242	81 203	3.968	0.44 0.66	3.1
28	23	80	7×11×9	14	20	4000 (3500)	18700 27300	29600 50500	282 480	153 415	128 350	4.762	0.76 1.2	4.8
34	27.5	80	9×14×12	17	20	4000 (3500)	26000 38000	40000 68500	465 800	234 620	196 520	5.556	1.2 1.7	7

3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.  
\* Standard mounting hole of SS15 rail is for M3 bolts (Hole size: 3.5×6×4.5).  
If you require the mounting hole for M4 bolts (Hole size: 4.5×7.5×5.3), please specify it when ordering.

A-5-1.3 LH Series

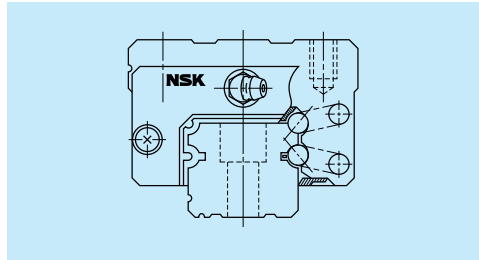
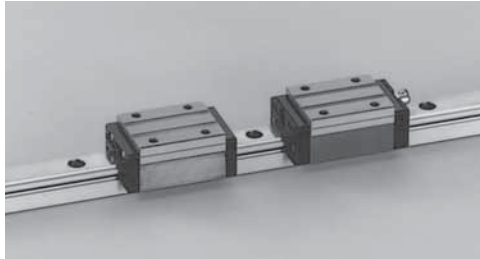


Fig. 1 LH Series

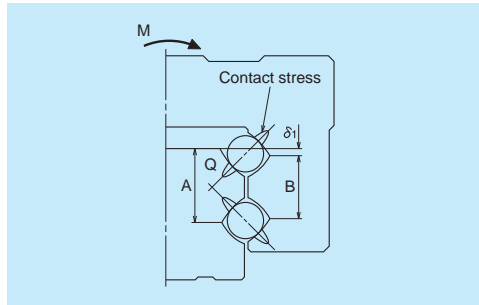


Fig. 2 Enlarged illustration of the offset Gothic arch groove

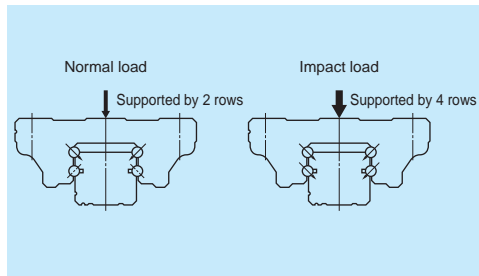


Fig. 3 When load is applied

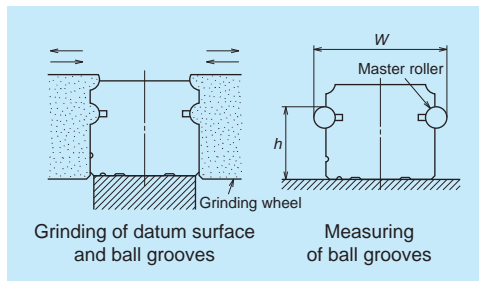


Fig. 4 Rail grinding and measuring

(1) Features

1. High self-aligning capability (rolling direction)

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

2. High load carrying capacity to vertical direction

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

3. High resistance against impact load

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

4. High accuracy

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

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

Balls are retained in the retainer, therefore they do not fall out when the ball slide is withdrawn from the rail. (LH10 to LH65)

6. Abundant models and sizes

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

7. Fast delivery

Lineup of random-matching rails and ball slides supports and facilitates fast delivery. (LH15 to LH65)

(2) Ball slide shape

Ball slide Model	Shape/installation method	Type	
		High-load type	Super-high-load type
AN BN		AN 	BN 
AL BL		AL 	BL 
EL GL		EL 	GL 
FL HL		FL 	HL 
EM GM		EM 	GM 

(3) Accuracy and preload

1. Running parallelism of ball slide

Table 1

Unit:  $\mu\text{m}$

Rail over all length (mm) over or less	Preloaded assembly (not random matching)						Random-matching type
	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC	
- 50	2	2	2	4.5	6	6	
50 - 80	2	2	3	5	6	6	
80 - 125	2	2	3.5	5.5	6.5	6.5	
125 - 200	2	2	4	6	7	7	
200 - 250	2	2.5	5	7	8	8	
250 - 315	2	2.5	5	8	9	9	
315 - 400	2	3	6	9	11	11	
400 - 500	2	3	6	10	12	12	
500 - 630	2	3.5	7	12	14	14	
630 - 800	2	4.5	8	14	16	16	
800 - 1000	2.5	5	9	16	18	18	
1000 - 1250	3	6	10	17	20	20	
1250 - 1600	4	7	11	19	23	23	
1600 - 2000	4.5	8	13	21	26	26	
2000 - 2500	5	10	15	22	29	29	
2500 - 3150	6	11	17	25	32	32	
3150 - 4000	9	16	23	30	34	34	

Note: LH08, 10, and 12 are not available in random matching. For LH08,10, and 12, P4, P5, P6, and PN grades are available.

2. Accuracy standard

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

• Tolerance of preloaded assembly

Table 2

Unit:  $\mu\text{m}$

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)		$\pm 10$ 3	LH08,10,12 LH15 - $\pm 10$ $\pm 10$ 3 5	LH08,10,12 LH15 - $\pm 20$ $\pm 20$ 5 7	LH08,10,12 LH15 - $\pm 40$ $\pm 40$ 7 15	LH08,10,12 LH15 - $\pm 80$ $\pm 80$ 15 25	
Mounting width $W_2$ or $W_3$ Variation of $W_2$ or $W_3$ (All ball slides on reference rail)		$\pm 15$ 3	LH08,10,12 LH15 - $\pm 10$ $\pm 15$ 5 7	LH08,10,12 LH15 - $\pm 15$ $\pm 25$ 7 10	LH08,10,12 LH15 - $\pm 25$ $\pm 50$ 10 20	LH08,10,12 LH15 - $\pm 50$ $\pm 100$ 20 30	
Running parallelism of face C to face A Running parallelism of face D to face B		Shown in Table 1, Fig. 5, and Fig. 6					

Note: For LH08, 10, and 12, accuracy of P4, P5, P6, and PN grades are available.

• Tolerance of random-matching type: Normal grade PC

Table 3

Unit:  $\mu\text{m}$

Characteristics	Model No.	LH15, 20, 25, 30, 35	LH45, 55, 65
Mounting height $H$		$\pm 20$	$\pm 30$
Variation of mounting height $H$		15① 30②	20① 35②
Mounting width $W_2$ or $W_3$		$\pm 30$	$\pm 35$
Variation of mounting width $W_2$ or $W_3$		25	30
Running parallelism of face C to face A Running parallelism of face D to face B		See Table 1, Fig. 5 and Fig. 6	

Note: 1) LH08, 10, 12 are not available in random matching. 2) 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
Without NSK K1 lubrication unit	P3	P4	P5	P6	PN	PC
With NSK K1 lubrication unit	K3	K4	K5	K6	KN	KC
With NSK K1 for food and medical equipment	F3	F4	F5	F6	FN	FC
Preload	Fine clearance Z0	○	○	○	○	—
	Slight preload Z1	○	○	○	○	—
	Medium preload Z3	○	○	○	○	—
	Random-matching type with fine clearance ZT	—	—	—	—	○
	Random-matching type with slight preload ZZ	—	—	—	—	○

4. Assembled accuracy

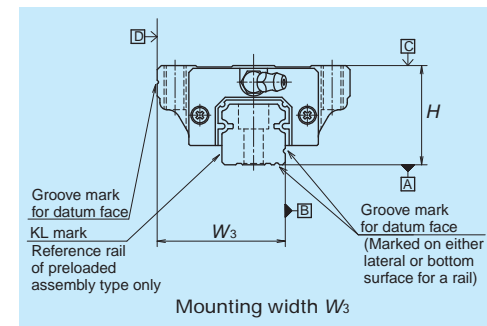
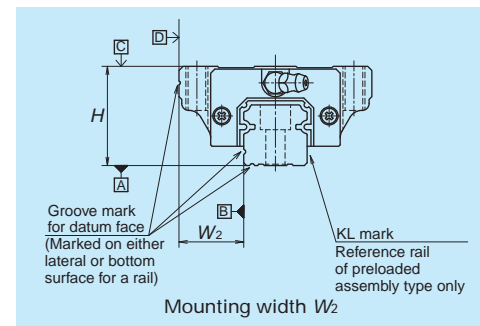


Fig. 5 Special high carbon steel

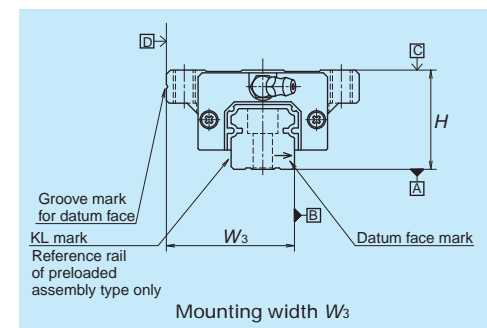
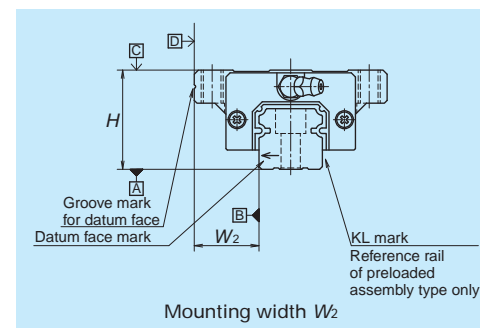


Fig. 6 Stainless steel



### 5. Preload and rigidity

We offer five levels of preload: slight preload Z1, medium preload Z3 and fine clearance Z0, along with random-matching type of fine clearance ZT and slight preload ZZ. Values for preload and rigidity of the preloaded assembly are shown in Table 5. Rigidities are for the median of the preload range.

#### • Preload and rigidity of preloaded assembly

Table 5

Model No.	Preload (N)		Rigidity (N/ $\mu$ m)			
			Vertical direction		Lateral direction	
	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3
LH08 AN	5	—	33	—	23	—
LH10 AN	9	—	44	—	31	—
LH12 AN	22	—	68	—	47	—
LH15 AN, EL, FL, EM	78	490	137	226	98	186
LH20 AN, EL, FL, EM	147	835	186	335	137	245
LH25 AN, AL, EL, FL, EM	196	1270	206	380	147	284
LH30 AN, AL	245	1570	216	400	157	294
LH30 EL, FL, EM	294	1770	265	480	186	355
LH35 AN, AL, EL, FL, EM	390	2350	305	560	216	390
LH45 AN, AL, BL, EL, FL, EM	635	3900	400	745	284	540
LH55 AN, AL, EL, FL, EM	980	5900	490	910	345	645
LH65 AN, EL, FL, EM	1470	8900	580	1070	400	755
LH15 BN, GL, HL, GM	98	685	196	345	137	284
LH20 BN, GL, HL, GM	196	1080	265	480	196	355
LH25 BN, BL, GL, HL, GM	245	1570	294	560	216	400
LH30 BN, BL, GL, HL, GM	390	2260	360	665	265	480
LH35 BN, BL, GL, HL, GM	490	2940	430	795	305	570
LH45 BN, BL, GL, HL, GM	785	4800	520	960	370	695
LH55 BN, BL, GL, HL, GM	1180	7050	635	1170	440	835
LH65 BN, GL, HL, GM	1860	11300	805	1480	550	1040

Note: Clearance for fine clearance Z0 is 0 to 3 $\mu$ m. Therefore, preload is zero. However, Z0 of PN grade is 0 to 15 $\mu$ m.

#### • Clearance and preload of random-matching type

Table 6 Unit:  $\mu$ m

Model No.	Fine clearance ZT	Slight preload ZZ
LH15	-4 - 15	-4 - 0
LH20	-5 - 15	-5 - 0
LH25		-5 - 0
LH30		-7 - 0
LH35		-7 - 0
LH45		-7 - 0
LH55		-9 - 0
LH65		-9 - 0

Note: 1) Minus sign denotes that a value is an amount of preload (elastic deformation of balls).  
2) LH08, 10, and 12 are not available in random matching.

### (4) Available length of rail

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

Table 7 Length limitations of rails

Unit: mm

Series	Material	Size										
		08	10	12	15	20	25	30	35	45	55	65
LH	Special high carbon steel				2000	3960	3960	4000	4000	3990	3960	3900
	Stainless steel	375	600	800	1800	3500	3500	3500				

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

### (5) Installation

#### 1. Permissible values of mounting error

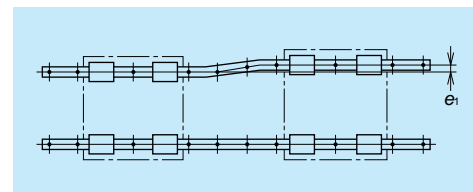


Fig. 7

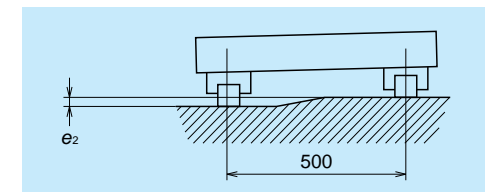


Fig. 8

Table 8

Unit:  $\mu$ m

Value	Preload	Model No.										
		LH08	LH10	LH12	LH15	LH20	LH25	LH30	LH35	LH45	LH55	LH65
Permissible values of parallelism in two rails $e_1$	Z0, ZT	9	12	19	22	30	40	45	55	65	80	110
	Z1, ZZ	8	11	18	18	20	25	30	35	45	55	70
	Z3	-	-	-	13	15	20	25	30	40	45	60
Permissible values of parallelism (height) in two rails $e_2$	Z0, ZT	375 $\mu$ m/500 mm										
	Z1, ZZ, Z3	330 $\mu$ m/500 mm										

#### 2. Shoulder height of the mounting face and corner radius r

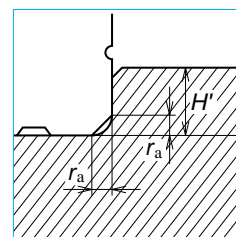


Fig. 9 Shoulder for the rail datum face

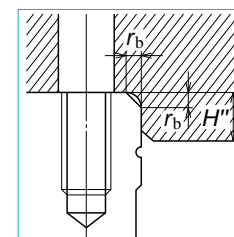


Fig. 10 Shoulder for the ball slide datum face

Table 9

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
LH15	0.5	0.5	4	4
LH20	0.5	0.5	4.5	5
LH25	0.5	0.5	5	5
LH30	0.5	0.5	6	6
LH35	0.5	0.5	6	6
LH45	0.7	0.7	8	8
LH55	0.7	0.7	10	10
LH65	1	1	11	11

## (6) Lubrication components

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

### 1. Types of lubrication accessories

Figure 11 and Table 10 show grease fittings and tube fittings.

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

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

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

Please ask NSK for stainless lubrication accessories.

### 2. Mounting position of lubrication accessories

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

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

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

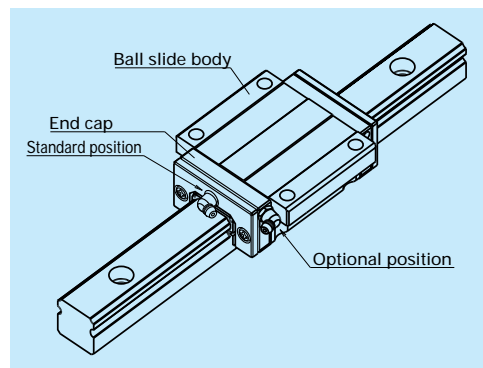


Fig. 12 Mounting position of lubrication accessories

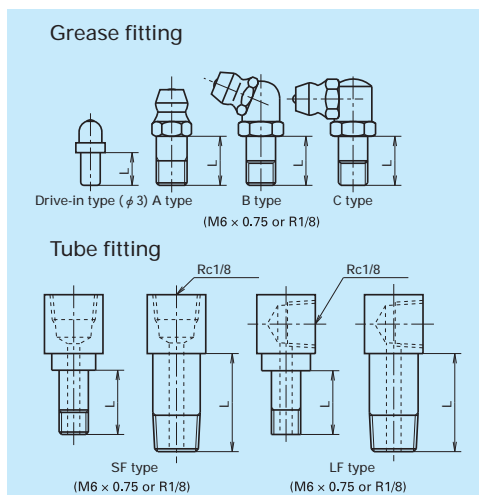


Fig. 11 Grease fitting and tube fitting

Model No.	Dust proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
LH12	Standard	5	-
	With NSK K1	10	-
	Double seal	*	-
	Protector	*	-
LH15	Standard	5	-
	With NSK K1	10	-
	Double seal	*	-
	Protector	*	-
LH20	Standard	5	-
	With NSK K1	12	-
	Double seal	10	-
	Protector	10	-
LH25	Standard	5	6**
	With NSK K1	12	11**
	Double seal	10	9**
	Protector	10	9**
LH30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
LH35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
LH45	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
LH55	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
LH65	Standard	8	17
	With NSK K1	20	25.5
	Double seal	16	19
	Protector	16	17

\*) Please contact NSK as a connector is required.  
 \*\*) Only available for AN and BN type ball slides.

## (7) Dust proof components

### 1. Standard specification

To keep foreign matters from entering inside the ball slide, LH Series has an end seal on both ends, and bottom seals at the bottom.

However, the bottom seals are not used to LH08 and 10.

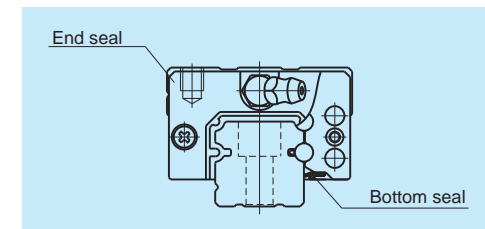


Fig. 13

Table 11 Seal friction per ball slide (maximum value)

Series	Size	Unit : N										
		08	10	12	15	20	25	30	35	45	55	65
LH		0.5	1	1.5	8	9	10	10	12	17	22	29

### 2. NSK K1™

Table 12 shows the dimension of linear guides equipped with the NSK K1.

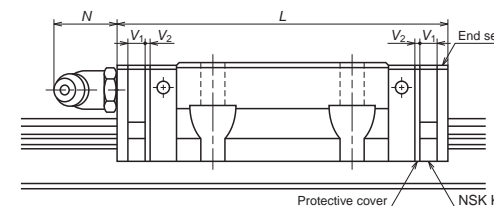


Table 12

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V <sub>1</sub>	Protective cover thickness V <sub>2</sub>	Protruding area of the grease fitting N
LH08	Standard	AN	24	31	3	0.5	—
LH10	Standard	AN	31	40	4	0.5	—
LH12	Standard	AN	45	54	4	0.5	(4)
LH15	Standard	AN, EL, FL, EM	55	65.6	4.5	0.8	(5)
	Long	BN, GL, HL, GM	74	84.6			
LH20	Standard	AN, EL, FL, EM	69.8	80.4	4.5	0.8	(14)
	Long	BN, GL, HL, GM	91.8	102.4			
LH25	Standard	AL, AN, EL, FL, EM	79.0	90.6	5.0	0.8	(14)
	Long	BL, BN, GL, HL, GM	107	118.6			
LH30	Standard	AL, AN	85.6	97.6	5.0	1.0	(14)
	Flange type	EL, FL, EM	98.6	110.6			
LH35	Standard	AL, AN, EL, FL, EM	109	122	5.5	1.0	(14)
	Long	BL, BN, GL, HL, GM	143	156			
LH45	Standard	AL, AN, EL, FL, EM	139	154	6.5	1.0	(15)
	Long	BL, BN, GL, HL, GM	171	186			
LH55	Standard	AL, AN, EL, FL, EM	163	178	6.5	1.0	(15)
	Long	BL, BN, GL, HL, GM	201	216			
LH65	Standard	AN, EL, FL, EM	193	211	8.0	1.0	(16)
	Long	BN, GL, HL, GM	253	271			

Note: 1) NSK K1 for food and medical equipments are available for LH12 to LH35.

2) Ball slide length equipped with NSK K1 = (Standard ball slide length) + (Thickness of NSK K1, V<sub>1</sub> × Number of NSK K1) + (Thickness of the protective cover, V<sub>2</sub> × 2)

### 3. Double seal

Use a double seal set as showing in Table 13, when installing an extra seal to completed standard products. (Fig. 14)

When installing a grease fitting after the installation of double seals, a connector is required.

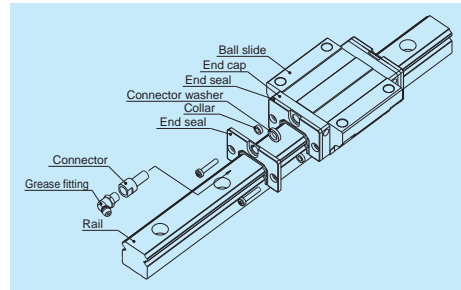


Fig. 14 Double seal

### 4. Protector

Use a protector set as showing Table 14, when installing a protector to completed standard products. (Fig.15)

When installing a grease fitting after the installation of protectors, a connector is required.

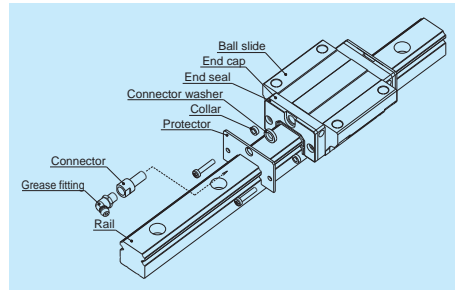


Fig. 15 Protector

Table 13 Double-seal set

Model No.	Reference No.		Increased thickness $V_1$
	Without connector	With connector	
LH15	LH15WS-01	*	2.5
LH20	LH20WS-01	LH20WSC-01	2.5
LH25	LH25WS-01	LH25WSC-01	2.8
LH30	LH30WS-01	LH30WSC-01	3.6
LH35	LH35WS-01	LH35WSC-01	3.6
LH45	LH45WS-01	LH45WSC-01	4.3
LH55	LH55WS-01	LH55WSC-01	4.3
LH65	LH65WS-01	LH65WSC-01	4.9

Table 14 Protector set

Model No.	Reference No.		Increased thickness $V_2$
	Without connector	With connector	
LH15	LH15PT-01	*	2.7
LH20	LH20PT-01	LH20PTC-01	2.9
LH25	LH25PT-01	LH25PTC-01	3.2
LH30	LH30PT-01	LH30PTC-01	4.2
LH35	LH35PT-01	LH35PTC-01	4.2
LH45	LH45PT-01	LH45PTC-01	4.9
LH55	LH55PT-01	LH55PTC-01	4.9
LH65	LH65PT-01	LH65PTC-01	5.5

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

Note: Double seal and protector for LH08, 10, and 12, please consult NSK.

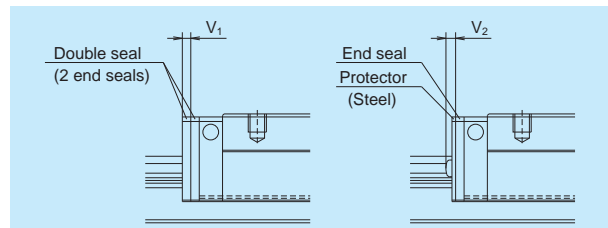


Fig. 16

### 5. Cap to cover the bolt hole for rail mounting

Table 15 Caps to cover rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
LH10, LH12	M3	LG-CAP/M3	20
LH15	M4	LG-CAP/M4	20
LH20	M5	LG-CAP/M5	20
LH25	M6	LG-CAP/M6	20
LH30, LH35	M8	LG-CAP/M8	20
LH45	M12	LG-CAP/M12	20
LH55	M14	LG-CAP/M14	20
LH65	M16	LG-CAP/M16	20

### 7. Bellows

Use a bellows fastener kit as showing Table 17, when installing bellows to completed standard products. A bellows fastener kit is supplied with one of bellows fastener, two of M1 set screws, two of M2 set screws, and two collars for M2 set screw.

The bellows for LH08, 10, 12, and 15, please consult NSK.

### 6. Inner seal

Inner seal can be manufactured for models shown below.

Table 16

Series	Model No.
LH	LH20, LH25, LH30, LH35, LH45, LH55, LH65

Table 17 Bellows fastner kit reference No.

Model No.	Kit reference No.
LH20	LH20FS-01
LH25	LH25FS-01
LH30	LH30FS-01
LH35	LH35FS-01
LH45	LH45FS-01
LH55	LH55FS-01
LH65	LH65FS-01

Dimension tables of bellows  
LH Series

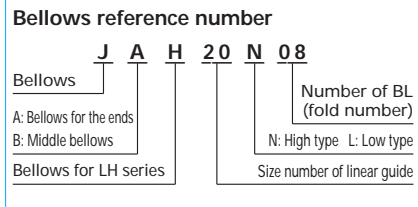
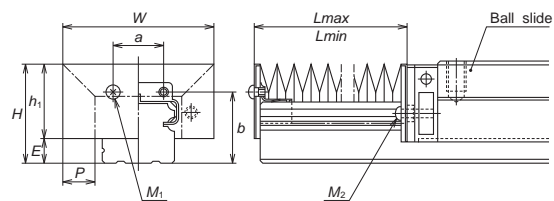


Fig. 17 Dimensions of bellows

Table 18 Dimensions of bellows

Unit: mm

Model No.	H	h <sub>1</sub>	E	W	P	a	b	BL minimum length	M <sub>1</sub> Tap x depth	M <sub>2</sub> Tap x depth
JAH20N	29.5	24.5	5	48	10	13	22	17	M3x5	M2.5x16
JAH25L	35	28	7	51	10	16	26	17	M3x5	M3x18
JAH25N	39	32		61	15					
JAH30L	41	32	9	60	12	18	31	17	M4x6	M4x22
JAH30N	44	35		66	15					
JAH35L	47	37.5	9.5	72	15	24	34	17	M4x6	M4x23
JAH35N	54	44.5		82	20					
JAH45L	59	45	14	83	15	32	44.5	17	M5x8	M5x28
JAH45N	69	55		103	25					
JAH55L	69	54	15	101	20	40	50.5	17	M5x8	M5x30
JAH55N	79	64		121	30					
JAH65N	89	73	16	131	30	48	61	17	M6x8	M6x35

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
		L <sub>min</sub>	34	68	102	136	170	204	238	272	306
JAH20N	Stroke	106	212	318	424	530	636	742	848	954	1060
	L <sub>max</sub>	140	280	420	560	700	840	980	1120	1260	1400
JAH25L	Stroke	106	212	318	424	530	636	742	848	954	1060
	L <sub>max</sub>	140	280	420	560	700	840	980	1120	1260	1400
JAH25N	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
	L <sub>max</sub>	210	420	630	840	1050	1260	1470	1680	1890	2100
JAH30L	Stroke	134	268	402	536	670	804	938	1072	1206	1340
	L <sub>max</sub>	168	336	504	672	840	1008	1176	1344	1512	1680
JAH30N	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
	L <sub>max</sub>	210	420	630	840	1050	1260	1470	1680	1890	2100
JAH35L	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
	L <sub>max</sub>	210	420	630	840	1050	1260	1470	1680	1890	2100
JAH35N	Stroke	246	492	738	984	1230	1476	1722	1968	2214	2460
	L <sub>max</sub>	280	560	840	1120	1400	1680	1960	2240	2520	2800
JAH45L	Stroke	176	352	528	704	880	1058	1232	1408	1584	1760
	L <sub>max</sub>	210	420	630	840	1050	1260	1470	1680	1890	2100
JAH45N	Stroke	316	632	948	1264	1580	1896	2212	2528	2844	3160
	L <sub>max</sub>	350	700	1050	1400	1750	2100	2450	2800	3150	3500
JAH55L	Stroke	246	492	738	984	1230	1476	1722	1968	2214	2460
	L <sub>max</sub>	280	560	840	1120	1400	1680	1960	2240	2520	2800
JAH55N	Stroke	386	772	1158	1544	1930	2316	2702	3088	3474	3860
	L <sub>max</sub>	420	840	1260	1680	2100	2520	2940	3360	3780	4200
JAH65N	Stroke	386	772	1158	1544	1930	2316	2702	3088	3474	3860
	L <sub>max</sub>	420	840	1260	1680	2100	2520	2940	3360	3780	4200

Remarks: Values of odd numbers BL (3, 5, 7, ...) can be obtained by adding two values of even number BLs on both sides, then dividing the sum by two.

LH Series

(8) Reference number

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

1. Reference number for preloaded assembly

**LH 30 1000 ANC 2 -\*\* P5 3**

Series name									
Size									Preload code (See page A164)
Rail length (mm)									Accuracy code (See Table 21)
Ball slide shape code (See page A162)									Design serial number
Material/surface treatment code (See Table 20)									Added to the reference number.
									Number of ball slides per rail

2. Reference number for random-matching type

**LAH 30 ANC -\*\*PCZ**

Random-matching ball slide series code LAH : LH Series random-matching ball slide									Preload code T: Fine clearance. Z: Slight preload (See page A164)
Size									Accuracy code : PC PC: Normal grade is only available
Ball slide shape code (See page A162)									Design serial number
Material/surface treatment code (See Table 20)									Added to the reference number.

**Rail L1H30 1200 LCN -\*\* PC Z**

Random-matching rail series code L1H : LH Series random-matching rail									Preload code T: Fine clearance. Z: Slight preload (See page A164)
Size									Accuracy code : PC PC: Normal grade is only available
Rail length (mm)									Design serial number
Rail shape code: L L : Standard									Added to the reference number.
Material/surface treatment code (See Table 20)									*Butting rail specification N: Non-butting. L: Butting specification

\*Please consult with NSK for butting rail specification.

Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is fine clearance "T" or slight preload "Z" (Refer to page A164).

Table 20 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
K	Stainless steel (LH08 to LH30 only)
D	Special high carbon steel with surface treatment
H	Stainless steel with surface treatment
Z	Other, special

Table 21 Accuracy code

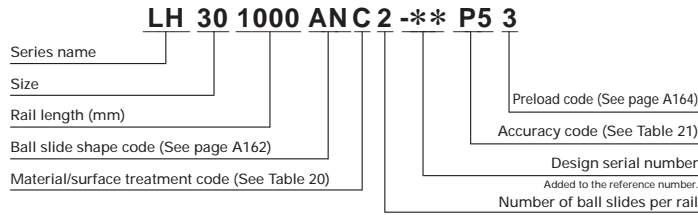
Accuracy	Standard (Without NSK K1)	With NSK K1	With NSK K1 for food and medical equipment
Ultra precision grade	P3	K3	F3
Super precision grade	P4	K4	F4
High precision grade	P5	K5	F5
Precision grade	P6	K6	F6
Normal grade	PN	KN	FN
Normal grade (random-matching type)	PC	KC	FC

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

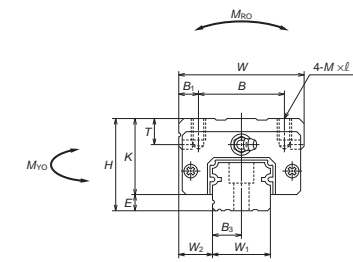
(9) Dimensions

LH-AN (High-load type)

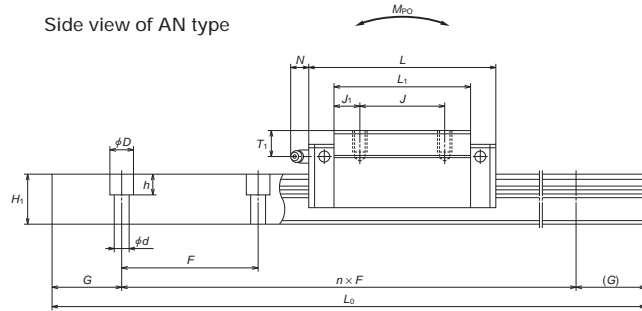
LH-BN (Super-high-load type)



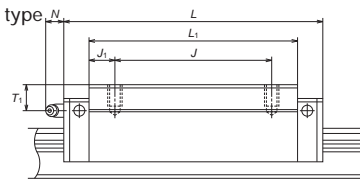
Front view of AN and BN types



Side view of AN type



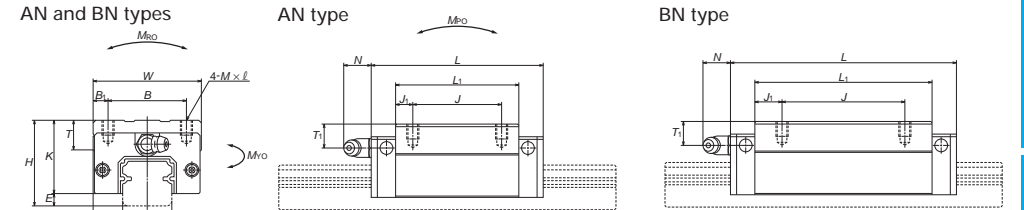
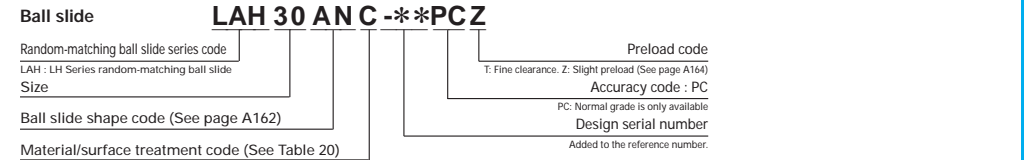
Side view of BN type



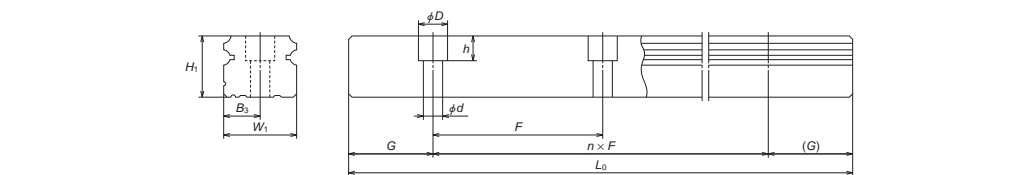
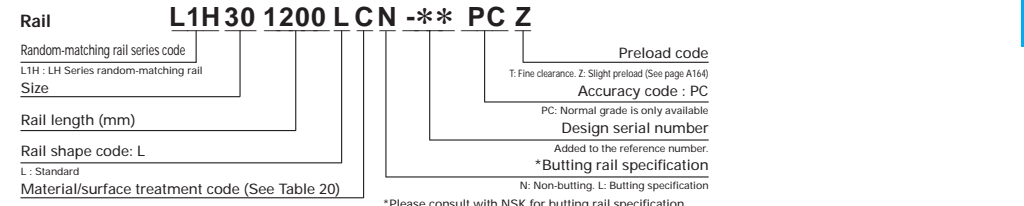
Model No.	Assembly				Ball slide											Grease fitting		
	Height		Width	Length	Mounting hole											Hole size		
	H	E			B	J	M x pitch x l	B1	L1	J1	K	T	T1	N				
LH08AN	11	2.1	4	16	24	10	10	M2x0.4x2.5	3	15	2.5	8.9	—	—	—	—	—	—
LH10AN	13	2.4	5	20	31	13	12	M2.6x0.45x3	3.5	20.2	4.1	10.6	6	—	—	—	—	—
LH12AN	20	3.2	7.5	27	45	15	15	M4x0.7x5	6	31	8	16.8	6	phi 3	5	4	—	—
LH15AN	28	4.6	9.5	34	55	26	26	M4x0.7x6	4	39	6.5	23.4	8	phi 3	8.5	3.3	—	—
LH15BN					74					16								
LH20AN	30	5	12	44	69.8	32	36	M5x0.8x6	6	50	7	25	12	M6x0.75	5	11	—	—
LH20BN					91.8					11								
LH25AN	40	7	12.5	48	79	35	50	M6x1x9	6.5	58	11.5	33	12	M6x0.75	10	11	—	—
LH25BN					107					18								
LH30AN	45	9	16	60	85.6	40	40	M8x1.25x10	10	59	9.5	36	14	M6x0.75	10	11	—	—
LH30BN					124.6					19								
LH35AN	55	9.5	18	70	109	50	50	M8x1.25x12	10	80	15	45.5	15	M6x0.75	15	11	—	—
LH35BN					143					21								
LH45AN	70	14	20.5	86	139	60	60	M10x1.5x17	13	105	22.5	56	17	Rc1/8	20	13	—	—
LH45BN					171					28.5								
LH55AN	80	15	23.5	100	163	75	75	M12x1.75x18	12.5	126	25.5	65	18	Rc1/8	21	13	—	—
LH55BN					201					34.5								
LH65AN	90	16	31.5	126	193	76	70	M16x2x20	25	147	38.5	74	23	Rc1/8	19	13	—	—
LH65BN					253					43.5								

Remarks : 1) LH08 does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.  
 2) The external appearance of stainless steel ball slides differs from those of standard material ball slide.  
 3) Only stainless steel models are available for LH08 to LH12.

Reference number for ball slide of random-matching type



Reference number for rail of random-matching type

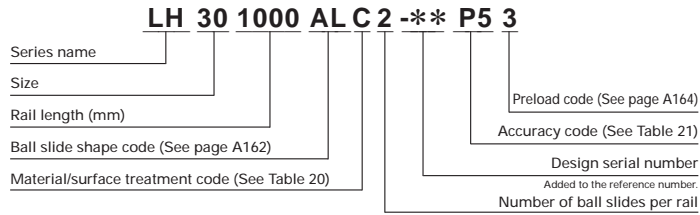


Unit: mm

Rail							Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole	G	Max. length L0max (mm) for stainless	Dynamic C (N)	Static C0 (N)	Static moment MRO (N·m)	MPO (N·m)	MPO (N·m)	DW	Ball slide (kg)	Rail (kg/m)	
8	5.5	20	2.4x4.2x2.3	4	7.5 (375)	1240	2630	7.25	4.55	3.8	1.2000	0.013	0.31	
10	6.5	25	3.5x6x3.5	5	10 (600)	2250	4500	16.2	10.5	8.8	1.5875	0.026	0.44	
12	10.5	40	3.5x6x4.5	6	15 (800)	5650	11300	47.5	41.5	35	2.3812	0.082	0.88	
15	15	60	4.5x7.5x5.3	7.5	20 (1800)	10800	20700	108	94.5	79.5	3.175	0.18	1.6	
20	18	60	6x9.5x8.5	10	20 (3500)	17400	32500	219	185	155	3.968	0.33	2.6	
23	22	60	7x11x9	11.5	20 (3500)	25600	46000	360	320	267	4.762	0.55	3.6	
28	26	80	9x14x12	14	20 (3500)	34500	71000	555	725	610	5.556	0.82	5.2	
34	29	80	9x14x12	17	20	4000	91500	870	1030	865	6.350	1.5	7.2	
45	38	105	14x20x17	22.5	22.5	3990	187000	2860	3000	2520	7.937	3.0	12.3	
53	44	120	16x23x20	26.5	30	3960	264000	4850	5150	4350	9.525	4.7	16.9	
63	53	150	18x26x22	31.5	35	3900	281000	6150	4950	4150	11.906	6.1	24.3	

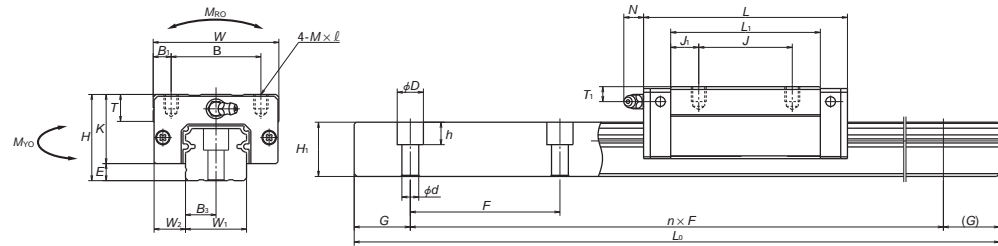
4) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C10 for 100 km rating fatigue life, divide the C by 1.26.  
 5) Random matching is available for LH15 to LH65.

LH-AL (High-load type)  
LH-BL (Super-high-load type)

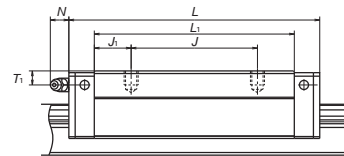


Front view of AL and BL types

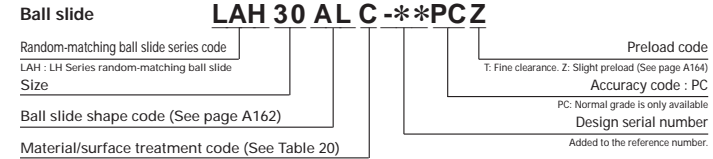
Side view of AL type



Side view of BL type



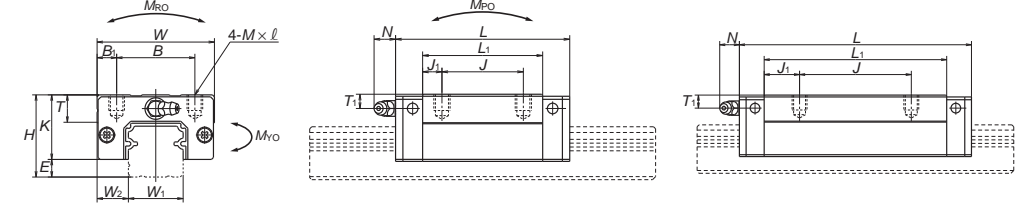
Reference number for ball slide of random-matching type



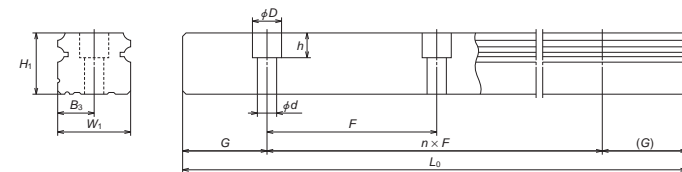
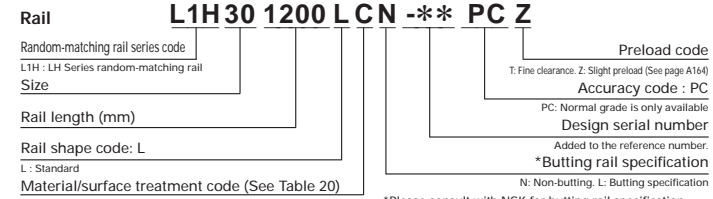
AL and BL types

AL type

BL type



Reference number for rail of random-matching type



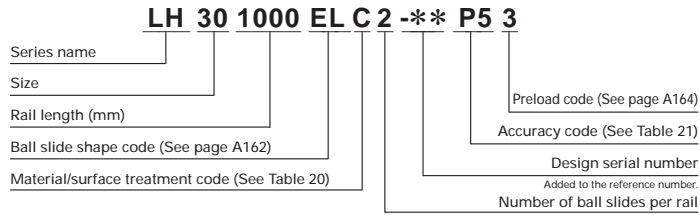
Model No.	Assembly			Ball slide										Grease fitting		
	Height $H$	$E$	$W_2$	Width $W$	Length $L$	Mounting hole				$B_1$	$L_1$	$J_1$	$K$	$T$	Hole size	
						$B$	$J$	$M \times \text{pitch} \times \ell$	$T_1$						$N$	
LH25AL LH25BL	36	7	12.5	48	79 107	35	35 50	M6×1×6	6.5	58 86	11.5 18	29	12	M6×0.75	6	11
LH30AL LH30BL	42	9	16	60	85.6 124.6	40	40 60	M8×1.25×8	10	59 98	9.5 19	33	14	M6×0.75	7	11
LH35AL LH35BL	48	9.5	18	70	109 143	50	50 72	M8×1.25×8	10	80 114	15 21	38.5	15	M6×0.75	8	11
LH45AL LH45BL	60	14	20.5	86	139 171	60	60 80	M10×1.5×10	13	105 137	22.5 28.5	46	17	Rc1/8	10	13
LH55AL LH55BL	70	15	23.5	100	163 201	75	75 95	M12×1.75×13	12.5	126 164	25.5 34.5	55	15	Rc1/8	11	13

Remarks : 1) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

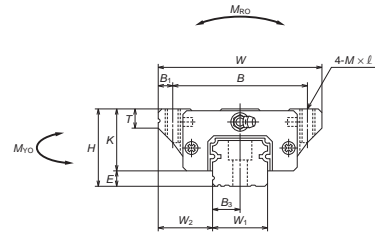
Rail										Basic load rating					Ball dia.	Weight	
Width $W_1$	Height $H_1$	Pitch $F$	Mounting bolt hole $d \times D \times h$	$B_3$	$G$	Max. length $L_{0max}$ ( ) for stainless	Dynamic $C$ (N)	Static $C_0$ (N)	Static moment			$D_w$	Ball slide (kg)	Rail (kg/m)			
									$M_{RO}$ (N·m)	$M_{PO}$ (N·m)	$M_{VO}$ (N·m)						
23	22	60	7×11×9	11.5	20	3960 (3500)	25600 34500	46000 71000	360 555	320 725	267 610	4.762	0.46 0.69	3.6			
28	26	80	9×14×12	14	20	4000 (3500)	31000 46000	51500 91500	490 870	350 1030	292 865	5.556	0.69 1.16	5.2			
34	29	80	9×14×12	17	20	4000	47500 61500	80500 117000	950 1380	755 1530	630 1280	6.350	1.2 1.7	7.2			
45	38	105	14×20×17	22.5	22.5	3990	81000 99000	140000 187000	2140 2860	1740 3000	1460 2520	7.937	2.2 2.9	12.3			
53	44	120	16×23×20	26.5	30	3960	119000 146000	198000 264000	3600 4850	3000 5150	2510 4350	9.525	3.7 4.7	16.9			

2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface.  
When converting the basic dynamic load rating  $C$  to the dynamic load rating  $C_{100}$  for 100 km rating fatigue life, divide the  $C$  by 1.26.

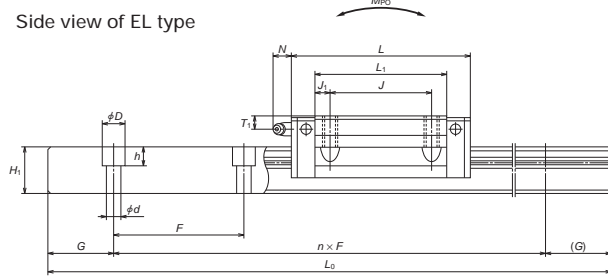
LH-EL (High-load type)  
LH-GL (Super-high-load type)



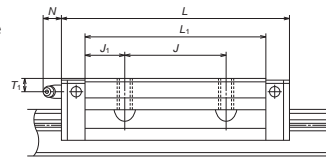
Front view of EL and GL types



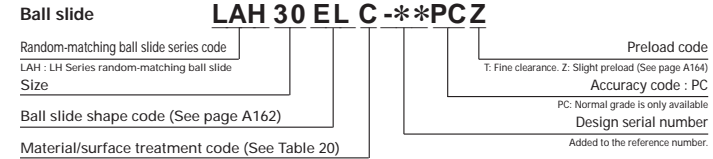
Side view of EL type



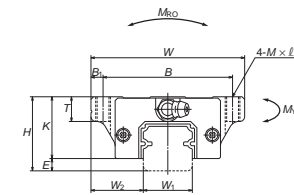
Side view of GL type



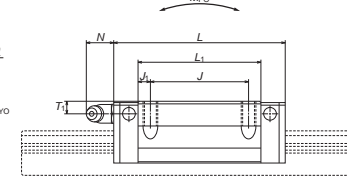
Reference number for ball slide of random-matching type



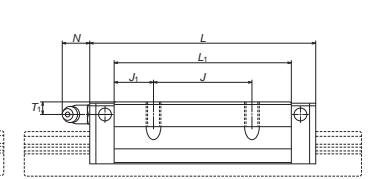
EL and GL types



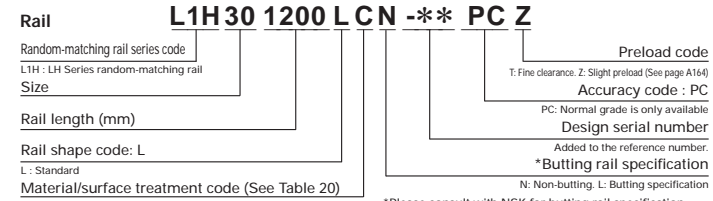
EL type



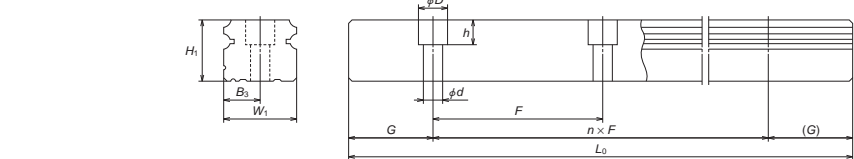
GL type



Reference number for rail of random-matching type



Rail



Model No.	Assembly			Ball slide												
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole					Grease fitting					
						B	J	M × pitch × l	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Hole size	T <sub>1</sub>	N
LH15EL LH15GL	24	4.6	16	47	55 74	38	30	M5×0.8×8	4.5	39 58	4.5 14	19.4	8	φ3	4.5	3.3
LH20EL LH20GL	30	5	21.5	63	69.8 91.8	53	40	M6×1×10	5	50 72	5 16	25	10	M6×0.75	5	11
LH25EL LH25GL	36	7	23.5	70	79 107	57	45	M8×1.25×16 (M8×1.25×12)	6.5	58 86	6.5 20.5	29	11 (12)	M6×0.75	6	11
LH30EL LH30GL	42	9	31	90	98.6 124.6	72	52	M10×1.5×18 (M10×1.5×15)	9	72 98	10 23	33	11 (15)	M6×0.75	7	11
LH35EL LH35GL	48	9.5	33	100	109 143	82	62	M10×1.5×20	9	80 114	9 26	38.5	12	M6×0.75	8	11
LH45EL LH45GL	60	14	37.5	120	139 171	100	80	M12×1.75×24	10	105 137	12.5 28.5	46	13	Rc1/8	10	13
LH55EL LH55GL	70	15	43.5	140	163 201	116	95	M14×2×28	12	126 164	15.5 34.5	55	15	Rc1/8	11	13
LH65EL LH65GL	90	16	53.5	170	193 253	142	110	M16×2×24	14	147 207	18.5 48.5	74	23	Rc1/8	19	13

Remarks: 1) Parenthesized dimensions are for items made of stainless steel.  
2) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

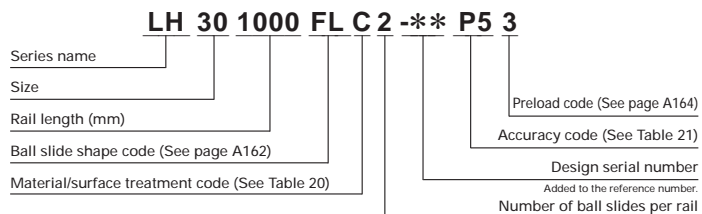
Unit: mm

Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Mounting bolt hole d × D × h	B <sub>3</sub>	G	Max. length L <sub>0max</sub> ( ) For stainless	Basic load rating					Ball dia. D <sub>w</sub>	Weight	
							Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment				Ball slide (kg)	Rail (kg/m)
									M <sub>RO</sub> (N·m)	M <sub>PO</sub> (N·m)	M <sub>VO</sub> (N·m)			
15	15	60	4.5×7.5×5.3	7.5	20	2000 (1800)	10800 14600	20700 32000	108 166	94.5 216	79.5 181	3.175	0.17 0.25	1.6
20	18	60	6×9.5×8.5	10	20	3960 (3500)	17400 23500	32500 50500	219 340	185 420	155 355	3.968	0.45 0.65	2.6
23	22	60	7×11×9	11.5	20	3960 (3500)	25600 34500	46000 71000	360 555	320 725	267 610	4.762	0.63 0.93	3.6
28	26	80	9×14×12	14	20	4000 (3500)	35500 46000	63000 91500	600 870	505 1030	425 865	5.556	1.2 1.6	5.2
34	29	80	9×14×12	17	20	4000	47500 61500	80500 117000	950 1380	755 1530	630 1280	6.350	1.7 2.4	7.2
45	38	105	14×20×17	22.5	22.5	3990	81000 99000	140000 187000	2140 2860	1740 3000	1460 2520	7.937	3.0 3.9	12.3
53	44	120	16×23×20	26.5	30	3960	119000 146000	198000 264000	3600 4850	3000 5150	2510 4350	9.525	5.0 6.5	16.9
63	53	150	18×26×22	31.5	35	3900	181000 235000	281000 410000	6150 8950	4950 10100	4150 8450	11.906	10.0 14.1	24.3

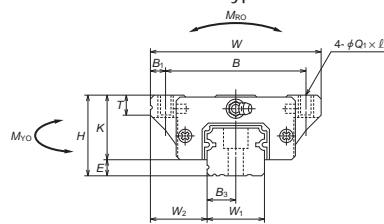
3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.



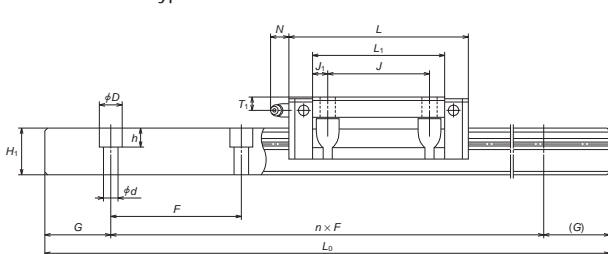
LH-FL (High-load type)  
LH-HL (Super-high-load type)



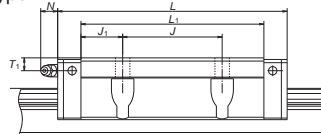
Front view of FL and HL types



Side view of FL type



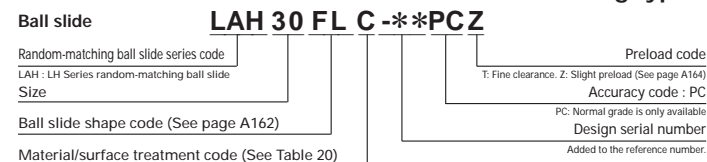
Side view of HL type



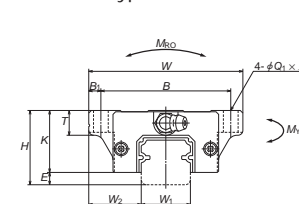
Model No.	Assembly			Ball slide											Grease fitting			
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole					B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Hole size	T <sub>1</sub>	N
						B	J	Q <sub>1</sub> × l										
LH15FL LH15HL	24	4.6	16	47	55 74	38	30	4.5×7		4.5	39 58	4.5 14	19.4	8	φ3	4.5	3.3	
LH20FL LH20HL	30	5	21.5	63	69.8 91.8	53	40	6×9.5		5	50 72	5 16	25	10	M6×0.75	5	11	
LH25FL LH25HL	36	7	23.5	70	79 107	57	45	7×10 (7×11.5)		6.5	58 86	6.5 20.5	29	11 (12)	M6×0.75	6	11	
LH30FL LH30HL	42	9	31	90	98.6 124.6	72	52	9×12 (9×14.5)		9	72 98	10 23	33	11 (15)	M6×0.75	7	11	
LH35FL LH35HL	48	9.5	33	100	109 143	82	62	9×13		9	80 114	9 26	38.5	12	M6×0.75	8	11	
LH45FL LH45HL	60	14	37.5	120	139 171	100	80	11×15		10	105 137	12.5 28.5	46	13	Rc1/8	10	13	
LH55FL LH55HL	70	15	43.5	140	163 201	116	95	14×18		12	126 164	15.5 34.5	55	15	Rc1/8	11	13	
LH65FL LH65HL	90	16	53.5	170	193 253	142	110	16×24		14	147 207	18.5 48.5	74	23	Rc1/8	19	13	

Remarks: 1) Parenthesized dimensions are for items made of stainless steel.  
 2) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

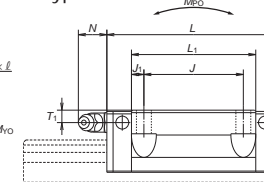
Reference number for ball slide of random-matching type



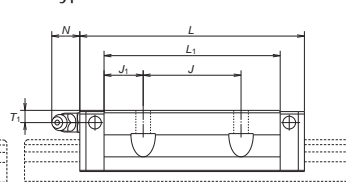
FL and HL types



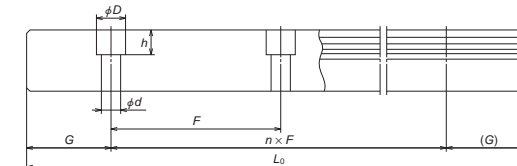
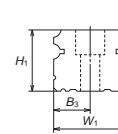
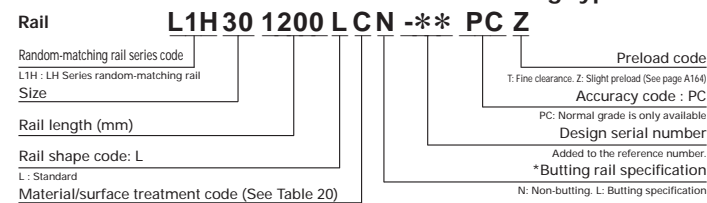
FL type



HL type



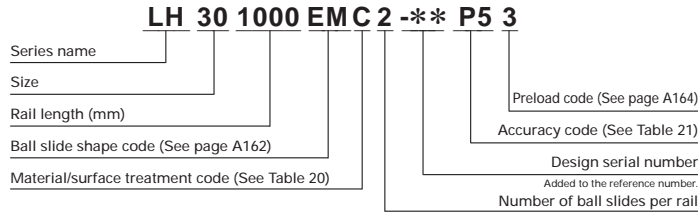
Reference number for rail of random-matching type



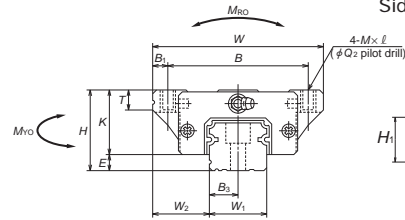
Rail								Basic load rating					Ball dia.		Weight	
Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Mounting bolt hole d × D × h	B <sub>3</sub>	G (reference)	Max. length L <sub>0max</sub> ( ) for stainless	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment			D <sub>w</sub>	Ball slide (kg)	Rail (kg/m)		
									M <sub>RO</sub> (N·m)	M <sub>PO</sub> (N·m)	M <sub>VO</sub> (N·m)					
15	15	60	4.5×7.5×5.3	7.5	20	2000 (1800)	10800 14600	20700 32000	108 166	94.5 216	79.5 181	3.175	0.17 0.25	1.6		
20	18	60	6×9.5×8.5	10	20	3960 (3500)	17400 23500	32500 50500	219 340	185 420	155 355	3.968	0.45 0.65	2.6		
23	22	60	7×11×9	11.5	20	3960 (3500)	25600 34500	46000 71000	360 555	320 725	267 610	4.762	0.63 0.93	3.6		
28	26	80	9×14×12	14	20	4000 (3500)	35500 46000	63000 91500	600 870	505 1030	425 865	5.556	1.2 1.6	5.2		
34	29	80	9×14×12	17	20	4000	47500 61500	80500 117000	950 1380	755 1530	630 1280	6.35	1.7 2.4	7.2		
45	38	105	14×20×17	22.5	22.5	3990	81000 99000	140000 187000	2140 2860	1740 3000	1460 2520	7.937	3 3.9	12.3		
53	44	120	16×23×20	26.5	30	3990	119000 146000	198000 264000	3600 4850	3000 5150	2510 4350	9.525	5 6.5	16.9		
63	53	150	18×26×22	31.5	35	3900	181000 235000	281000 410000	6150 8950	4950 10100	4150 8450	11.906	10 14.1	24.3		

3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.

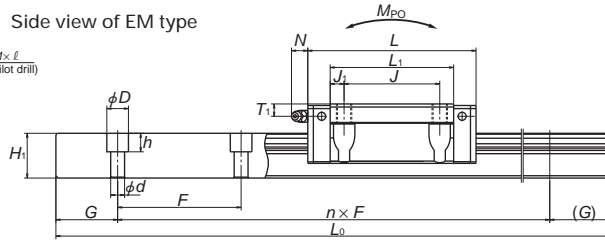
LH-EM (High-load type)  
LH-GM (Super-high-load type)



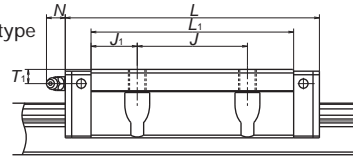
Front view of EM and GM types



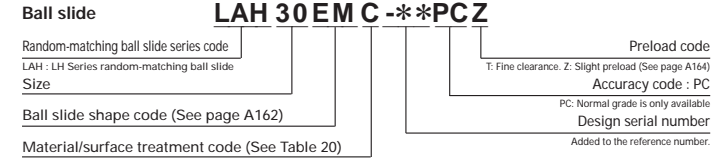
Side view of EM type



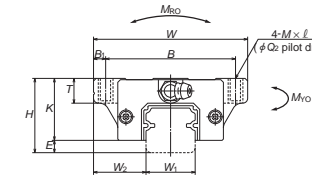
Side view of GM type



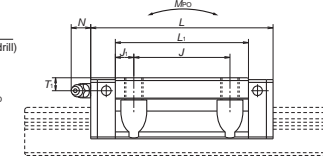
Reference number for ball slide of random-matching type



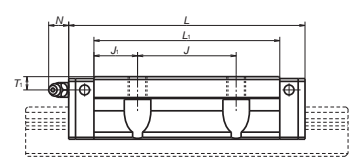
EM and GM types



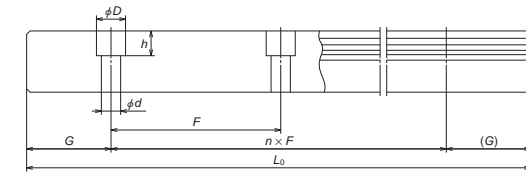
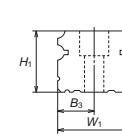
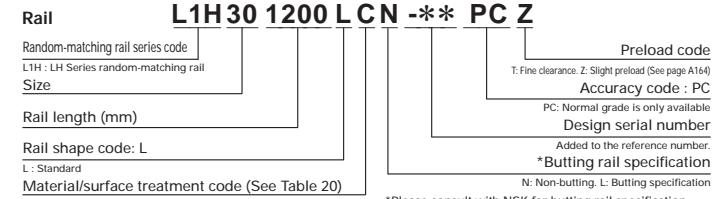
EM type



GM type



Reference number for rail of random-matching type



Model No.	Assembly			Ball slide													
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole						Grease fitting					
						B	J	M × pitch × ℓ	Q <sub>2</sub>	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Hole size	T <sub>1</sub>	N
LH15EM LH15GM	24	4.6	16	47	55 74	38	30	M5×0.8×7	4.4	4.5	39 58	4.5 14	19.4	8	φ 3	4.5	3.3
LH20EM LH20GM	30	5	21.5	63	69.8 91.8	53	40	M6×1×9.5	5.3	5	50 72	5 16	25	10	M6×0.75	5	11
LH25EM LH25GM	36	7	23.5	70	79 107	57	45	M8×1.25×10 (M8×1.25×11.5)	6.8	6.5	58 86	6.5 20.5	29	11 (12)	M6×0.75	6	11
LH30EM LH30GM	42	9	31	90	98.6 124.6	72	52	M10×1.5×12 (M10×1.5×14.5)	8.6	9	72 98	10 23	33	11 (15)	M6×0.75	7	11
LH35EM LH35GM	48	9.5	33	100	109 143	82	62	M10×1.5×13	8.6	9	80 114	9 26	38.5	12	M6×0.75	8	11
LH45EM LH45GM	60	14	37.5	120	139 171	100	80	M12×1.75×15	10.5	10	105 137	12.5 28.5	46	13	Rc1/8	10	13
LH55EM LH55GM	70	15	43.5	140	163 201	116	95	M14×2×18	12.5	12	126 164	15.5 34.5	55	15	Rc1/8	11	13
LH65EM LH65GM	90	16	53.5	170	193 253	142	110	M16×2×24	14.6	14	147 207	18.5 48.5	74	23	Rc1/8	19	13

Remarks: 1) Parenthesized dimensions are for items made of stainless steel.  
 2) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Unit: mm

Rail								Basic load rating					Ball dia.		Weight	
Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Mounting bolt hole d × D × h	B <sub>3</sub>	G (reference)	Max. length L <sub>0max</sub> ( <sup>○</sup> ) for stainless	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment			D <sub>w</sub>	Ball slide (kg)	Rail (kg/m)		
									M <sub>RO</sub> (N·m)	M <sub>PO</sub> (N·m)	M <sub>VO</sub> (N·m)					
15	15	60	4.5×7.5×5.3	7.5	20	2000 (1800)	10800 14600	20700 32000	108 166	94.5 216	79.5 181	3.175	0.17 0.25	1.6		
20	18	60	6×9.5×8.5	10	20	3960 (3500)	17400 23500	32500 50500	219 340	185 420	155 355	3.968	0.45 0.65	2.6		
23	22	60	7×11×9	11.5	20	3960 (3500)	25600 34500	46000 71000	360 555	320 725	267 610	4.762	0.63 0.93	3.6		
28	26	80	9×14×12	14	20	4000 (3500)	35500 46000	63000 91500	600 870	505 1030	425 865	5.556	1.2 1.6	5.2		
34	29	80	9×14×12	17	20	4000	47500 61500	80500 117000	950 1380	755 1530	630 1280	6.35	1.7 2.4	7.2		
45	38	105	14×20×17	22.5	22.5	3990	81000 99000	140000 187000	2140 2860	1740 3000	1460 2520	7.937	3 3.9	12.3		
53	44	120	16×23×20	26.5	30	3990	119000 146000	198000 264000	3600 4850	3000 5150	2510 4350	9.525	5 6.5	16.9		
63	53	150	18×26×22	31.5	35	3900	181000 235000	281000 410000	6150 8950	4950 10100	4150 8450	11.906	10 14.1	24.3		

3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>10</sub> for 100 km rating fatigue life, divide the C by 1.26.

### A-5-1.4 LS Series

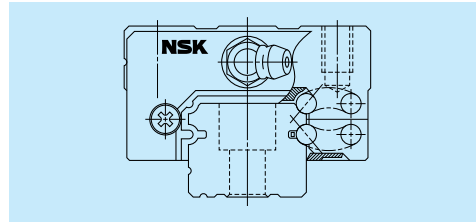
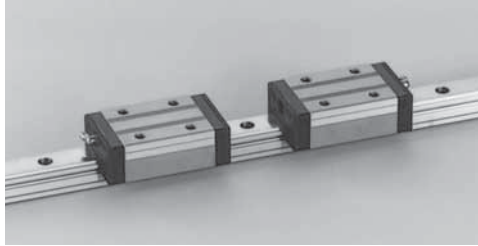


Fig. 1 LS Series

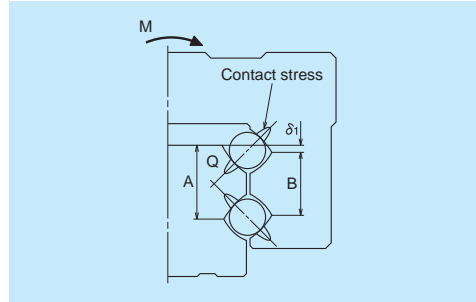


Fig. 2 Enlarged illustration of the offset Gothic arch groove

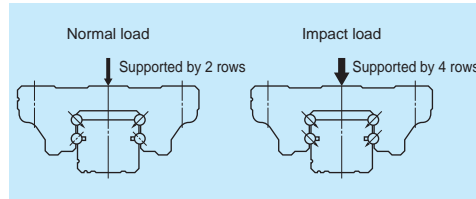


Fig. 3 When load is applied

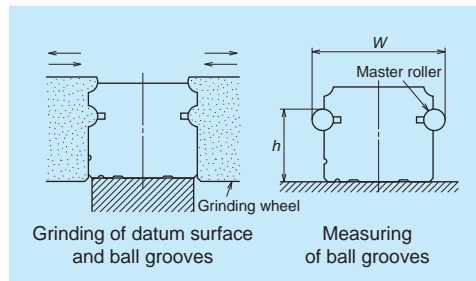


Fig. 4 Rail-grinding and measuring

#### (1) Features

##### 1. High self aligning capability (rolling direction)

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

##### 2. High load carrying capacity to vertical direction

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

##### 3. High resistance against impact load

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

##### 4. High accuracy

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

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

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

##### 6. Abundant models and sizes come in series.

Each series has several ball slide models, rendering the linear guide available for numerous uses. The LS Series also has standardized long stainless-steel rail (maximum: 3 500 mm).

##### 7. Fast delivery

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

#### (2) Ball slide shape

Ball slide Model	Shape/installation method	Type	
		Medium-load type	High-load type
AL CL		CL 	AL 
EL JL		JL 	EL 
FL KL		KL 	FL 
EM JM		JM 	EM 

(3) Accuracy and preload

1. Running parallelism of ball slide

Table 1

Unit:  $\mu\text{m}$

Rail over all length (mm) over or less	Preloaded assembly (not random matching)						Random-matching type
	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC	
- 50	2	2	2	4.5	6	6	
50 - 80	2	2	3	5	6	6	
80 - 125	2	2	3.5	5.5	6.5	6.5	
125 - 200	2	2	4	6	7	7	
200 - 250	2	2.5	5	7	8	8	
250 - 315	2	2.5	5	8	9	9	
315 - 400	2	3	6	9	11	11	
400 - 500	2	3	6	10	12	12	
500 - 630	2	3.5	7	12	14	14	
630 - 800	2	4.5	8	14	16	16	
800 - 1000	2.5	5	9	16	18	18	
1000 - 1250	3	6	10	17	20	20	
1250 - 1600	4	7	11	19	23	23	
1600 - 2000	4.5	8	13	21	26	26	
2000 - 2500	5	10	15	22	29	29	
2500 - 3150	6	11	17	25	32	32	
3150 - 4000	9	16	23	30	34	34	

2. Accuracy standard

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

• Tolerance of preloaded assembly

Table 2

Unit:  $\mu\text{m}$

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)		$\pm 10$ 3	$\pm 10$ 5	$\pm 20$ 7	$\pm 40$ 15	$\pm 80$ 25
Mounting width $W_2$ or $W_3$ Variation of $W_2$ or $W_3$ (All ball slides on reference rail)		$\pm 15$ 3	$\pm 15$ 7	$\pm 25$ 10	$\pm 50$ 20	$\pm 100$ 30
Running parallelism of face C to face A Running parallelism of face D to face B		See Table 1, Fig. 5 and Fig. 6				

• Tolerance of random-matching type: Normal grade PC

Table 3

Unit:  $\mu\text{m}$

Characteristics	Model No.	LS15, 20, 25, 30, 35
Mounting height $H$		$\pm 20$
Variation of mounting height $H$		15 <sup>①</sup> 30 <sup>②</sup>
Mounting width $W_2$ or $W_3$		$\pm 30$
Variation of mounting width $W_2$ or $W_3$		25
Running parallelism of face C to face A Running parallelism of face D to face 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	
Without NSK K1 lubrication unit	P3	P4	P5	P6	PN	PC	
With NSK K1 lubrication unit	K3	K4	K5	K6	KN	KC	
With NSK K1 for food and medical equipment	F3	F4	F5	F6	FN	FC	
Preload	Fine clearance Z0	○	○	○	○	○	—
	Slight preload Z1	○	○	○	○	○	—
	Medium preload Z3	○	○	○	○	—	—
	Random-matching type with fine clearance ZT	—	—	—	—	—	○
	Random-matching type with slight preload ZZ	—	—	—	—	—	○

4. Assembled accuracy

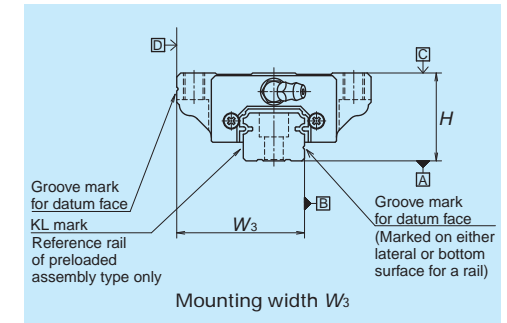
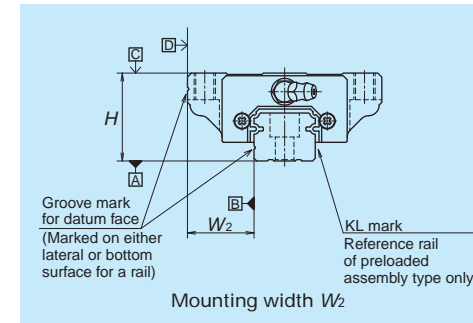


Fig. 5 Special high carbon steel

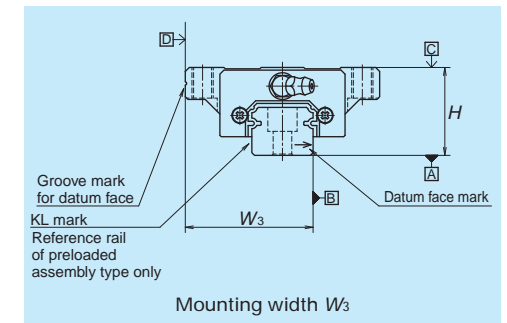
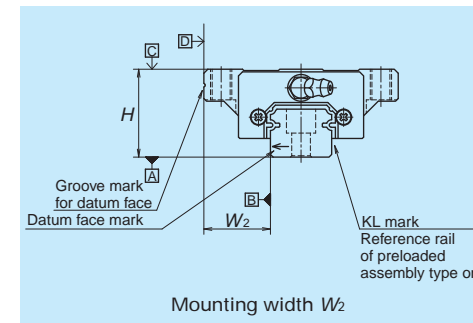


Fig. 6 Stainless steel

5. Preload and rigidity

We offer five levels of preload: slight preload Z1, medium preload Z3 and fine clearance Z0, along with random-matching type of fine clearance ZT and slight preload ZZ. Values for preload and rigidity of the preloaded assembly are shown in Table 5. Rigidities are for the median of the preload range.

• Preload and rigidity of preloaded assembly

Table 5

Model No.	Preload (N)		Rigidity (N/μm)				
	Slight preload Z1	Medium preload Z3	Vertical direction		Lateral direction		
			Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3	
High-load type	LS15 AL, EL, FL, EM	69	390	127	226	88	167
	LS20 AL, EL, FL, EM	88	540	147	284	108	206
	LS25 AL, EL, FL, EM	147	880	206	370	147	275
	LS30 AL, EL, FL, EM	245	1370	255	460	186	345
	LS35 AL, EL, FL, EM	345	1960	305	550	216	400
Medium-load type	LS15 CL, JL, KL, JM	49	294	78	147	59	108
	LS20 CL, JL, KL, JM	69	390	108	186	78	137
	LS25 CL, JL, KL, JM	98	635	127	235	88	177
	LS30 CL, JL, KL, JM	147	980	147	275	108	206
	LS35 CL, JL, KL, JM	245	1370	186	335	137	245

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

• Clearance and preload of random-matching type

Table 6

Unit: μm

Model No.	Fine clearance	Slight preload
	ZT	ZZ
LS15	-4 - 15	-4 - 0
LS20	-4 - 15	-4 - 0
LS25	-5 - 15	-5 - 0
LS30	-5 - 15	-5 - 0
LS35	-5 - 15	-6 - 0

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

(4) Available length of rail

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

Table 7 Length limitations of rails

Unit: mm

Series	Material	Size				
		15	20	25	30	35
LS	Special high carbon steel	2000	3960	3960	4000	4000
	Stainless steel	1700	3500	3500	3500	3500

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

(5) Installation

1. Permissible values of mounting error

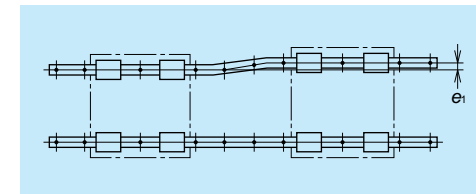


Fig. 7

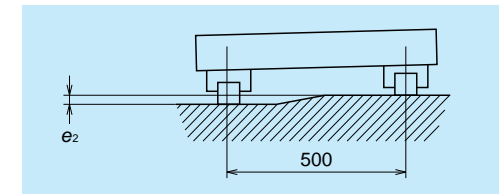


Fig. 8

Table 8

Unit: μm

Value	Preload	Model No.				
		LS15	LS20	LS25	LS30	LS35
Permissible values of parallelism in two rails e <sub>1</sub>	Z0, ZT	20	22	30	35	40
	Z1, ZZ	15	17	20	25	30
	Z3	12	15	15	20	25
Permissible values of parallelism (height) in two rails e <sub>2</sub>	Z0, ZT	375 μm/500 mm				
	Z1, ZZ, Z3	330 μm/500 mm				

2. Shoulder height of the mounting face and corner radius r

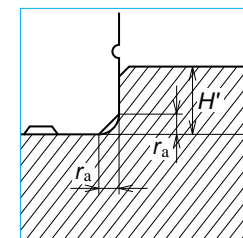


Fig. 9 Shoulder for the rail datum face

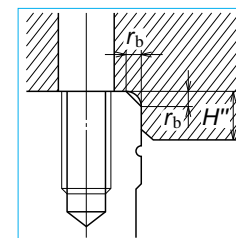


Fig. 10 Shoulder for the ball slide datum face

Table 9

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r <sub>a</sub>	r <sub>b</sub>	H'	H''
LS15	0.5	0.5	4	4
LS20	0.5	0.5	4.5	5
LS25	0.5	0.5	5	5
LS30	0.5	0.5	6	6
LS35	0.5	0.5	6	6

## (6) Lubrication components

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

### 1. Types of lubrication accessories

Figure 11 and Table 10 show grease fittings and tube fittings.

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

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

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

Please ask NSK for stainless lubrication accessories.

### 2. Mounting position of lubrication accessories

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

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

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

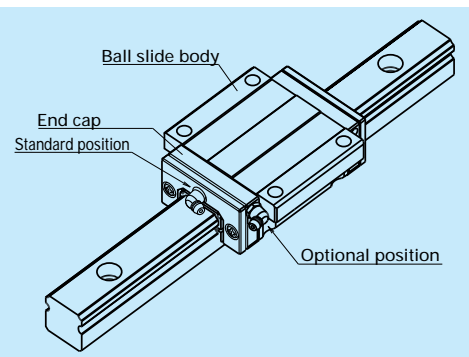


Fig. 12 Mounting position of lubrication accessories

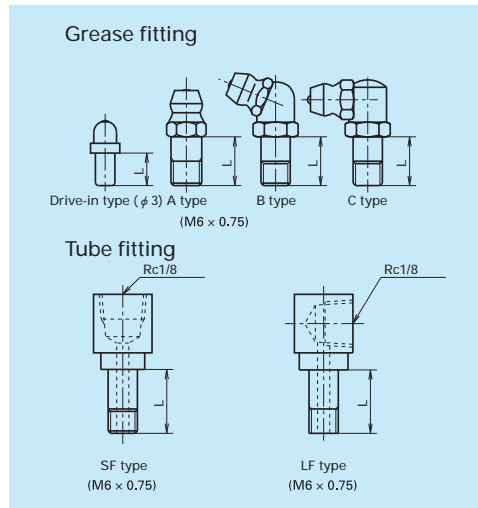


Fig. 11 Grease fitting and tube fitting

Model No.	Dust proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
LS15	Standard	5	-
	With NSK K1	10	-
	Double seal	*	-
	Protector	*	-
LS20	Standard	5	-
	With NSK K1	10	-
	Double seal	8	-
	Protector	8	-
LS25	Standard	5	6
	With NSK K1	12	11
	Double seal	10	9
	Protector	10	9
LS30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
LS35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11

\*) Please contact NSK as a connector is required.

## (7) Dust proof components

### 1. Standard specification

To keep foreign matters from entering inside the ball slide, LS Series has an end seal on both ends, and bottom seals at the bottom.

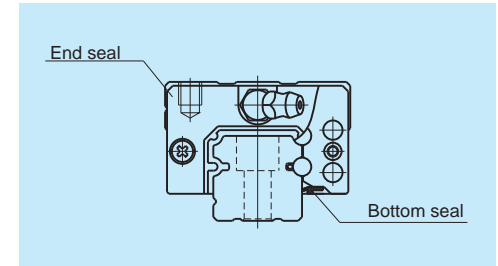


Fig. 13

Table 11 Seal friction per ball slide (maximum value)

Series	Size	Unit : N				
		15	20	25	30	35
LS		8	9	9	9	10

### 2. NSK K1™

Table 12 shows the dimension of linear guides equipped with the NSK K1.

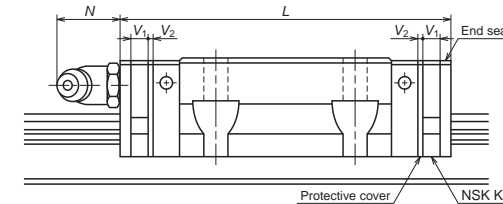


Table 12

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Unit: mm		Protruding area of the grease fitting N
					Per NSK K1 thickness V <sub>1</sub>	Protective cover thickness V <sub>2</sub>	
LS15	Standard	AL, EL, FL, EM	56.8	66.4	4.0	0.8	(5)
	Short	CL, JL, KL, JM	40.4	50			
LS20	Standard	AL, EL, FL, EM	65.2	75.8	4.5	0.8	(14)
	Short	CL, JL, KL, JM	47.2	57.8			
LS25	Standard	AL, EL, FL, EM	81.6	92.2	4.5	0.8	(14)
	Short	CL, JL, KL, JM	59.6	70.2			
LS30	Standard	AL, EL, FL, EM	96.4	108.4	5.0	1.0	(14)
	Short	CL, JL, KL, JM	67.4	79.4			
LS35	Standard	AL, EL, FL, EM	108	121	5.5	1.0	(14)
	Short	CL, JL, KL, JM	77	90			

Note: Ball slide length equipped with NSK K1 = (Standard ball slide length) + (Thickness of NSK K1, V<sub>1</sub> × Number of NSK K1) + (Thickness of the protective cover, V<sub>2</sub> × 2)

### 3. Double seal

Use a double seal set as showing in Table 13, when installing an extra seal to completed standard products. (Fig. 14)

When installing a grease fitting after the installation of double seals, a connector is required.

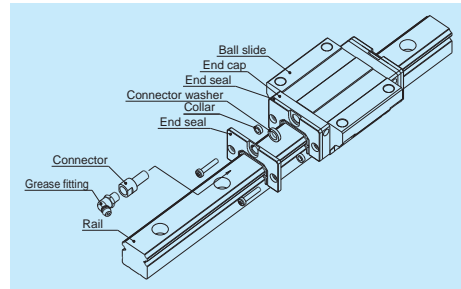


Fig. 14 Double seal

### 4. Protector

Use a protector set as showing Table 14, when installing a protector to completed standard products. (Fig.15)

When installing a grease fitting after the installation of protectors, a connector is required.

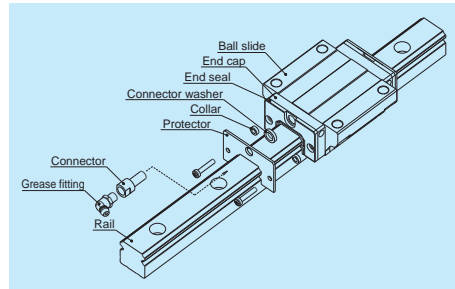


Fig. 15 Protector

Table 13 Double-seal set

Model No.	Reference No.		Increased thickness $V_1$
	Without connector	With connector	
LS15	LS15WS-01	*	2.8
LS20	LS20WS-01	LS20WSC-01	2.5
LS25	LS25WS-01	LS25WSC-01	2.8
LS30	LS30WS-01	LS30WSC-01	3.6
LS35	LS35WS-01	LS35WSC-01	3.6

Table 14 Protector set

Model No.	Reference No.		Increased thickness $V_2$
	Without connector	With connector	
LS15	LS15PT-01	*	3
LS20	LS20PT-01	LS20PTC-01	2.7
LS25	LS25PT-01	LS25PTC-01	3.2
LS30	LS30PT-01	LS30PTC-01	4.2
LS35	LS35PT-01	LS35PTC-01	4.2

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

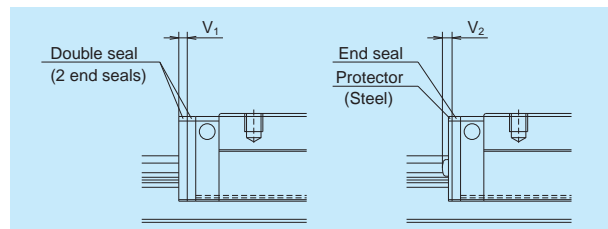


Fig. 16

### 5. Cap to cover the bolt hole for rail mounting

Table 15 Caps to cover rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
LS15	M3	LG-CAP/M3	20
LS15	M4	LG-CAP/M4	20
LS20	M5	LG-CAP/M5	20
LS25, LS30	M6	LG-CAP/M6	20
LS35	M8	LG-CAP/M8	20

### 7. Bellows

Use a bellows fastener kit as showing Table 17, when installing bellows to completed standard products. A bellows fastener kit is supplied with one of bellows fastener, two of M1 set screws, two of M2 set screws, and two collars for M2 set screw.

### 6. Inner seal

Inner seal can be manufactured for models shown below.

Table 16

Series	Model No.
LS	LS20, LS25, LS30, LS35

Table 17 Bellows fastener kit reference No.

Model No.	Kit reference No.
LS15	LS15FS-01
LS20	LS20FS-01
LS25	LS25FS-01
LS30	LS30FS-01
LS35	LS35FS-01

Dimension tables of bellows  
LS Series

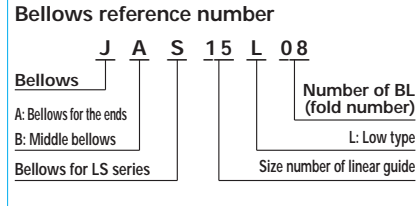
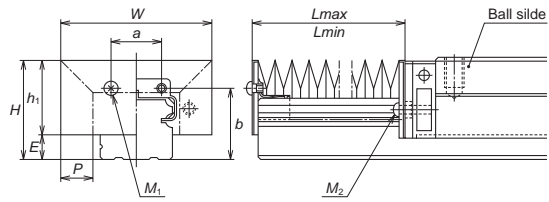


Fig. 17 Dimensions of bellows

Table 18 Dimensions of bellows

Unit: mm

Model No.	H	h <sub>1</sub>	E	W	P	a	b	BL minimum length	M <sub>1</sub> Tap x depth	M <sub>2</sub> Tap x depth
JAS15L	23.5	18.9	4.6	43	10	8	16.5	17	M3x5	M3x14
JAS20L	27	21	6	48	10	13	19.7	17	M3x5	M2.5x14
JAS25L	32	25	7	51	10	15	23.2	17	M3x5	M3x18
JAS30L	41	32	9	66	15	16	29	17	M4x6	M4x19
JAS35L	47	36.5	10.5	72	15	22	33.5	17	M4x6	M4x22

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
		L <sub>min</sub>	34	68	102	136	170	204	238	272	306
JAS15L	Stroke	106	212	318	424	530	636	742	848	954	1060
	L <sub>max</sub>	140	280	420	560	700	840	980	1120	1260	1400
JAS20L	Stroke	106	212	318	424	530	636	742	848	954	1060
	L <sub>max</sub>	140	280	420	560	700	840	980	1120	1260	1400
JAS25L	Stroke	106	212	318	424	530	636	742	848	954	1060
	L <sub>max</sub>	140	280	420	560	700	840	980	1120	1260	1400
JAS30L	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
	L <sub>max</sub>	210	420	630	840	1050	1260	1470	1680	1890	2100
JAS35L	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
	L <sub>max</sub>	210	420	630	840	1050	1260	1470	1680	1890	2100

Remarks: Values of odd number BL (3, 5, 7, ...) can be obtained by adding two values of even number BLs on both side, then dividing the sum by two.



**(8) Reference number**

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.

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

**1. Reference number for preloaded assembly**

**LS 30 1000 AL C 2 -\*\* P5 3**

Series name	Size	Rail length (mm)	Ball slide shape code (See page A186)	Material/surface treatment code (See Table 20)	Preload code (See page A188)	Accuracy code (See Table 21)	Design serial number	Number of ball slides per rail
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Added to the reference number.

**2. Reference number for random-matching type**

**LAS 30 AL C -\*\*PCZ**

Random-matching ball slide series code <small>LAS : LS Series random-matching ball slide</small>	Size	Ball slide shape code (See page A186)	Material/surface treatment code (See Table 20)	Preload code <small>T: Fine clearance. Z: Slight preload (See page A188)</small>	Accuracy code : PC <small>PC: Normal grade is only available</small>	Design serial number
---	------	---------------------------------------	--	---	---	----------------------

Added to the reference number.

**L1S 30 1000 L C N -\*\* PC Z**

Random-matching rail series code <small>L1S : LS Series random-matching rail</small>	Size	Rail length (mm)	Rail shape code <small>L: Standard, LS15 with mounting holes for M3 T: LS15 with mounting holes for M4</small>	Material/surface treatment code (See Table 20)	Preload code <small>T: Fine clearance. Z: Slight preload (See page A188)</small>	Accuracy code : PC <small>PC: Normal grade is only available</small>	Design serial number	*Butting rail specification <small>N: Non-butting. L: Butting specification</small>
---	------	------------------	---	--	---	---	----------------------	--

Added to the reference number.

\*Please consult with NSK for butting rail specification.

Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is fine clearance "T" or slight preload "Z" (Refer to page A188).

**Table 20 Material/surface treatment code**

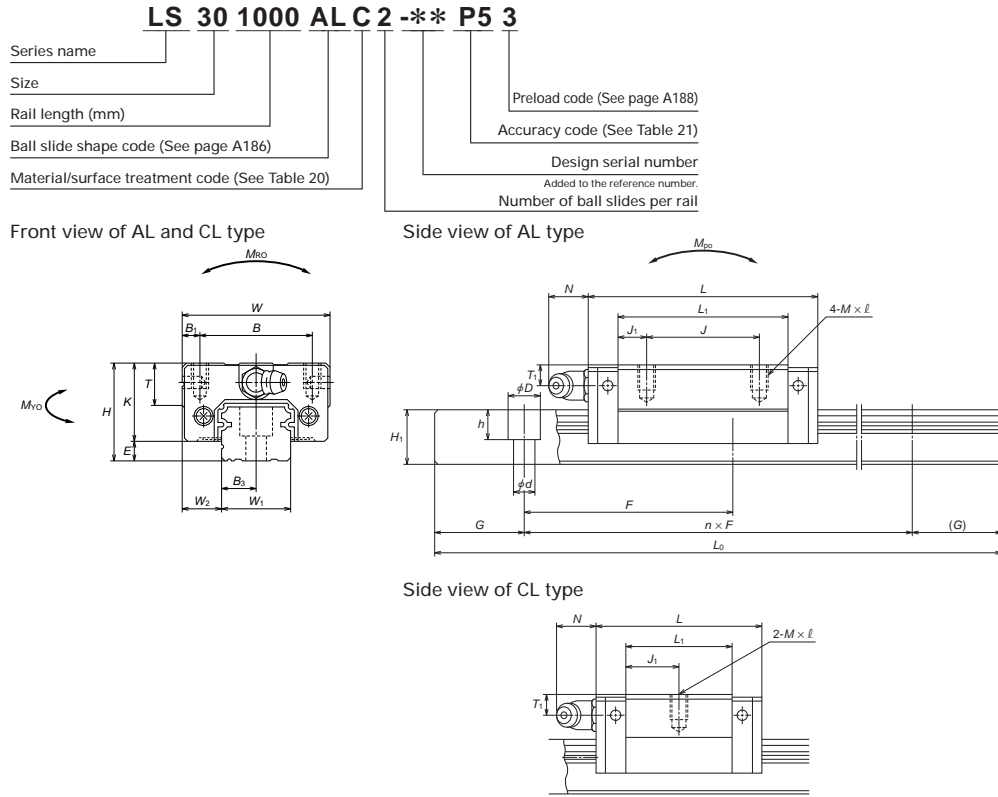
Code	Description
C	Special high carbon steel (NSK standard)
K	Stainless steel
D	Special high carbon steel with surface treatment
H	Stainless steel with surface treatment
Z	Other, special

**Table 21 Accuracy code**

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

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

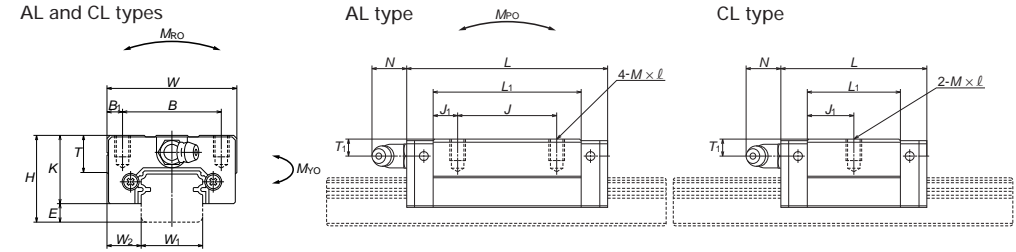
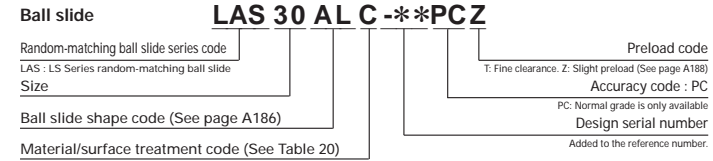
(9) Dimensions  
LS-CL (Medium-load type)  
LS-AL (High-load type)



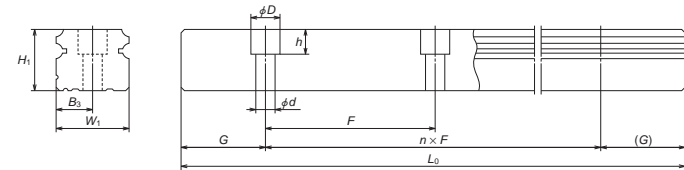
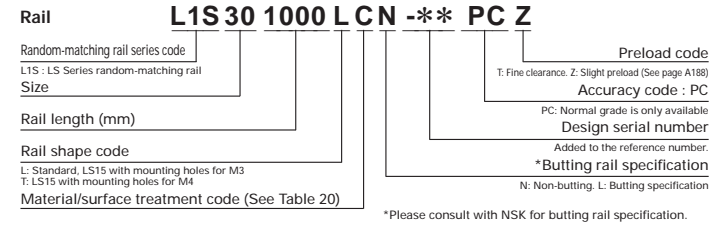
Model No.	Assembly					Ball slide										
	Height		Width	Length	Mounting hole						Grease fitting					
	H	E			B	J	M x pitch x l	B1	L1	J1	K	T	Hole size	T1	N	
LS15CL LS15AL	24	4.6	9.5	34	40.4 56.8	26	26	M4x0.7x6	4	23.6 40	11.8 7	19.4	10	phi 3	6	3
LS20CL LS20AL	28	6	11	42	47.2 65.2	32	32	M5x0.8x7	5	30 48	15 8	22	12	M6x0.75	5.5	11
LS25CL LS25AL	33	7	12.5	48	59.6 81.6	35	35	M6x1x9	6.5	38 60	19 12.5	26	12	M6x0.75	7	11
LS30CL LS30AL	42	9	16	60	67.4 96.4	40	40	M8x1.25x12	10	42 71	21 15.5	33	13	M6x0.75	8	11
LS35CL LS35AL	48	10.5	18	70	77 108	50	50	M8x1.25x12	10	49 80	24.5 15	37.5	14	M6x0.75	8.5	11

Remarks: 1) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Reference number for ball slide of random-matching type



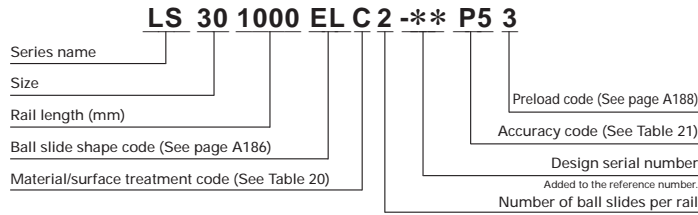
Reference number for rail of random-matching type



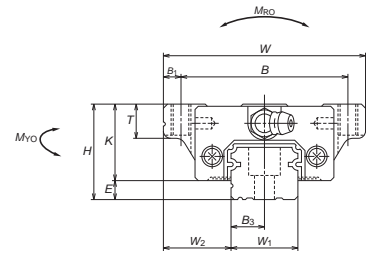
Rail										Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole	B3	G (reference)	Max. length Lmax ( ) for stainless	Dynamic C (N)	Static C0 (N)	Static moment Mro (N-m)	Mfo (N-m)	Mvo (N-m)	Dw	Ball slide (kg)	Rail (kg/m)			
15	12.5	60	*3.5x6x4.5 4.5x7.5x5.3	7.5	20	2000 (1700)	5400 8350	9100 16900	45.5 84.5	24.5 77	20.5 64.5	2.778	0.14 0.20	1.4			
20	15.5	60	6x9.5x8.5	10	20	3960 (3500)	7900 11700	13400 23500	91.5 160	46.5 133	39 111	3.175	0.19 0.28	2.3			
23	18	60	7x11x9	11.5	20	3960 (3500)	12700 18800	20800 36500	164 286	91 258	76 217	3.968	0.34 0.51	3.1			
28	23	80	7x11x9	14	20	4000 (3500)	18700 28800	29600 55000	282 520	139 435	116 365	4.762	0.58 0.85	4.8			
34	27.5	80	9x14x12	17	20	4000 (3500)	26000 40000	40000 74500	465 865	220 695	185 580	5.556	0.86 1.3	7.0			

2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C100 for 100 km rating fatigue life, divide the C by 1.26.  
\* Standard mounting hole of LS15 rail is for M3 bolts (Hole size: 3.5x6x4.5).  
If you require the mounting hole for M4 bolts (Hole size: 4.5x7.5x5.3), please specify it when ordering.

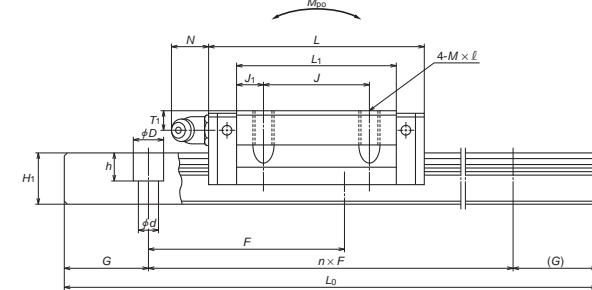
LS-JL (Medium-load type)  
LS-EL (High-load type)



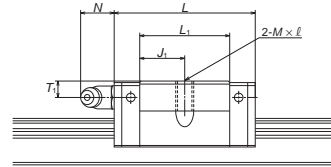
Front view of EL and JL type



Side view of EL type



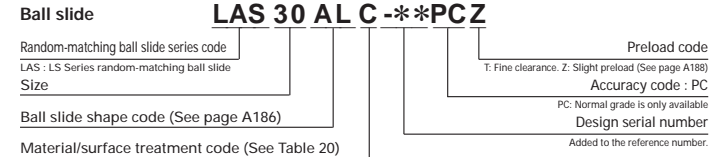
Side view of JL type



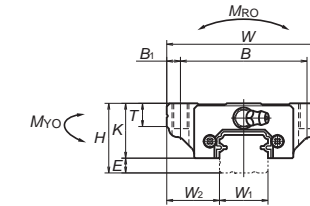
Model No.	Assembly			Ball slide											Grease fitting			
	Height	Width	Length	Mounting hole							B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Hole size	T <sub>1</sub>	N
				B	J	M × pitch × l												
LS15JL LS15EL	24	4.6	18.5	52	40.4 56.8	41	— 26	M5×0.8×8	5.5	23.6 40	11.8 7	19.4	8	8	φ 3	6	3	
LS20JL LS20EL	28	6	19.5	59	47.2 65.2	49	— 32	M6×1×10	5	30 48	15 8	22	10	10	M6×0.75	5.5	11	
LS25JL LS25EL	33	7	25	73	59.6 81.6	60	— 35	M8×1.25×12	6.5	38 60	19 12.5	26	11 (12)	11	M6×0.75	7	11	
LS30JL LS30EL	42	9	31	90	67.4 96.4	72	— 40	M10×1.5×18 (M10×1.5×15)	9	42 71	21 15.5	33	11 (15)	11	M6×0.75	8	11	
LS35JL LS35EL	48	10.5	33	100	77 108	82	— 50	M10×1.5×20 (M10×1.5×15)	9	49 80	24.5 15	37.5	12 (15)	12	M6×0.75	8.5	11	

Remarks: 1) The external appearance of stainless steel ball slides differs from those of standard material ball slide.  
 2) Parenthesized dimensions are for items made of stainless steel.

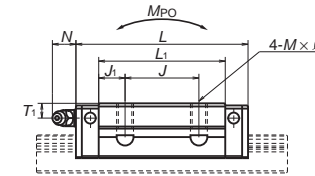
Reference number for ball slide of random-matching type



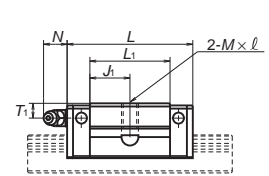
EL and JL types



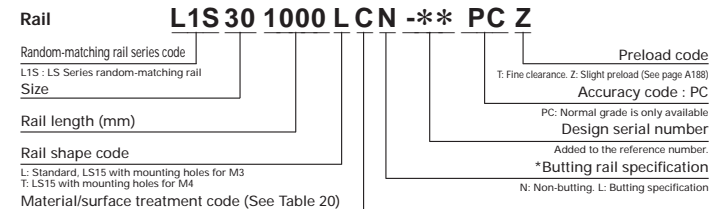
EL type



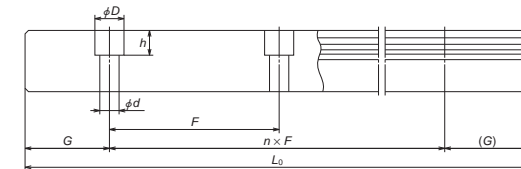
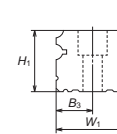
JL type



Reference number for rail of random-matching type



\*Please consult with NSK for butting rail specification.

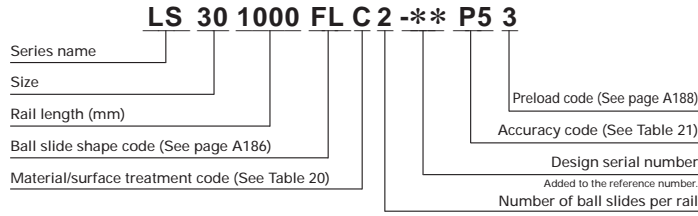


Rail											Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole	B <sub>3</sub>	G	Max. length L <sub>max</sub> ( ) for stainless	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment M <sub>RO</sub> (N·m)	M <sub>PO</sub> (N·m)	M <sub>VO</sub> (N·m)	D <sub>w</sub>	Ball slide (kg)	Rail (kg/m)				
15	12.5	60	*3.5×6×4.5 4.5×7.5×5.3	7.5	20	2000 (1700)	5400 8350	9100 16900	45.5 84.5	24.5 77	20.5 64.5	2.778	0.17 0.26	1.4				
20	15.5	60	6×9.5×8.5	10	20	3960 (3500)	7900 11700	13400 23500	91.5 160	46.5 133	39 111	3.175	0.24 0.35	2.3				
23	18	60	7×11×9	11.5	20	3960 (3500)	12700 18800	20800 36500	164 286	91 258	76 217	3.968	0.44 0.66	3.1				
28	23	80	7×11×9	14	20	4000 (3500)	18700 28800	29600 55000	282 520	139 435	116 365	4.762	0.76 1.2	4.8				
34	27.5	80	9×14×12	17	20	4000 (3500)	26000 40000	40000 74500	465 865	220 695	185 580	5.556	1.2 1.7	7.0				

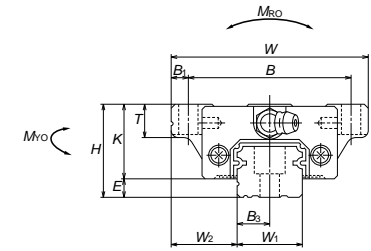
3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.

\* Standard mounting hole of LS15 rail is for M3 bolts (Hole size: 3.5×6×4.5).  
 If you require the mounting hole for M4 bolts (Hole size: 4.5×7.5×5.3), please specify it when ordering.

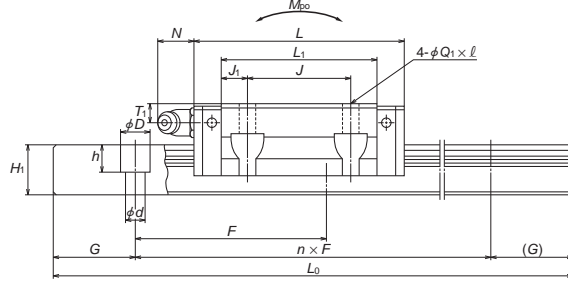
LS-KL (Medium-load type)  
LS-FL (High-load type)



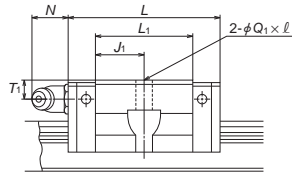
Front view of FL and KL type



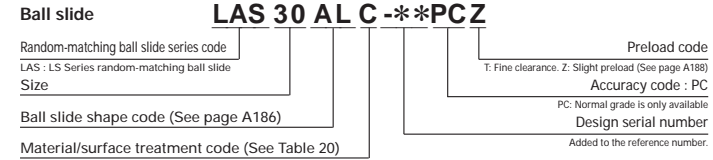
Side view of FL type



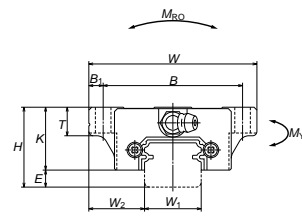
Side view of KL type



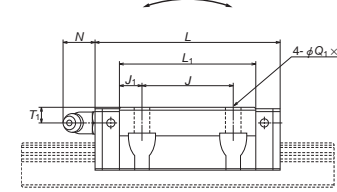
Reference number for ball slide of random-matching type



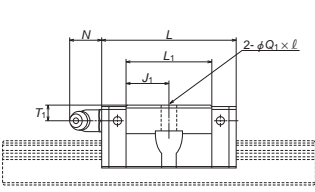
FL and KL types



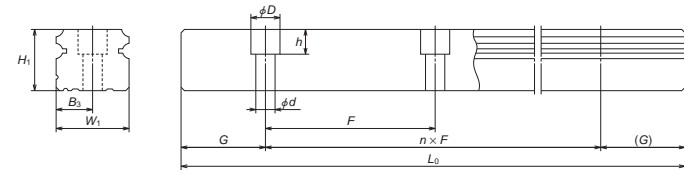
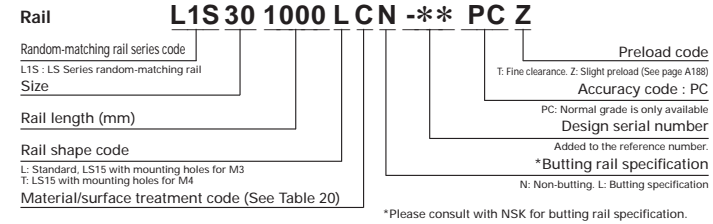
FL type



KL type



Reference number for rail of random-matching type



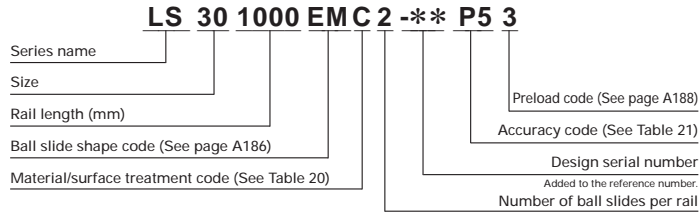
Model No.	Assembly			Ball slide											Grease fitting			
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole					B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Hole size	T <sub>1</sub>	N
						B	J	Q <sub>1</sub> ×ℓ										
LS15KL LS15FL	24	4.6	18.5	52	40.4 56.8	41 26	—	4.5×7			5.5	23.6 40	11.8 7	19.4	8	φ 3	6	3
LS20KL LS20FL	28	6	19.5	59	47.2 65.2	49 32	—	5.5×9 (5.5×9.5)			5	30 48	15 8	22	10	M6×0.75	5.5	11
LS25KL LS25FL	33	7	25	73	59.6 81.6	60 35	—	7×10 (7×11.5)			6.5	38 60	19 12.5	26	11 (12)	M6×0.75	7	11
LS30KL LS30FL	42	9	31	90	67.4 96.4	72 40	—	9×12 (9×14.5)			9	42 71	21 15.5	33	11 (15)	M6×0.75	8	11
LS35KL LS35FL	48	10.5	33	100	77 108	82 50	—	9×13 (9×14.5)			9	49 80	24.5 15	37.5	12 (15)	M6×0.75	8.5	11

Remarks: 1) The external appearance of stainless steel ball slides differs from those of standard material ball slide.  
2) Parenthesized dimensions are for items made of stainless steel.

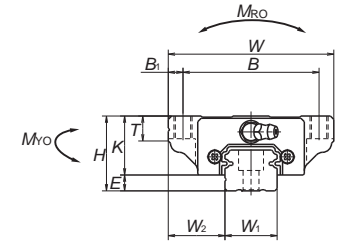
Rail							Basic load rating					Ball dia.		Weight	
Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Mounting bolt hole d×D×h	B <sub>3</sub>	G (reference)	Max. length L <sub>0max</sub> ( ) for stainless	Dynamic			Static		D <sub>w</sub>	Ball slide (kg)	Rail slide (kg/m)	
							C (N)	C <sub>0</sub> (N)	M <sub>RO</sub> (N·m)	M <sub>PO</sub> (N·m)	M <sub>VO</sub> (N·m)				
15	12.5	60	*3.5×6×4.5 4.5×7.5×5.3	7.5	20	2000 (1700)	5400 8350	9100 16900	45.5 84.5	24.5 77	20.5 64.5	2.778	0.17 0.26	1.4	
20	15.5	60	6×9.5×8.5	10	20	3960 (3500)	7900 11700	13400 23500	91.5 160	46.5 133	39 111	3.175	0.24 0.35	2.3	
23	18	60	7×11×9	11.5	20	3960 (3500)	12700 18800	20800 36500	164 286	91 258	76 217	3.968	0.44 0.66	3.1	
28	23	80	7×11×9	14	20	4000 (3500)	18700 28800	29600 55000	282 520	139 435	116 365	4.762	0.76 1.2	4.8	
34	27.5	80	9×14×12	17	20	4000 (3500)	26000 40000	40000 74500	465 865	220 695	185 580	5.556	1.2 1.7	7	

3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.  
\* Standard mounting hole of LS15 rail is for M3 bolts (Hole size: 3.5×6×4.5).  
If you require the mounting hole for M4 bolts (Hole size: 4.5×7.5×5.3), please specify it when ordering.

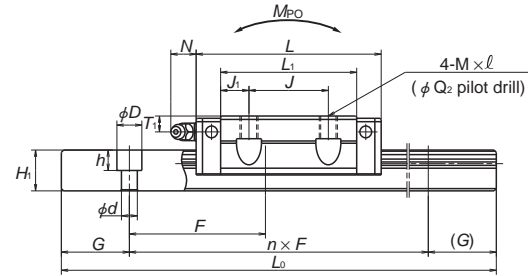
LS-JM (Medium-load type)  
LS-EM (High-load type)



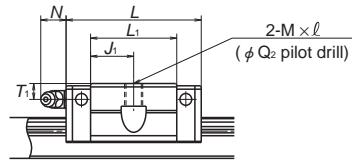
Front view of EM and JM type



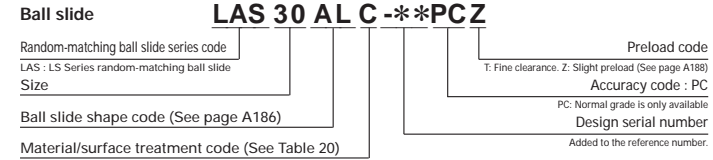
Side view of EM type



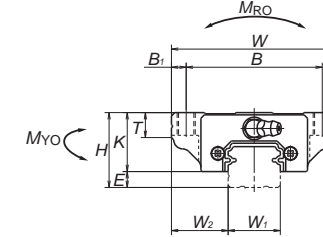
Side view of JM type



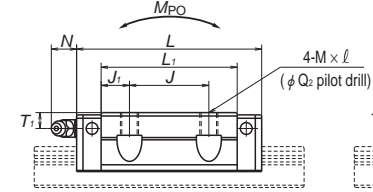
Reference number for ball slide of random-matching type



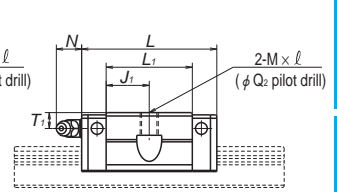
EM and JM types



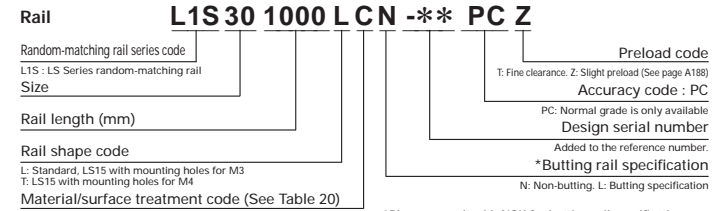
EM type



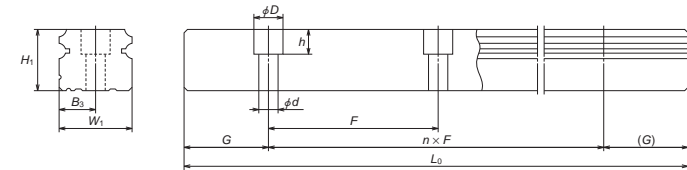
JM type



Reference number for rail of random-matching type



\*Please consult with NSK for butting rail specification.



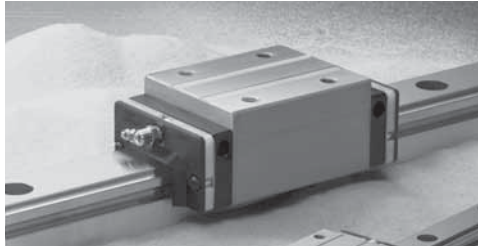
Model No.	Assembly		Ball slide														Grease fitting		
	Height H	E	W <sub>2</sub>	W	L	Mounting hole				Q <sub>2</sub>	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Hole size	T <sub>1</sub>	N	
						B	J	M × pitch × l	Q <sub>2</sub>										
LS15JM LS15EM	24	4.6	18.5	52	40.4 56.8	41 26	—	M5×0.8×7	4.4	5.5	23.6 40	11.8 7	19.4	8	φ 3	6	3		
LS20JM LS20EM	28	6	19.5	59	47.2 65.2	49 32	—	M6×1×9 (M6×1×9.5)	5.3	5	30 48	15 8	22	10	M6×0.75	5.5	11		
LS25JM LS25EM	33	7	25	73	59.6 81.6	60 35	—	M8×1.25×10 (M8×1.25×11.5)	6.8	6.5	38 60	19 12.5	26	11 (12)	M6×0.75	7	11		
LS30JM LS30EM	42	9	31	90	67.4 96.4	72 40	—	M10×1.5×12 (M10×1.5×14.5)	8.6	9	42 71	21 15.5	33	11 (15)	M6×0.75	8	11		
LS35JM LS35EM	48	10.5	33	100	77 108	82 50	—	M10×1.5×13 (M10×1.5×14.5)	8.6	9	49 80	24.5 15	37.5	12 (15)	M6×0.75	8.5	11		

Remarks: 1) The external appearance of stainless steel ball slides differs from those of standard material ball slide.  
 2) Parenthesized dimensions are for items made of stainless steel.

Rail							Basic load rating					Ball dia.	Weight	
Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Mounting bolt hole d × D × h	B <sub>3</sub>	G (reference)	Max. length L <sub>0max</sub> ( ) for stainless	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment			D <sub>w</sub>	Ball slide (kg)	Rail slide (kg/m)
									M <sub>RO</sub> (N·m)	M <sub>PO</sub> (N·m)	M <sub>VO</sub> (N·m)			
15	12.5	60	*3.5×6×4.5 4.5×7.5×5.3	7.5	20	2000 (1700)	5400 8350	9100 16900	45.5 84.5	24.5 77	20.5 64.5	2.778	0.17 0.26	1.4
20	15.5	60	6×9.5×8.5	10	20	3960 (3500)	7900 11700	13400 23500	91.5 160	46.5 133	39 111	3.175	0.24 0.35	2.3
23	18	60	7×11×9	11.5	20	3960 (3500)	12700 18800	20800 36500	164 286	91 258	76 217	3.968	0.44 0.66	3.1
28	23	80	7×11×9	14	20	4000 (3500)	18700 28800	29600 55000	282 520	139 435	116 365	4.762	0.76 1.2	4.8
34	27.5	80	9×14×12	17	20	4000 (3500)	26000 40000	40000 74500	465 865	220 695	185 580	5.556	1.2 1.7	7

3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.  
 \* Standard mounting hole of LS15 rail is for M3 bolts (Hole size: 3.5×6×4.5).  
 If you require the mounting hole for M4 bolts (Hole size: 4.5×7.5×5.3), please specify it when ordering.

## A-5-1.5 VH Series



### (1) Features

#### 1. High-performance end seals

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

#### 2. NSK K1™ lubrication unit (standard)

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

#### 3. Tapped holes on a rail bottom face (optional)

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

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

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

#### 5. High load carrying capacity to vertical direction

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

#### 6. High resistance against impact load

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

is applied vertically as shown in Fig. 3. This assures high resistance to the impact load.

#### 7. High accuracy

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

#### 8. Fast delivery

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

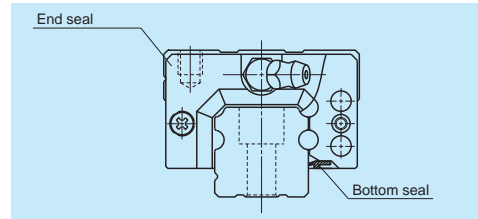


Fig. 1 VH Series

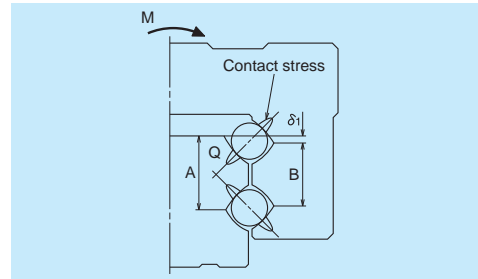


Fig. 2 Enlarged illustration of the offset Gothic arch groove

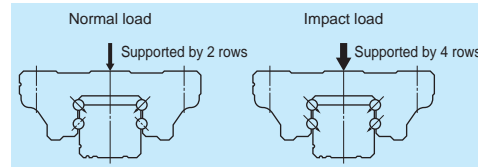


Fig. 3 When load is applied

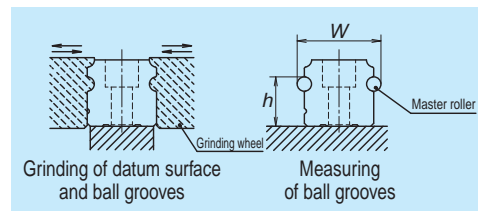
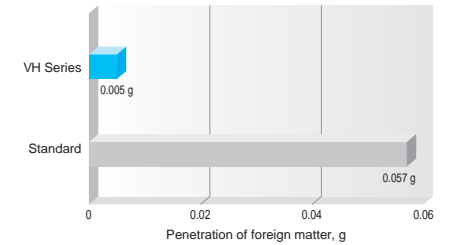


Fig. 4 Rail grinding and measuring

### ●Comparison with NSK standard products

**Less than 1/10 the level of fine contaminants**  
Results of dust-proof tests reveal that the entry of fine contaminants is reduced to less than one-tenth of existing standard series due to improvements in sealing capability.

Specimen : VH30AN  
Speed : 16.7 mm/sec  
Foreign matter : Graphite powder (average grain size: 0.037 mm) + Grease

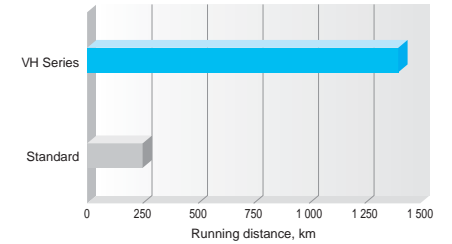


**Operating life under contaminated environments is more than 5 times longer**

#### Durability test with rubber fragments

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

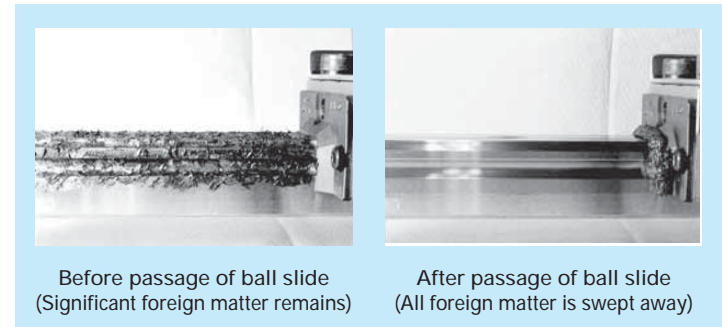
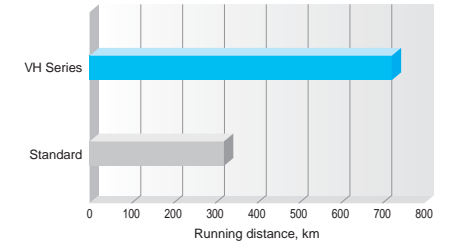
Specimen : VH30AN, preload with Z1 (preload of 245 N)  
Rail orientation : Horizontal (wall mount)  
Speed : 500 mm/sec  
Lubrication : AS2 Grease (charged only at the beginning)  
Foreign matter : Rubber fragments



#### Durability test with fine wood particles

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

Specimen : VH30AN (preload of 3 200 N)  
Rail orientation : Horizontal (wall mount)  
Feed rate : 400 mm/sec  
Lubrication : AS2 Grease (charged only at the beginning)  
Foreign matter : Fine wood particles



Before passage of ball slide (Significant foreign matter remains)

After passage of ball slide (All foreign matter is swept away)

(2) Ball slide shape

Ball slide Model	Shape/installation method	Type	
		High-load type	Super-high-load type
AN BN		AN 	BN 
AL BL		AL 	BL 
FL HL		FL 	HL 
EL GL		EL 	GL 
EM GM		EM 	GM 

(3) Accuracy and preload

1. Running parallelism of ball slide

Table 1

Unit:  $\mu\text{m}$

Rail over all length (mm) over or less	Preloaded assembly (not random matching)					Random-matching type
	Ultra precision K3	Super precision K4	High precision K5	Precision grade K6	Normal grade KN	Normal grade KC
- 50	2	2	2	4.5	6	6
50 - 80	2	2	3	5	6	6
80 - 125	2	2	3.5	5.5	6.5	6.5
125 - 200	2	2	4	6	7	7
200 - 250	2	2.5	5	7	8	8
250 - 315	2	2.5	5	8	9	9
315 - 400	2	3	6	9	11	11
400 - 500	2	3	6	10	12	12
500 - 630	2	3.5	7	12	14	14
630 - 800	2	4.5	8	14	16	16
800 - 1000	2.5	5	9	16	18	18
1000 - 1250	3	6	10	17	20	20
1250 - 1600	4	7	11	19	23	23
1600 - 2000	4.5	8	13	21	26	26
2000 - 2500	5	10	15	22	29	29
2500 - 3150	6	11	17	25	32	32
3150 - 4000	9	16	23	30	34	34

2. Accuracy standard

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

• Tolerance of preloaded assembly

Table 2

Unit:  $\mu\text{m}$

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

• Tolerance of random-matching type: Normal grade KC

Table 3

Unit:  $\mu\text{m}$

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

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

### 3. Combinations of accuracy and preload

Table 4

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

### 4. Assembled accuracy

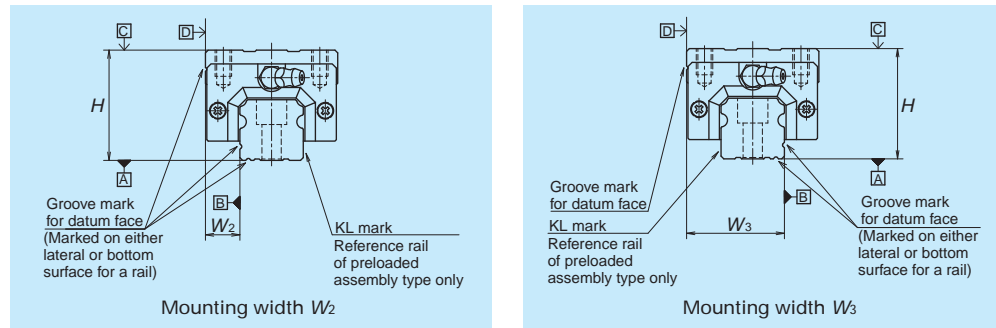


Fig. 5 Special high carbon steel

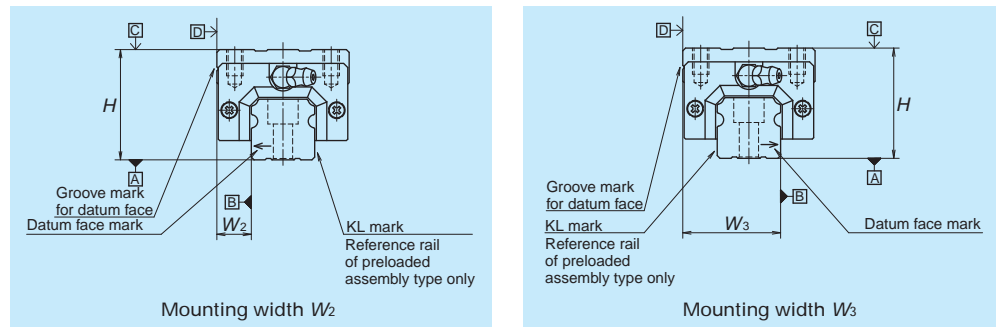


Fig. 6 Stainless steel

### 5. Preload and rigidity

We offer five levels of preload: slight preload Z1, medium preload Z3 and fine clearance Z0, along with random-matching type of fine clearance ZT and slight preload ZZ. Values for preload and rigidity of the preloaded assembly are shown in Table 5. Rigidities are for the median of the preload range.

#### • Preload and rigidity of preloaded assembly

Table 5

Model No.		Preload (N)		Rigidity (N/μm)			
		Slight preload Z1		Vertical directions		Lateral direction	
				Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3
High-load type	VH15 AN, EL, FL, EM	78	490	137	226	98	186
	VH20 AN, EL, FL, EM	147	835	186	335	137	245
	VH25 AN, AL, EL, FL, EM	196	1270	206	380	147	284
	VH30 AN, AL	245	1570	216	400	157	294
	VH30 EL, FL, EM	294	1770	265	480	186	355
	VH35 AN, AL, EL, FL, EM	390	2350	305	560	216	390
Super-high-load type	VH45 AN, AL, EL, FL, EM	635	3900	400	745	284	540
	VH55 AN, AL, EL, FL, EM	980	5900	490	910	345	645
	VH15 BN, GL, HL, GM	98	685	196	345	137	284
	VH20 BN, GL, HL, GM	196	1080	265	480	196	355
	VH25 BN, BL, GL, HL, GM	245	1570	294	560	216	400
	VH30 BN, BL, GL, HL, GM	390	2260	360	665	265	480
	VH35 BN, BL, GL, HL, GM	490	2940	430	795	305	570
	VH45 BN, BL, GL, HL, GM	785	4800	520	960	370	695
	VH55 BN, BL, GL, HL, GM	1180	7050	635	1170	440	835

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

#### • Preload of random-matching type

Table 6

Unit: μm

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

#### (4) Available length of rail

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

Table 7 Length limitations of rails

Unit: mm

Series	Size	15	20	25	30	35	45	55
	Material							
VH	Special high carbon steel	2000	3960	3960	4000	4000	3990	3960
	Stainless steel	1800	3500	3500	3500			

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



(5) Installation

1. Permissible values of mounting error

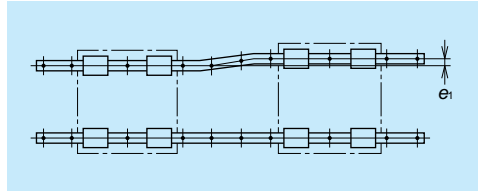


Fig. 7

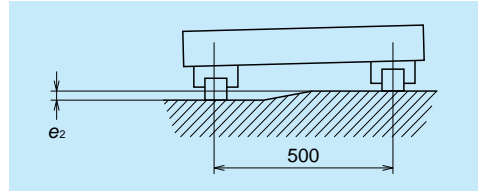


Fig. 8

Table 8

Unit:  $\mu\text{m}$

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

2. Shoulder height of the mounting face and corner radius r

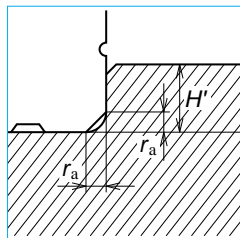


Fig. 9 Shoulder for the rail datum face

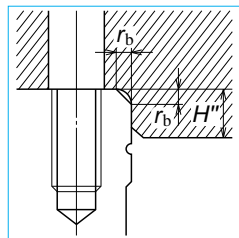


Fig. 10 Shoulder for the ball slide datum face

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

- Accuracy grades are precision grade (K6) and normal grades (KN and KC).
- Minimum rail length for production is 400 mm.
- Tapping pitch is the same as the pitch for regular mounting bolt holes. Please refer to the dimension table.

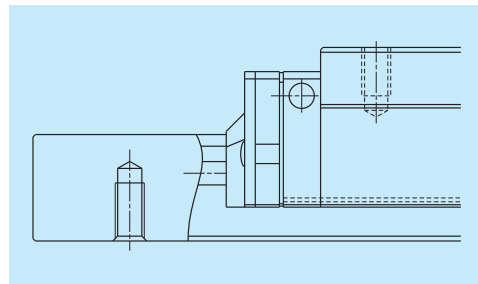


Fig. 11

(6) Lubrication components

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

1. Types of lubrication accessories

Figure 12 and Table 10 show grease fittings and tube fittings.

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

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

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

Please ask NSK for stainless lubrication accessories.

2. Mounting position of lubrication accessories

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

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

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

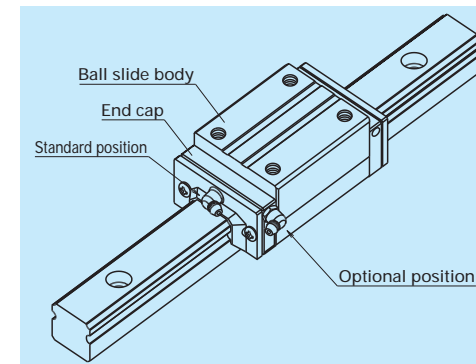


Fig. 13 Mounting position of lubrication accessories

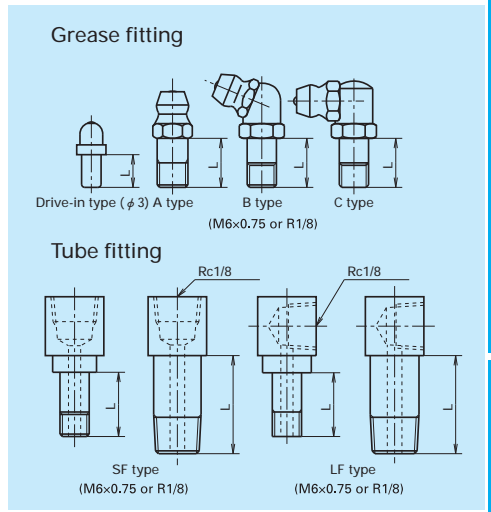


Fig. 12 Grease fitting and tube fitting

Table 10

Unit: mm

Model No.	Dust proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
VH15	Standard	10*	-
	With NSK K1	-	-
	Double seal	**	-
	Protector	**	-
VH20	Standard	12*	-
	With NSK K1	-	-
	Double seal	18	-
	Protector	18	-
VH25	Standard	12*	17***
	With NSK K1	-	-
	Double seal	18	23***
	Protector	18	19***
VH30	Standard	14*	18
	With NSK K1	-	-
	Double seal	22	25
	Protector	22	19
VH35	Standard	14*	15
	With NSK K1	-	-
	Double seal	22	25
	Protector	22	22
VH45	Standard	18*	21.5
	With NSK K1	-	-
	Double seal	22	32
	Protector	28	30
VH55	Standard	18*	20
	With NSK K1	-	-
	Double seal	22	32
	Protector	28	30

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

\*\*) Please contact NSK as a connector is required.

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

(7) Dust proof components

1. Standard specification

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

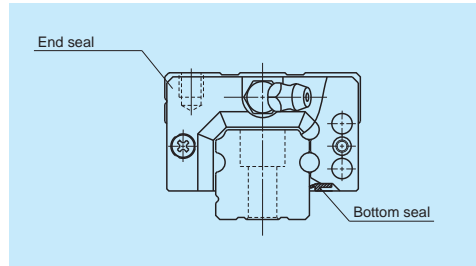


Fig. 14

Table 11 Seal friction per ball slide (maximum value)

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

2. Double seal and protector

For VH Series, double-seal and protector can be installed only before shipping from the factory. Please consult NSK.

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

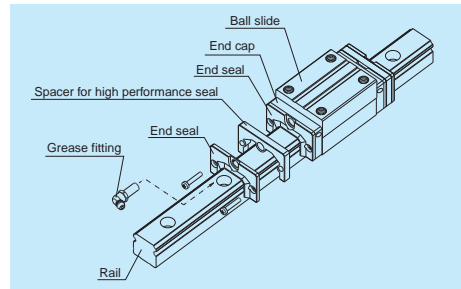


Fig. 15 Double seal

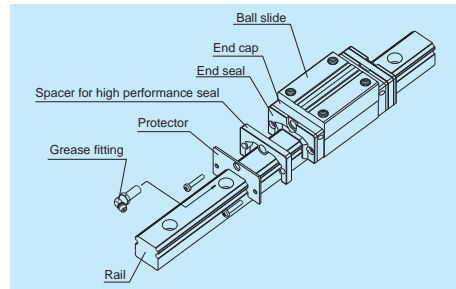


Fig. 16 Protector

Table 12 Dimension of installing dust proof optional components

Unit: mm

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

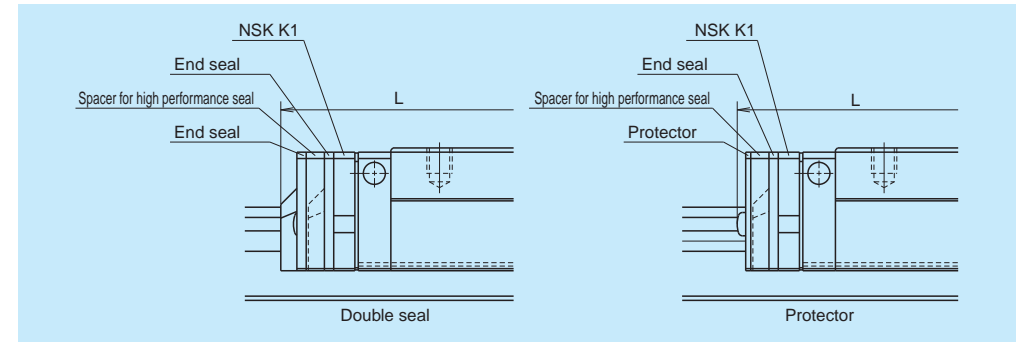


Fig. 17

3. Cap to cover the bolt hole for rail mounting

Table 13 Caps to cover 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 seal can be manufactured for models shown below.

Table 14

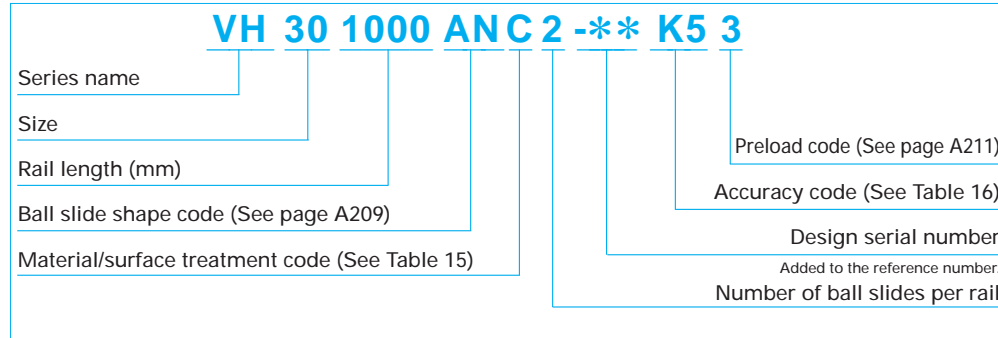
Series	Model No.
VH	VH20, VH25, VH30, VH45, VH55

**(8) Reference number**

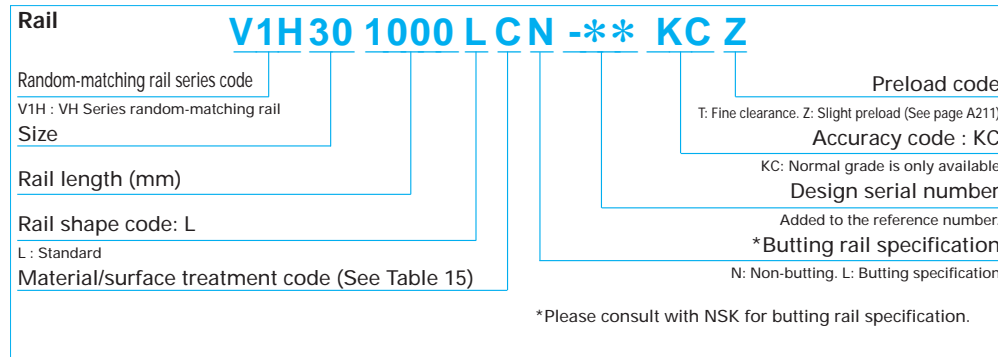
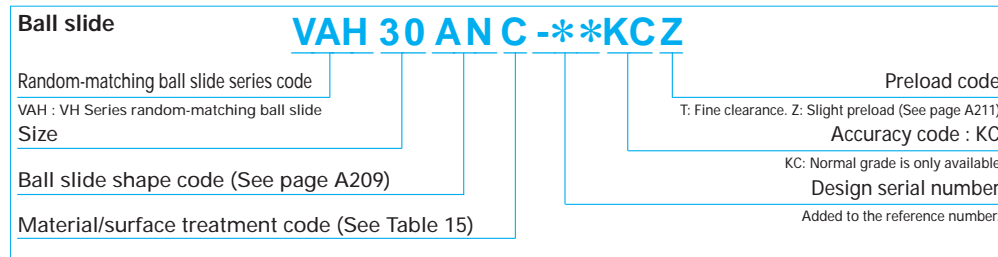
Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.

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

**1. Reference number for preloaded assembly**



**2. Reference number for random-matching type**



Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is fine clearance "T" or slight preload "Z" (Refer to page A211).

**Table 15 Material/surface treatment code**

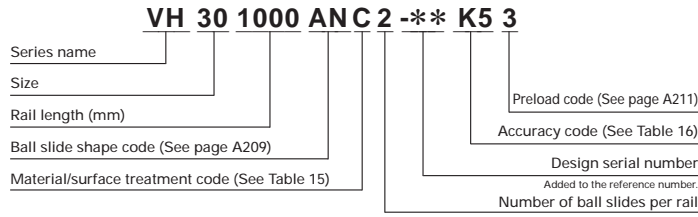
Code	Description
C	Special high carbon steel (NSK standard) + counterbores on a rail top surface
K	Stainless steel + counterbores on a rail top surface
D	Special high carbon steel with surface treatment + counterbores on a rail top surface
H	Stainless steel with surface treatment + counterbores on a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

**Table 16 Accuracy code**

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

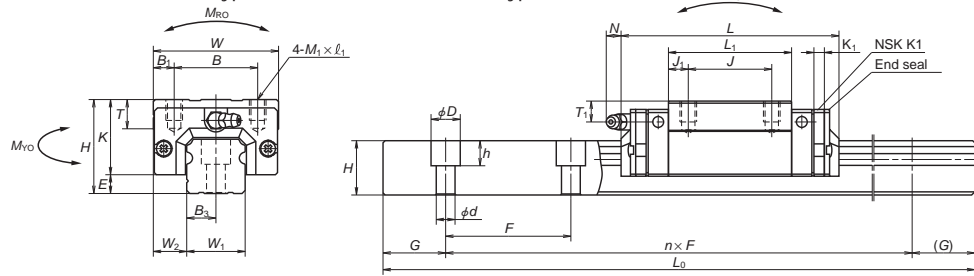
Note: Refer to Page A38 for NSK K1 lubrication unit.

(9) Dimensions  
 VH-AN (High-load type)  
 VH-BN (Super-high-load type)



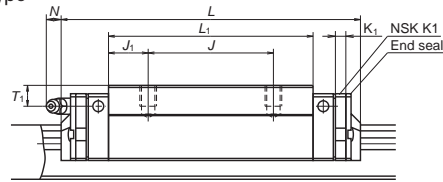
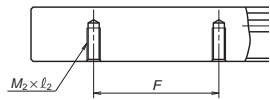
Front view of AN and BN type

Side view of AN type

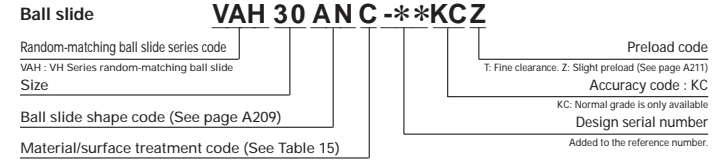


Specification for tapped holes on a rail bottom face

Side view of BN type



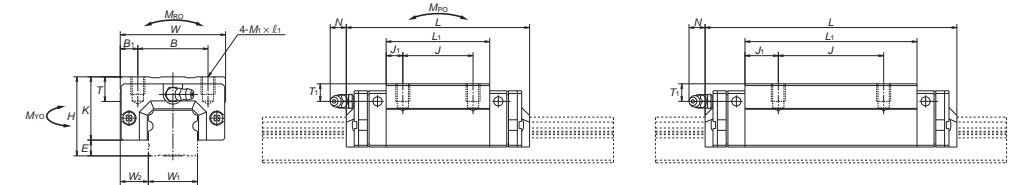
Reference number for ball slide of random-matching type



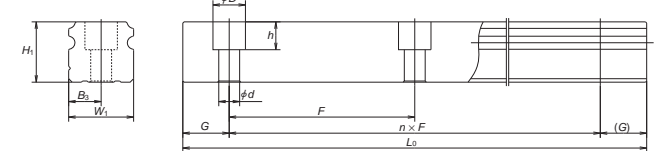
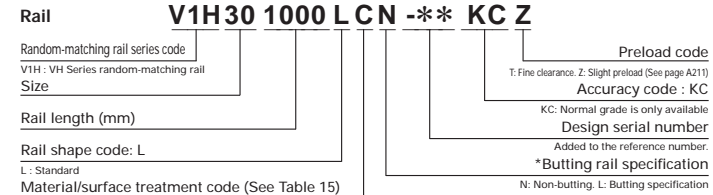
AN and BN types

AN type

BN type



Reference number for rail of random-matching type



Model No.	Assembly		Ball slide														
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole				Grease fitting							
						B	J	M × pitch × ℓ	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	K <sub>1</sub>	Hole size	T <sub>1</sub>	N
VH15AN VH15BN	28	4.6	9.5	34	70.6 ( 77) 89.6 ( 96)	26	26	M4×0.7×6	4	39 58	6.5 16	23.4	8	4.5	φ3	8.5	1 ( 8.2)
VH20AN VH20BN	30	5	12	44	87.4 ( 94.2) 109.4 (116.2)	32	36 50	M5×0.8×6	6	50 72	7 11	25	12	4.5	M6×0.75	5	11.1 (12.3)
VH25AN VH25BN	40	7	12.5	48	97 (104.4) 125 (132.4)	35	35 50	M6×1×9	6.5	58 86	11.5 18	33	12	5	M6×0.75	10	9.6 (12.9)
VH30AN VH30BN	45	9	16	60	104.4 (114.8) 143.4 (153.8)	40	40 60	M8×1.25×10	10	59 98	9.5 19	36	14	5	M6×0.75	10	11.4 (14.2)
VH35AN VH35BN	55	9.5	18	70	128.8 (139.2) 162.8 (173.2)	50	50 72	M8×1.25×12	10	80 114	15 21	45.5	15	5.5	M6×0.75	15	10.9 (13.7)
VH45AN VH45BN	70	14	20.5	86	161.4 (174.2) 193.4 (206.2)	60	60 80	M10×1.5×17	13	105 137	22.5 28.5	56	17	6.5	Rc1/8	20	12.5 (14.1)
VH55AN VH55BN	80	15	23.5	100	185.4 (198.2) 223.4 (236.2)	75	75 95	M12×1.75×18	12.5	126 164	25.5 34.5	65	18	6.5	Rc1/8	21	12.5 (14.1)

- Remarks: 1) Figure inside ( ) is the dimension when equipped with the protector.  
 2) VH Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.  
 3) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

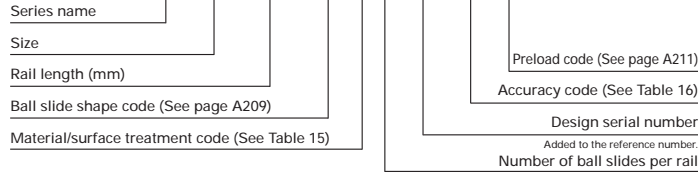
Unit: mm

Rail								Basic load rating					Ball dia. D <sub>w</sub>	Weight	
Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Counterbore d × D × h	Tapped hole M × pitch × ℓ <sub>2</sub>	B <sub>3</sub>	G (reference)	Maximum length L <sub>max</sub> ( ) for stainless	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment				Ball slide (kg)	Rail (kg/m)
W <sub>1</sub>	H <sub>1</sub>	F	d × D × h	M × pitch × ℓ <sub>2</sub>	B <sub>3</sub>	G	L <sub>max</sub>	C	C <sub>0</sub>	M <sub>RO</sub>	M <sub>PO</sub>	M <sub>VO</sub>	D <sub>w</sub>		
15	15	60	4.5×7.5×5.3	M5×0.8×8	7.5	20	2 000 [1 800]	10 800 14 600	20 700 32 000	108 166	94.5 216	79.5 181	3.175	0.18 0.26	
20	18	60	6×9.5×8.5	M6×1×10	10	20	3 960 [3 500]	17 400 23 500	32 500 50 500	219 340	185 420	155 355	3.968	0.33 0.48	
23	22	60	7×11×9	M6×1×12	11.5	20	3 960 [3 500]	25 600 34 500	46 000 71 000	360 555	320 725	267 610	4.762	0.55 0.82	
28	26	80	9×14×12	M8×1.25×15	14	20	4 000 [3 500]	31 000 46 000	51 500 91 500	490 870	350 1 030	292 865	5.556	0.77 1.3	
34	29	80	9×14×12	M8×1.25×17	17	20	4 000	47 500 61 500	80 500 117 000	950 1 380	755 1 530	630 1 280	6.350	1.5 2.1	
45	38	105	14×20×17	M12×1.75×24	22.5	22.5	3 990	81 000 99 000	140 000 187 000	2 140 2 860	1 740 3 000	1 460 2 520	7.937	3.0 3.9	
53	44	120	16×23×20	M14×2×24	26.5	30	3 960	119 000 146 000	198 000 264 000	3 600 4 850	3 000 5 150	2 510 4 350	9.525	4.7 6.1	

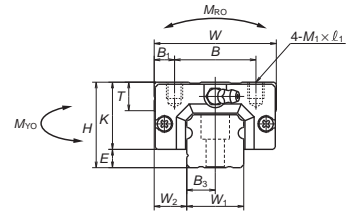
- 4) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.

VH-AL (High-load type)  
VH-BL (Super-high-load type)

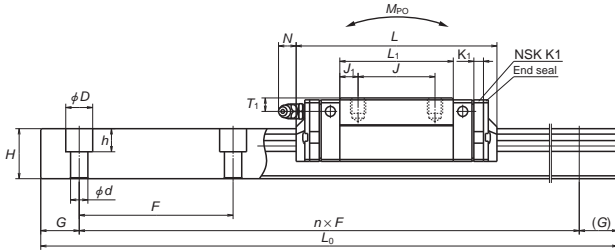
**VH 30 1000 AL C 2 -\*\* K5 3**



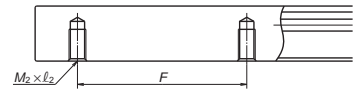
Front view of AL and BL type



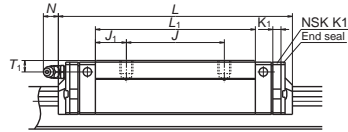
Side view of AL type



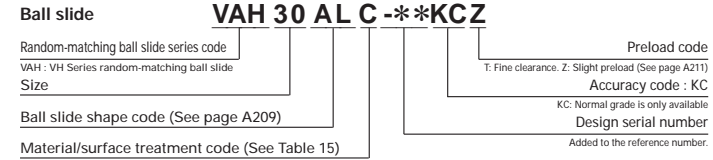
Specification for tapped holes on a rail bottom face



Side view of BL type



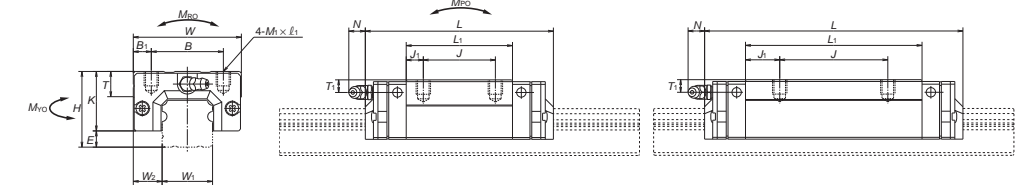
Reference number for ball slide of random-matching type



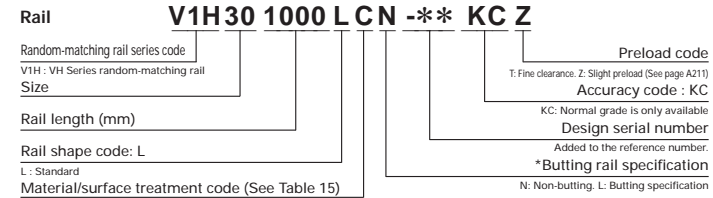
AL and BL types

AL type

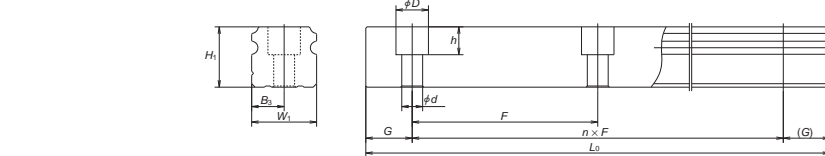
BL type



Reference number for rail of random-matching type



\*Please consult with NSK for butting rail specification.



Unit: mm

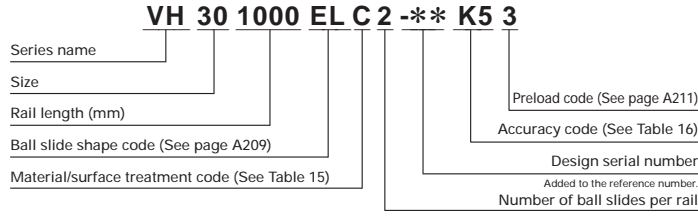
Model No.	Assembly		Ball slide															
	Height H	Pitch E	Width W <sub>2</sub>	Length L	Mounting hole					Grease fitting								
					B	J	M × pitch × l	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	K <sub>1</sub>	Hole size	T <sub>1</sub>	N		
VH25AL VH25BL	36	7	12.5	48	97 125	(104.4) (132.4)	35	35 50	M6×1×6	6.5	58 86	11.5 18	29	12	5	M6×0.75	6	9.6 (12.9)
VH30AL VH30BL	42	9	16	60	104.4 143.4	(114.8) (153.8)	40	40 60	M8×1.25×8	10	59 98	9.5 19	33	14	5	M6×0.75	7	11.4 (14.2)
VH35AL VH35BL	48	9.5	18	70	128.8 162.8	(139.2) (173.2)	50	50 72	M8×1.25×8	10	80 114	15 21	38.5	15	5.5	M6×0.75	8	10.9 (13.7)
VH45AL VH45BL	60	14	20.5	86	161.4 193.4	(174.2) (206.2)	60	60 80	M10×1.5×10	13	105 137	22.5 28.5	46	17	6.5	Rc1/8	10	12.5 (14.1)
VH55AL VH55BL	70	15	23.5	100	185.4 223.4	(198.2) (236.2)	75	75 95	M12×1.75×12	12.5	126 164	25.5 34.5	55	18	6.5	Rc1/8	11	12.5 (14.1)

Remarks: 1) Figure inside ( ) is the dimension when equipped with the protector.  
2) VH Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.  
3) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

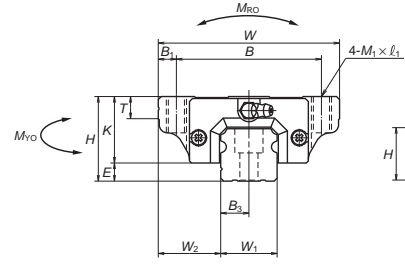
Rail										Basic load rating					Ball dia. D <sub>w</sub>	Weight	
Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Counterbore d × D × h	Tapped hole M × pitch × l <sub>2</sub>	B <sub>3</sub>	G	Maximum length L <sub>max</sub> ( ) for stainless	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment			Ball slide (kg)	Rail (kg/m)			
										M <sub>RO</sub> (N·m)	M <sub>PO</sub> (N·m)	M <sub>VO</sub> (N·m)					
23	22	60	7×11×9	M6×1×12	11.5	20	3 960 [3 500]	25 600 34 500	46 000 71 000	360 555	320 725	267 610	4.762	0.46 0.69	3.6		
28	26	80	9×14×12	M8×1.25×15	14	20	4 000 [3 500]	31 000 46 000	51 500 91 500	490 870	350 1 030	292 865	5.556	0.69 1.16	5.2		
34	29	80	9×14×12	M8×1.25×17	17	20	4 000	47 500 61 500	80 500 117 000	950 1 380	755 1 530	630 1 280	6.350	1.2 1.7	7.2		
45	38	105	14×20×17	M12×1.75×24	22.5	22.5	3 990	81 000 99 000	140 000 187 000	2 140 2 860	1 740 3 000	1 460 2 520	7.937	2.2 2.9	12.3		
53	44	120	16×23×20	M14×2×24	26.5	30	3 960	119 000 146 000	198 000 264 000	3 600 4 850	3 000 5 150	2 510 4 350	9.525	3.7 4.7	16.9		

4) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.

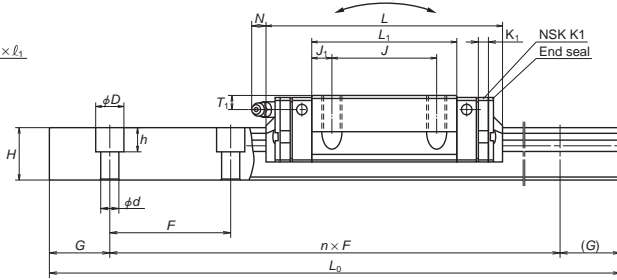
VH-EL (High-load type)  
VH-GL (Super-high-load type)



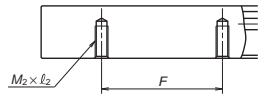
Front view of EL and GL type



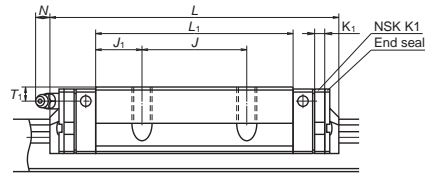
Side view of EL type



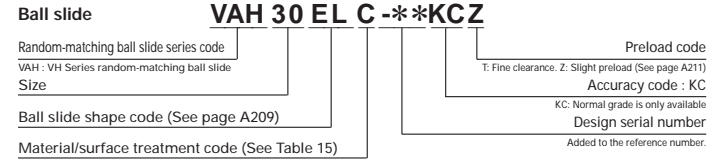
Specification for tapped holes on a rail bottom face



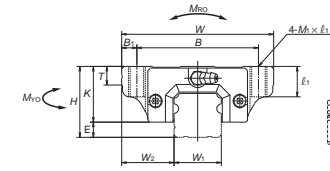
Side view of GL type



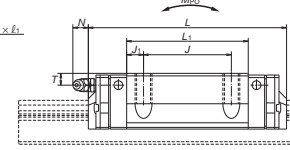
Reference number for ball slide of random-matching type



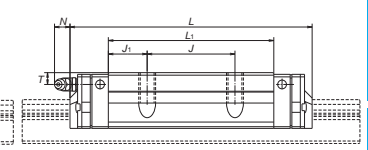
EL and GL types



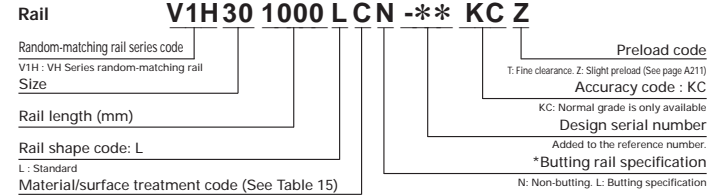
EL type



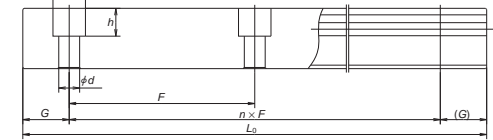
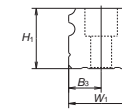
GL type



Reference number for rail of random-matching type



\*Please consult with NSK for butting rail specification.



Model No.	Assembly		Ball slide																	
	Height H	E	Width W2	Length L	Mounting hole								Grease fitting							
					B	J	M1 × pitch × l1	B1	L1	J1	K	T	K1	Hole size	T1	N				
VH15EL VH15GL	24	4.6	16	47	70.6 ( 77) 89.6 ( 96)	38	30	M5×0.8×8	4.5	39 58	4.5 14	19.4	8	4.5	phi 3	4.5	1 ( 8.2)			
VH20EL VH20GL	30	5	21.5	63	87.4 ( 94.2) 109.4 (116.2)	53	40	M6×1×10	5	50 72	5 16	25	10	4.5	M6×0.75	5	11.1 (12.3)			
VH25EL VH25GL	36	7	23.5	70	97 (104.4) 125 (132.4)	57	45	M8×1.25×16 [M8×1.25×12]	6.5	58 86	6.5 20.5	29	11 [12]	5	M6×0.75	6	9.6 (12.9)			
VH30EL VH30GL	42	9	31	90	117.4 (127.8) 143.4 (153.8)	72	52	M10×1.5×18 [M10×1.5×15]	9	72 98	10 23	33	11 [15]	5	M6×0.75	7	11.4 (14.2)			
VH35EL VH35GL	48	9.5	33	100	128.8 (139.2) 162.8 (173.2)	82	62	M10×1.5×20	9	80 114	9 26	38.5	12	5.5	M6×0.75	8	10.9 (13.7)			
VH45EL VH45GL	60	14	37.5	120	161.4 (174.2) 193.4 (206.2)	100	80	M12×1.75×24	10	105 137	12.5 28.5	46	13	6.5	Rc1/8	10	12.5 (14.1)			
VH55EL VH55GL	70	15	43.5	140	185.4 (198.2) 223.4 (236.2)	116	95	M14×2×28	12	126 164	15.5 34.5	55	15	6.5	Rc1/8	11	12.5 (14.1)			

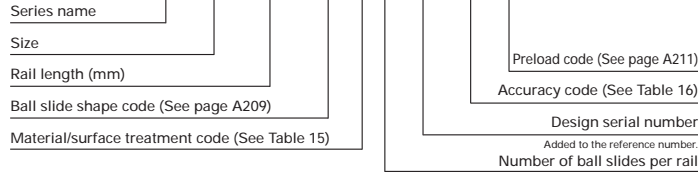
- Remarks: 1) Figure inside ( ) is the dimension when equipped with the protector.
- 2) Figure inside [ ] is applied to stainless products.
- 3) VH Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.
- 4) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Rail								Basic load rating					Ball dia. Dw	Weight	
Width W1	Height H1	Pitch F	Counterbore dx D x h	Tapped hole M2 × pitch × l2	B3	G (reference)	Maximum length Lmax ( ) for stainless	Dynamic C (N)	Static C0 (N)	Static moment MR0 (N·m) MPO (N·m) MVO (N·m)				Ball slide (kg)	Rail (kg/m)
15	15	60	4.5×7.5×5.3	M5×0.8×8	7.5	20	2 000 [1 800]	10 800 14 600	20 700 32 000	108 166	94.5 216	79.5 181	3.175		
20	18	60	6×9.5×8.5	M6×1×10	10	20	3 960 [3 500]	17 400 32 500	32 500 50 500	219 340	185 420	155 355	3.968	0.45 0.65	2.6
23	22	60	7×11×9	M6×1×12	11.5	20	3 960 [3 500]	25 600 34 500	46 000 71 000	360 555	320 725	267 610	4.762	0.63 0.93	3.6
28	26	80	9×14×12	M8×1.25×15	14	20	4 000 [3 500]	35 500 46 000	63 000 91 500	600 870	505 1 030	425 865	5.556	1.2 1.6	5.2
34	29	80	9×14×12	M8×1.25×17	17	20	4 000	47 500 61 500	80 500 117 000	950 1 380	755 1 530	630 1 280	6.350	1.7 2.4	7.2
45	38	105	14×20×17	M12×1.75×24	22.5	22.5	3 990	81 000 99 000	140 000 187 000	2 140 2 860	1 740 3 000	1 460 2 520	7.937	3.0 3.9	12.3
53	44	120	16×23×20	M14×2×24	26.5	30	3 960	119 000 146 000	198 000 264 000	3 600 4 850	3 000 5 150	2 510 4 350	9.525	5.0 6.5	16.9

- 5) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C100 for 100 km rating fatigue life, divide the C by 1.26.

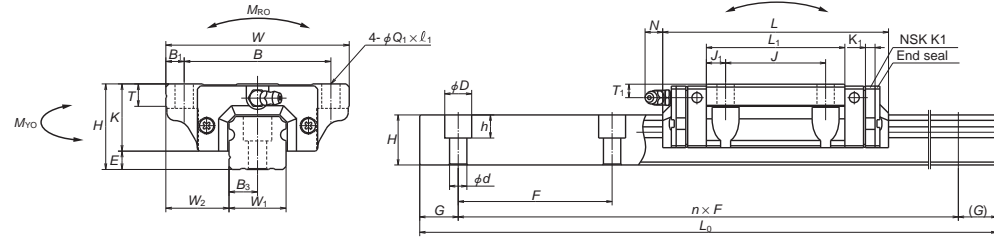
VH-FL (High-load type)  
VH-HL (Super-high-load type)

**VH 30 1000 FL C 2 -\*\* K5 3**



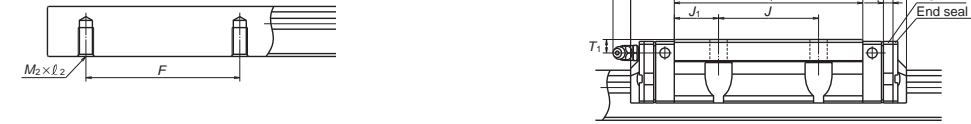
Front view of FL and HL type

Side view of FL type

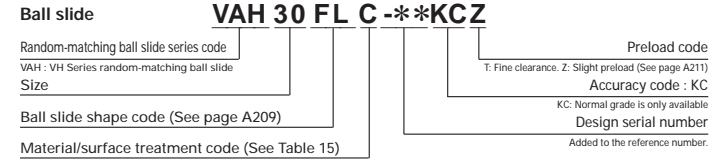


Specification for tapped holes on a rail bottom face

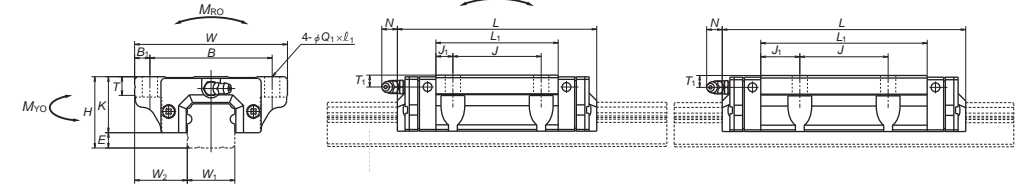
Side view of HL type



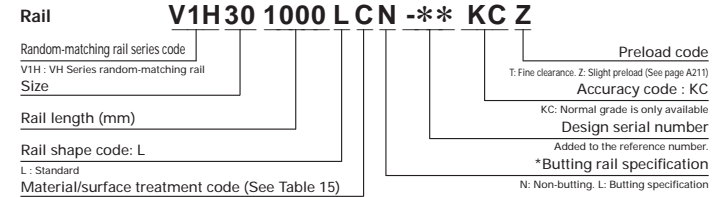
Reference number for ball slide of random-matching type



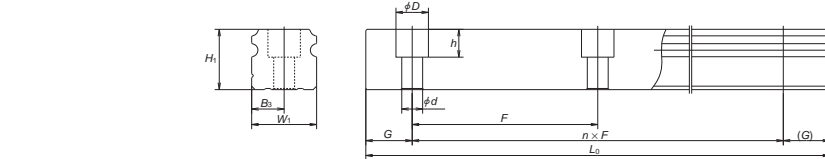
FL and HL types



Reference number for rail of random-matching type



\*Please consult with NSK for butting rail specification.



Model No.	Assembly		Ball slide														
	Height H	Width W <sub>2</sub>	Width W	Length L	Mounting hole										Grease fitting		
					B	J	Q <sub>1</sub> × ℓ <sub>1</sub>	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	K <sub>1</sub>	Hole size	T <sub>1</sub>	N	
VH15FL VH15HL	24	4.6	16	47	70.6 (77) 89.6 (96)	38	30	4.5×7	4.5	39 58	4.5 14	19.4	8	4.5	φ3	4.5	1 (8.2)
VH20FL VH20HL	30	5	21.5	63	87.4 (94.2) 109.4 (116.2)	53	40	6×9.5	5	50 72	5 16	25	10	4.5	M6×0.75	5	11.1 (12.3)
VH25FL VH25HL	36	7	23.5	70	97 (104.4) 125 (132.4)	57	45	7×10 [7×11.5]	6.5	58 86	6.5 20.5	29	11 12	5	M6×0.75	6	9.6 (12.9)
VH30FL VH30HL	42	9	31	90	117.4 (127.8) 143.4 (153.8)	72	52	9×12 [9×14.5]	9	72 98	10 23	33	11 15	5	M6×0.75	7	11.4 (14.2)
VH35FL VH35HL	48	9.5	33	100	128.8 (139.2) 162.8 (173.2)	82	62	9×13	9	80 114	9 26	38.5	12	5.5	M6×0.75	8	10.9 (13.7)
VH45FL VH45HL	60	14	37.5	120	161.4 (174.2) 193.4 (206.2)	100	80	11×15	10	105 137	12.5 28.5	46	13	6.5	Rc1/8	10	12.5 (14.1)
VH55FL VH55HL	70	15	43.5	140	185.4 (198.2) 223.4 (236.2)	116	95	14×18	12	126 164	15.5 34.5	55	15	6.5	Rc1/8	11	12.5 (14.1)

- 1) Figure inside ( ) is the dimension when equipped with the protector.
- 2) Figure inside [ ] is applied to stainless products.
- 3) VH Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.
- 4) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Rail										Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Counterbore	Tapped hole	G	Maximum length L <sub>max</sub> (reference) ( ) for stainless	Dynamic C	Static C <sub>0</sub>	Static moment			D <sub>w</sub>	Ball slide (kg)	Rail (kg/m)			
W <sub>1</sub>	H <sub>1</sub>	F	d × D × h	M <sub>2</sub> × pitch × ℓ <sub>2</sub>	B <sub>3</sub>	(reference)	(N)	(N)	M <sub>RO</sub>	M <sub>PO</sub>	M <sub>VO</sub>						
15	15	60	4.5×7.5×5.3	M5×0.8×8	7.5	20	2 000 [1 800]	10 800 14 600	20 700 32 000	108 166	94.5 216	79.5 181	3.175	0.17 0.25	1.6		
20	18	60	6×9.5×8.5	M6×1×10	10	20	3 960 [3 500]	17 400 23 500	32 500 50 500	219 340	185 420	155 355	3.968	0.45 0.65	2.6		
23	22	60	7×11×9	M6×1×12	11.5	20	3 960 [3 500]	25 600 34 500	46 000 71 000	360 555	320 725	267 610	4.762	0.63 0.93	3.6		
28	26	80	9×14×12	M8×1.25×15	14	20	4 000 [3 500]	35 500 46 000	63 000 91 500	600 870	505 1 030	425 865	5.556	1.2 1.6	5.2		
34	29	80	9×14×12	M8×1.25×17	17	20	4 000	47 500 61 500	80 500 117 000	950 1 380	755 1 530	630 1 280	6.350	1.7 2.4	7.2		
45	38	105	14×20×17	M12×1.75×24	22.5	22.5	3 990	81 000 99 000	140 000 187 000	2 140 2 860	1 740 3 000	1 460 2 520	7.937	3.0 3.9	12.3		
53	44	120	16×23×20	M14×2×24	26.5	30	3 960	119 000 146 000	198 000 264 000	3 600 4 850	3 000 5 150	2 510 4 350	9.525	5.0 6.5	16.9		

- 5) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.





## A-5-1.6 LW Series

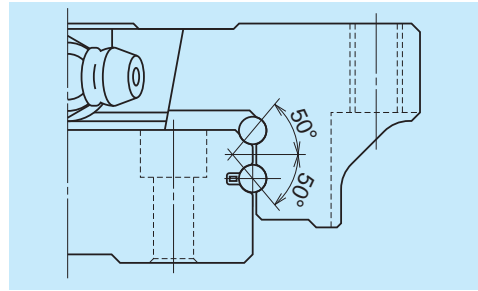
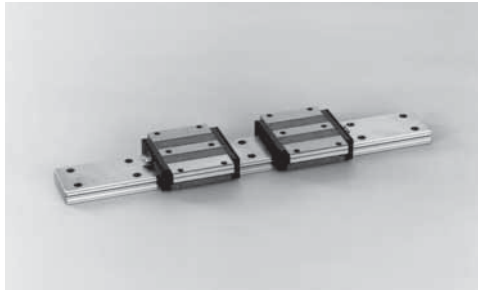


Fig. 1 Balls in contact

## (1) Features

## 1. Ideal for use of single rail

Thanks to the wide rail, rigidity and load carrying capacity are high against moment load from rolling direction. This makes LW Series ideal in use of single rail as the linear guide.

## 2. High load carrying capacity to vertical direction

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

## 3. High resistance against impact load

Same as the LH and LS series, the offset Gothic arch grooves support a large load, such as an impact, by four rows.

## 4. High accuracy

Fixing master rollers is easy thanks to the Gothic arch groove. This makes easy and accurate measuring of ball grooves.

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

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

## 6. Fast delivery

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

## (2) Ball slide shape

Ball slide Model	Shape / installation method	Type
EL		

## (3) Accuracy and preload

## 1. Running parallelism of ball slide

Table 1

Unit:  $\mu\text{m}$ 

Rail over all length (mm) over   or less	Preloaded assembly (not random matching)			Random-matching type
	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 - 1000	9	16	18	18
1000 - 1250	10	17	20	20
1250 - 1600	11	19	23	23
1600 - 2000	13	21	26	26
2000 - 2500	15	22	29	29
2500 - 3150	17	25	32	32
3150 - 4000	23	30	34	34

## 2. Accuracy standard

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

## • Tolerance of preloaded assembly type

Table 2

Unit:  $\mu\text{m}$ 

Characteristics	High precision P5	Precision grade P6	Normal grade PN
Mounting height $H$ Variation of $H$ (All ball slides on a set of rails)	$\pm 20$ 7	$\pm 40$ 15	$\pm 80$ 25
Mounting width $W_2$ or $W_3$ Variation of $W_2$ or $W_3$ (All ball slides on reference rail)	$\pm 25$ 10	$\pm 50$ 20	$\pm 100$ 30
Running parallelism of face C to face A Running parallelism of face D to face B	Shown in Table 1 and Fig. 2		

## • Tolerance of random-matching type: Normal grade PC

Table 3

Unit:  $\mu\text{m}$ 

Characteristics	Model No.
	LW17, 21, 27, 35, 50
Mounting height $H$	$\pm 20$
Variation of mounting height $H$	15 <sup>①</sup> 30 <sup>②</sup>
Mounting width $W_2$ or $W_3$	$\pm 30$
Variation of mounting width $W_2$ or $W_3$	25
Running parallelism of face C to face A Running parallelism of face D to face 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	Random matching	
Without NSK K1 lubrication unit	P5	P6	PN	PC	
With NSK K1 lubrication unit	K5	K6	KN	KC	
With NSK K1 for food and medical equipment	F5	F6	FN	FC	
Preload	Fine clearance Z0	○	○	○	—
	Slight preload Z1	○	○	○	—
	Medium preload Z3	○	○	—	—
	Random-matching type with fine clearance ZT	—	—	—	○
	Random-matching type with slight preload ZZ	—	—	—	○

Note: Z3 medium preload are LW35 and 50 only

### 4. Assembled accuracy

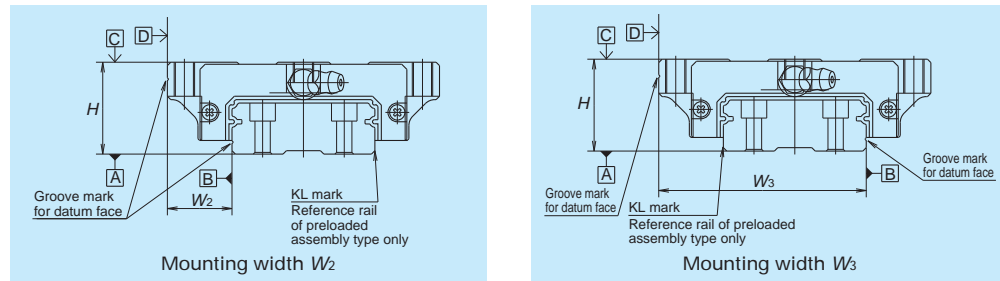


Fig. 2

### 5. Preload and rigidity

We offer five levels of preload: slight preload Z1, medium preload Z3 and fine clearance Z0, along with random-matching type of fine clearance ZT and slight preload ZZ. Values for preload and rigidity of the preloaded assembly are shown in Table 5. Rigidities are for the median of the preload range.

#### • Preload and rigidity of preloaded assembly

Table 5

Model No.	Preload (N)		Rigidity (N/μm)			
	Slight preload Z1	Medium preload Z3	Vertical directions		Lateral direction	
			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	1470	345	600	246	425

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

#### • Clearance and preload of random-matching type

Table 6

Unit: μm

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

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

### (5) Installation

#### 1. Permissible values of mounting error

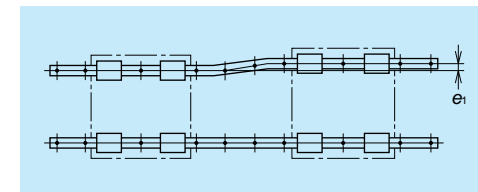


Fig. 3

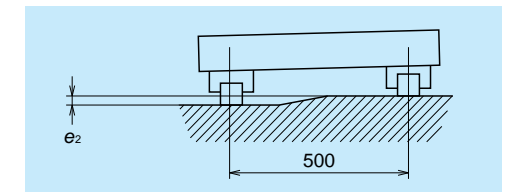


Fig. 4

Table 8

Unit: μm

Value	Preload	Model No.				
		LW17	LW21	LW27	LW35	LW50
Permissible values of parallelism in two rails $e_1$	Z0, ZT	20	20	25	38	50
	Z1	9	9	13	23	34
Permissible values of parallelism (height) in two rails $e_2$	Z0, ZT	100 μm/500 mm				
	Z1	45 μm/500 mm				

#### 2. Shoulder height of the mounting face and corner radius r

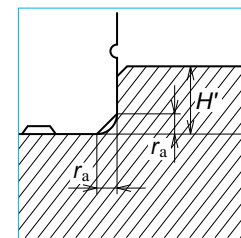


Fig. 5 Shoulder for the rail datum face

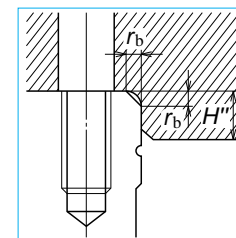


Fig. 6 Shoulder for the ball slide datum face

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 page A38 and D13 for the lubrication of linear guides.

### 1. Types of lubrication accessories

Figure 11 and Table 10 show grease fittings and tube fittings.

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

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

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

Please ask NSK for stainless lubrication accessories.

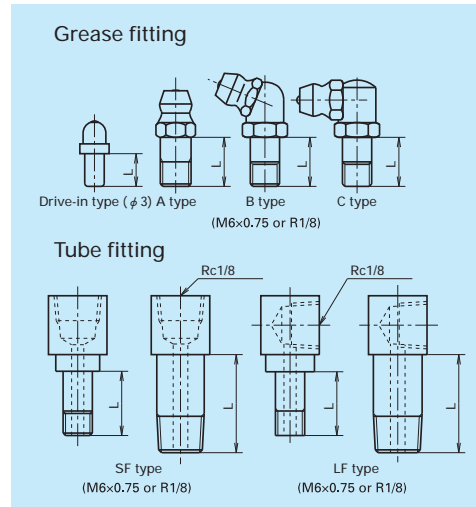


Fig. 7 Grease fitting and tube fitting

### 2. Mounting position of lubrication accessories

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

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

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

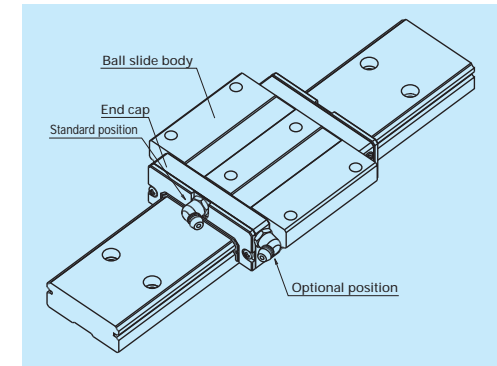


Fig. 8 Mounting position of lubrication accessories

Table 10 Unit: mm

Model No.	Dust proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
LW17	Standard	5	-
	With NSK K1	10	-
	Double seal	*	-
	Protector	*	-
LW21	Standard	5	-
	With NSK K1	12	-
	Double seal	10	-
	Protector	10	-
LW27	Standard	5	-
	With NSK K1	12	-
	Double seal	10	-
	Protector	10	-
LW35	Standard	5	6
	With NSK K1	14	13
	Double seal	10	9
	Protector	10	9
LW50	Standard	8	17
	With NSK K1	18	19
	Double seal	14	17
	Protector	14	17

\*) Please contact NSK as a connector is required.

(7) Dust proof components

1. Standard Specification

To keep foreign matters from entering inside the ball slide, LW Series has an end seal on both ends, and bottom seals at the bottom.

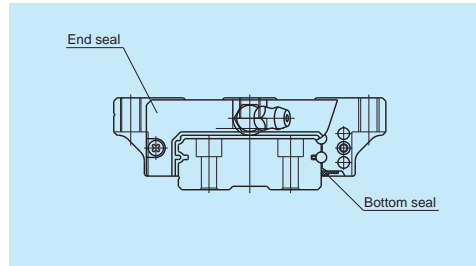


Fig. 9

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

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

2. NSK K1™

Table 12 shows the dimension of linear guides equipped with the NSK K1.

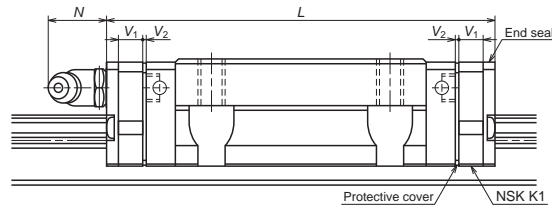


Table 12 (Unit : mm)

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V <sub>1</sub>	Protective cover thickness V <sub>2</sub>	Protruding area of the grease fitting N
LW17	Standard	EL	51.4	61.6	4.5	0.6	(5)
LW21	Standard	EL	58.8	71.4	5.5	0.8	(13)
LW27	Standard	EL	74	86.6	5.5	0.8	(13)
LW35	Standard	EL	108	123	6.5	1.0	(13)
LW50	Standard	EL	140.6	155.6	6.5	1.0	(14)

Note: NSK K1 for food and medical equipments are available for LW17 to LW35.

3. Double seal

Use a double seal set as showing in Table 13, when installing an extra seal to completed standard products. (Fig. 10)

When installing a grease fitting after the installation of double seals, a connector is required.

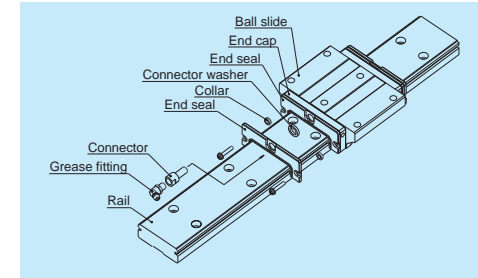


Fig. 10 Double seal

Table 13 Double-seal set

Model No.	Reference No.		Increased thickness V <sub>1</sub>
	Without connector	With connector	
LW17	LW17WS-01	*	2.6
LW21	LW21WS-01	LW21WSC-01	2.8
LW27	LW27WS-01	LW27WSC-01	2.5
LW35	LW35WS-01	LW35WSC-01	3
LW50	LW50WS-01	LW50WSC-01	3.6

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

4. Protector

Use a protector set as showing Table 14, when installing a protector to completed standard products. (Fig.11)

When installing a grease fitting after the installation of protectors, a connector is required.

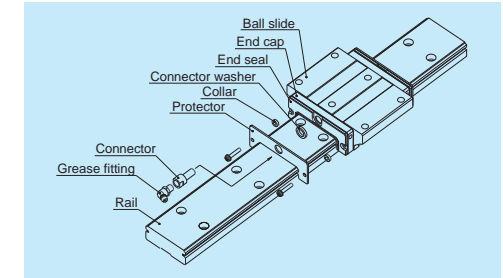


Fig. 11 Protector seal

Table 14 Protector set

Model No.	Reference No.		Increased thickness V <sub>2</sub>
	Without connector	With connector	
LW17	LW17PT-01	*	3.2
LW21	LW21PT-01	LW21PTC-01	3.2
LW27	LW27PT-01	LW27PTC-01	2.9
LW35	LW35PT-01	LW35PTC-01	3.6
LW50	LW50PT-01	LW50PTC-01	4.2

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

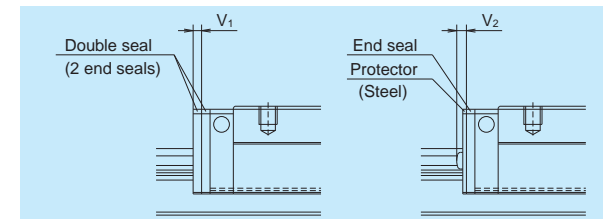


Fig. 12

5. Cap to cover the bolt hole for rail mounting

Table 15 Caps to cover 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

- While removing machine screws which secure the end seal to install the bellows to the slide, for LW17 and 21, hold the end cap by hand not to be detached from the slide.
- Make tap holes to the rail end face to fix the bellows mounting plate. NSK processes tap holes to the rail end face when ordered with a linear guide.

Dimension tables of bellows  
LW series

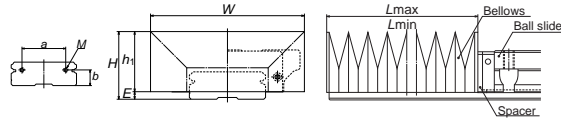


Fig. 13

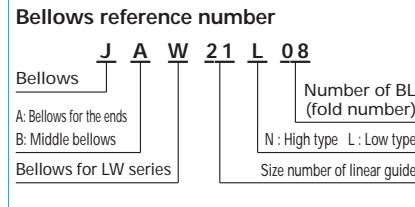


Table 16 Dimensions of bellows

Unit: mm

Model No.	H	h <sub>1</sub>	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 <sub>min</sub>	34	68	102	136	170	204	238	272	306
JAW17N	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
	L <sub>max</sub>	210	420	630	840	1050	1260	1470	1680	1890	2100
JAW21N	Stroke	204	408	612	816	1020	1224	1428	1632	1836	2040
	L <sub>max</sub>	238	476	714	952	1190	1428	1666	1904	2142	2380
JAW27N	Stroke	246	492	738	984	1230	1476	1722	1968	2214	2460
	L <sub>max</sub>	280	560	840	1120	1400	1680	1960	2240	2520	2800
JAW35L	Stroke	162	324	486	648	810	972	1134	1296	1458	1620
	L <sub>max</sub>	196	392	588	784	980	1176	1372	1568	1764	1960
JAW35N	Stroke	218	436	654	872	1090	1308	1526	1744	1962	2180
	L <sub>max</sub>	252	504	756	1008	1260	1512	1764	2016	2268	2520
JAW50L	Stroke	246	492	738	984	1230	1476	1722	1968	2214	2460
	L <sub>max</sub>	280	560	840	1120	1400	1680	1960	2240	2520	2800
JAW50N	Stroke	386	772	1158	1544	1930	2316	2702	3088	3474	3860
	L <sub>max</sub>	420	840	1260	1680	2100	2520	2940	3360	3780	4200

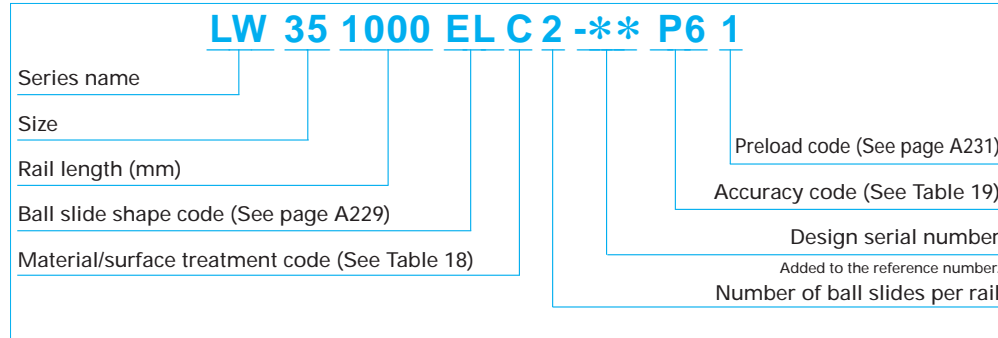
Remarks: Values of odd numbers BL (3, 5, 7, ...) can be obtained by adding two values of even number BLs on both sides, then dividing the sum by two.

**(8) Reference number**

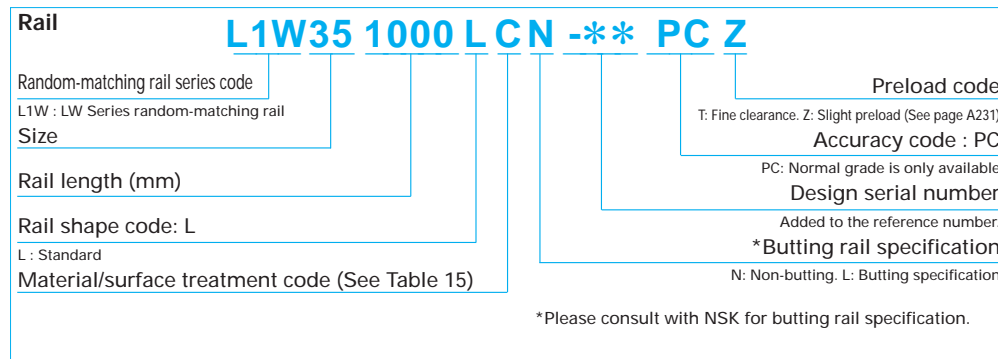
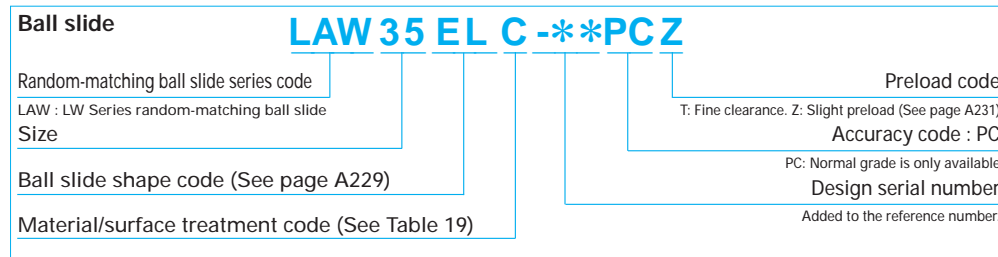
Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.

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

**1. Reference number for preloaded assembly**



**2. Reference number for random-matching type**



Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is fine clearance "T" or slight preload "Z" (Refer to page A231).

**Table 18 Material/surface treatment code**

Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
Z	Other, special

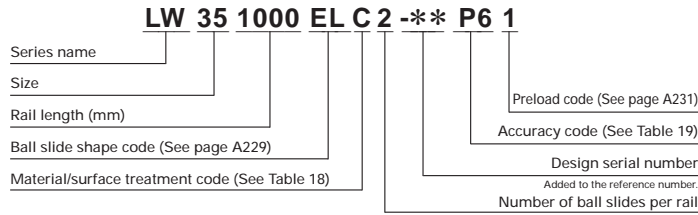
**Table 19 Accuracy code**

Accuracy	Standard (Without NSK K1)	With NSK K1	With NSK K1 for food and medical equipment
High precision grade	P5	K5	F5
Precision grade	P6	K6	F6
Normal grade	PN	KN	FN
Normal grade (random-matching type)	PC	KC	FC

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

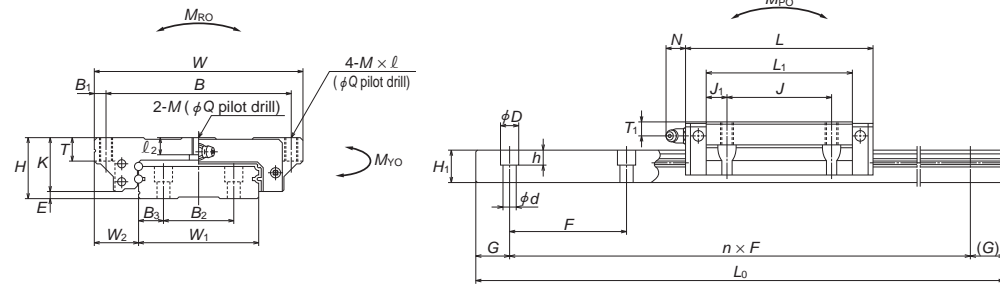
(9) Dimensions

LW-EL

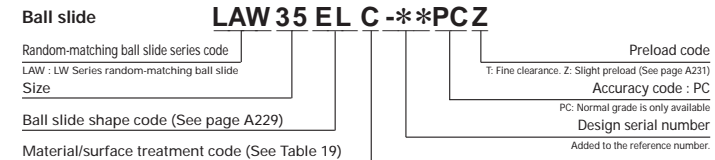


Front view of EL types

Side view of EL type

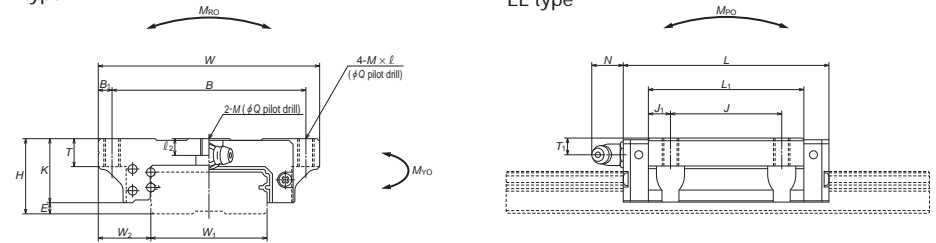


Reference number for ball slide of random-matching type

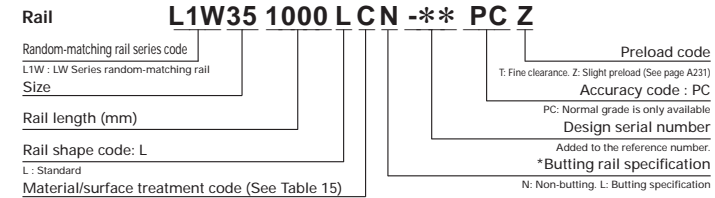


EL type

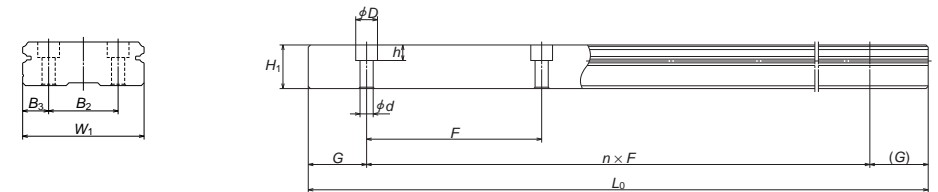
EL type



Reference number for rail of random-matching type



\*Please consult with NSK for butting rail specification.



Model No.	Assembly			Ball slide															
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole								Grease fitting					
						B	J	M × pitch × l	l <sub>2</sub>	Q	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Hole size	T <sub>1</sub>	N	
LW17EL	17	2.5	13.5	60	51.4	53	26	M4×0.7×6	3.2	3.3	3.5	35	4.5	14.5	6	φ3	4	3	
LW21EL	21	3	15.5	68	58.8	60	29	M5×0.8×8	3.7	4.4	4	41	6	18	8	M6×0.75	4.5	11	
LW27EL	27	4	19	80	74	70	40	M6×1×10	6	5.3	5	56	8	23	10	M6×0.75	6	11	
LW35EL	35	4	25.5	120	108	107	60	M8×1.25×14	9	6.8	6.5	84	12	31	14	M6×0.75	8	11	
LW50EL	50	4.5	36	162	140.6	144	80	M10×1.5×18	14	8.6	9	108	14	45.5	18	Rc1/8	14	14	

Rail										Basic load rating					Ball dia.	Weight	
Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch B <sub>2</sub>	Mounting bolt hole F	d × D × h	B <sub>3</sub>	G Reference	Maximum length L <sub>0max</sub>	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment			D <sub>w</sub>	Ball slide (kg)	Rail (kg/m)		
										M <sub>RO</sub> (N-m)	M <sub>PO</sub> (N-m)	M <sub>VO</sub> (N-m)					
33	8.7	18	40	4.5×7.5×5.3	7.5	15	1000	5600	11300	135	44	37	2.381	0.2	2.1		
37	10.5	22	50	4.5×7.5×5.3	7.5	15	1600	6450	13900	185	65.5	55	2.381	0.3	2.9		
42	15	24	60	4.5×7.5×5.3	9	20	2000	12800	26900	400	171	143	3.175	0.5	4.7		
69	19	40	80	7×11×9	14.5	20	2400	33000	66500	1690	645	545	4.762	1.5	9.6		
90	24	60	80	9×14×12	15	20	3000	61500	117000	3900	1530	1280	6.350	4.0	15.8		

Remarks: 1) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface.  
 When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.

## A-5-1.7 TS Series

### (1) Features

#### 1. Inexpensive

Newly developed manufacturing process of rail, and design review of ball slide contribute to substantial cost reductions.

#### 2. High capacity

Optimum ball diameter for higher capacity design.

#### 3. High dust proof capability

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

#### 4. Maintenance free

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



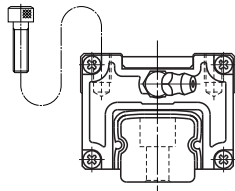
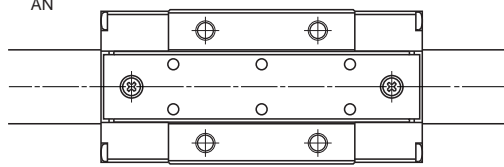
#### 5. Rust prevention

NSK provides a lineup of products with antirust surface treatment for corrosive environments.

#### 6. Fast delivery

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

### (2) Ball slide shape

Ball slide Model	Shape / installation method	Type
AN		AN 

### (3) Accuracy and preload

Accuracy grade: Normal grade for transportation

Tolerance of mounting height  $H$ :  $\pm 0.1$  mm

Running parallelism: 100  $\mu$ m or less

Running parallelism (height): 500  $\mu$ m/500 mm

Clearance: 60  $\mu$ m or less

### (4) Available length of rail

Table 1 shows the limitations of rail length (maximum length).

Table 1 Length limitations of rails

Series	Size Material	Unit: mm				
		15	20	25	* 30	* 35
TS	Special high carbon steel	1960	2920	4000	4040	4040

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

\*)The maximum length of fluoride low temperature chrome plated products is 4 000 (G = 80).

### (5) Lubrication components

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

#### 1. Types of lubrication accessories

Figure 2 and Table 2 show grease fittings and tube fittings.

#### 2. Mounting position of lubrication accessories

The standard position of grease fittings is the end face of ball slide. We mount them on a side of end cap for an option. (Fig. 2)

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

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

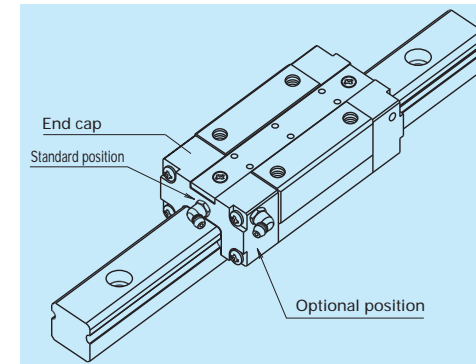


Fig. 2 Mounting position of lubrication accessories

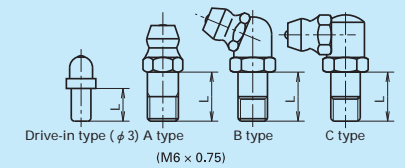
### (6) Dust proof components

#### 1. Standard specification

To keep foreign matters from entering inside the ball slide, TS series has an end seal and NSK K1 on both ends, and bottom seals at the bottom.

Also, the inner seal is a standard equipment.

#### Grease fitting



#### Tube fitting

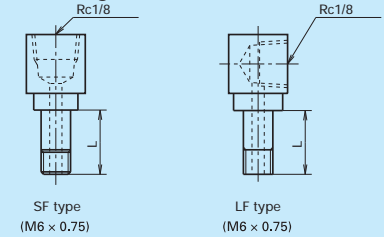


Fig. 1 Grease fitting and tube fitting

Table 2 Unit: mm

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

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

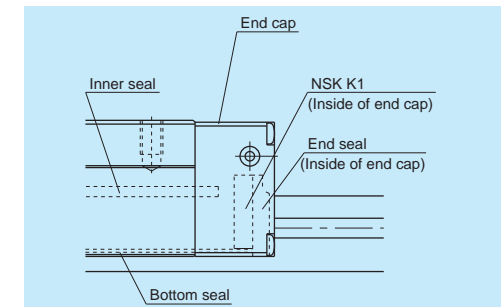


Fig. 3



## 2. Protector

It is possible to mount a protector to TS series as an option.

Please consult NSK as the protector for TS series can be installed only before shipping from the factory.

Fig. 4 and Table 3 show the ball slide length when protector is installed.

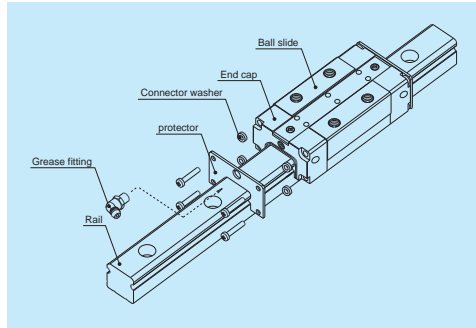


Fig. 5 Protector

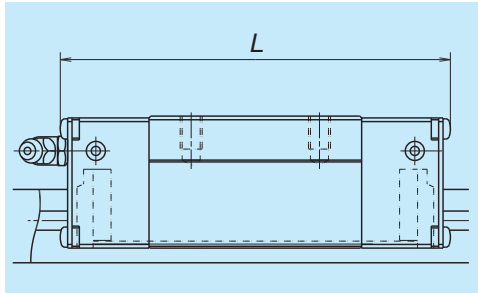


Fig. 4

Table 3 Dimension when equipped with the protector

Model No.	Ball slide length L		
	Standard length	Protector installation*	Increased thickness
TS15	72.2	77.6	2.7
TS20	87	92.8	2.9
TS25	100	106.4	3.2
TS30	115	123.4	4.2
TS35	135.8	144.2	4.2

\*) Showing the ball slide length when one protector is installed in both ends.

## 3. Cap to cover the bolt hole for rail mounting

Table 4 Caps to cover rail bolt hole

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

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

## (7) Reference number

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.

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

### 1. Reference number for assembly of random-matching ball slide and rail

**TS 30 2400 ANP 2 -\*\* KL S**

Series name	Preload code : S
Size	S: Clearance of 60 μm or less
Rail length (mm)	Accuracy code : KL
Ball slide shape code (See page A243)	KL: Normal grade is only available
Surface treatment/Rail design code	Design serial number
Added to the reference number.	
Number of ball slides per rail	

P: No surface treatment/Counterbores on a rail top face (Type I)  
 V: No surface treatment/Tapped holes on a rail bottom face (Type II)  
 R: Fluoride low temperature chrome plating/Counterbores on a rail top face (Type I)  
 W: Fluoride low temperature chrome plating/Tapped holes on a rail bottom face (Type II)

### 2. Reference number for random-matching type

**Ball slide**

**TAS 30 ANC -\*\*KLS**

Random-matching ball slide series code	Preload code : S
TAS : TS Series random-matching ball slide	S: Clearance of 60 μm or less
Size	Accuracy code : KL
Ball slide shape code (See page A243)	KL: Normal grade is only available
Material/surface treatment code	Design serial number
Added to the reference number.	

C: Special high carbon steel  
 D: Special high carbon steel with surface treatment  
 Z: Other, Special

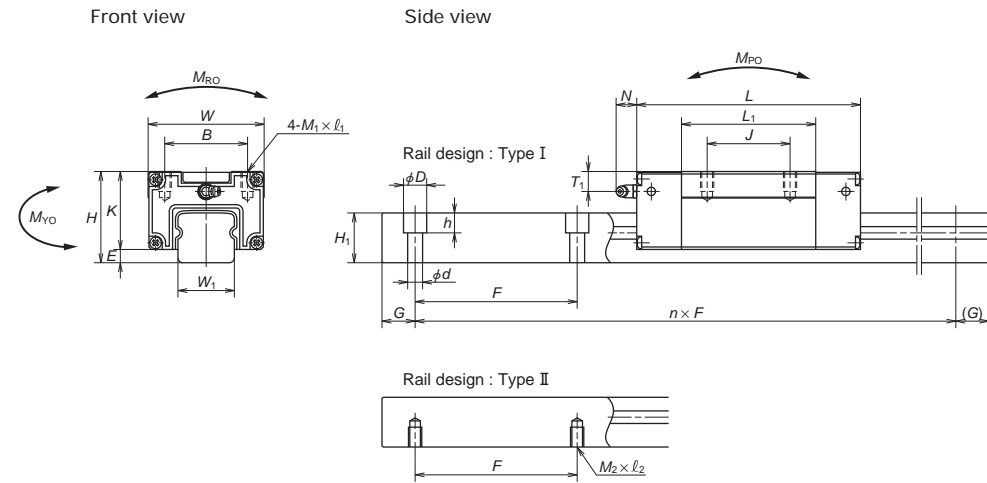
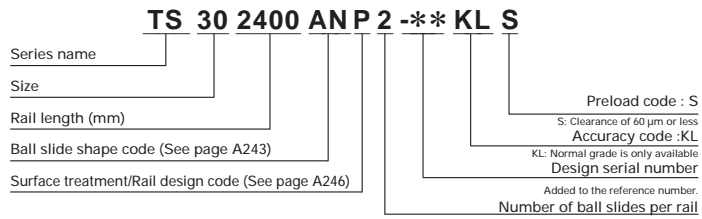
**Rail**

**T1S 30 2400 LPN -\*\* KL S**

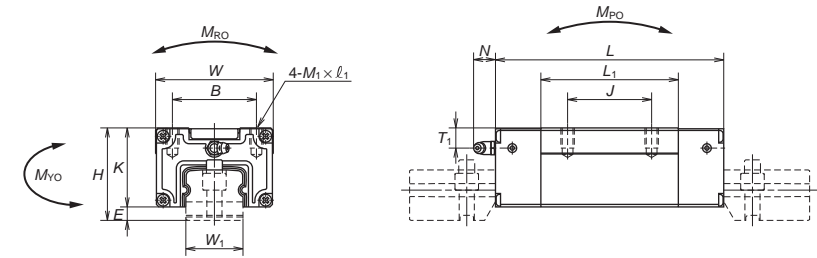
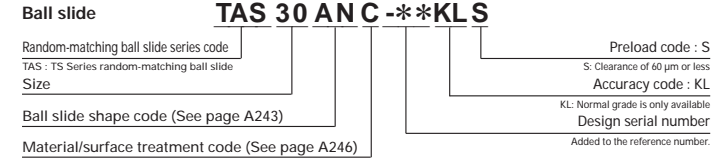
Random-matching rail series code	Preload code : S
T1S : TS Series random-matching rail	S: Clearance of 60 μm or less
Size	Accuracy code : KL
Rail length (mm)	KL: Normal grade is only available
Rail shape code: L	Design serial number
L : Standard	Added to the reference number.
Surface treatment/rail design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

\*Please consult with NSK for butting rail specification.

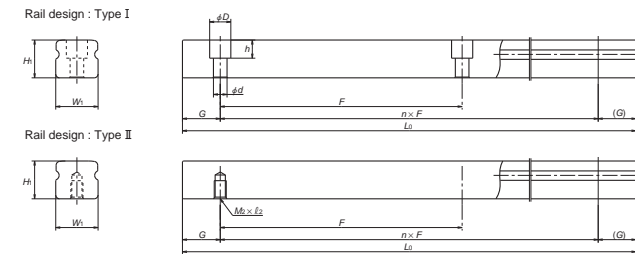
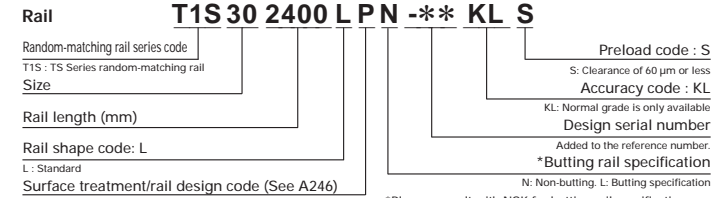
**(8) Dimensions**  
Combinations of random-matching type



Reference number for ball slide of random-matching type



Reference number for rail of random-matching type



Unit: mm

Model No.	Assembly		Ball slide												
	Height	Width	Length	Mounting hole						Grease fitting			width	height	Pitch
				B	J	M × pitch × l <sub>1</sub>	L <sub>1</sub>	K	Hole size	T <sub>1</sub>	N	W <sub>1</sub>			
TS15AN	28	3	34	72.2	26	26	M4×0.7×6	39	25	φ 3	6.5	(5)	15	14	120
TS20AN	30	3	44	87	32	36	M5×0.8×8	50	27	M6×0.75	6.5	(14)	20	15	120
TS25AN	40	4	48	100	35	35	M6×1×9	58	36	M6×0.75	9.5	(14)	23	20	120
TS30AN	45	6.5	60	115	40	40	M8×1.25×10	70	38.5	M6×0.75	9.5	(14)	28	25	160
TS35AN	55	8	70	135.8	50	50	M8×1.25×12	81.8	47	M6×0.75	12	(14)	34	30	160

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

Rail		Basic load rating					Ball dia.	Weight			
Mounting hole		G	Maximum length L <sub>0max</sub>	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment			Ball slide (kg)	Rail (kg/m)	
Type I d × D × h	Type II M <sub>2</sub> × pitch × l <sub>2</sub>					M <sub>RO</sub> (N·m)	M <sub>PO</sub> (N·m)	M <sub>VO</sub> (N·m)			
4.5×7.5×5.3	M4×0.7×6	20	1 960	9 800	11 800	92	63.5	63.5	3.968	0.21	1.5
6×9.5×8.5	M5×0.8×8	20	2 920	15 700	19 100	196	137	137	4.762	0.37	2.1
7×11×9	M6×1×9	20	4 000	21 800	26 000	320	217	217	5.556	0.47	3.4
9×14×12	M8×1.25×12	20	4 040*	31 000	37 500	565	395	395	6.350	0.77	5.3
9×14×12	M8×1.25×12	20	4 040*	46 500	53 000	970	635	635	7.937	1.3	7.7

2) The basic dynamic load rating C is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. To convert C to C100 for a 100 km fatigue life, divide C by 1.26.

3) Consult with NSK when using a TS series in a single rail configuration.

\* The maximum length of fluoride low temperature chrome plated products is 4 000 (G = 80).

1. RA Series

A251

2. LA Series

A269

## A-5-2 Machine Tools

A-5-2.1 RA Series



(1) Features

1. Super-high load capacity

By installing rollers that are the largest possible diameter and length within the existing standard cross-section dimension in a rational layout based on analysis technology, we have realized the world's highest load capacity,\* far superior to conventional roller guides. Super-long life is achieved and impact load can be sufficiently handled.

\* Compared with products of the same size, as of September 1, 2003, researched by NSK.

2. Super-high rigidity

Using NSK's advanced analysis technology, we pursued a complete, optimal design, down to the detailed shape of roller slides and rails, thereby realizing super-high rigidity superior to that of competitor's roller guides.

3. Super-high motion accuracy

NSK has developed its own unique method of simulating rolling element passage vibration and method of designing optimal roller slide specifications for damping roller passage vibration. These developments have dramatically enhanced roller slide motion accuracy for the RA series.

4. Smooth motion

Installing a retaining piece between rollers and restraining the skew peculiar to roller bearings achieve smooth motion.

5. Low friction

Using rollers for rolling elements helps minimize dynamic friction.

6. Fast delivery

Lineup of random-matching rails and roller slides supports random matching and facilitates fast delivery. (RA25 to RA65)

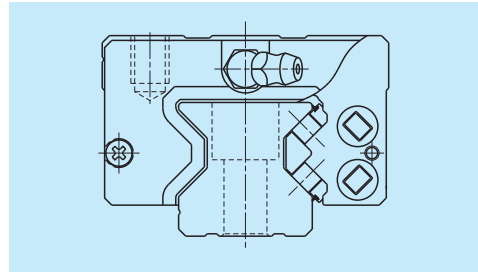


Fig. 1 RA Series

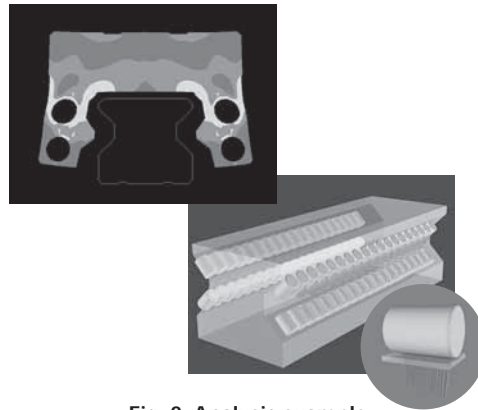


Fig. 2 Analysis example

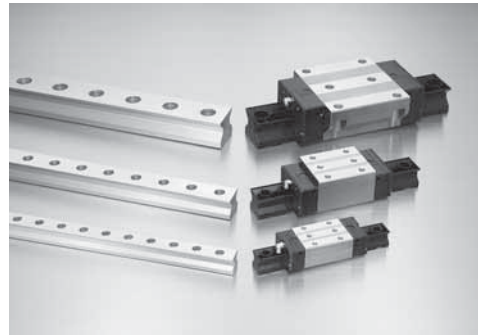


Fig. 3 Random-matching type

(2) Roller slide shape

Roller slide Model	Shape/installation method	Type	
		High-load type	Super-high-load type
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 over all length (mm) over or less	Preloaded assembly			Random-matching type
	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6
- 50	2	2	2	4.5
50 - 80	2	2	3	5
80 - 125	2	2	3.5	5.5
125 - 200	2	2	4	6
200 - 250	2	2.5	5	7
250 - 315	2	2.5	5	8
315 - 400	2	3	6	9
400 - 500	2	3	6	10
500 - 630	2	3.5	7	12
630 - 800	2	4	8	14
800 - 1 000	2.5	4.5	9	16
1 000 - 1 250	3	5	10	17
1 250 - 1 600	4	6	11	19
1 600 - 2 000	4.5	7	13	21
2 000 - 2 500	5	8	15	22
2 500 - 3 150	6	9.5	17	25
3 150 - 3 500	9	16	23	30

2. Accuracy standard

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

• Tolerance of preloaded assembly

Table 2 Unit:  $\mu\text{m}$

Accuracy grade	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6
Characteristics				
Mounting height $H$	$\pm 8$	$\pm 10$	$\pm 20$	$\pm 40$
Variation of $H$ (All roller slides on a set of rails)	3	5	7	15
Mounting width $W_2$ or $W_3$	$\pm 10$	$\pm 15$	$\pm 25$	$\pm 50$
Variation of $W_2$ or $W_3$ (All roller slides on reference rail)	3	7	10	20
Running parallelism of face C to face A Running parallelism of face D to face B	Shown in Table 1 and Fig. 4			

• Tolerance of random-matching type

Table 3 Unit:  $\mu\text{m}$

Accuracy grade	Random-matching with precision grade P6
Characteristics	
Mounting height $H$	$\pm 20$
Variation of mounting height $H$	15① 30②
Mounting width $W_2$ or $W_3$	$\pm 25$
Variation of mounting width $W_2$ or $W_3$	20
Running parallelism of face C to face A Running parallelism of face D to face B	See Table 1 and Fig. 4

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

3. Assembled accuracy

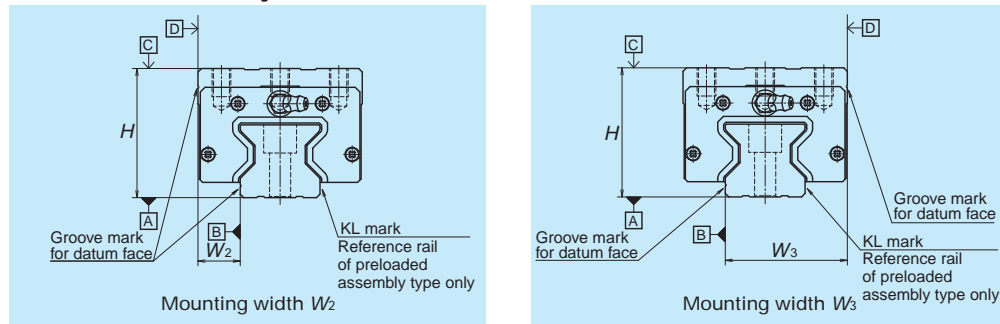


Fig. 4

4. Preload and rigidity

Preload is set for the RA series by slightly changing the size of the roller used. Applying preload enhances rigidity and minimizes elastic deformation.

With the characteristics of the roller guide, there is minimal variation in rigidity according to amount of preload, and it offers stable, high rigidity. Because of that, for the RA series, only medium preload type Z3 (preload: 10% of  $C$ , where  $C$  is the basic dynamic load rating) is set. Preload is shown in Table 4, and theoretical rigidity lines are shown in Fig. 6 and Fig. 7.

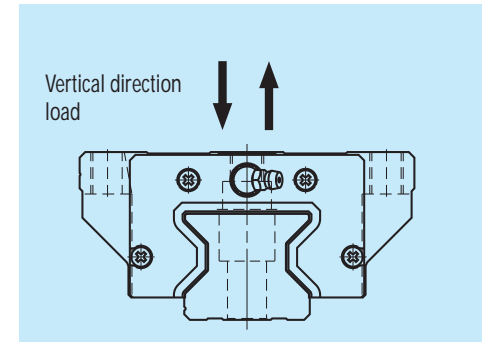


Fig. 5 Direction of load

Table 4 Preload Unit: N

Model No.	High-load type Medium preload (Z3)	Super-high-load type Medium preload (Z3)
RA15	1 030	1 300
RA20	1 920	2 400
RA25	2 920	3 540
RA30	3 890	4 760
RA35	5 330	6 740
RA45	9 280	11 600
RA55	12 900	16 800
RA65	21 000	28 800

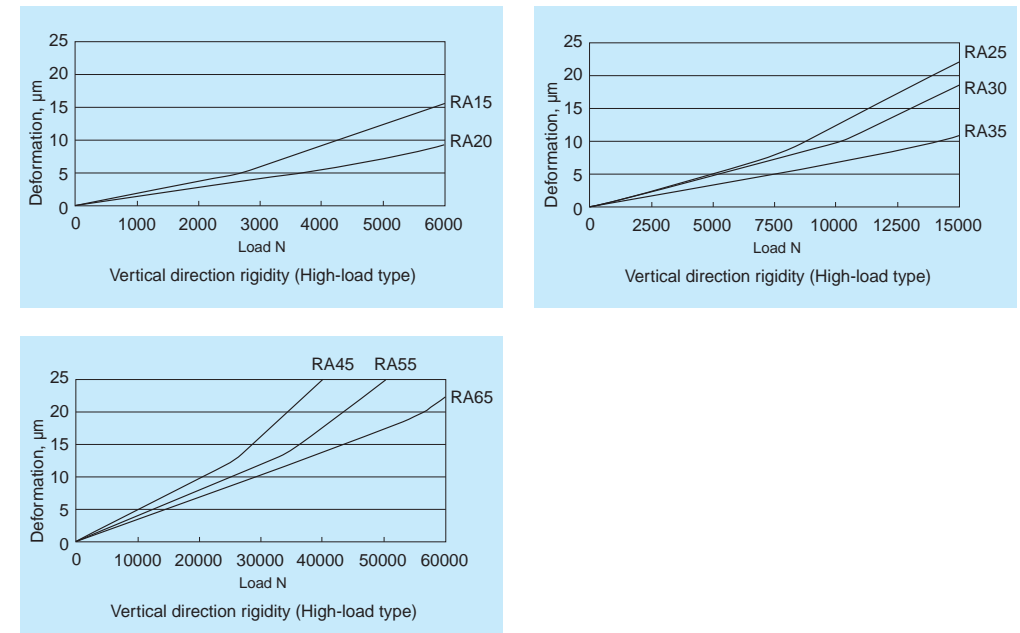


Fig. 6 Vertical direction theoretical rigidity line: High-load type (Roller slide shape: AN, AL, EM)

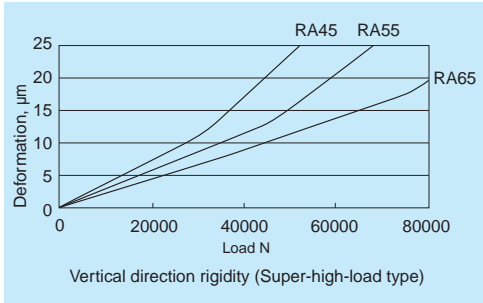
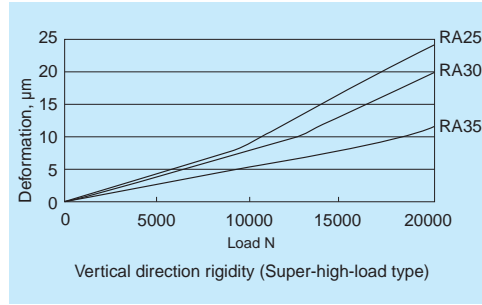
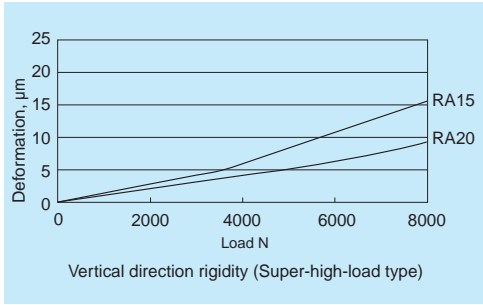


Fig. 7 Vertical direction theoretical rigidity line: Super-high-load type (Roller slide shape: BN, BL, GM)

(4) Available length of rail

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

**Table 5 Length limitation of rails** Unit : mm

Series	Size	RA15	RA20	RA25	RA30	RA35	RA45	RA55	RA65
RA		2000	3000	3000	3500	3500	3500	3500	3500

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

(5) Installation

1. Permissible values of mounting error

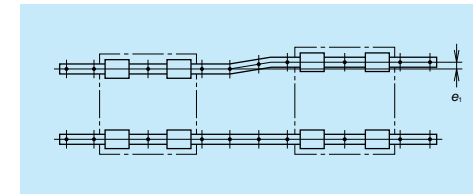


Fig. 8

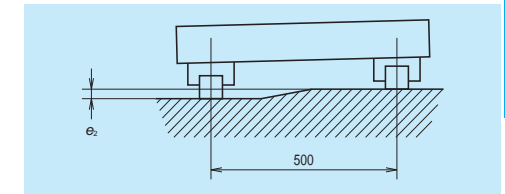


Fig. 9

**Table 6** Unit :  $\mu\text{m}$

Value	Preload	Model No.							
		RA15	RA20	RA25	RA30	RA35	RA45	RA55	RA65
Permissible values of parallelism in two rails $e_1$	Z3	5	7	9	11	13	17	19	30
Permissible values of parallelism (height) in two rails $e_2$	Z3	150 $\mu\text{m}$ /500 mm							

2. Shoulder height of the mounting face and corner radius r

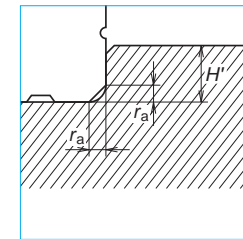


Fig. 10 Shoulder for the rail datum face

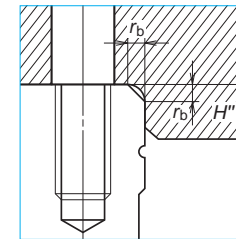


Fig. 11 Shoulder for the roller slide datum face

**Table 7** 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 page A38 and D13 for the lubrication of linear guides.

1. Types of lubrication accessories

Figure 14 and Table 10 show grease fittings and tube fittings.

2. Mounting position of lubrication accessories

The standard position of grease fittings is the end face of roller slide. We mount them on a side of end cap for an option. (Fig. 12) Mounting positions are shown in Fig.12, 13, Table 8 and 9.

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

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

A lubrication hole can also be provided on the top of the end cap. Fig.13, Table 8 and 9 show the mounting position.

A spacer is required for AN and BN type of roller slides.

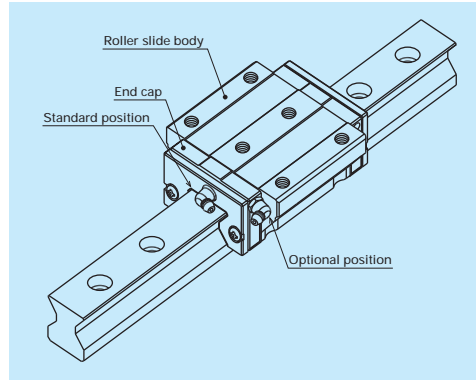


Fig. 12 Mounting position of lubrication accessories

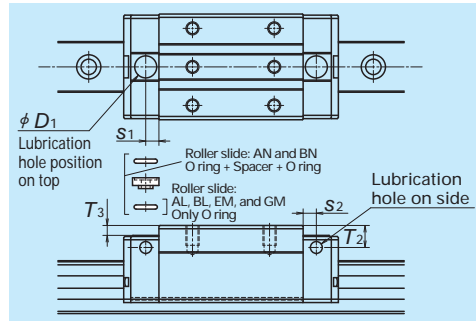


Fig.13 Top and side lubrication hole positions

Table 8 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	$\phi 3$	4	7	P5	Necessary	8.2	4.4	4.2
RA20		$\phi 3$	4	4	P6	—	9.2	5.4	0.2
RA25		M6×0.75	6	10	P7	Necessary	10.2	6	4.5
RA30		M6×0.75	5	10	P7	Necessary	10.2	6	3.5
RA35		M6×0.75	5.5	15	P7	Necessary	10.2	7	7.4
RA45		Rc 1/8	7.2	20	P7	Necessary	10.2	7.2	10.4
RA55		Rc 1/8	7.2	21	P7	Necessary	10.2	7.2	10.4
RA65		Rc 1/8	7.2	19	P7	—	10.2	7.2	0.4

Table 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)	$D_1$	$s_1$	$T_3$
RA15	AL, BL, EM, GM	$\phi 3$	4	3	P5	8.2	4.4	0.2
RA20	EM, GM	$\phi 3$	4	4	P6	9.2	5.4	0.2
RA25	AL, BL, EM, GM	M6×0.75	6	6	P7	10.2	6	0.4
RA30		M6×0.75	5	7	P7	10.2	6	0.4
RA35		M6×0.75	5.5	8	P7	10.2	7	0.4
RA45		Rc 1/8	7.2	10	P7	10.2	7.2	0.4
RA55		Rc 1/8	7.2	11	P7	10.2	7.2	0.4
RA65		EM, GM	Rc 1/8	7.2	19	P7	10.2	7.2

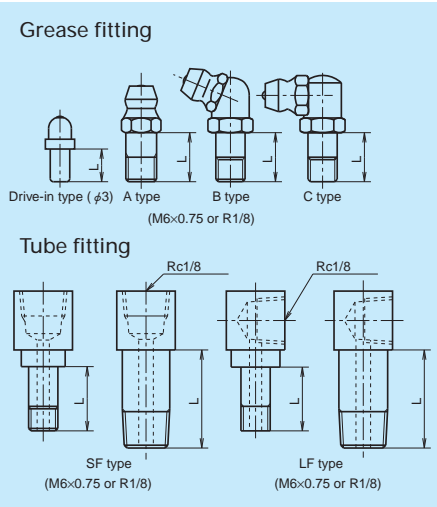


Fig. 14 Grease fitting and tube fitting

(7) Dust proof components

1. Standard specification

RA series is equipped with end, inner\* and bottom seals to prevent foreign matter from entering the inside of the roller slide. Under normal applications, the RA series can be used without modification.

For severe usage conditions, optional rail covers\*\* are available. Contact NSK for information on how to mount the cover.

\*) Inner seals for RA15 and RA20 are available as options.

\*\*\*) Rail cover is applicable to RA25 to RA65.

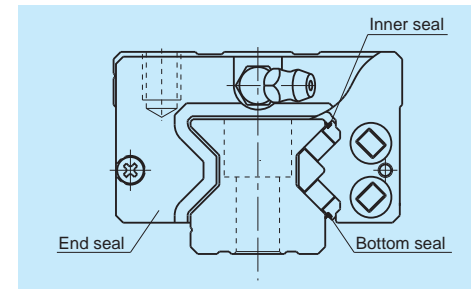


Fig. 15



Fig. 16 Rail cover

Table 11 Seal friction per roller slide (maximum value)

Series	Size	Unit : N							
		15	20	25	30	35	45	55	65
RA		4	5.5	5	5	6	8	8	14

2. NSK K1™

Table 12 shows the dimension of linear guides equipped with the NSK K1.

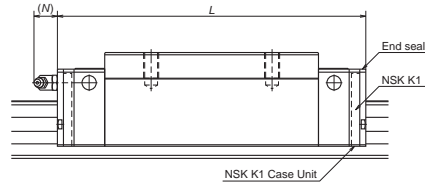


Table 12

Unit: mm

Model No.	Roller slide length	Roller slide model	Standard roller slide length	Roller slide length installed with NSK K1 Case Unit L	Per NSK K1 case unit thickness	Protruding area of the grease fitting N
RA15	Standard	AN, AL, EM	70	79	4.5	(3)
	Long	BN, BL, GM	85.4	94.4		
RA20	Standard	AN, EM	86.5	95.5	4.5	(3)
	Long	BN, GM	106.3	115.3		
RA25	Standard	AN, AL, EM	97.5	107.5	5	(11)
	Long	BN, BL, GM	115.5	125.5		
RA30	Standard	AN, AL, EM	110.8	122.8	6	(11)
	Long	BN, BL, GM	135.4	147.4		
RA35	Standard	AN, AL, EM	123.8	136.8	6.5	(11)
	Long	BN, BL, GM	152	165		
RA45	Standard	AN, AL, EM	154	168	7	(14)
	Long	BN, BL, GM	190	204		
RA55	Standard	AN, AL, EM	184	198	7	(14)
	Long	BN, BL, GM	234	248		
RA65	Standard	AN, EM	228.4	243.4	7.5	(14)
	Long	BN, GM	317.5	317.5		

Roller slide length equipped with NSK K1 case unit = (Standard roller slide length) + (Thickness of NSK K1 case unit × Number of NSK K1 case unit)

3. Double seal and protector

For RA Series, double seal and protector can be installed only before shipping from the factory. Table 13 shows the increased thickness when end seal and protector are installed.

Table 13

Model No.	Thickness of end seal	Thickness of protector
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

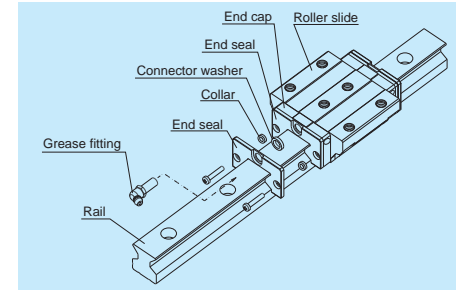


Fig. 17 Double seal

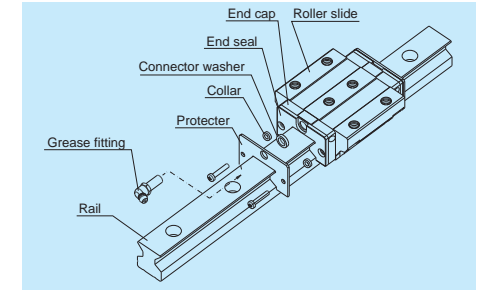


Fig. 18 Protector

4. Rail cover

When the rail cover is used, use the cover bracket to secure the rail cover. Fig.19 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 65)
- Please confirm the interference with your machine at the stroke end.
- Machine stroke
  - Room for the end of the rail

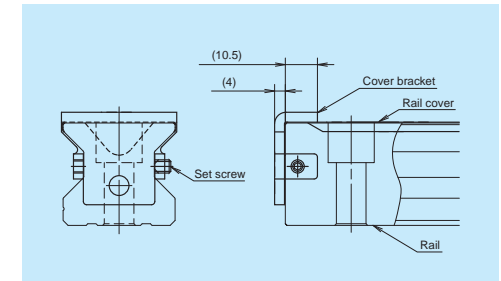


Fig. 19 End configuration of rail equipped with the rail cover

The height of the rail with the rail cover is shown in Table 14.

Table 14 Height of rails equipped with rail cover  
Unit: mm

Model No.	Standard height H <sub>i</sub>	Cover installation
RA25	24	24.25
RA30	28	28.25
RA35	31	31.25
RA45	38	38.3
RA55	43.5	43.8
RA65	55	55.3

5. Cap to cover the bolt hole for rail mounting

Table 15 Caps to cover rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
RA15	M4	LG-CAP/M4	20
RA20	M5	LG-CAP/M5	20
RA25	M6	LG-CAP/M6	20
RA30, RA35	M8	LG-CAP/M8	20
RA45	M12	LG-CAP/M12	20
RA55	M14	LG-CAP/M14	20
RA65	M16	LG-CAP/M16	20

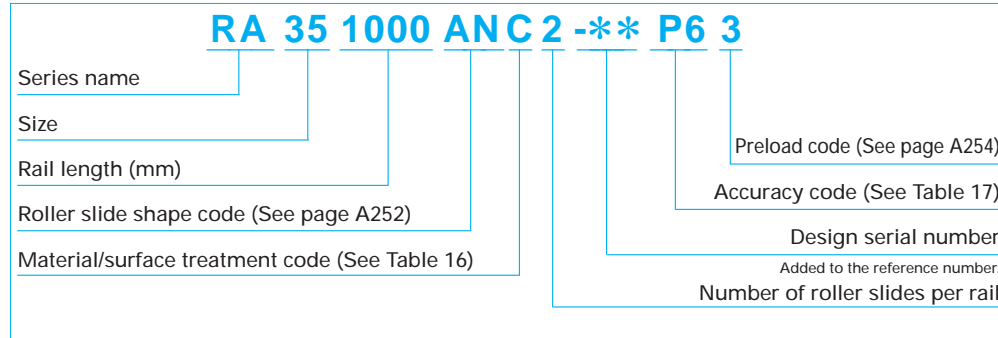


**(8) Reference number**

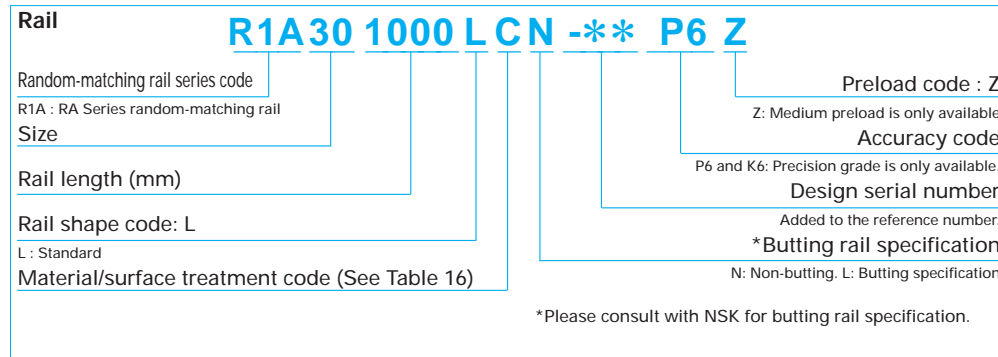
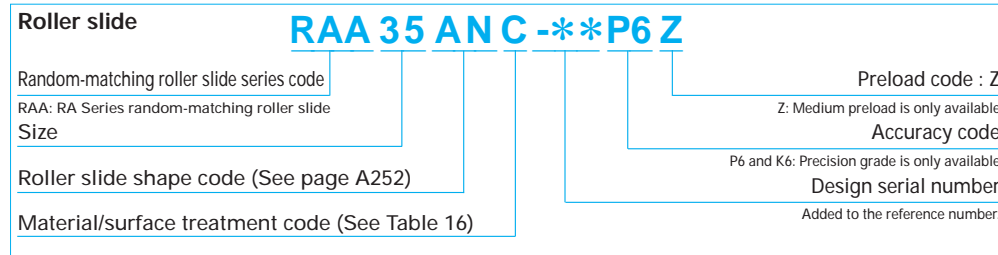
Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.

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

**1. Reference number for preloaded assembly**



**2. Reference number for random-matching type**



Reference number for assembly of random-matching roller slide and rail is the same as the coding of preloaded assembly. However, preload code is medium preload "Z".

**Table 16 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 17 Accuracy code**

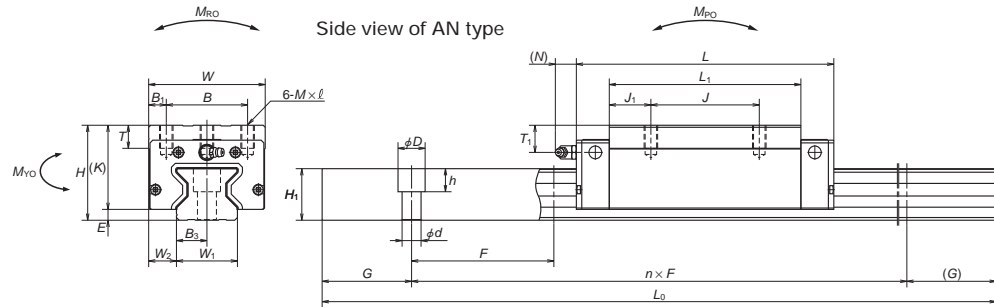
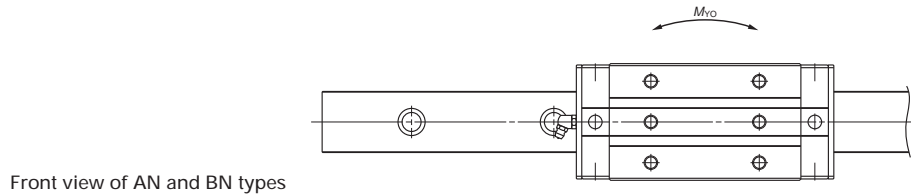
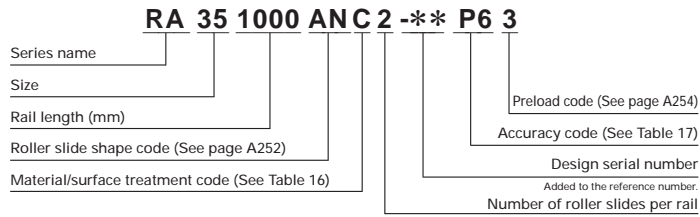
Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5
Precision grade	P6	K6

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

(9) Dimensions

RA-AN (High-load type)

RA-BN (Super-high-load type)

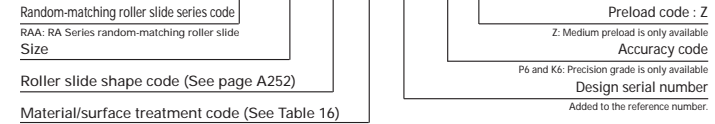


Model No.	Assembly			Roller slide												
	Height		Width	Length	Mounting hole						Grease fitting					
	H	E			W <sub>2</sub>	W	L	B	J	M × pitch × ℓ	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Hole size
RA15AN RA15BN	28	4	9.5	34	70 85.4	26	26	M4×0.7×6	4	44.8 60.2	9.4 17.1	24	8	φ3	8	3
RA20AN RA20BN	30	5	12	44	86.5 106.3	32	36	M5×0.8×6	6	57.5 77.3	10.75 13.65	25	12	φ3	4	3
RA25AN RA25BN	40	5	12.5	48	97.5 115.5	35	35	M6×1×9	6.5	65.5 83.5	15.25 16.75	35	12	M6×0.75	10	11
RA30AN RA30BN	45	6.5	16	60	110.8 135.4	40	40	M8×1.25×11	10	74 98.6	17 19.3	38.5	14	M6×0.75	10	11
RA35AN RA35BN	55	6.5	18	70	123.8 152	50	50	M8×1.25×12	10	83.2 111.4	16.6 19.7	48.5	15	M6×0.75	15	11
RA45AN RA45BN	70	8	20.5	86	154 190	60	60	M10×1.5×17	13	105.4 141.4	22.7 30.7	62	17	Rc1/8	20	14
RA55AN RA55BN	80	9	23.5	100	184 234	75	75	M12×1.75×18	12.5	128 178	26.5 41.5	71	18	Rc1/8	21	14
RA65AN RA65BN	90	13	31.5	126	228.4 302.5	76	76	M16×2×20	25	155.4 229.5	42.7 54.75	77	22	Rc1/8	19	14

Remarks: 1) Select either one of dimensions for pitch of holes for rail fixing F without parenthesis for standard dimension and with parenthesis for semi-standard dimension.

Reference number for roller slide of random-matching type

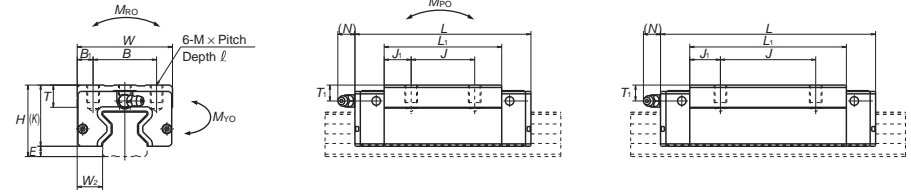
Roller slide **RAA 35 AN C -\*\* P6 Z**



AN and BN types

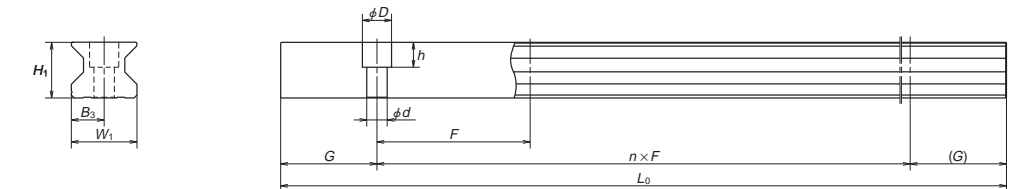
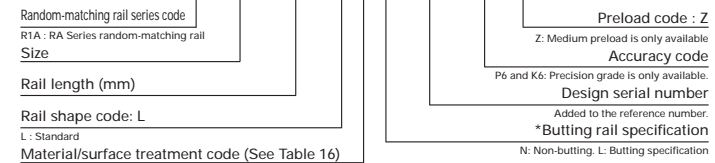
AN type

BN type



Reference number for rail of random-matching type

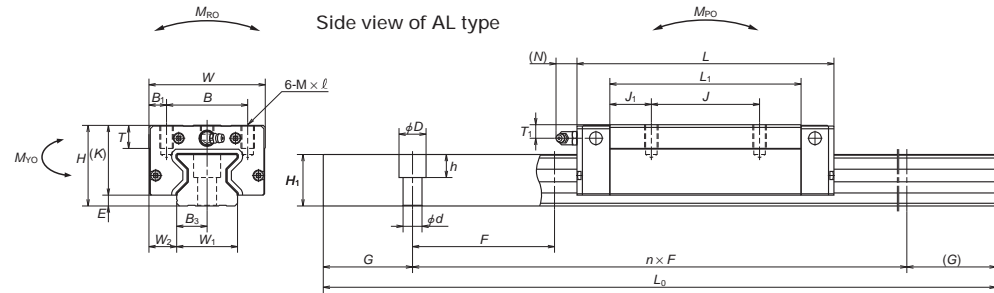
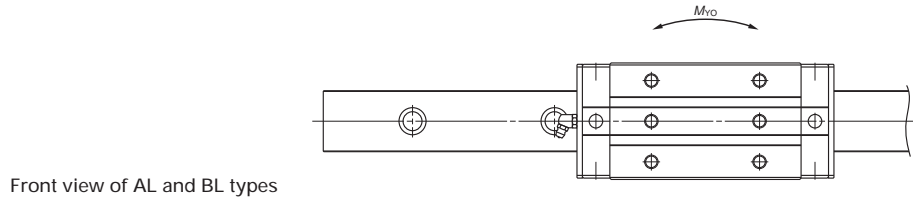
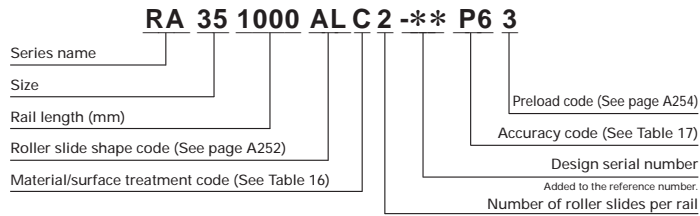
Rail **R1A30 1000 LCN -\*\* P6 Z**



Rail							Basic load rating					Weight	
Width	Height	Pitch	Mounting bolt hole	G	Maximum length	L <sub>0max</sub>	Dynamic		Static moment			Roller slide	Rail
							C (N)	C <sub>0</sub> (N)	M <sub>ro</sub> (N·m)	M <sub>po</sub> (N·m)	M <sub>yo</sub> (N·m)		
15	16.3	60 (30)	4.5×7.5×5.3	7.5	20	2 000	10 300 13 000	27 500 37 000	260 350	210 375	210 375	0.21 0.30	1.6
20	20.8	60 (30)	6×9.5×8.5	10	20	3 000	19 200 24 000	52 500 70 000	665 890	505 900	505 900	0.38 0.50	2.6
23	24	30	7×11×9	11.5	20	3 000	29 200 35 400	72 700 92 900	970 1 240	760 1 240	760 1 240	0.60 0.91	3.4
28	28	40	9×14×12	14	20	3 500	38 900 47 600	93 500 121 000	1 670 2 170	1 140 1 950	1 140 1 950	1.0 1.3	4.9
34	31	40	9×14×12	17	20	3 500	53 300 67 400	129 000 175 000	2 810 3 810	1 800 3 250	1 800 3 250	1.6 2.1	6.8
45	38	52.5	14×20×17	22.5	22.5	3 500	92 800 116 000	229 000 305 000	6 180 8 240	4 080 7 150	4 080 7 150	3.0 4.1	10.9
53	43.5	60	16×23×20	26.5	30	3 500	129 000 168 000	330 000 462 000	10 200 14 300	7 060 13 600	7 060 13 600	4.9 6.7	14.6
63	55	75	18×26×22	31.5	35	3 500	210 000 288 000	504 000 756 000	19 200 28 700	12 700 28 600	12 700 28 600	9.3 12.2	22.0

2) RA25 to RA65 are available in random matching.  
3) The basic load rating complies with ISO standards (ISO14728-1, ISO14728-2).  
If the basic dynamic load rating (100 km rating) is converted into 50 km rating, use the following formula:  
 $C_{50km} = 1.23 \times C_{100km}$

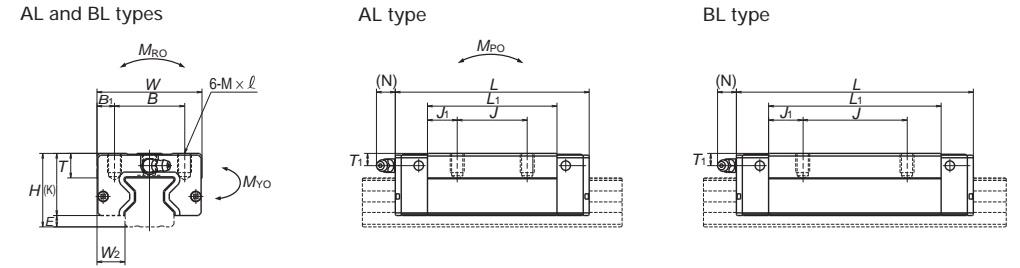
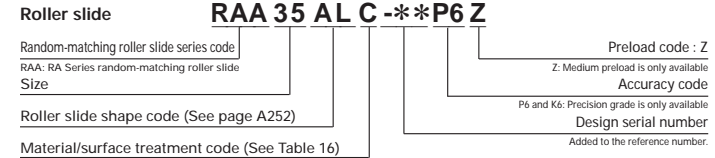
RA-AL (High-load type)  
RA-BL (Super-high-load type)



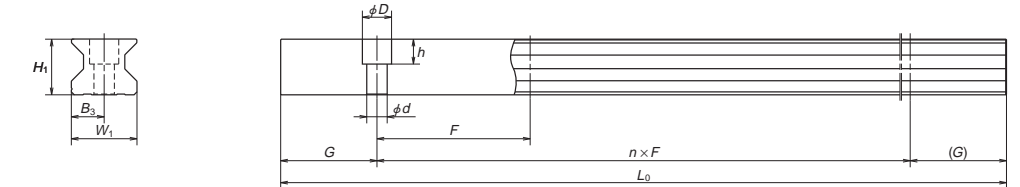
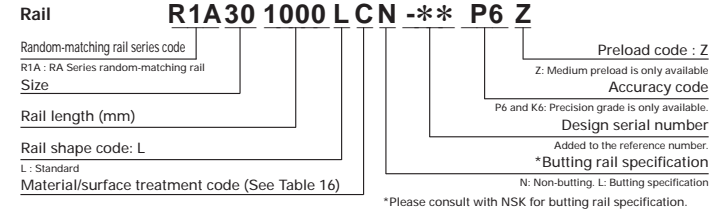
Model No.	Assembly			Roller slide												
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole			B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Grease fitting		
						B	J	M × pitch × ℓ						Hole size	T <sub>1</sub>	N
RA15AL RA15BL	24	4	9.5	34	70 85.4	26	26	M4×0.7×5.5	4	44.8 60.2	9.4 17.1	20	8	φ3	4	3
RA25AL RA25BL	36	5	12.5	48	97.5 115.5	35	35	M6×1×8	6.5	65.5 83.5	15.25 16.75	31	12	M6×0.75	6	11
RA30AL RA30BL	42	6.5	16	60	110.8 135.4	40	40	M8×1.25×11	10	74 98.6	17 19.3	35.5	14	M6×0.75	7	11
RA35AL RA35BL	48	6.5	18	70	123.8 152	50	50	M8×1.25×12	10	83.2 111.4	16.6 19.7	41.5	15	M6×0.75	8	11
RA45AL RA45BL	60	8	20.5	86	154 190	60	60	M10×1.5×16	13	105.4 141.4	22.7 30.7	52	17	Rc1/8	10	14
RA55AL RA55BL	70	9	23.5	100	184 234	75	75	M12×1.75×18	12.5	128 178	26.5 41.5	61	18	Rc1/8	11	14

Remarks: 1) Select either one of dimensions for pitch of holes for rail fixing F without parenthesis for standard dimension and with parenthesis for semi-standard dimension.

Reference number for roller slide of random-matching type



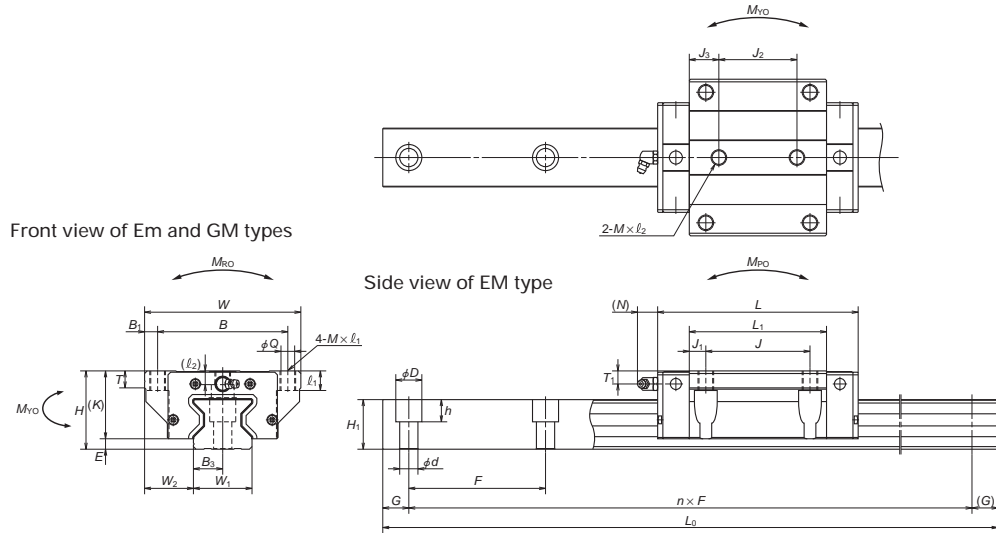
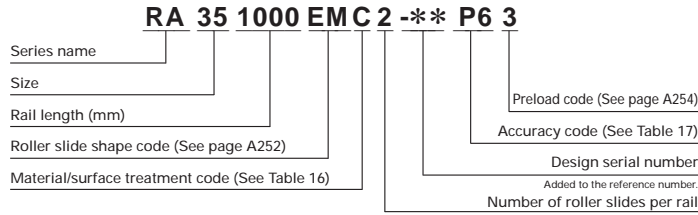
Reference number for rail of random-matching type



Rail							Basic load rating					Weight	
Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Mounting bolt hole d × D × h	B <sub>3</sub>	G (Reference)	Maximum length L <sub>0max</sub>	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment			Roller slide (kg)	Rail (kg/m)
									M <sub>RO</sub> (N-m)	M <sub>PO</sub> (N-m)	M <sub>YO</sub> (N-m)		
15	16.3	60 (30)	4.5×7.5×5.3	7.5	20	2 000	10 300 13 000	27 500 37 000	260 350	210 375	210 375	0.17 0.25	1.6
23	24	30	7×11×9	11.5	20	3 000	29 200 35 400	72 700 92 900	970 1 240	760 1 240	760 1 240	0.45 0.80	3.4
28	28	40	9×14×12	14	20	3 500	38 900 47 600	93 500 121 000	1 670 2 170	1 140 1 950	1 140 1 950	0.85 1.1	4.9
34	31	40	9×14×12	17	20	3 500	53 300 67 400	129 000 175 000	2 810 3 810	1 800 3 250	1 800 3 250	1.2 1.7	6.8
45	38	52.5	14×20×17	22.5	22.5	3 500	92 800 116 000	229 000 305 000	6 180 8 240	4 080 7 150	4 080 7 150	2.5 3.4	10.9
53	43.5	60	16×23×20	26.5	30	3 500	129 000 168 000	330 000 462 000	10 200 14 300	7 060 13 600	7 060 13 600	4.1 5.7	14.6

2) RA25 to RA55 are available in random matching.  
3) The basic load rating complies with ISO standards (ISO14728-1, ISO14728-2).  
If the basic dynamic load rating (100 km rating) is converted into 50 km rating, use the following formula:  
C<sub>50 km</sub> = 1.23 × C<sub>100 km</sub>

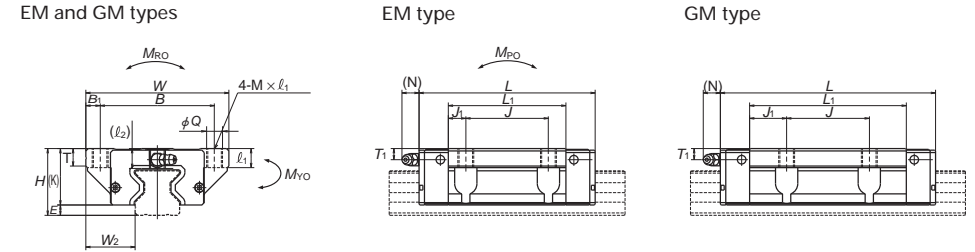
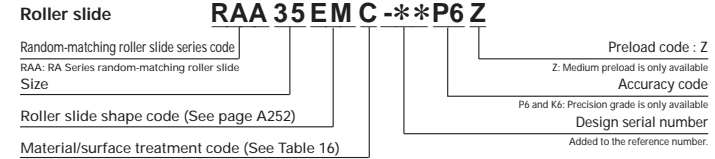
RA-EM (High-load type)  
RA-GM (Super-high-load type)



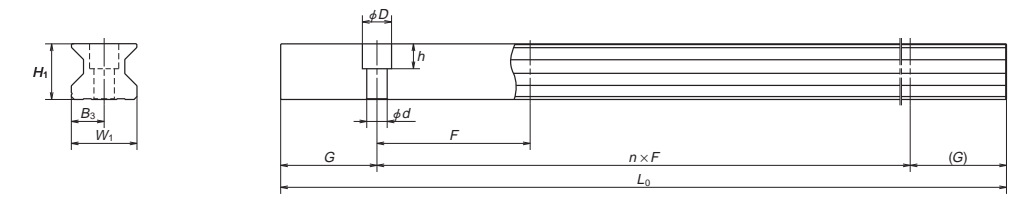
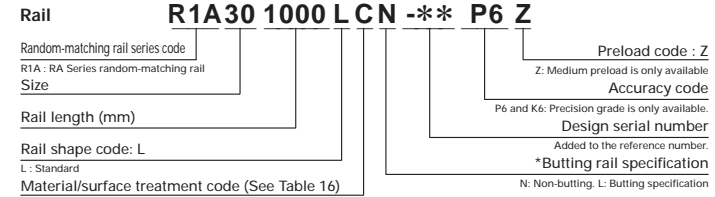
Model No.	Assembly		Roller slide														
	Height H	E	Width W <sub>2</sub>	Width W	Length L	Mounting hole					B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	J <sub>3</sub>	K	T	
						B	J	J <sub>2</sub>	M × pitch × ℓ <sub>1</sub> (ℓ <sub>2</sub> )	Q <sub>2</sub>							
RA15EM	24	4	16	47	70	38	30	26	M5×0.8×8.5 (6.5)	4.4	4.5	44.8	7.4	9.4	20	8	
RA15GM					85.4							60.2	15.1	17.1			
RA20EM	30	5	21.5	63	86.5	53	40	35	M6×1×9.5 (8)	5.3	5	57.5	8.75	11.25	25	10	
RA20GM					106.3							77.3	18.65	21.15			
RA25EM	36	5	23.5	70	97.5	57	45	40	M8×1.25×10 (11)	6.8	6.5	65.5	10.25	12.75	31	11	
RA25GM					115.5							83.5	19.25	21.75			
RA30EM	42	6.5	31	90	110.8	72	52	44	M10×1.5×12 (12.5)	8.6	9	74	11	15	35.5	11	
RA30GM					135.4							98.6	23.3	27.3			
RA35EM	48	6.5	33	100	123.8	82	62	52	M10×1.5×13 (7)	8.6	9	83.2	10.6	15.6	41.5	12	
RA35GM					152							111.4	24.7	29.7			
RA45EM	60	8	37.5	120	154	100	80	60	M12×1.75×15 (10.5)	10.5	10	105.4	12.7	22.7	52	13	
RA45GM					190							141.4	30.7	40.7			
RA55EM	70	9	43.5	140	184	116	95	70	M14×2×18 (13)	12.5	12	128	16.5	29	61	15	
RA55GM					234							178	41.5	54			
RA65EM	90	13	53.5	170	228.4	142	110	82	M16×2×24 (18.5)	14.6	14	155.4	22.7	36.7	77	22	
RA65GM					302.5							229.5	59.75	73.75			

Remarks: 1) Select either one of dimensions for pitch of holes for rail fixing F without parenthesis for standard dimension and with parenthesis for semi-standard dimension.

Reference number for roller slide of random-matching type



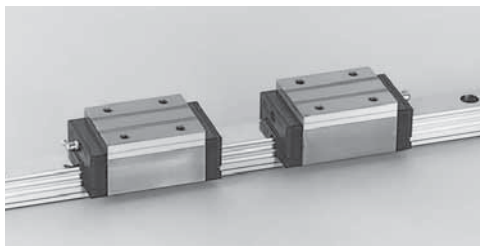
Reference number for rail of random-matching type



Grease fitting Hole size	T <sub>1</sub>	N	Rail										Basic load rating					Weight	
			Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Mounting bolt hole d × D × h	B <sub>3</sub>	G	Maximum length L <sub>max</sub>	Dynamic C	Static C <sub>0</sub>	Static moment M <sub>Ro</sub>	M <sub>Vo</sub>	M <sub>Vo</sub>	Roller slide (kg)	Rail (kg/m)			
			Reference	Reference	Reference	Reference	Reference	Reference	Reference	(N)	(N)	(N-m)	(N-m)	(N-m)	(kg)	(kg/m)			
φ3	4	3	15	16.3	60 (30)	4.5×7.5×5.3	7.5	20	2 000	10 300	27 500	260	210	210	0.21	1.6			
φ3	4	3	20	20.8	60 (30)	6×9.5×8.5	10	20	3 000	19 200	52 500	665	505	505	0.45	2.6			
M6×0.75	6	11	23	24	30	7×11×9	11.5	20	3 000	29 200	72 700	970	760	760	0.80	3.4			
M6×0.75	7	11	28	28	40	9×14×12	14	20	3 500	35 400	92 900	1 240	1 240	1 240	1.1	4.9			
M6×0.75	8	11	34	31	40	9×14×12	17	20	3 500	38 900	93 500	1 670	1 140	1 140	1.3	6.8			
Rc1/8	10	14	45	38	52.5	14×20×17	22.5	22.5	3 500	47 600	121 000	2 170	1 950	1 950	1.7	10.9			
Rc1/8	11	14	53	43.5	60	16×23×20	26.5	30	3 500	53 300	129 000	2 810	1 800	1 800	1.7	14.6			
Rc1/8	19	14	63	55	75	18×26×22	31.5	35	3 500	67 400	175 000	3 810	3 250	3 250	2.3	22.0			

2) RA25 to RA65 are available in random matching.  
3) The basic load rating complies with ISO standards (ISO14728-1, ISO14728-2).  
If the basic dynamic load rating (100 km rating) is converted into 50 km rating, use the following formula:  
C<sub>50km</sub> = 1.23 × C<sub>100km</sub>

A-5-2.2 LA Series



(1) Features

1. High rigidity and high load carrying capacity

A set of three ball grooves is made on both sides. This contributes to the increased rigidity and load carrying capacity. The top and bottom groove are formed in the circular arc with a closer radius of ball, which ensures great rigidity and load carrying capacity. With the Gothic arch center groove, rigidity and load carrying capacity are further increased.

2. Moderate friction

A well-balanced combination of 2-point contacts at the top and bottom grooves and 4 points contact at the center groove provides moderate friction while ensuring rigidity by appropriate preload.

3. Load distribution four directions

Contact angle is set at 45 degrees in all grooves, dispersing the load 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 rows at all times. The number of rows which receive the load is larger than in other linear guides, making this series stronger against shock load.

5. High accuracy

Fixing the measuring rollers is easy thanks to the Gothic arch groove. Ball-groove measuring is accurate and simple. This benefits a highly precise and stable manufacturing.

6. The dust protection design

The rail's cross section is designed as simple as possible. Furthermore, the improved seal enhances the sealing function. Inner seal is available as an option.

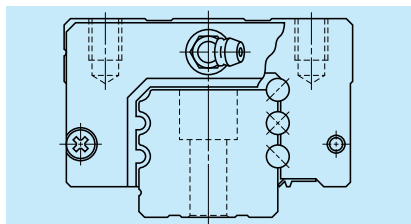


Fig. 1 LA Series

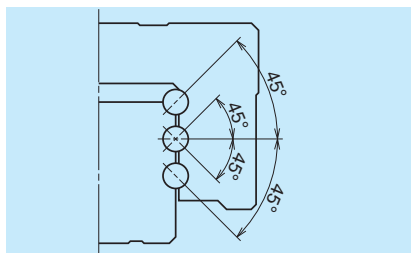


Fig. 2 Super rigidity design

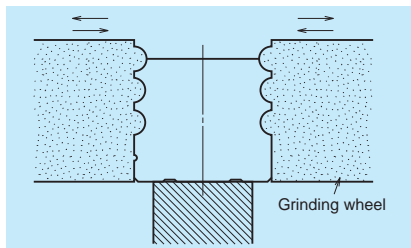


Fig. 3 Rail grinding

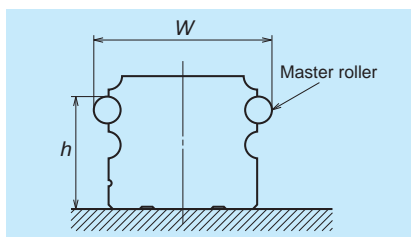


Fig. 4 Measuring groove accuracy

(2) Ball slide shape

Ball slide Model	Shape/installation method	Type	
		High-load type	Super-high-load type
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:  $\mu\text{m}$

Rail over all length (mm) over   or less	Preloaded assembly (not random matching)			
	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6
- 50	2	2	2	4.5
50 - 80	2	2	3	5
80 - 125	2	2	3.5	5.5
125 - 200	2	2	4	6
200 - 250	2	2.5	5	7
250 - 315	2	2.5	5	8
315 - 400	2	3	6	9
400 - 500	2	3	6	10
500 - 630	2	3.5	7	12
630 - 800	2	4.5	8	14
800 - 1000	2.5	5	9	16
1000 - 1250	3	6	10	17
1250 - 1600	4	7	11	19
1600 - 2000	4.5	8	13	21
2000 - 2500	5	10	15	22
2500 - 3150	6	11	17	25
3150 - 4000	9	16	23	30

## 2. Accuracy standard

LA series have four degrees such as ultra precision P3, super precision P4, high precision P5, and precision grade P6.

**Table 2** Unit:  $\mu\text{m}$

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)	$\pm 10$ 3	$\pm 10$ 5	$\pm 20$ 7	$\pm 40$ 15
Mounting width $W_2$ or $W_3$ Variation of $W_2$ or $W_3$ (All ball slides on reference rail)	$\pm 15$ 3	$\pm 15$ 7	$\pm 25$ 10	$\pm 50$ 20
Running parallelism of face C to face A Running parallelism of face D to face B	Shown in Table 1 and Fig. 5			

## 3. Assembled accuracy

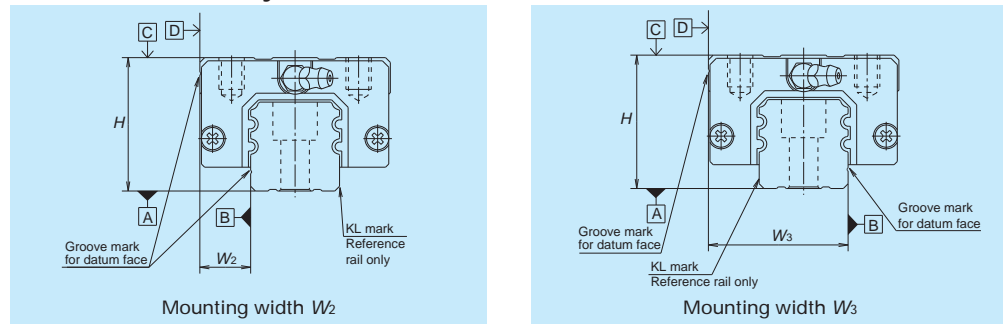


Fig. 5

## 4. Preload and rigidity

Table 3 shows preload and rigidity of LA Series.

LA Series has two types of preload Z3 (medium preload) and Z4 (heavy preload).

**Table 3**

	Model No.	Preload (N)		Rigidity (N/ $\mu\text{m}$ )	
		Medium preload Z3	Heavy preload Z4	Medium preload Z3	Heavy preload Z4
High-load type	LA25 AL, AN, EL, FL	1670	2110	475	550
	LA30 AL, AN, EL, FL	2450	3140	705	835
	LA35 AL, AN, EL, FL	3450	4300	825	970
	LA45 AL, AN, EL, FL	5050	6350	1100	1240
	LA55 AL, AN, EL, FL	8100	10200	1400	1540
Super-high-load type	LA65 AN, EL, FL	13800	18800	1730	2030
	LA25 BL, BN, GL, HL	2260	2840	700	820
	LA30 BL, BN, GL, HL	3250	4050	1000	1180
	LA35 BL, BN, GL, HL	4450	5650	1200	1400
	LA45 BL, BN, GL, HL	6150	7750	1450	1640
	LA55 BL, BN, GL, HL	9550	12100	1840	2020
LA65 BN, GL, HL	18000	24400	2450	2840	

## (4) Available length of rail

Show the limitations of rail length (maximum length). However, the limitations vary by accuracy grade.

**Table 4** Unit: mm

Series	Size	25	30	35	45	55	65
LA		3960	4000	4000	3990	3960	3900

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

## (5) Installation

### 1. Permissible values of mounting error

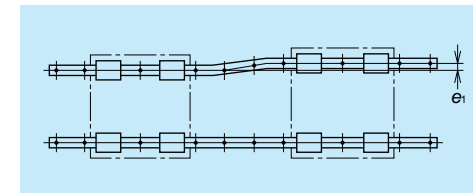


Fig. 6

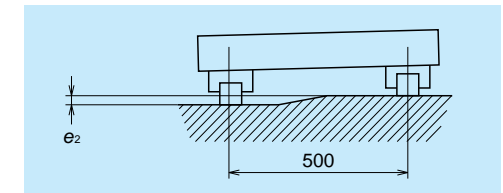


Fig. 7

**Table 5**

Value	Preload	Model No.					
		LA25	LA30	LA35	LA45	LA55	LA65
Permissible values of parallelism in two rails $e_1$	Z3	15	17	20	25	30	40
	Z4	13	15	17	20	25	30
Permissible values of parallelism (height) in two rails $e_2$	Z3, Z4	185 $\mu\text{m}/500\text{ mm}$					

Unit:  $\mu\text{m}$

### 2. Shoulder height of the mounting face and corner radius $r$

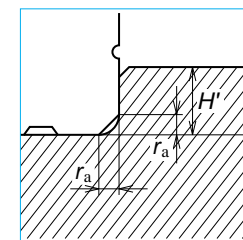


Fig. 8 Shoulder for the rail datum face

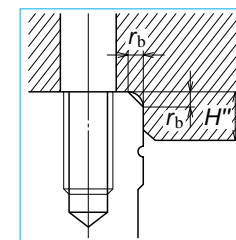


Fig. 9 Shoulder for the ball slide datum face

**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 page A38 and D13 for the lubrication of linear guides.

#### 1. Types of lubrication accessories

Figure 10 and Table 7 show grease fittings and tube fittings.

#### 2. Mounting position of lubrication accessories

The standard position of grease fittings is the end face of ball slide. We mount them on a side of end cap for an option. (Fig. 11).

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

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

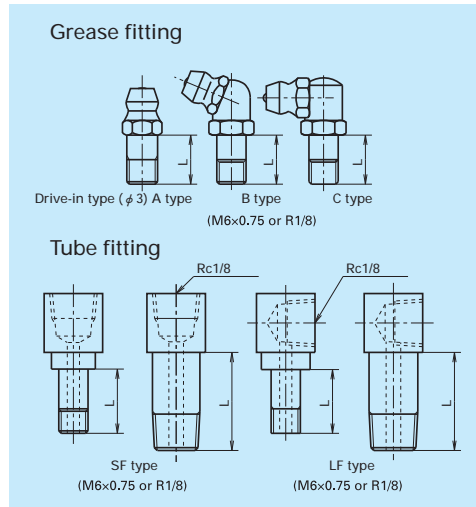


Fig. 10 Grease fitting and tube fitting

**Table 7** Unit: mm

Model No.	Dust proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
LA25	Standard	5	6*
	With NSK K1	14	13*
	Double seal	10	9*
	Protector	10	9*
LA30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
LA35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
LA45	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
LA55	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
LA65	Standard	8	17
	With NSK K1	22	25.5
	Double seal	16	19
	Protector	16	17

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

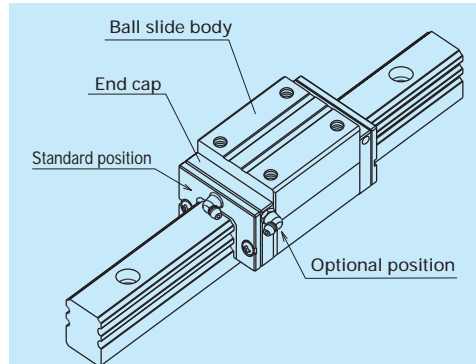


Fig. 11 Mounting position of lubrication accessories

### (7) Dust proof components

#### 1. Standard Specification

To keep foreign matters from entering inside the ball slide, LA Series has an end seal on both ends, and bottom seals at the bottom.

Inner seal is available as an option.

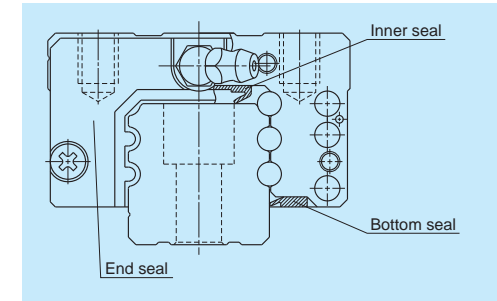


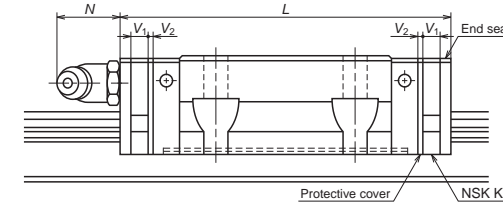
Fig. 12

**Table 8 Seal friction per ball slide (maximum value)** Unit: N

Series	Size	25	30	35	45	55	65
LA		11	11	12	17	17	23

#### 2. NSK K1™

Table 9 shows the dimension of linear guides equipped with the NSK K1.



**Table 9** Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V <sub>1</sub>	Protective cover thickness V <sub>2</sub>	Protruding area of the grease fitting N
LA25	Standard	AL, AN, EL, FL	79.8	91.8	5.0	1.0	(14)
	Long	BL, BN, GL, HL	107.8	119.8			
LA30	Standard	AL, AN, EL, FL	100.2	113.2	5.5	1.0	(14)
	Long	BL, BN, GL, HL	126.2	139.2			
LA35	Standard	AL, AN, EL, FL	110.6	123.6	5.5	1.0	(14)
	Long	BL, BN, GL, HL	144.6	157.6			
LA45	Standard	AL, AN, EL, FL	141.4	156.4	6.5	1.0	(15)
	Long	BL, BN, GL, HL	173.4	188.4			
LA55	Standard	AL, AN, EL, FL	165.4	180.4	6.5	1.0	(15)
	Long	BL, BN, GL, HL	203.4	218.4			
LA65	Standard	AN, EL, FL	196.2	214.2	8.0	1.0	(16)
	Long	BN, GL, HL	256.2	274.2			

Note: Ball slide length equipped NSK K1 = (Standard ball slide length) + (Thickness of NSK K1, V<sub>1</sub> × Number of NSK K1) + (Thickness of the protective cover V<sub>2</sub> × 2)

### 3. Double seal and protector

For LA series, double seal and protector can be installed only before shipping from the factory. Please consult with NSK.

Table 10 shows the increased thickness of  $V_1$  and  $V_2$  when end seals and protectors are installed (Fig. 15).

Table 10

Unit: mm

Model No.	Thickness of end seal: $V_1$	Thickness of protector: $V_2$
LA25	3.2	3.6
LA30	4.4	4.2
LA35	4.4	4.2
LA45	5.5	4.9
LA55	5.5	4.9
LA65	6.5	5.5

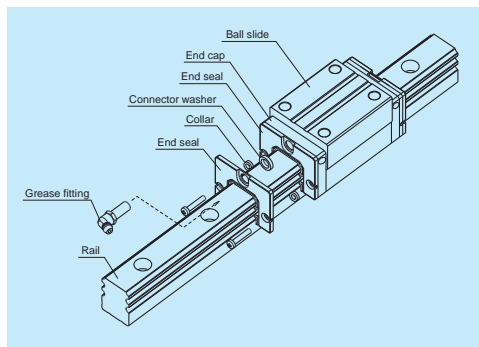


Fig. 13 Double seal

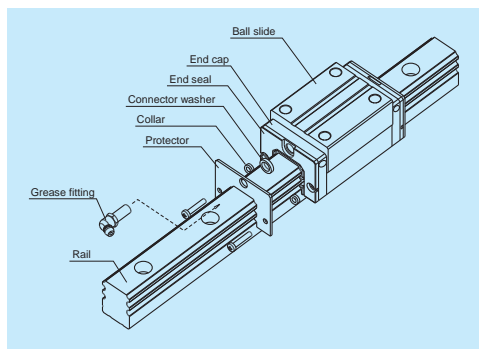


Fig. 14 Protector

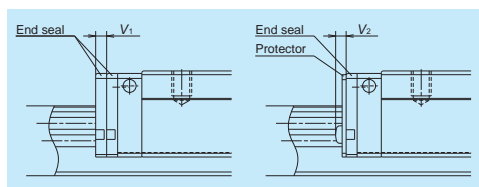


Fig. 15

### 4. Cap to cover the bolt hole for rail mounting

Table 11 Caps to cover rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
LA25	M6	LG-CAP/M6	20
LA30, LA35	M8	LG-CAP/M8	20
LA45	M12	LG-CAP/M12	20
LA55	M14	LG-CAP/M14	20
LA65	M16	LG-CAP/M16	20

### 5. Bellows

Make tap holes to the rail end face to fix the bellows mounting plate.

NSK processes tap holes to the rail end face when ordered with a linear guide.

### Dimension tables of bellows LA Series

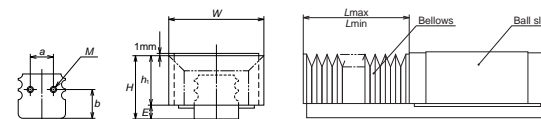


Fig. 16 An installed bellows

#### Bellows reference number

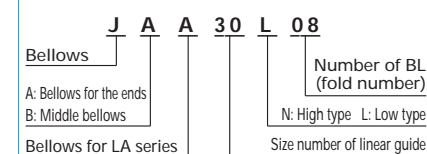


Table 12 Dimensions of bellows

Unit: mm

Model No.	H	$h_1$	E	W	P	a	b	Length of BL	Tap (M) xdepth
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	Number of folds (BL)									
			2	4	6	8	10	12	14	16	18	20
Low type	JAA25L	Stroke	134	268	402	536	670	804	938	1072	1206	1340
		$L_{max}$	168	336	504	672	840	1008	1176	1344	1512	1680
High type	JAA25N	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
		$L_{max}$	210	420	630	840	1050	1260	1470	1680	1890	2100
Low type	JAA30L	Stroke	134	268	402	536	670	804	938	1072	1206	1340
		$L_{max}$	168	336	504	672	840	1008	1176	1344	1512	1680
High type	JAA30N	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
		$L_{max}$	210	420	630	840	1050	1260	1470	1680	1890	2100
Low type	JAA35L	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
		$L_{max}$	210	420	630	840	1050	1260	1470	1680	1890	2100
High type	JAA35N	Stroke	246	492	738	984	1230	1476	1722	1968	2214	2460
		$L_{max}$	280	560	840	1120	1400	1680	1960	2240	2520	2800
Low type	JAA45L	Stroke	246	492	738	984	1230	1476	1722	1968	2214	2460
		$L_{max}$	280	560	840	1120	1400	1680	1960	2240	2520	2800
High type	JAA45N	Stroke	386	772	1158	1544	1930	2316	2702	3088	3474	3860
		$L_{max}$	420	840	1260	1680	2100	2520	2940	3360	3780	4200
Low type	JAA55L	Stroke	246	492	738	984	1230	1476	1722	1968	2214	2460
		$L_{max}$	280	560	840	1120	1400	1680	1960	2240	2520	2800
High type	JAA55N	Stroke	386	772	1158	1544	1930	2316	2702	3088	3474	3860
		$L_{max}$	420	840	1260	1680	2100	2520	2940	3360	3780	4200
Low/high type	JAA65N	Stroke	386	772	1158	1544	1930	2316	2702	3088	3474	3860
		$L_{max}$	420	840	1260	1680	2100	2520	2940	3360	3780	4200

Note <sup>(1)</sup> Bellows for LA65 is for both low and high types.

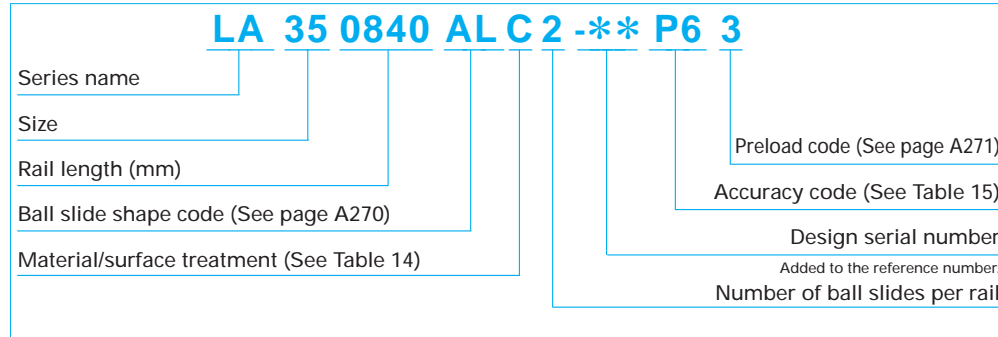
Remarks : Values of odd number BLs are obtained by adding values of the even number BLs on both sides, then dividing the sum by two.



**(8) Reference number**

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.

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



**Table 14 Material/surface treatment code**

Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
Z	Other, special

**Table 15 Accuracy code**

Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5
Precision grade	P6	K6

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

(9) Dimensions

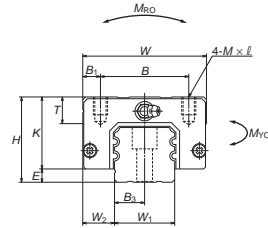
LA-AL (High-load type)

LA-BL (Super-high-load type)

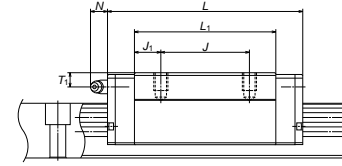
**LA 35 0840 AL C 2 -\*\* P6 3**

Series name	Preload code (See page A271)
Size	Accuracy code (See Table 15)
Rail length (mm)	Design serial number
Ball slide shape code (See page A270)	Added to the reference number.
Material/surface treatment (See Table 14)	Number of ball slides per rail

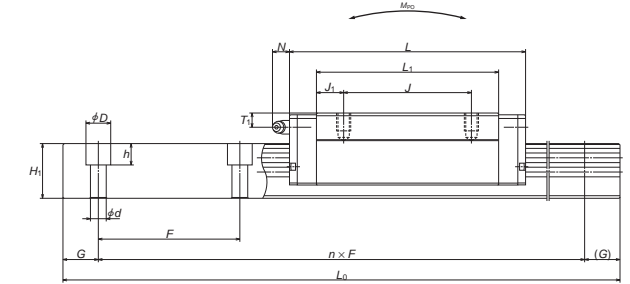
Front view of AL and BL types



Side view of AL type



Side view of BL type



Model No.	Assembly			Ball slide															
	Height <i>H</i>	<i>E</i>	<i>W</i> <sub>2</sub>	Width <i>W</i>	Length <i>L</i>	Mounting hole						Grease fitting							
						<i>B</i>	<i>J</i>	<i>M</i> ×pitch× <i>l</i>	<i>B</i> <sub>1</sub>	<i>L</i> <sub>1</sub>	<i>J</i> <sub>1</sub>	<i>K</i>	<i>T</i>	Hole size	<i>T</i> <sub>1</sub>	<i>N</i>			
<b>LA25AL</b>	36	5.5	12.5	48	79.8	35	35	M6×1×7	6.5	58	11.5								
<b>LA25BL</b>					107.8	50				86	18								
<b>LA30AL</b>	42	7.5	16	60	100.2	40	40	M8×1.25×10	10	72	16								
<b>LA30BL</b>					126.2	60				98	19								
<b>LA35AL</b>	48	7.5	18	70	110.6	50	50	M8×1.25×10	10	80	15								
<b>LA35BL</b>					144.6	72				114	21								
<b>LA45AL</b>	60	10	20.5	86	141.4	60	60	M10×1.5×16	13	105	22.5								
<b>LA45BL</b>					173.4	80				137	28.5			Rc1/8	10	13			
<b>LA55AL</b>	70	12	23.5	100	165.4	75	75	M12×1.75×16	12.5	126	25.5								
<b>LA55BL</b>					203.4	95				164	34.5			Rc1/8	11	13			

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

Unit: mm

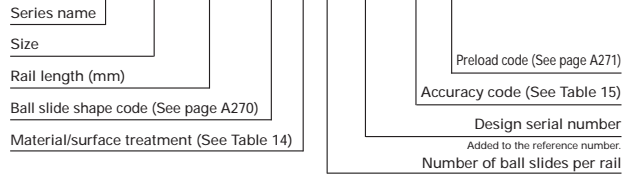
Rail							Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole	<i>B</i> <sub>3</sub>	<i>G</i>	Max. length	Dynamic	Static	Static moment			<i>D</i> <sub>W</sub>	Ball slide (kg)	Rail (kg/m)
<i>W</i> <sub>1</sub>	<i>H</i> <sub>1</sub>	<i>F</i>	<i>d</i> × <i>D</i> × <i>h</i>	(Reference)		<i>L</i> <sub>0max</sub>	<i>C</i> (N)	<i>C</i> <sub>0</sub> (N)	<i>M</i> <sub>RO</sub> (N·m)	<i>M</i> <sub>PO</sub> (N·m)	<i>M</i> <sub>VO</sub> (N·m)			
23	22	60	7×11×9	11.5	20	3960	30000	50000	290	410	410	3.968	0.5	3.7
							40500	77000	445	935	935		0.8	
28	28	80	9×14×12	14	20	4000	47000	77500	535	820	820	4.762	0.8	5.8
							58000	105000	725	1470	1470		1.2	
34	30.8	80	9×14×12	17	20	4000	61500	98000	845	1130	1130	5.556	1.3	7.7
							80500	143000	1240	2330	2330		1.6	
45	36	105	14×20×17	22.5	22.5	3990	91000	148000	1840	2210	2210	6.350	2.5	12.0
							111000	197000	2460	3850	3850		3.2	
53	43.2	120	16×23×20	26.5	30	3960	139000	215000	3150	3800	3800	7.937	3.9	17.2
							172000	292000	4250	6800	6800		5.1	

2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface.

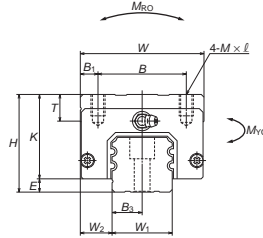
When converting the basic dynamic load rating *C* to the dynamic load rating *C*<sub>100</sub> for 100 km rating fatigue life, divide the *C* by 1.26.

LA-AN (High-load type)  
LA-BN (Super-high-load type)

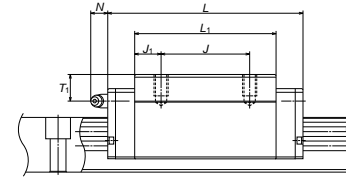
**LA 35 0840 ANC 2 -\*\* P6 3**



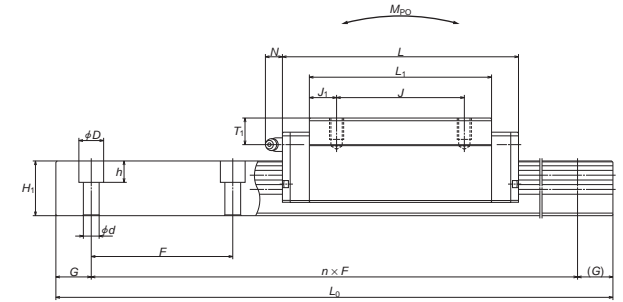
Front view of AN and BN types



Side view of AN type



Side view of BN type



Model No.	Assembly			Ball slide												
	Height	Width	Length	Mounting hole									Grease fitting			
				H	E	W <sub>2</sub>	W	L	B	J	M×pitch×l	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T
<b>LA25AN</b> <b>LA25BN</b>	40	5.5	12.5	48	79.8	35	35	M6×1×10	6.5	58	11.5	34.5	12	M6×0.75	10	11
<b>LA30AN</b> <b>LA30BN</b>	45	7.5	16	60	100.2	40	40	M8×1.25×11	10	72	16	37.5	14	M6×0.75	9.5	11
<b>LA35AN</b> <b>LA35BN</b>	55	7.5	18	70	110.6	50	50	M8×1.25×12	10	80	15	47.5	15	M6×0.75	15	11
<b>LA45AN</b> <b>LA45BN</b>	70	10	20.5	86	141.4	60	60	M10×1.5×16	13	105	22.5	60	17	Rc1/8	20	13
<b>LA55AN</b> <b>LA55BN</b>	80	12	23.5	100	165.4	75	75	M12×1.75×18	12.5	126	25.5	68	18	Rc1/8	21	13
<b>LA65AN</b> <b>LA65BN</b>	90	14	31.5	126	196.2	76	70	M16×2×19	25	147	38.5	76	22	Rc1/8	19	13

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

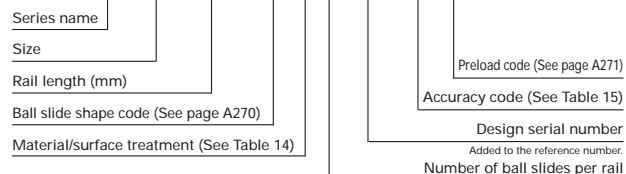
Unit: mm

Rail							Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole	G	Max. length	L <sub>0max</sub>	Dynamic C	Static C <sub>0</sub>	Static moment			D <sub>w</sub>	Ball slide (kg)	Rail (kg/m)
W <sub>1</sub>	H <sub>1</sub>	F	d×D×h	B <sub>3</sub>	(Reference)		(N)	(N)	M <sub>RO</sub>	M <sub>PO</sub>	M <sub>VO</sub>			
23	22	60	7×11×9	11.5	20	3960	30000	50000	290	410	410	3.968	0.6	3.7
28	28	80	9×14×12	14	20	4000	40500	77000	445	935	935	4.762	0.9	5.8
34	30.8	80	9×14×12	17	20	4000	47000	77500	535	820	820	5.556	1.5	7.7
45	36	105	14×20×17	22.5	22.5	3990	80500	143000	1240	2330	2330	6.350	3.0	12.0
53	43.2	120	16×23×20	26.5	30	3960	91000	148000	1840	2210	2210	7.937	4.7	17.2
63	55	150	18×26×22	31.5	35	3900	172000	292000	4250	6800	6800	10.318	7.7	25.9

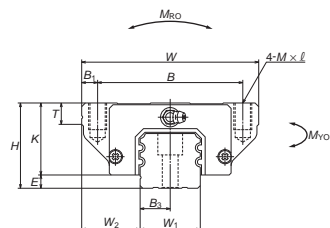
2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life: it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.

LA-EL (High-load type)  
LA-GL (Super-high-load type)

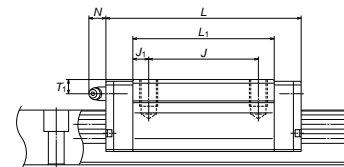
**LA 35 0840 EL C 2 -\*\* P6 3**



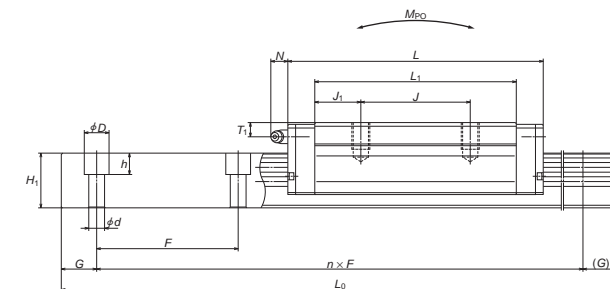
Front view of EL and GL types



Side view of EL type



Side view of GL type



Model No.	Assembly			Ball slide												
	Height	Width	Length	Mounting hole									Grease fitting			
				H	E	W <sub>2</sub>	W	L	B	J	M×pitch×l	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T
LA25EL	36	5.5	23.5	70	79.8	57	45	M8×1.25×12	6.5	58	6.5	30.5	11	M6×0.75	6	11
LA25GL					107.8					86	20.5					
LA30EL	42	7.5	31	90	100.2	72	52	M10×1.5×16	9	72	10	34.5	11	M6×0.75	6.5	11
LA30GL					126.2					98	23					
LA35EL	48	7.5	33	100	110.6	82	62	M10×1.5×15	9	80	9	40.5	12	M6×0.75	8	11
LA35GL					144.6					114	26					
LA45EL	60	10	37.5	120	141.4	100	80	M12×1.75×18	10	105	12.5	50	13	Rc1/8	10	13
LA45GL					173.4					137	28.5					
LA55EL	70	12	43.5	140	165.4	116	95	M14×2×21	12	126	15.5	58	15	Rc1/8	11	13
LA55GL					203.4					164	34.5					
LA65EL	90	14	53.5	170	196.2	142	110	M16×2×24	14	147	18.5	76	22	Rc1/8	19	13
LA65GL					256.2					207	48.5					

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

Unit: mm

Rail							Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole	G	Max. length	L <sub>0max</sub>	Dynamic C	Static C <sub>0</sub>	Static moment			D <sub>w</sub>	Ball slide (kg)	Rail (kg/m)
W <sub>1</sub>	H <sub>1</sub>	F	d×D×h	B <sub>3</sub>	(Reference)		(N)	(N)	M <sub>R0</sub>	M <sub>FO</sub>	M <sub>VO</sub>			
23	22	60	7×11×9	11.5	20	3960	30000	50000	290	410	410	3.968	0.8	3.7
28	28	80	9×14×12	14	20	4000	47000	77500	535	820	820	4.762	1.3	5.8
34	30.8	80	9×14×12	17	20	4000	61500	98000	845	1130	1130	5.556	1.9	7.7
45	36	105	14×20×17	22.5	22.5	3990	91000	148000	1840	2210	2210	6.350	3.3	12.0
53	43.2	120	16×23×20	26.5	30	3960	139000	215000	3150	3800	3800	7.937	5.5	17.2
63	55	150	18×26×22	31.5	35	3900	260000	420000	7300	9050	9050	10.318	11.0	25.9
							340000	615000	10700	18700	18700		15.5	

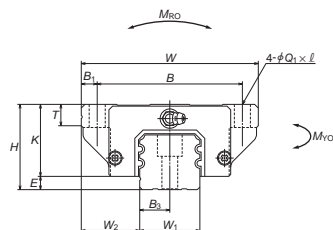
2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life: it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.

LA-FL (High-load type)  
LA-HL (Super-high-load type)

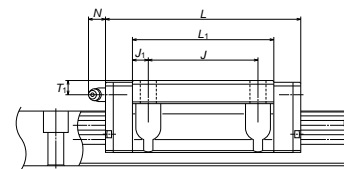
**LA 35 0840 FL C 2 -\*\* P6 3**

Series name	Preload code (See page A271)
Size	Accuracy code (See Table 15)
Rail length (mm)	Design serial number Added to the reference number.
Ball slide shape code (See page A270)	Number of ball slides per rail
Material/surface treatment (See Table 14)	

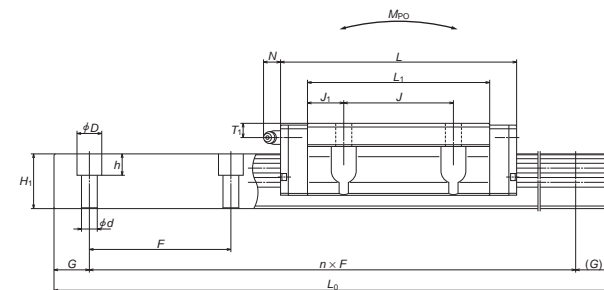
Front view of FL and HL types



Side view of FL type



Side view of HL type



Unit: mm

Model No.	Assembly			Ball slide												
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole					Grease fitting					
						B	J	Q <sub>1</sub> ×l	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Hole size	T <sub>1</sub>	N
<b>LA25FL</b>	36	5.5	23.5	70	79.8	57	45	7×10	6.5	58	6.5	30.5	11	M6×0.75	6	11
<b>LA25HL</b>					107.8					86	20.5					
<b>LA30FL</b>	42	7.5	31	90	100.2	72	52	9×12	9	72	10	34.5	11	M6×0.75	6.5	11
<b>LA30HL</b>					126.2					98	23					
<b>LA35FL</b>	48	7.5	33	100	110.6	82	62	9×13	9	80	9	40.5	12	M6×0.75	8	11
<b>LA35HL</b>					144.6					114	26					
<b>LA45FL</b>	60	10	37.5	120	141.4	100	80	11×15	10	105	12.5	50	13	Rc1/8	10	13
<b>LA45HL</b>					173.4					137	28.5					
<b>LA55FL</b>	70	12	43.5	140	165.4	116	95	14×18	12	126	15.5	58	15	Rc1/8	11	13
<b>LA55HL</b>					203.4					164	34.5					
<b>LA65FL</b>	90	14	53.5	170	196.2	142	110	16×23	14	147	18.5	76	22	Rc1/8	19	13
<b>LA65HL</b>					256.2					207	48.5					

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

Rail							Basic load rating					Ball dia.	Weight	
Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Mounting bolt hole d×D×h	B <sub>3</sub>	G	Max. length L <sub>0max</sub>	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment			D <sub>w</sub>	Ball slide (kg)	Rail (kg/m)
				(Reference)					M <sub>Ro</sub> (N·m)	M <sub>Po</sub> (N·m)	M <sub>Vo</sub> (N·m)			
23	22	60	7×11×9	11.5	20	3960	30000	50000	290	410	410	3.968	0.8	3.7
							40500	77000	445	935	935			
28	28	80	9×14×12	14	20	4000	47000	77500	535	820	820	4.762	1.3	5.8
							58000	105000	725	1470	1470			
34	30.8	80	9×14×12	17	20	4000	61500	98000	845	1130	1130	5.556	1.9	7.7
							80500	143000	1240	2330	2330			
45	36	105	14×20×17	22.5	22.5	3990	91000	148000	1840	2210	2210	6.350	3.3	12.0
							111000	197000	2460	3850	3850			
53	43.2	120	16×23×20	26.5	30	3960	139000	215000	3150	3800	3800	7.937	5.5	17.2
							172000	292000	4250	6800	6800			
63	55	150	18×26×22	31.5	35	3900	260000	420000	7300	9050	9050	10.318	11.0	25.9
							340000	615000	10700	18700	18700			

2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life: it is a vertical and constant load to the ball slide mounting surface.  
When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.

- |              |      |
|--------------|------|
| 1. PU Series | A289 |
| 2. PE Series | A299 |
| 3. LU Series | A309 |
| 4. LE Series | A321 |
| 5. LL Series | A335 |

## A-5-3 Liquid Crystal Display and Semiconductor

A-5-3.1 PU Series (Miniature type)

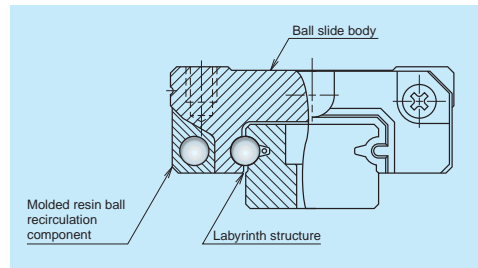
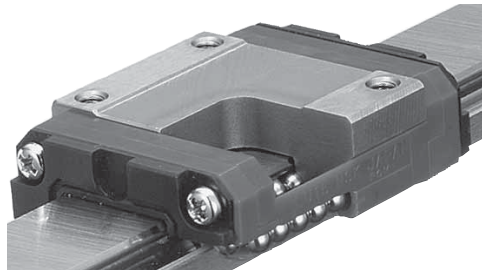


Fig. 1

(1) Features

1. Motion performance

Newly designed recirculation component facilitates smooth circulation of steel balls.

2. Lightweight

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

3. Reduced noise intensity

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

4. Low dust generation

The structure of the ball slide is designed to prevent dust generation.

5. Excellent dust-proofing

The labyrinth structure adopted for the side of the rails and the inner walls of the ball slide allows effects equivalent to a bottom seal.

6. High corrosion resistance

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

7. Easy to handle

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

8. Long-term maintenance-free

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

9. Fast delivery

Lineup of random-matching rails and ball slides in the series supports random matching and facilitates fast delivery. (PU09 to PU15)

(2) Ball slide shape

Ball slide Model	Shape/installation method	Type	
		Standard type	High-load type
AR TR AL UR BL		TR, AR, AL 	UR, BL 

(3) Accuracy and preload

1. Runing parallelism tolerance

Table 1

Unit:  $\mu\text{m}$

Rail length (mm) over   or less	Preloaded assembly type (not random matching)				Random-matching type
	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 - 1000	5	9	16	18	18
1000 - 1250	6	10	17	20	20

### 2. Accuracy standard

The preloaded assembly types products have four accuracy grades; Super precision P4, High precision P5, Precision grade P6, and normal grade PN, while the random-matching type has a normal grade PC.

Table 2 shows the accuracy standard for the preloaded assembly type while Table 3 shows the accuracy standard for the random-matching types.

• Tolerance of preloaded assembly

**Table 2** Unit:  $\mu\text{m}$

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)		$\pm 10$ 5	$\pm 15$ 7	$\pm 20$ 15	$\pm 40$ 25
Mounting width $W_2$ or $W_3$ Variation of $W_2$ or $W_3$ (All ball slides on reference rail)		$\pm 15$ 7	$\pm 20$ 10	$\pm 30$ 20	$\pm 50$ 30
Running parallelism of face C to face A Running parallelism of face D to face B		Shown in Table 1 and Fig. 2			

• Tolerance of random-matching type: Normal grade PC

**Table 3** Unit:  $\mu\text{m}$

Characteristics	Accuracy grade	Normal grade PC
Mounting height $H$		$\pm 20$
Variation of mounting height $H$		15① 30②
Mounting width $W_2$ or $W_3$		$\pm 20$
Variation of mounting width $W_2$ or $W_3$		20
Running parallelism of face C to face A Running parallelism of face D to face B		Shown in Table 1 and Fig. 2

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

### 3. Assembled accuracy

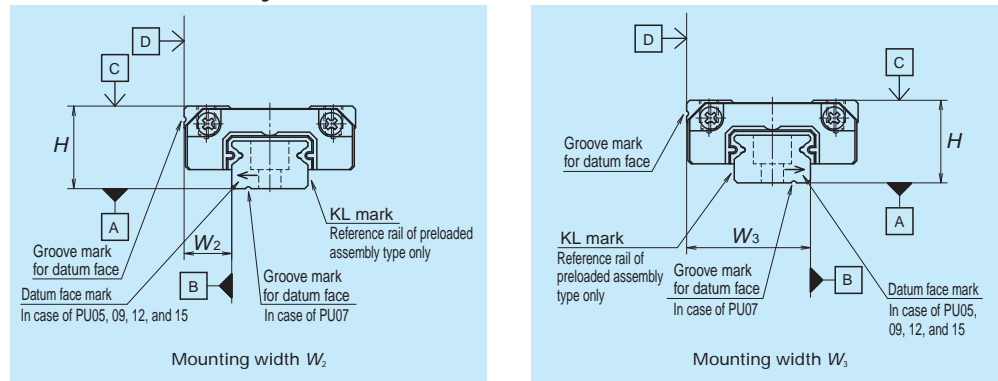


Fig. 2

Note: Please refer to page A67 for marks on the datum faces.

### 4. Preload and rigidity

We offer three levels of preload: Slight preload Z1 and Fine clearance Z0, along with random-matching type of Fine clearance ZT. Values for preload and rigidity of the preloaded assembly type are shown in Tables 4. Rigidities are for the median of the preload range.

• Preload and rigidity of preloaded assembly

**Table 4**

Model No.	Preload (N)	Rigidity (N/ $\mu\text{m}$ )	
	Slight preload (Z1)	Slight preload (Z1)	
Standard type	PU05TR	0 – 3	17
	PU07AR	0 – 8	22
	PU09TR	0 – 10	30
	PU12TR	0 – 17	33
	PU15AL	0 – 33	45
High-load type	PU09UR	0 – 14	46
	PU12UR	0 – 25	52
	PU15BL	0 – 51	75

Note: Clearance of fine clearance Z0 is 0 to 3  $\mu\text{m}$ . Therefore, preload is zero. However, Z0 of PN grade is 3 to 10  $\mu\text{m}$ . Clearance values of the random-matching type are shown in Tables 5.

• Clearance of random-matching type

**Table 5** Unit:  $\mu\text{m}$

Model No.	Fine clearance ZT
PU09TR	3 or less
PU12TR	
PU15AL	

#### (4) Available length of rail

Table 6 shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grade.

**Table 6 Length limitations of rails** Unit: mm

Series	Material	Size				
		05	07	09	12	15
PU	Stainless steel	210	375	600	800	1000

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



(5) Installation

1. Permissible values of mounting error

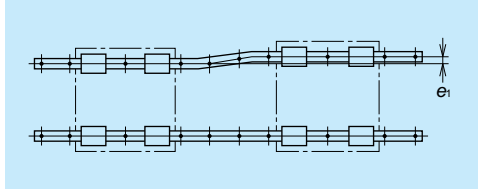


Fig. 3

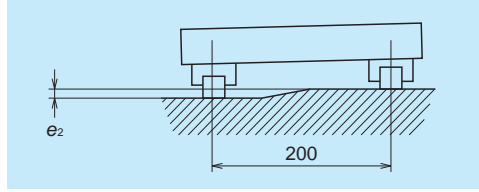


Fig. 4

Table 7

Unit:  $\mu\text{m}$

Value	Preload	Model No.				
		PU05	PU07	PU09	PU12	PU15
Permissible values of parallelism in two rails $e_1$	Z0, ZT	10	12	15	20	25
	Z1	7	10	13	15	21
Permissible values of parallelism (height) in two rails $e_2$	Z0, ZT	150 $\mu\text{m}/200\text{ mm}$				
	Z1	90 $\mu\text{m}/200\text{ mm}$				

2. Shoulder height of the mounting face and corner radius r

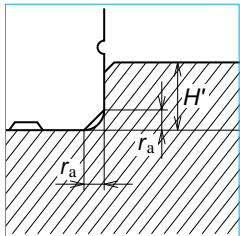


Fig. 5 Shoulder for the rail datum face

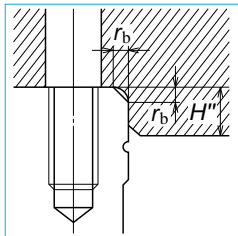


Fig. 6 Shoulder for the ball slide datum face

Table 8

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	$r_a$	$r_b$	$H'$	$H''^*$
PU05	0.2	0.2	0.7	2.3
PU07	0.2	0.3	1.2	2.5
PU09	0.3	0.3	1.9	2.6
PU12	0.3	0.3	2.5	3.4
PU15	0.3	0.5	3.5	4.4

\*)  $H''$  is the minimum recommended value based on the dimension T in dimension table.

(6) Lubrication accessory

PU15 can select drive-in type grease fitting as an option.

For PU05 to PU12, apply grease directly to the ball grooves of rail using a point nozzle.



Drive-in type

(7) Dust proof components

1. Standard specification

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

Bottom seal function: A labyrinth structure of the ball slide bottom face functions as sealing effect.

Seal friction per standard ball slide is shown in Table 9.

Table 9 Seal friction per ball slide (maximum value)

Unit: N

Series	Size	05	07	09	12	15
PU		0.3	0.3	0.5	0.5	0.5

2. NSK K1™

Table 10 shows the dimension of linear guides equipped with the NSK K1.

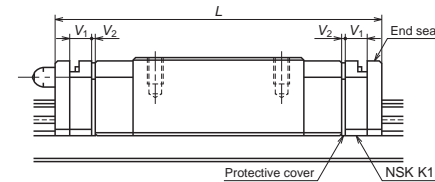


Table 10

Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length equipped with two NSK K1 L	Thickness of NSK K1, $V_1$	Thickness of protective cover, $V_2$
PU05	Standard	TR	19.4	24.4	2	0.5
PU07	Standard	AR	23.4	29.4	2.5	0.5
PU09	Standard	TR	30	36.4	2.7	0.5
	Long	UR	41	47.4		
PU12	Standard	TR	35	42	3	0.5
	Long	UR	48.7	55.7		
PU15	Standard	AL	43	51.2	3.5	0.6
	Long	BL	61	69.2		

Note: Ball slide length equipped with NSK K1 =

(Standard ball slide length) + (Thickness of NSK K1,  $V_1 \times$  Number of NSK K1) +

(Thickness of the protective cover  $V_2 \times 2$ )

PU Series

(8) Reference number

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.

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

1. Reference number for preloaded assembly

**PU 15 0470 AL K 2 -\*\* P5 1**

Series name	Preload code (See page A292)
Size	Accuracy code (See Table 12)
Rail length (mm)	Design serial number
Ball slide shape code (See page A290)	Added to the reference number.
Material/surface treatment code (See Table 11)	Number of ball slides per rail

2. Reference number for random-matching type

**PAU 15 AL K -\*\*PCT**

Random-matching ball slide series code PAU : PU Series random-matching ball slide	Preload code T: Fine clearance (See page A292)
Size	Accuracy code : PC PC: Normal grade is only available
Ball slide shape code (See page A290)	Design serial number
Material/surface treatment code (See Table 11)	Added to the reference number.

**P1U15 0470 RKN -\*\* PC T**

Random-matching rail series code P1U : PU Series random-matching rail	Preload code T: Fine clearance (See page A292)
Size	Accuracy code : PC PC: Normal grade is only available
Rail length (mm)	Design serial number
Rail shape code S: PU09, 12. R: PU15	Added to the reference number.
Material/surface treatment code (See Table 11)	*Butting rail specification N: Non-butting. L: Butting specification

\*Please consult with NSK for butting rail specification.

Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is fine clearance "T" (Refer to page A292).

Table 11 Material/surface treatment code

Code	Description
K	Stainless steel
H	Stainless steel with surface treatment
Z	Other, special

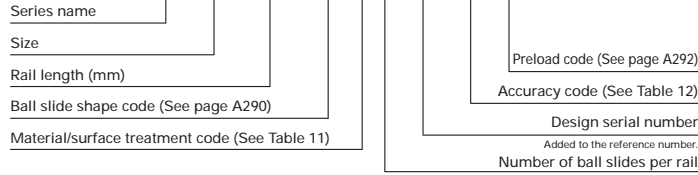
Table 12 Accuracy code

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

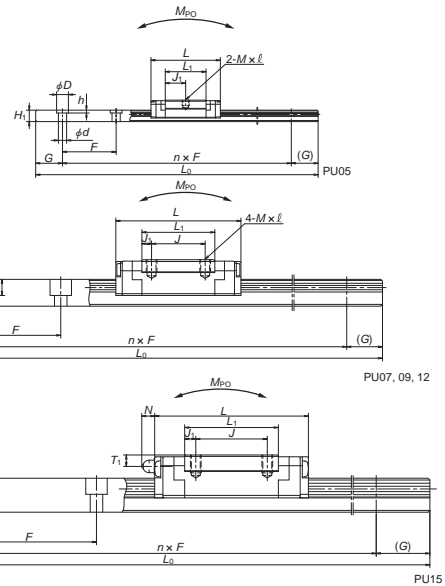
Note: Refer to Page A38 and A61 for NSK K1 lubrication unit.

(9) Dimensions

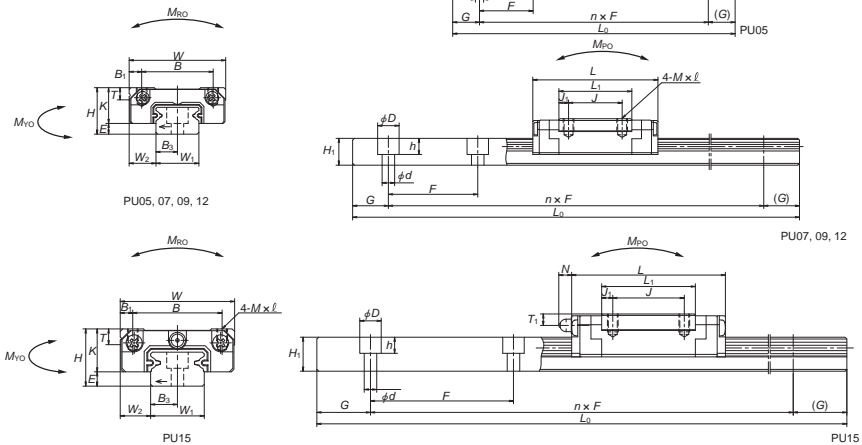
**PU 15 0470 AL K 2 -\*\* P5 1**



Side view



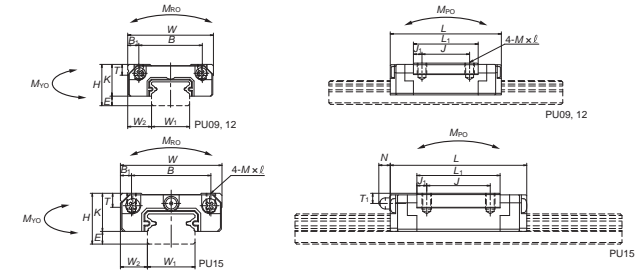
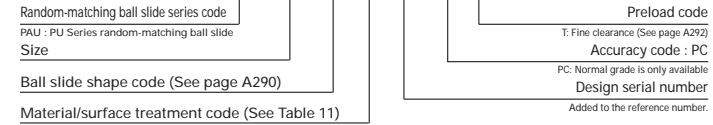
Front view



Reference number for ball slide of random-matching type

Ball slide

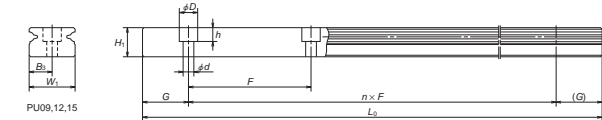
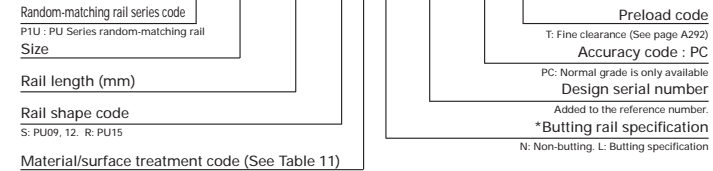
**PAU 15 AL K -\*\*PCT**



Reference number for rail of random-matching type

Rail

**P1U15 0470 RKN -\*\* PC T**



Model No.	Assembly				Ball slide													
	Height	Width	Length	Mounting hole	Mounting hole							Grease fitting						
					H	E	W <sub>2</sub>	W	L	B	J	MxPitchxℓ	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Hole size
PU05TR	6	1	3.5	12	19.4	8	—	M2x0.4x1.5	2	11.4	5.7	5	2.3	—	—	—	—	—
PU07AR	8	1.5	5	17	23.4	12	8	M2x0.4x2.4	2.5	13.3	2.65	6.5	2.45	—	—	—	—	—
PU09TR	10	2.2	5.5	20	30	15	10	M3x0.5x3	2.5	19.6	4.8	7.8	2.6	—	—	—	—	—
PU09UR					41		16			30.6	7.3							
PU12TR	13	3	7.5	27	35	20	15	M3x0.5x3.5	3.5	20.4	2.7	10	3.4	—	—	—	—	—
PU12UR					48.7		20			34.1	7.05							
PU15AL	16	4	8.5	32	43	25	20	M3x0.5x5	3.5	26.2	3.1	12	4.4	φ 3	3.2	(3.6)	—	—
PU15BL					61		25			44.2	9.6							

Remarks: 1) Ball slide of PU05TR has only two mounting tap holes in the center.

Rail								Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole	B <sub>3</sub>	G	Maximum length	Dynamic	Static	Static moment			D <sub>w</sub>	Ball slide	Rail	
W <sub>1</sub>	H <sub>1</sub>	F	d x D x h	B <sub>3</sub>	(Reference)	L <sub>0max</sub>	C (N)	C <sub>0</sub> (N)	M <sub>RO</sub> (N·m)	M <sub>PO</sub> (N·m)	M <sub>YO</sub> (N·m)	D <sub>w</sub>	(g)	(g/100mm)	
5	3.2	15	2.3x3.3x0.8	2.5	5	210	520	775	2.06	1.28	1.28	1	4	11	
7	4.7	15	2.4x4.2x2.3	3.5	5	375	1 090	1 370	5.20	2.70	2.70	1.5875	8	23	
9	5.5	20	3.5x6x4.5	4.5	7.5	600	1 490	2 150	9.90	6.10	6.10	1.5875	16	35	
							2100	3 500	16.2	15.6	15.6		25		
12	7.5	25	3.5x6x4.5	6	10	800	2 830	3 500	21.1	11.4	11.4	2.3812	32	65	
							4 000	5 700	34.5	28.3	28.3		53		
15	9.5	40	3.5x6x4.5	7.5	15	1 000	5 550	6 600	49.5	25.6	25.6	3.175	59	105	
							8 100	11 300	84.5	69.5	69.5		100		

- The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.
- To fix rail of PU05TR, use M2 x 0.4 cross-recessed pan head machine screw for precision instrument. (JCIS 10-70 No. 0 pan head machine screw No.1.) (JCIS : Japanese Camera Industrial Standard.)

## A-5-3.2 PE Series (Miniature type)

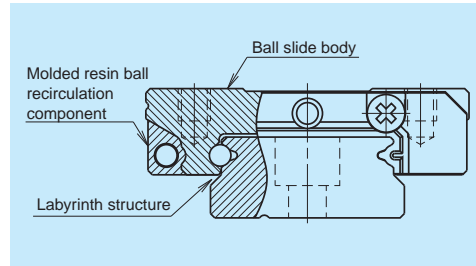


Fig. 1

## (1) Features

## 1. Motion performance

Newly designed recirculation component facilitates smooth circulation of steel balls.

## 2. Lightweight

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

## 3. Reduced noise intensity

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

## 4. Low dust generation

The structure of the ball slide is designed to prevent dust generation.

## 5. Excellent dust-proofing

The labyrinth structure adopted for the side of the rails and the inner walls of the ball slide allows effects equivalent to a bottom seal.

## 6. High corrosion resistance

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

## 7. Easy to handle

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

## 8. Long-term maintenance-free

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

## 9. Fast delivery

Lineup of random-matching rails and ball slides in the series supports random matching and facilitates fast delivery. (PE09 to PE15)

## (2) Ball slide shape

Ball slide Model	Shape/installation method	Type	
		Standard type	High-load type
AR, TR, UR, BR		AR, TR 	UR, BL 

## (3) Accuracy and preload

## 1. Runing parallelism tolerance

Table 1

Unit:  $\mu\text{m}$ 

Rail length (mm) over   or less	Preloaded assembly type (not random matching)				Random-matching type
	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 - 1000	5	9	16	18	18
1000 - 1250	6	10	17	20	20

## 2. Accuracy standard

The preloaded assembly types products have four accuracy grades; Super precision P4, High precision P5, Precision P6, and Normal PN grades, while the random-matching type has Normal PC grade.

Table 2 shows the accuracy standard for the preloaded assembly type while Table 3 shows the accuracy standard for the random-matching types.

### • Tolerance of preloaded assembly

Table 2

Unit:  $\mu\text{m}$ 

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)		$\pm 10$ 5	$\pm 15$ 7	$\pm 20$ 15	$\pm 40$ 25
Mounting width $W_2$ or $W_3$ Variation of $W_2$ or $W_3$ (All ball slides on reference rail)		$\pm 15$ 7	$\pm 20$ 10	$\pm 30$ 20	$\pm 50$ 30
Running parallelism of face C to face A Running parallelism of face D to face B		Shown in Table 1 and Fig. 2			

### • Tolerance of random-matching type: Normal grade PC

Table 3

Unit:  $\mu\text{m}$ 

Characteristics	Accuracy grade	Normal grade PC
Mounting height $H$		$\pm 20$
Variation of mounting height $H$		15 <sup>①</sup> 30 <sup>②</sup>
Mounting width $W_2$ or $W_3$		$\pm 20$
Variation of mounting width $W_2$ or $W_3$		20
Running parallelism of face C to face A Running parallelism of face D to face B		Shown in Table 1 and Fig. 2

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

## 3. Assembled accuracy

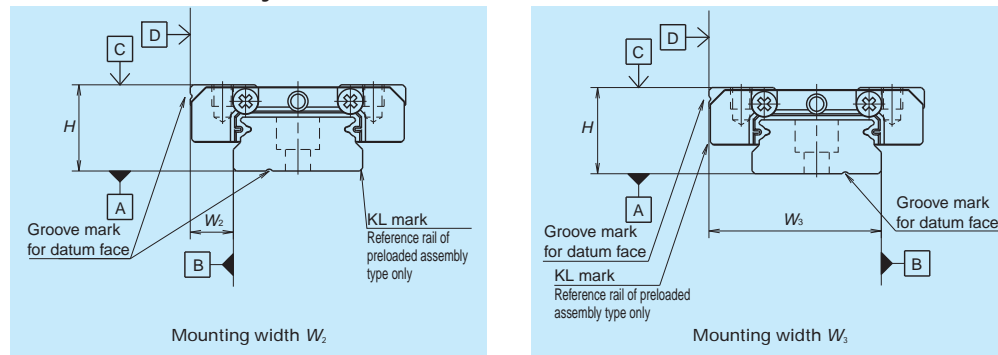


Fig. 2

## 4. Preload and rigidity

We offer three levels of preload: Slight preload Z1 and Fine clearance Z0, along with random-matching type of Fine clearance ZT. Values for preload and rigidity of the preloaded assembly types are shown in Tables 4. Rigidities are for the median of the preload range.

Table 4 Preload and rigidity of preloaded assembly

Model No.	Preload (N)	Rigidity (N/ $\mu\text{m}$ )	
	Slight preload (Z1)	Slight preload (Z1)	
Standard type	PE05AR	0 – 28	45
	PE07TR	0 – 29	46
	PE09TR	0 – 37	61
	PE12AR	0 – 40	63
	PE15AR	0 – 49	66
High-load type	PE09UR	0 – 54	86
	PE12BR	0 – 59	97
	PE15BR	0 – 75	114

Note: Clearance of fine clearance Z0 is 0 to 3  $\mu\text{m}$ . Therefore, preload is zero. However, Z0 of PN grade is 3 to 10  $\mu\text{m}$ .

Clearance values of the random-matching types are shown in Tables 5.

### • Clearance of random matching type

Table 5

Unit:  $\mu\text{m}$ 

Model No.	Fine clearance ZT
PE09TR	3 or less
PE12AR	
PE15AR	

### (4) Available length of rail

Table 6 shows the limitations of rail length (maximum length).

However, the limitations vary by accuracy grade.

Table 6 Length limitations of rails

Unit: mm

Series	Material	Size				
		05	07	09	12	15
PE	Stainless steel	150	600	800	1000	1200

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

(5) Installation

1. Permissible values of mounting error

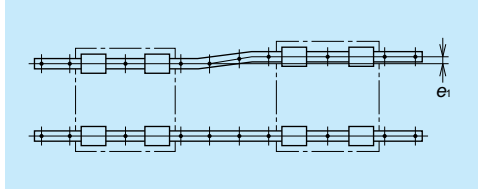


Fig. 3

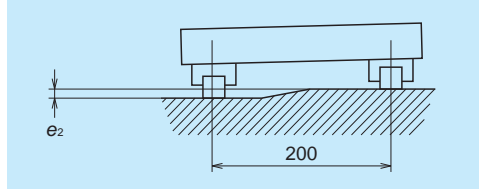


Fig. 4

Table 7

Unit:  $\mu\text{m}$

Value	Preload	Model No.				
		PE05	PE07	PE09	PE12	PE15
Permissible values of parallelism in two rails $e_1$	Z0, ZT	10	12	15	18	22
	Z1	5	7	10	13	17
Permissible values of parallelism (height) in two rails $e_2$	Z0, ZT	50 $\mu\text{m}/200\text{ mm}$				
	Z1	35 $\mu\text{m}/200\text{ mm}$				

2. Shoulder height of the mounting face and corner radius r

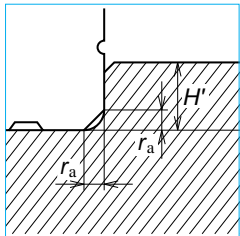


Fig. 5 Shoulder for the rail datum face

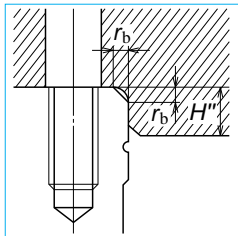


Fig. 6 Shoulder for the ball slide datum face

Table 8

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	$r_a$	$r_b$	$H'$	$H''^*$
PE05	0.2	0.2	1.1	2.5
PE07	0.2	0.3	1.7	3
PE09	0.3	0.3	3.5	2.8
PE12	0.3	0.3	3.5	3.2
PE15	0.3	0.5	3.5	4.1

\*)  $H''$  is the minimum recommended value based on the dimension T in dimension table.

(6) Lubrication accessory

PE15 can select drive-in type grease fitting as an option.

For PE05 to PE12, apply grease directly to the ball grooves of rail using a point nozzle.



Drive-in type

(7) Dust proof components

1. Standard specification

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

Bottom seal function: A labyrinth structure of the ball slide bottom face functions as sealing effect.

Seal friction per standard ball slide is shown in Table 9.

Table 9 Seal friction per ball slide (maximum value)

Unit: N

Series	Size	05	07	09	12	15
PE		0.4	0.4	0.8	1	1.2

2. NSK K1™

Table 10 shows the dimension of linear guides equipped with the NSK K1.

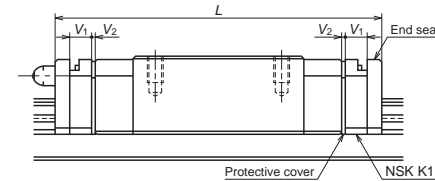


Table 10

Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length equipped with two NSK K1 L	Thickness of NSK K1, $V_1$	Thickness of protective cover, $V_2$
PE05	Standard	AR	24.1	28.9	2	0.4
PE07	Standard	TR	31.1	37.1	2.5	0.5
PE09	Standard	TR	39.8	46.8	3	0.5
	Long	UR	51.2	58.2		
PE12	Standard	AR	45	53	3.5	0.5
	Long	BR	60	68		
PE15	Standard	AR	56.6	66.2	4	0.8
	Long	BR	76	85.6		

Note: Ball slide length equipped with NSK K1 =

$$(\text{Standard ball slide length}) + (\text{Thickness of NSK K1, } V_1 \times \text{Number of NSK K1}) + (\text{Thickness of the protective cover } V_2 \times 2)$$

**(8) Reference number**

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.

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

**1. Reference number for preloaded assembly**

**PE 15 0470 ARK 2 -\*\* P5 1**

Series name							
Size							Preload code (See page A302)
Rail length (mm)							Accuracy code (See Table 12)
Ball slide shape code (See page A300)							Design serial number
Material/surface treatment code (See Table 11)							Added to the reference number.
							Number of ball slides per rail

**2. Reference number for random-matching type**

**PAE 15 ARK -\*\*PCT**

Ball slide							
Random-matching ball slide series code							Preload code
PAE : PE Series random-matching ball slide							T: Fine clearance (See page A302)
Size							Accuracy code : PC
Ball slide shape code (See page A300)							PC: Normal grade is only available
Material/surface treatment code (See Table 11)							Design serial number
							Added to the reference number.

**Rail**  
**P1E15 0470 RKN -\*\* PC T**

Random-matching rail series code							
P1E : PE Series random-matching rail							Preload code
Size							T: Fine clearance (See page A302)
Rail length (mm)							Accuracy code : PC
Rail shape code							PC: Normal grade is only available
R: PE09, 12. P: PE15							Design serial number
Material/surface treatment code (See Table 11)							Added to the reference number.
							*Butting rail specification
							N: Non-butting. L: Butting specification

\*Please consult with NSK for butting rail specification.

Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is fine clearance "T" (Refer to page A302).

**Table 11 Material/surface treatment code**

Code	Description
K	Stainless steel
H	Stainless steel with surface treatment
Z	Other, special

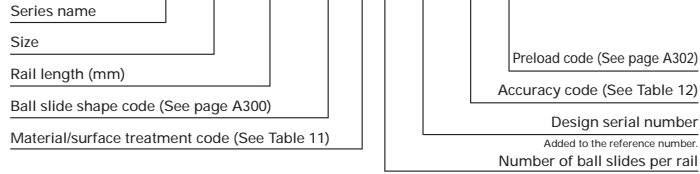
**Table 12 Accuracy code**

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

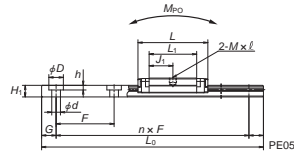
Note: Refer to Page A125 for NSK K1 lubrication unit.

(9) Dimensions

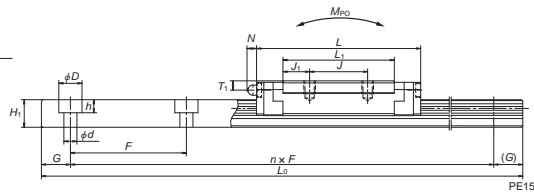
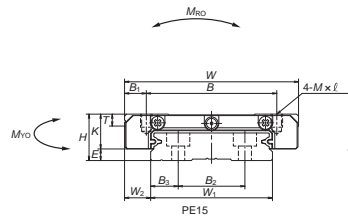
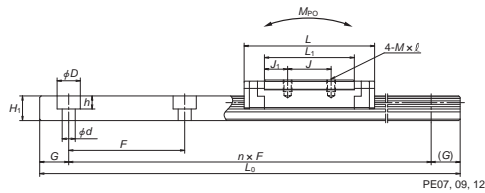
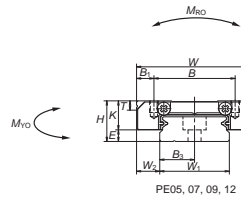
**PE 15 0470 ARK 2 -\*\* P5 1**



Side view



Front view

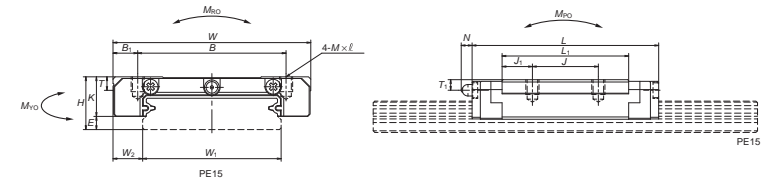
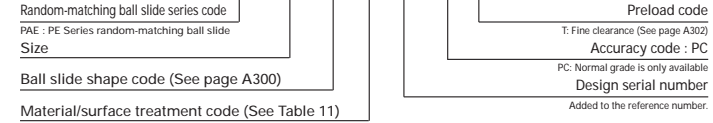


Model No.	Assembly				Ball slide											
	Height		Width	Length	Mounting hole						Grease fitting					
	H	E			B	J	MxPitchxℓ	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Hole size	T <sub>1</sub>	N	
PE05AR	6.5	1.4	3.5	17	24.1	13	—	M2.5x0.45x1.5	2	16.4	8.2	5.1	2.5	—	—	—
PE07TR	9	2	5.5	25	31.1	19	10	M3x0.5x2.8	3	20.8	5.4	7	3	—	—	—
PE09TR	12	4	6	30	39.8	21	12	M3x0.5x3	4.5	26.6	7.3	8	2.8	—	—	—
PE09UR	12	4	6	30	51.2	23	24	M3x0.5x3	3.5	38	7	8	2.8	—	—	—
PE12AR	14	4	8	40	45	28	15	M3x0.5x4	6	31	8	10	3.2	—	—	—
PE12BR	14	4	8	40	60	28	28	M3x0.5x4	6	46	9	10	3.2	—	—	—
PE15AR	16	4	9	60	56.6	45	20	M4x0.7x4.5	7.5	38.4	9.2	12	4.1	φ 3	3.2	(3.3)
PE15BR	16	4	9	60	76	45	35	M4x0.7x4.5	7.5	57.8	11.4	12	4.1	φ 3	3.2	(3.3)

Remarks: 1) Ball slide of PE05AR has only two mounting tap holes in the center.

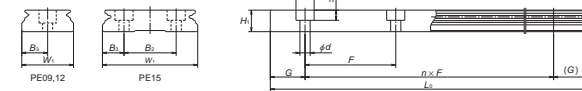
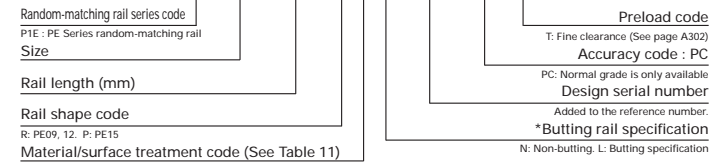
Reference number for ball slide of random-matching type

**PAE 15 ARK -\*\*PCT**



Reference number for rail of random-matching type

**P1E15 0470 RKN -\*\* PC T**



Rail													Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole	G	Maximum length	Dynamic			Static			D <sub>w</sub>	Ball slide (g)	Rail (g/100mm)						
W <sub>1</sub>	H <sub>1</sub>	B <sub>2</sub>	F	d x D x h	B <sub>3</sub>	(Reference)	L <sub>0max</sub>	C (N)	C <sub>0</sub> (N)	M <sub>RO</sub> (N·m)	M <sub>PO</sub> (N·m)				M <sub>YO</sub> (N·m)					
10	4	—	20	3x5x1.6	5	7.5	150	690	1 160	6.00	2.75	2.75	1	7	34					
14	5.2	—	30	3.5x6x3.2	7	10	600	1 580	2 350	16.7	7.20	7.20	1.5875	19	55					
18	7.5	—	30	3.5x6x4.5	9	10	800	3 000	4 500	36.5	17.3	17.3	2.000	35	95					
24	8.5	—	40	4.5x8x4.5	12	15	1 000	4 350	6 350	70.5	29.3	29.3	2.3812	66	140					
42	9.5	23	40	4.5x8x4.5	9.5	15	1 200	7 600	10 400	207	59.0	59.0	3.175	140	275					
								10 300	16 000	320	135	135		211						

2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface.  
When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.  
3) To fix rail of PE05AR, use M2.5 x 0.45 cross-recessed pan head machine screw for precision instrument.  
(JCIS 10-70 No. 0 pan head machine screw No.3.)  
(JCIS : Japanese Camera Industrial Standard.)



A-5-3.3 LU Series (Miniature type)

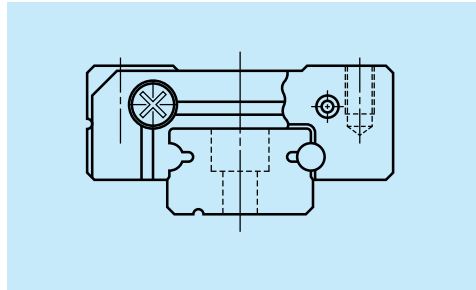


Fig. 1 LU Series

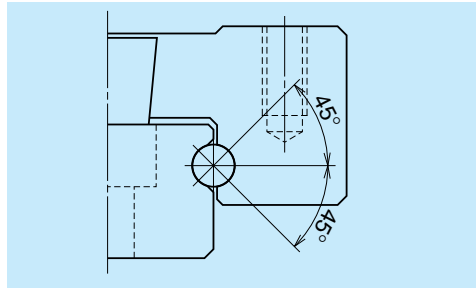


Fig. 2 Balls are in contact.

(1) Features

1. Super-small type

This compact guide owes its design to the single ball groove on both right and left sides (Gothic arch).

2. Equal load carrying capacity in vertical and lateral directions

Contact angle is set at 45 degrees, equally load carrying capacity in vertical and lateral directions.

This also provides equal rigidity in both directions.

3. Stainless steel is also standardized

Items made of the martensitic stainless steel are available as standard.

4. Some series have a ball retainer

Ball slide types AR and TR come with a ball retainer. Balls are retained in the retainer and do not fall out when the bearing is withdrawn from the rail. (Ball slides of random-matching parts as well as LU15 come with ball retainer.)

5. Fast delivery

The series enables random matching of rails and ball slides for prompt delivery. (LU09 to LU15)

(2) Ball slide shape

Ball slide Model	Shape/installation method	Type	
		Standard type	High-load type
AL TL AR TR BL UL		AL, TL, AR, TR 	BL, UL 

(3) Accuracy and preload

1. Runing parallelism tolerance

Table 1

Unit:  $\mu\text{m}$

Rail length (mm) over   or less	Preloaded assembly type (not random matching)				Random-matching type
	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 - 1000	5	9	16	18	18
1000 - 1250	6	10	17	20	20

**2. Accuracy standard**

The preloaded assembly types products have four accuracy grades; Super precision P4, High precision P5, Precision P6, and Normal PN grades, while the random-matching type has Normal PC grade.

Table 2 shows the accuracy standard for the preloaded assembly type while Table 3 shows the accuracy standard for the random-matching types.

• **Tolerance of preloaded assembly**

**Table 2** Unit:  $\mu\text{m}$

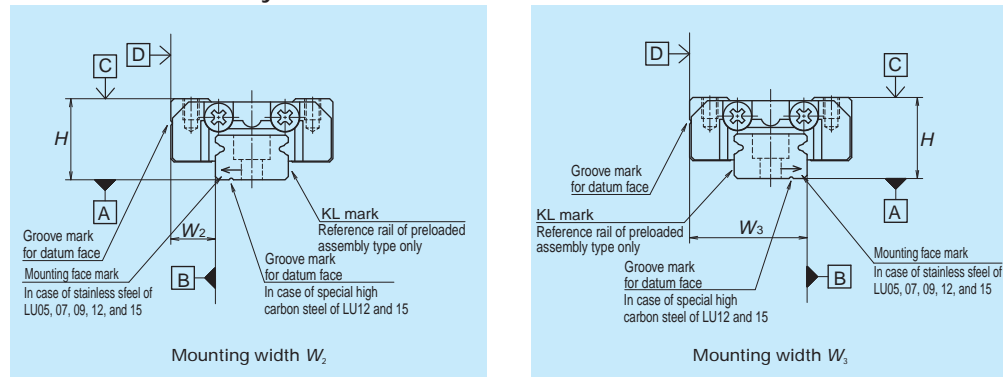
Characteristics	Accuracy grade	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height $H$ Variation of $H$ (All ball slides on a set of rails)		$\pm 10$ 5	$\pm 15$ 7	$\pm 20$ 15	$\pm 40$ 25
Mounting width $W_2$ or $W_3$ Variation of $W_2$ or $W_3$ (All ball slides on reference rail)		$\pm 15$ 7	$\pm 20$ 10	$\pm 30$ 20	$\pm 50$ 30
Running parallelism of face C to face A Running parallelism of face D to face B		Refer to Table 1 and Fig. 3			

• **Tolerance of random-matching type: Normal grade PC**

**Table 3** Unit:  $\mu\text{m}$

Characteristics	Accuracy grade	Normal grade PC
Mounting height $H$		$\pm 20$
Variation of mounting height $H$		40
Mounting width $W_2$ or $W_3$		$\pm 20$
Variation of mounting width $W_2$ or $W_3$		40
Running parallelism of face C to face A Running parallelism of face D to face B		Refer to Table 1 and Fig. 3

**3. Assembled accuracy**



**Fig. 3**

Note: Please refer to page A67 for marks on the datum faces.

**4. Preload and rigidity**

We offer three levels of preload: Slight preload (Z1) and Fine clearance (Z0), along with random-matching type of Fine clearance (ZT). Values for preloaded and rigidity of the preloaded assembly type are shown in Table 4. Rigidities are for the median of the preload range.

• **Preload and rigidity of preloaded assembly**

**Table 4**

Model No.	Preload (N)	Rigidity (N/ $\mu\text{m}$ )
	Slight preload (Z1)	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  $\mu\text{m}$ . Therefore, preload is zero. However, Z0 of PN grade is 3 to 10  $\mu\text{m}$ .

Clearance values of the random-matching type are shown in Table 5.

• **Clearance of random-matching type**

**Table 5** Unit:  $\mu\text{m}$

Model No.	Fine clearance ZT
LU09	0 – 15
LU12	
LU15	

**(4) Available length of rail**

Table 6 shows the limitations of rail length (maximum length).

However, the limitations vary by accuracy grade.

**Table 6 Length limitation of rails**

Unit: mm

Series	Size					
		Material	05	07	09	12
LU	Special high carbon steel	-	-	1200	1800	2000
	Stainless steel	210	375	600	800	1000

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

(5) Installation

1. Permissible values of mounting error

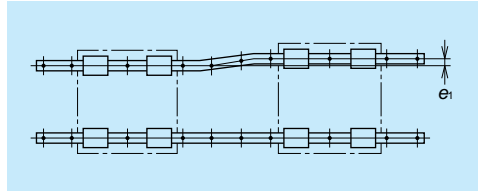


Fig. 4

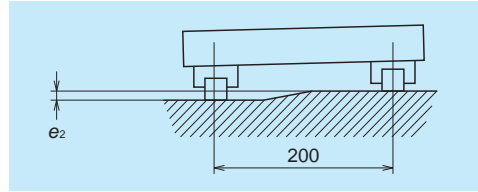


Fig. 5

Table 7

Unit:  $\mu\text{m}$

Value	Preload	Model No.				
		LU05	LU07	LU09	LU12	LU15
Permissible values of parallelism in two rails $e_1$	Z0, ZT	10	12	15	20	25
	Z1	7	10	13	15	21
Permissible values of parallelism (height) in two rails $e_2$	Z0, ZT	150 $\mu\text{m}/200\text{ mm}$				
	Z1	90 $\mu\text{m}/200\text{ mm}$				

2. Shoulder height of the mounting face and corner radius r

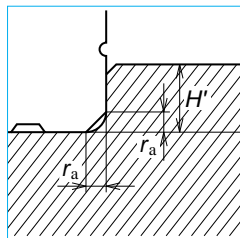


Fig. 6 Shoulder for the rail datum face

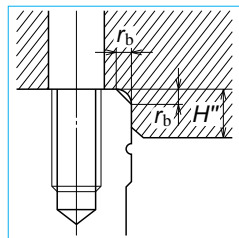


Fig. 7 Shoulder for the ball slide datum face

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 LU Series, apply grease directly to ball groove, etc. using a point nozzle.

(7) Dust proof components

1. Standard specification

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

LU05TL, LU07AL, LU09AL, and LU09TL can install as an option.

• Seal friction per standard ball slide is shown in Table 9.

Table 9 Seal friction per ball slide (maximum value)

Unit: N

Series	Size	05	07	09	12	15
LU		0.3	0.3	0.5	0.5	0.5

2. NSK K1™

Dimension of installing NSK K1 shown in Table 10.

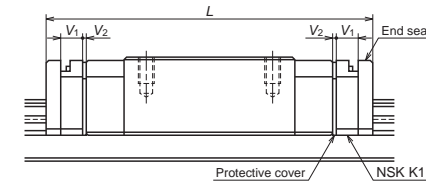


Table 10

Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness $V_1$	Protective cover thickness $V_2$
LU05	Standard	TL	18*	24.4	2.0	0.5
LU07	Standard	AL	20.4*	29.4	2.5	0.5
LU09	Standard	AR, TR	30	36.4	2.7	0.5
	Standard	AL, TL	26.8*	34.2		
LU12	Long	BL, UL	41	47.4	3.0	0.5
	Standard	AR	35.2	42.2		
LU15	Standard	AL, TL	34	41	3.5	0.6
	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 thickness of the end seal thickness (1.5 mm). However, it includes the height of the screw head for end cap installation (Included length - LU05, 0.8 mm; LU07, no projection; LU09, 1 mm)

Note: Ball slide length equipped with NSK K1 =

$$(\text{Standard ball slide length}) + (\text{Thickness of NSK K1, } V_1 \times \text{Number of NSK K1}) + (\text{Thickness of the protective cover } V_2 \times 2)$$

LU Series

(8) Reference number

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.

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

1. Reference number for preloaded assembly

**LU 12 0270 ARK 2 -\*\* P5 1**

Series name	Preload code (See page A312)
Size	Accuracy code (See Table 12)
Rail length (mm)	Design serial number
Ball slide shape code (See page A310)	Added to the reference number.
Material/surface treatment code (See Table 11)	Number of ball slides per rail

2. Reference number for random-matching type

**LAU 12 ARK -\*\*PCT**

Random-matching ball slide series code LAU : LU Series random-matching ball slide	Preload code T: Fine clearance (See page A312)
Size	Accuracy code : PC PC: Normal grade is only available
Ball slide shape code (See page A310)	Design serial number
Material/surface treatment code (See Table 11)	Added to the reference number.

**L1U12 0270 RKN -\*\* PC T**

Random-matching rail series code L1U : LU Series random-matching rail	Preload code T: Fine clearance (See page A312)
Size	Accuracy code : PC PC: Normal grade is only available
Rail length (mm)	Design serial number
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	Added to the reference number.
Material/surface treatment code (See Table 11)	*Butting rail specification N: Non-butting. L: Butting specification

\*Please consult with NSK for butting rail specification.

Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is fine clearance "T" (Refer to page A312).

Table 11 Material/surface treatment code

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

Table 12 Accuracy code

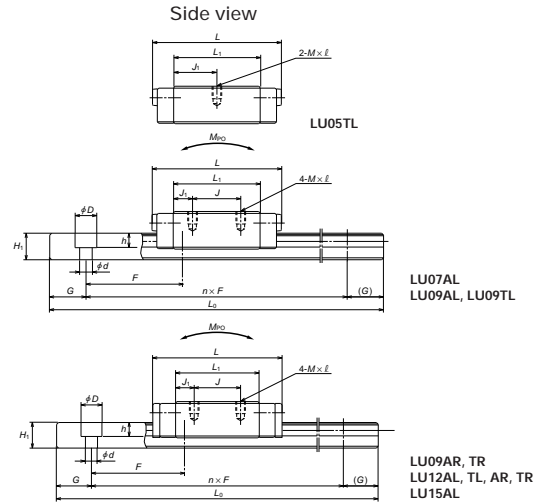
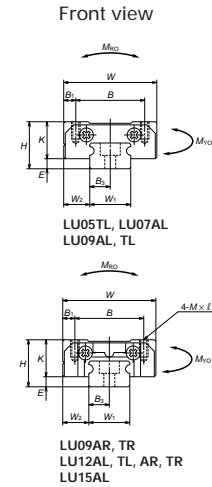
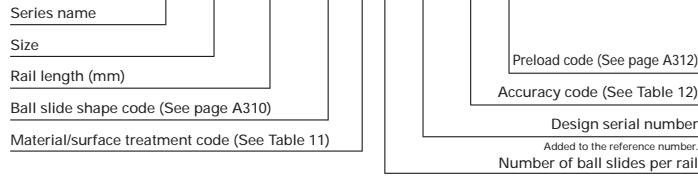
Accuracy	Standard (Without NSK K1)	With NSK K1
Super precision grade	P4	K4
High precision grade	P5	K5
Precision grade	P6	K6
Normal grade	PN	KN
Normal grade (random-matching type)	PC	KC

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

(9) Dimensions

LU-AL (LU15 is equipped with ball retainer)  
 LU-TL (Large mounting hole)  
 LU-AR (With ball retainer)  
 LU-TR (Large mounting hole, with ball retainer)

**LU 12 0270 AR K 2 -\*\* P5 1**



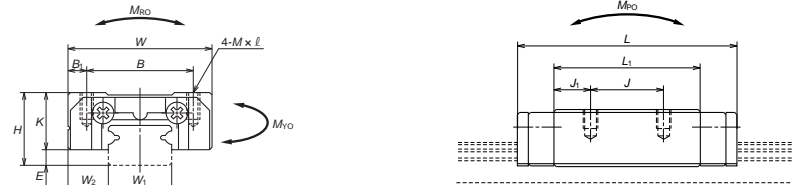
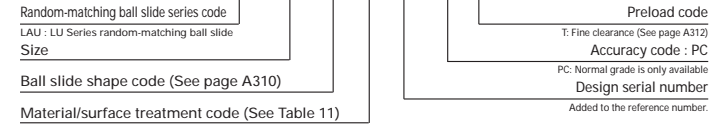
Model No.	Assembly			Ball slide									Width	Height		
	Height	E	W <sub>2</sub>	Width	Length	Mounting hole			B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K			W <sub>1</sub>	H <sub>1</sub>
						B	J	Mxpitchxℓ								
<b>LU05TL</b>	6	1	3.5	12	18	8	—	M2×0.4×1.5	2	12	6	5	5	3.2		
<b>LU07AL</b>	8	1.5	5	17	20.4	12	8	M2×0.4×2.4	2.5	13.6	2.8	6.5	7	4.7		
<b>LU09AL</b> <b>LU09TL</b>	10	2.2	5.5	20	26.8	15	13	M2×0.4×2.5 M3×0.5×3	2.5	18	2.5 4	7.8	9	5.5		
<b>LU09AR</b> <b>LU09TR</b>	10	2.2	5.5	20	30	15	13	M2×0.4×2.5 M3×0.5×3	2.5	20	3.5 5	7.8	9	5.5		
<b>LU12AL</b> <b>LU12TL</b>	13	3	7.5	27	34	20	15	M2.5×0.45×3 M3×0.5×3.5	3.5	21.8	3.4	10	12	7.5		
<b>LU12AR</b> <b>LU12TR</b>	13	3	7.5	27	35.2	20	15	M2.5×0.45×3 M3×0.5×3.5	3.5	21.8	3.4	10	12	7.5		
<b>LU15AL</b>	16	4	8.5	32	43.6	25	20	M3×0.5×4	3.5	27	3.5	12	15	9.5		

Remarks 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.

Random matching with retainer: LU09 - 12 are AR/TR, LU15 is AL.  
 Reference number for ball slide of random-matching type

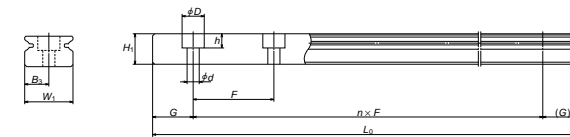
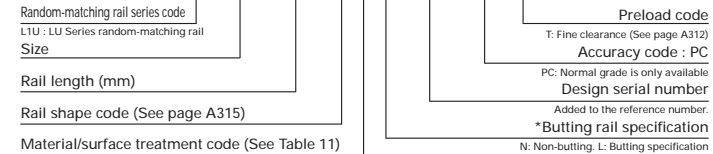
LAU-AR (With ball retainer)  
 LAU-TR (Large mounting hole, with ball retainer)  
 LAU-AL (LU15 is equipped with ball retainer)

**LAU 12 AR K -\*\*PCT**



Reference number for rail of random-matching type

**L1U12 0270 RKN -\*\* PC T**



\*Please consult with NSK for butting rail specification.

Unit: mm

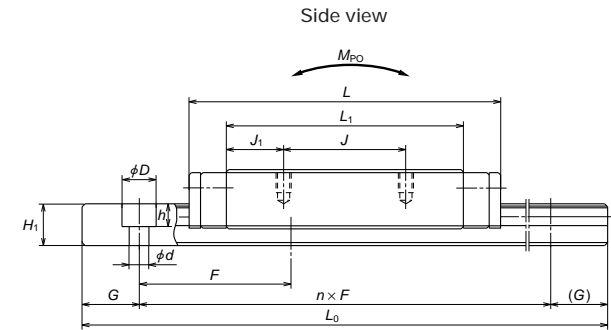
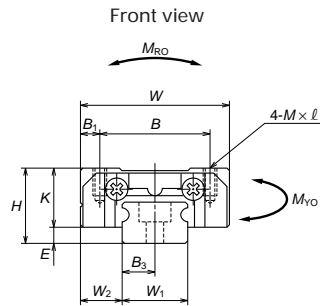
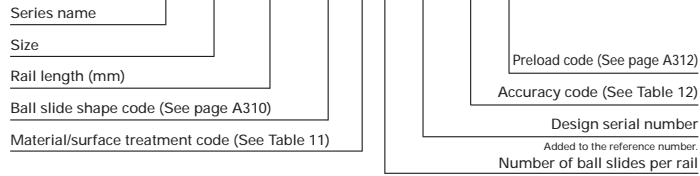
Pitch	Rail				Basic load rating					Ball dia. D <sub>w</sub>	Weight	
	Mounting bolt hole F	G	Max. length L <sub>0</sub> MAX- ( ) for stainless	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment			Ball slide (g)		Rail (g/100mm)	
						M <sub>RO</sub> (N·m)	M <sub>PO</sub> (N·m)	M <sub>VO</sub> (N·m)				
15	2.3×3.3×1.5	2.5	5	— (210)	545	740	1.93	1.22	1.22	1.2	4	11
15	2.4×4.2×2.3	3.5	5	— (375)	1090	1370	4.90	2.66	2.66	1.587	10	23
20	2.6×4.5×3 3.5×6×4.5	4.5	7.5	1200 (600)	1760	2220	10.2	6.10	6.10	2	17	35
20	2.6×4.5×3 3.5×6×4.5	4.5	7.5	— (600)	1490	2150	9.9	6.10	6.10	1.587	19	35
25	3×5.5×3.5 3.5×6×4.5	6	10	1800 (800)	2830	3500	21.1	11.4	11.4	2.381	38	65
25	3×5.5×3.5 3.5×6×4.5	6	10	— (800)	2830	3500	21.1	11.4	11.4	2.381	38	65
40	3.5×6×4.5	7.5	15	2000 (1000)	5550	6600	49.5	25.6	25.6	3.175	70	105

4) To fix rail of LU05TL, use M2 x 0.4 cross-recessed pan head machine screw for precision instrument.  
 (JCS 10-70 No. 0 pan head machine screw No.1.)  
 (JCS : Japanese Camera Industrial Standard.)

5) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface.  
 When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.

LU-BL (High-load type)  
LU-UL (High-load type, large mounting hole)

**LU 12 0270 BL K 2 -\*\* P5 1**



Model No.	Assembly			Ball slide									Width	Height
	Height	E	W <sub>2</sub>	Width	Length	Mounting hole			B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K		
						B	J	M x pitch x l						
LU09BL	10	2.2	5.5	20	41	15	16	M2x0.4x2.5	2.5	31.2	7.6	7.8	9	5.5
LU09UL								M3x0.5x3						
LU12BL	13	3	7.5	27	47.5	20	20	M2.5x0.45x3	3.5	35.3	7.65	10	12	7.5
LU12UL								M3x0.5x3.5						
LU15BL	16	4	8.5	32	61	25	25	M3x0.5x4	3.5	44.4	9.7	12	15	9.5

Remarks 1) LU09UL is available only in stainless steel.  
2) LU15BL is equipped with ball retainer.

Unit: mm

Pitch	Rail				Basic load rating					Ball dia.	Weight	
	Mounting bolt hole	G	Max. length	L <sub>0</sub> MAX. (°) for stainless	Dynamic	Static	Static moment				Ball slide	Rail
							C	C <sub>0</sub>	M <sub>RO</sub>			
F	d x D x h	B <sub>3</sub>	(Reference)		(N)	(N)	(N · m)	(N · m)	(N · m)	D <sub>w</sub>	(g)	(g/100mm)
20	2.6x4.5x3 3.5x6x4.5	4.5	7.5	1200 (600)	2600	3900	17.9	17.2	17.2	2	29	35
25	3x5.5x3.5 3.5x6x4.5	6	10	1800 (800)	4000	5700	34.5	28.3	28.3	2.381	59	65
40	3.5x6x4.5	7.5	15	2000 (1000)	8100	11300	84.5	69.5	69.5	3.175	107	105

3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.

## A-5-3.4 LE Series

### (Miniature type)

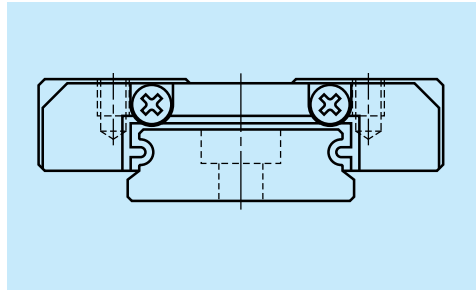


Fig. 1 LE Series

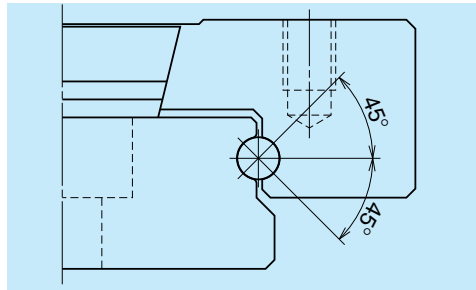


Fig. 2 Balls in contact

### (1) Features

#### 1. Ideal for use of single rail

LE Series linear guides are miniature and wide rail type. Thanks to the wide rail, load carrying capacity is high against moment load from rolling direction.

#### 2. Equal load carrying capacity in vertical and lateral directions

Contact angle is set at 45 degrees, equally dispersing the load from vertical and lateral directions. This also provides equal rigidity in the two directions.

#### 3. Guides are super-thin.

Super-thin guides owe their design to the single ball groove on right and left sides (Gothic arch).

#### 4. High accuracy

Fixing the master rollers is easy thanks to the Gothic arch groove. Groove measuring is accurate and easy.

#### 5. Stainless steel is standard.

Rails and ball slides are made of martensitic stainless steel.

#### 6. Ball retainer is available in some series.

Some series come with a ball retainer (ball slide model: AR and TR). Balls are retained in the retainer and do not fall out when a ball slide is withdrawn from the rail (random-matching ball slides come with a ball retainer).

#### 7. Fast delivery

The series enables random matching of rails and ball slides (interchangeability) for prompt delivery. (LE09 to LE15)

### (2) Ball slide shape

Ball slide Model	Shape/installation method	Type		
		Medium-load type	Standard type	High-load type
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. Runing parallelism tolerance

Table 1

Unit:  $\mu\text{m}$ 

Rail length (mm)	Preloaded assembly type (not random matching)			Random-matching type
	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC
over 50				
or less				
- 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 - 1000	9	16	18	18
1000 - 1250	10	17	20	20

## 2. Accuracy standard

The preloaded assembly types products have three accuracy grades: High precision P5, Precision P6, and Normal PN grades, while the random-matching type has Normal PC grade.

Table 2 shows the accuracy standard for the preloaded assembly type while Table 3 shows the accuracy standard for the random-matching types.

### • Tolerance of preloaded assembly

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)		$\pm 15$ 7	$\pm 20$ 15
Mounting width $W_2$ or $W_3$ Variation of $W_2$ or $W_3$ (All ball slides on reference rail)		$\pm 20$ 10	$\pm 30$ 20	$\pm 50$ 30
Running parallelism of face C to face A Running parallelism of face D to face B		Refer to Table 1 and Fig. 3		

### • Tolerance of random-matching type: Normal grade, PC

Characteristics	Accuracy grade	Normal grade PC
Mounting height $H$		$\pm 20$
Variation of mounting height $H$		40
Mounting width $W_2$ or $W_3$		$\pm 20$
Variation of mounting width $W_2$ or $W_3$		40
Running parallelism of face C to face A Running parallelism of face D to face B		Refer to Table 1 and Fig. 3

## 3. Assembled accuracy

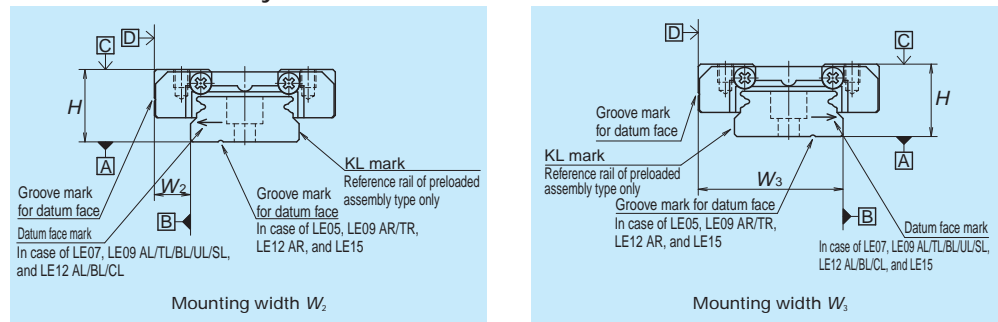


Fig. 3

## 4. Preload and rigidity

We offer three levels of preload: Slight preload (Z1) and Fine clearance (Z0), along with random-matching type of Fine clearance (ZT). Values for preloaded 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

Model No.	Preload (N)	Rigidity (N/ $\mu\text{m}$ )
	Slight preload (Z1)	Slight preload (Z1)
Standard type	LE05 AL	0 – 23 / 36
	LE07 TL	0 – 29 / 46
	LE09 AL, TL, AR, TR	0 – 37 / 61
	LE12 AL, AR	0 – 40 / 63
	LE15 AL, AR	0 – 49 / 66
Medium-load type	LE05 CL	0 – 18 / 29
	LE07 SL	0 – 16 / 28
	LE09 CL, SL	0 – 21 / 33
	LE12 CL	0 – 23 / 36
	LE15 CL	0 – 29 / 44
High-load type	LE07 UL	0 – 43 / 71
	LE09 BL, UL	0 – 54 / 86
	LE12 BL	0 – 59 / 97
LE15 BL	0 – 75 / 114	

Note: Clearance of fine clearance Z0 is 0 to 3  $\mu\text{m}$ . Therefore, preload is zero. However, Z0 of PN grade is 3 to 10  $\mu\text{m}$ . Clearance values of the random-matching type are shown in Table 5.

### • Clearance of random-matching type

Model No.	Fine clearance ZT
LE09	0 – 15
LE12	
LE15	

## (4) Available length of rail

Table 6 shows the limitations of rail length (maximum length).

However, the limitations vary by accuracy grade.

Series	Size	05	07	09	12	15
	Material					
LE	Stainless steel	150	600	800	1000	1200

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



(5) Installation

1. Permissible values of mounting error

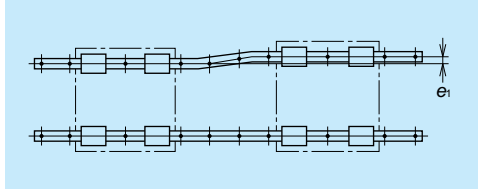


Fig. 4

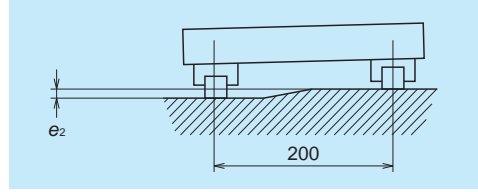


Fig. 5

Table 7

Unit:  $\mu\text{m}$

Value	Preload	Model No.				
		LE05	LE07	LE09	LE12	LE15
Permissible values of parallelism in two rails $e_1$	Z0, ZT	10	12	15	18	22
	Z1	5	7	10	13	17
Permissible values of parallelism (height) in two rails $e_2$	Z0, ZT	50 $\mu\text{m}/200 \text{ mm}$				
	Z1	35 $\mu\text{m}/200 \text{ mm}$				

2. Shoulder height of the mounting face and corner radius r

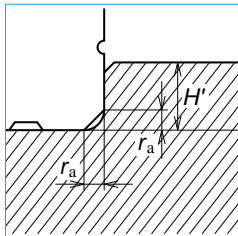


Fig. 6 Shoulder for the rail datum face

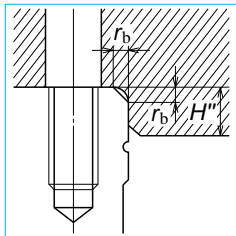


Fig. 7 Shoulder for the ball slide datum face

Table 8

Unit: mm

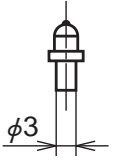
Model No.	Corner radius (maximum)		Shoulder height	
	$r_a$	$r_b$	$H'$	$H''$
LE05	0.2	0.2	1.1	2
LE07	0.2	0.3	1.7	3
LE09	0.3	0.3	3.5	3
LE12	0.3	0.3	3.5	4
LE15	0.3	0.5	3.5	5

(6) Lubrication accessories

LE15 AR can select drive-in type grease fitting as option.

There is no standard grease fitting for LE05 to 12.

For LE05 to 15, apply grease directly to ball groove, etc. using a point nozzle.



Drive-in type

(7) Dust proof components

1. Standard specification

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

• Seal friction per standard ball slide is shown in Table 9.

Table 9 Seal friction per ball slide (maximum value)

Unit: N

Series	Size	05	07	09	12	15
LE		0.4	0.4	0.8	1.0	1.2

2. NSK K1™

The dimension of linear guides equipped with NSK K1 are shown in Table 10.

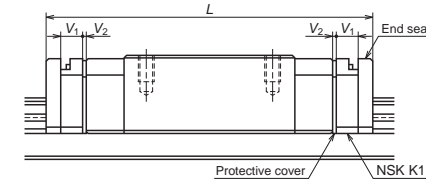


Table 10

Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness $V_1$	Protective cover thickness $V_2$
LE07	Standard	TL	31	37	2.5	0.5
	Long	UL	42	48		
	Short	SL	22.4	28.4		
LE09	Standard	AL, TL	39	46	3.0	0.5
	Standard	AR, TR	39.8	46.8		
	Long	BL, UL	50.4	57.4		
	Short	CL, SL	26.4	33.4		
LE12	Standard	AL	44	52	3.5	0.5
	Standard	AR	45	53		
	Long	BL	59	67		
	Short	CL	30.5	38.5		
LE15	Standard	AL	55.0	64.6	4.0	0.8
	Standard	AR	56.6	66.2		
	Long	BL	74.4	84		
	Short	CL	41.4	51		

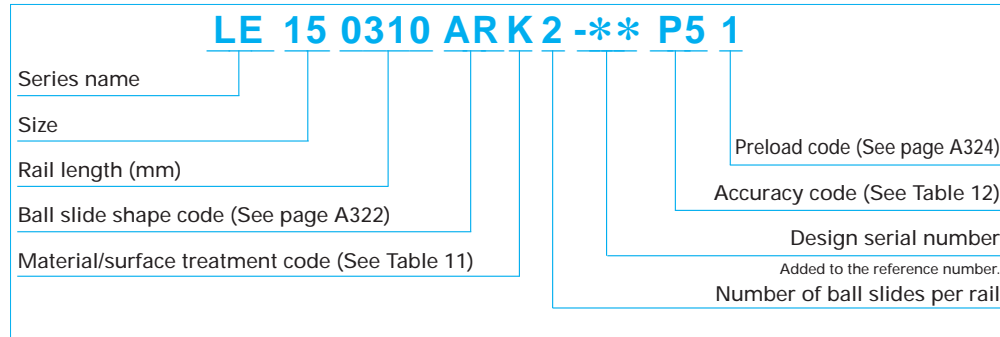
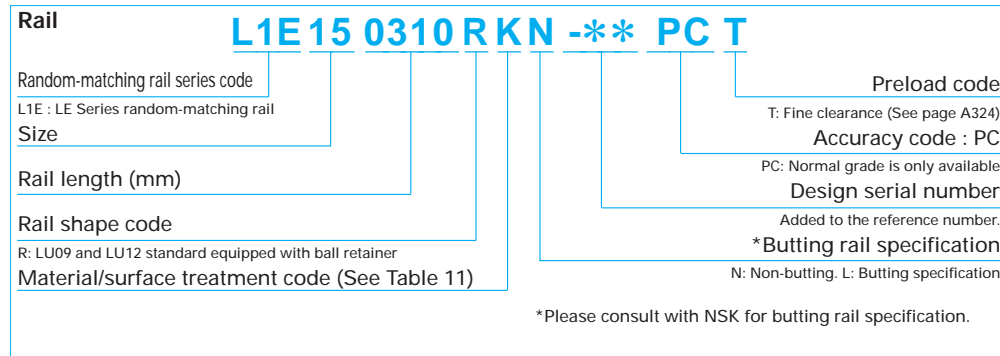
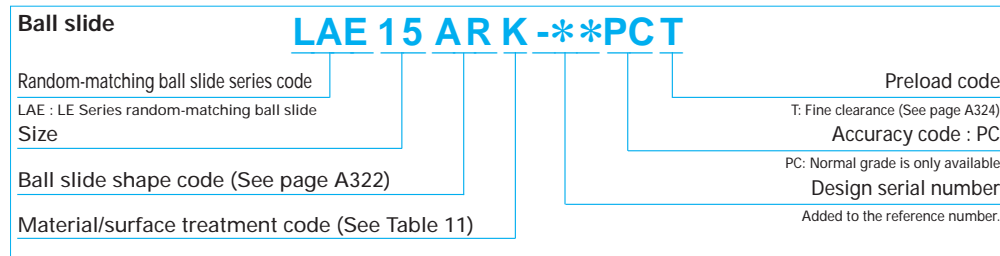
Note: Ball slide length equipped with NSK K1 =

(Standard ball slide length) + (Thickness of NSK K1,  $V_1 \times$  Number of NSK K1) + (Thickness of the protective cover  $V_2 \times 2$ )

**(8) Reference number**

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.

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

**1. Reference number for preloaded assembly****2. Reference number for random-matching type**

Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is fine clearance "T" (Refer to page A324).

**Table 11 Material/surface treatment code**

Code	Description
K	Stainless steel
H	Stainless steel with surface treatment
Z	Other, special

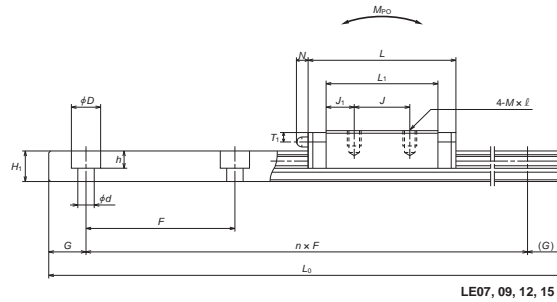
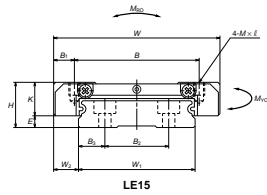
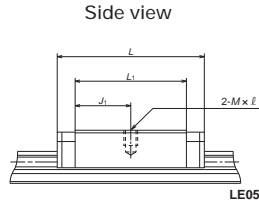
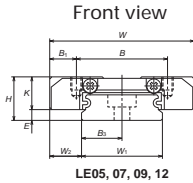
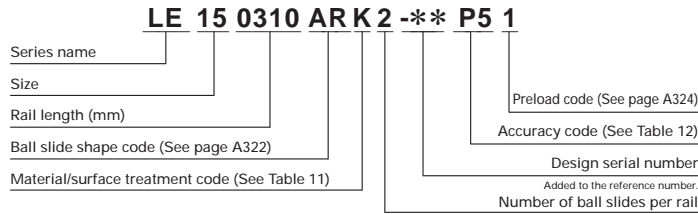
**Table 12 Accuracy code**

Accuracy	Standard (Without NSK K1)	With NSK K1
High precision grade	P5	K5
Precision grade	P6	K6
Normal grade	PN	KN
Normal grade (random-matching type)	PC	KC

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

(9) Dimensions

LE-AL  
LE-TL (Large mounting hole)  
LE-AR (With ball retainer)  
LE-TR (Large mounting hole, with ball retainer)



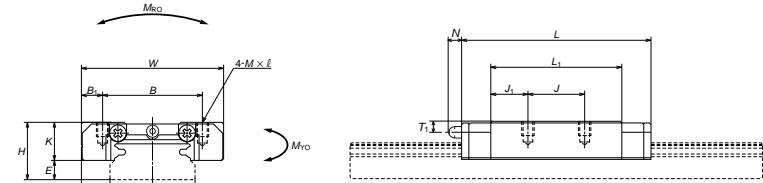
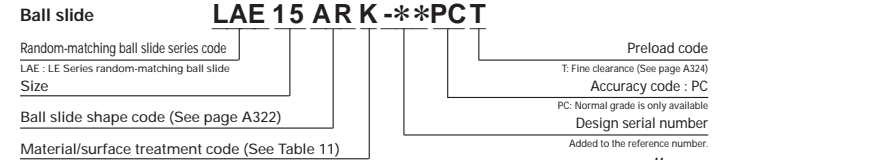
Model No.	Assembly			Ball slide										Grease fitting				
	Height	Width	Length	Mounting hole			B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	Hole size	T <sub>1</sub>	N	W <sub>1</sub>	H <sub>1</sub>			
				H	E	W <sub>2</sub>										B	J	M × pitch × ℓ
LE05AL	6.5	1.4	3.5	17	24	13	—	M2.5×0.45×2	2	17	8.5	5.1	—	—	—	10	4	
LE07TL	9	2	5.5	25	31	19	10	M3×0.5×3	3	21.2	5.6	7	—	—	—	14	5.2	
LE09AL LE09TL	12	4	6	30	39	21	12	M2.6×0.45×3 M3×0.5×3	4.5	27.6	7.8	8	—	—	—	18	7.5	
LE09AR LE09TR	12	4	6	30	39.8	21	12	M2.6×0.45×3 M3×0.5×3	4.5	27.6	7.8	8	—	—	—	18	7.5	
LE12AL LE12AR	14	4	8	40	44 45	28	15	M3×0.5×4	6	31	8	10	—	—	—	24	8.5	
LE15AL LE15AR	16	4	9	60	55 56.6	45	20	M4×0.7×4.5	7.5	38.4	9.2	12	φ3	—	—	3	42	9.5

Remarks: 1) Ball slide of LE05 has only two mounting tap holes.

Random matching with retainer: AR, TR.

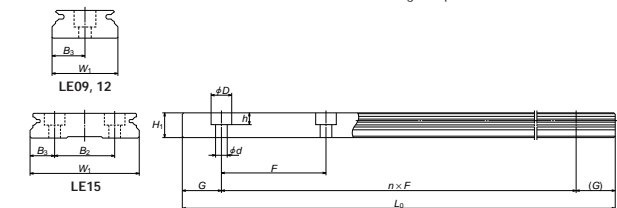
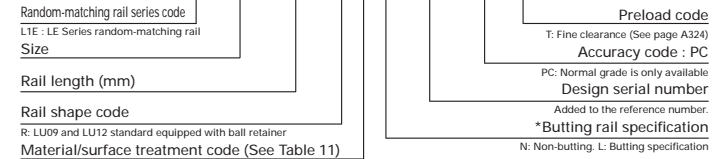
Reference number for ball slide of random-matching type

LAE-AR (With ball retainer)  
LAE-TR (Large mounting hole with ball retainer)



Reference number for rail of random-matching type

Rail **L1E 15 0310 RKN -\*\* PC T**

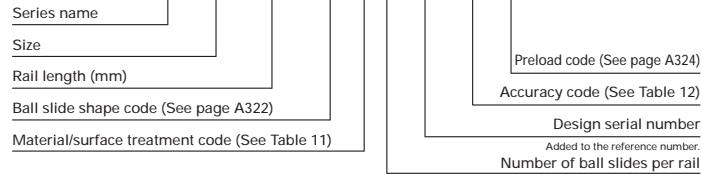


Rail						Basic load rating					Ball dia.	Weight	
B <sub>2</sub>	Pitch	Mounting bolt hole	G	Max. length	L <sub>0max</sub>	Dynamic	Static	Static moment			D <sub>w</sub>	Ball slide (g)	Rail (g/100mm)
F	d × D × h	B <sub>3</sub>	(Reference)	C		C <sub>0</sub>	M <sub>RC</sub>	M <sub>RO</sub>	M <sub>VO</sub>				
—	20	3×5×1.6	5	7.5	150	725	1110	5.65	2.58	2.58	1.200	11	34
—	30	3.5×6×3.2	7	10	600	1580	2350	16.7	7.20	7.20	1.587	25	55
—	30	3.5×6×4.5	9	10	800	3000	4500	36.5	17.3	17.3	2.000	40	95
—	30	3.5×6×4.5	9	10	800	3000	4500	36.5	17.3	17.3	2.000	40	95
—	40	4.5×8×4.5	12	15	1000	4350	6350	70.5	29.3	29.3	2.381	75	140
23	40	4.5×8×4.5	9.5	15	1200	7600	10400	207	59.0	59.0	3.175	150	275

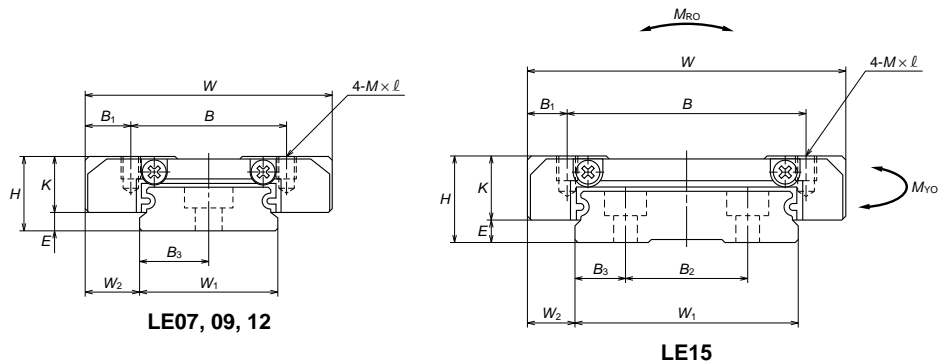
2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface.  
3) When converting the basic dynamic load rating C to the dynamic load rating C<sub>10</sub> for 100 km rating fatigue life, divide the C by 1.26.  
For fixing a rail of LE05AL, use M2.5x0.45 cross-recessed pan head machine screw for precision instruments.  
(JCS 10-70 : No.0 pan head machine screw No.3) (JCS : Japanese Camera Industrial Standard)

LE-BL (High-load type)  
LE-UL (High-load type, large mounting hole)

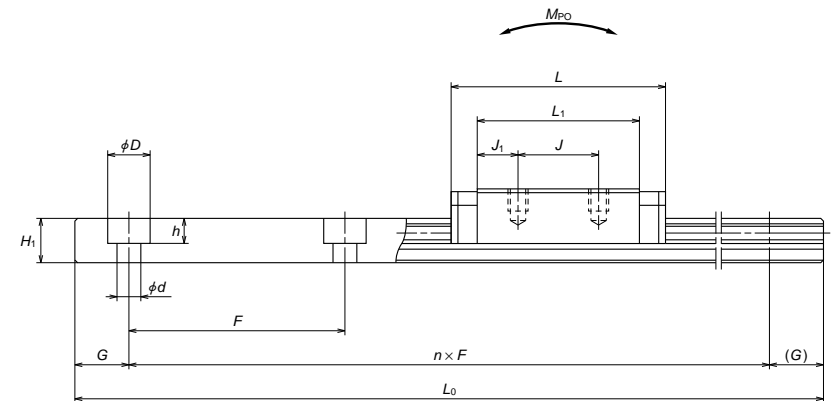
**LE 15 0310 ARK 2 -\*\* P5 1**



Front view



Side view



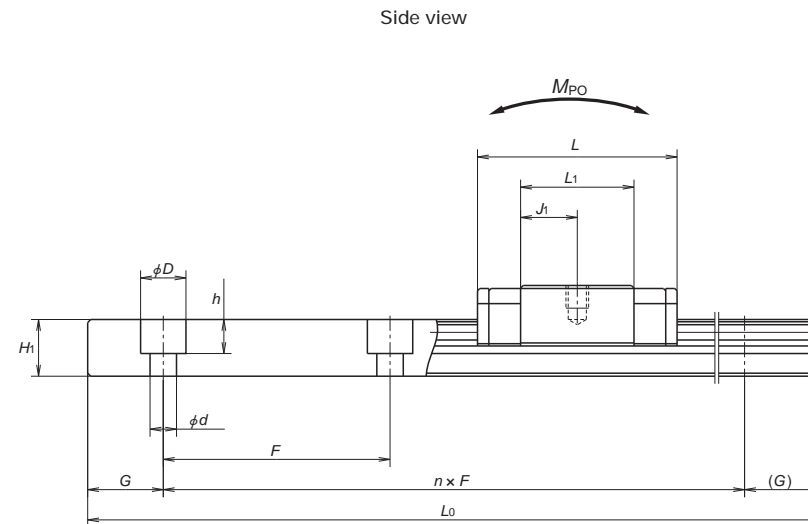
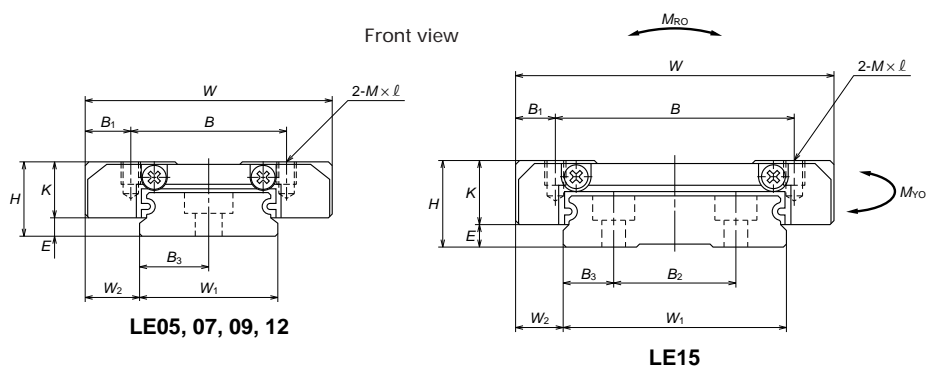
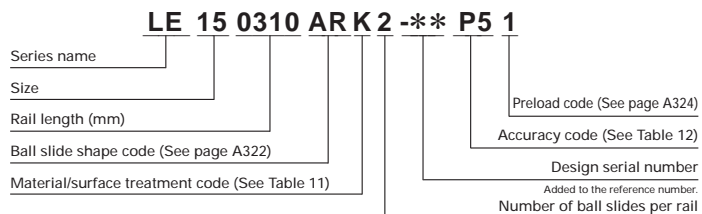
Model No.	Assembly			Ball slide												
	Height <i>H</i>	<i>E</i>	<i>W</i> <sub>2</sub>	Width <i>W</i>	Length <i>L</i>	Mounting hole					<i>B</i> <sub>1</sub>	<i>L</i> <sub>1</sub>	<i>J</i> <sub>1</sub>	<i>K</i>	Width <i>W</i> <sub>1</sub>	Height <i>H</i> <sub>1</sub>
						<i>B</i>	<i>J</i>	<i>M</i> × pitch × <i>l</i>	<i>B</i> <sub>2</sub>	<i>B</i> <sub>3</sub>						
<b>LE07UL</b>	9	2	5.5	25	42	19	19	M3×0.5×3	3	32.2	6.6	7	14	5.2		
<b>LE09BL</b> <b>LE09UL</b>	12	4	6	30	50.4	23	24	M2.6×0.45×3 M3×0.5×3	3.5	39	7.5	8	18	7.5		
<b>LE12BL</b>	14	4	8	40	59	28	28	M3×0.5×4	6	46	9	10	24	8.5		
<b>LE15BL</b>	16	4	9	60	74.4	45	35	M4×0.7×4.5	7.5	57.8	11.4	12	42	9.5		

Unit: mm

Rail						Basic load rating					Ball dia.	Weight	
<i>B</i> <sub>2</sub>	Pitch <i>F</i>	Mounting bolt hole <i>d</i> × <i>D</i> × <i>h</i>	<i>B</i> <sub>3</sub>	<i>G</i> (Reference)	Max. length <i>L</i> <sub>0max</sub>	Dynamic	Static	Static moment			<i>D</i> <sub>W</sub>	Ball slide (g)	Rail (g/100mm)
						<i>C</i> (N)	<i>C</i> <sub>0</sub> (N)	<i>M</i> <sub>RO</sub> (N·m)	<i>M</i> <sub>FO</sub> (N·m)	<i>M</i> <sub>VO</sub> (N·m)			
—	30	3.5×6×3.2	7	10	600	2180	3700	26.4	17.3	17.3	1.587	39	55
—	30	3.5×6×4.5	9	10	800	4000	6700	54.5	37.5	37.5	2.000	58	95
—	40	4.5×8×4.5	12	15	1000	5800	9550	106	63.5	63.5	2.381	115	140
23	40	4.5×8×4.5	9.5	15	1200	10300	16000	320	135	135	3.175	235	275

Remark: The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface.  
When converting the basic dynamic load rating *C* to the dynamic load rating *C*<sub>100</sub> for 100 km rating fatigue life, divide the *C* by 1.26.

LE-CL (Medium-load type)  
LE-SL (Medium-load type, large mounting hole)



Model No.	Assembly			Ball slide									Width	Height
	Height	E	W <sub>2</sub>	Width	Length	Mounting hole			B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K		
						B	J	M × pitch × l						
<b>LE05CL</b>	6.5	1.4	3.5	17	20	13	—	M2.5×0.45×2	2	13	6.5	5.1	10	4
<b>LE07SL</b>	9	2	5.5	25	22.4	19	—	M3×0.5×3	3	12.6	6.3	7	14	5.2
<b>LE09CL</b> <b>LE09SL</b>	12	4	6	30	26.4	21	—	M2.6×0.45×3 M3×0.5×3	4.5	15	7.5	8	18	7.5
<b>LE12CL</b>	14	4	8	40	30.5	28	—	M3×0.5×4	6	17.5	8.75	10	24	8.5
<b>LE15CL</b>	16	4	9	60	41.4	45	—	M4×0.7×4.5	7.5	24.8	12.4	12	42	9.5

Remarks: 1) Ball slide of CL and SL types have only two mounting tap holes in the center.

Unit: mm

B <sub>2</sub>	Pitch	Mounting bolt hole	B <sub>3</sub>	G	Max. length	Basic load rating					Ball dia.	Weight	
						Dynamic	Static	Static moment				Ball slide	Rail
								C	C <sub>0</sub>	M <sub>RO</sub>			
—	20	3×5×1.6	5	7.5	150	595	835	4.25	1.51	1.51	1.200	8	34
—	30	3.5×6×3.2	7	10	600	980	1170	8.35	2.01	2.01	1.587	17	55
—	30	3.5×6×4.5	9	10	800	1860	2240	18.2	4.85	4.85	2.000	25	95
—	40	4.5×8×4.5	12	15	1000	2700	3150	35.0	8.15	8.15	2.381	50	140
23	40	4.5×8×4.5	9.5	15	1200	5000	5650	113	19.4	19.4	3.175	110	275

2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26

3) For fixing a rail of LE05CL, use cross-recessed pan head machine screw for precision instruments M2.5×0.45 (JICIS 10-70 : Japan Camera Industry Association, No.0, class 3).

### A-5-3.5 LL Series

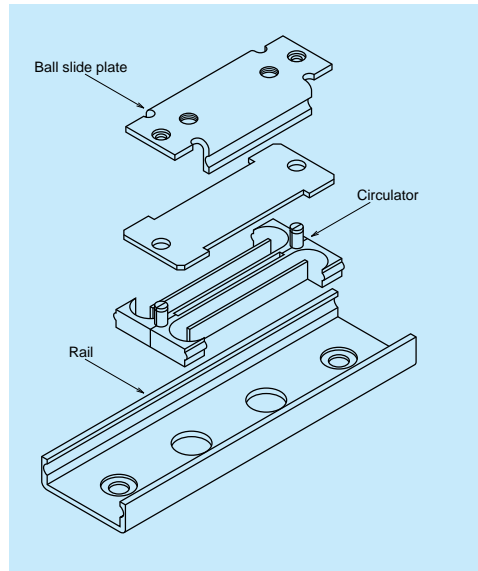


Fig. 1 LL Series structure

#### (1) Features

##### 1. Super light-weight

This compact guide has a single ball groove on both right and left sides (Gothic arch). Rails and ball slides are made of stainless steel plate, therefore they are lightweight.

##### 2. Compact

The ball groove is made outside the ball slide to reduce overall size and to obtain high speed.

##### 3. High corrosion resistance

High corrosion resistant martensitic stainless steel is used as standard material.

#### (2) Ball slide model

Ball slide model	Shape/installation method
PL	

#### (3) Accuracy and preload

##### 1. Accuracy standard

LL Series has a normal grade PN as accuracy. Table 1 shows tolerance.

Table 1 Tolerance of LL Series Normal grade (PN)  
Unit:  $\mu\text{m}$

Characteristic	Model No.	LL15
Mounting height		$\pm 20$
Running parallelism of face C to face A		20
Running parallelism of face D to face B		(See Fig. 2)

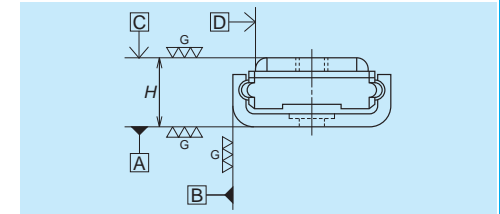


Fig. 2 Standard LL

##### 2. Preload

We offer clearance for LL Series.

Table 2 shows clearance.

Table 2 Radial clearance  
Unit:  $\mu\text{m}$

Model No.	Clearance
LL15	0 - 10

#### (4) Available length of rail

Table 3 Length limitation  
Unit: mm

Series	Size		15				
	Material						
LL	Stainless steel		40	60	75	90	120

#### (5) Reference number

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.

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

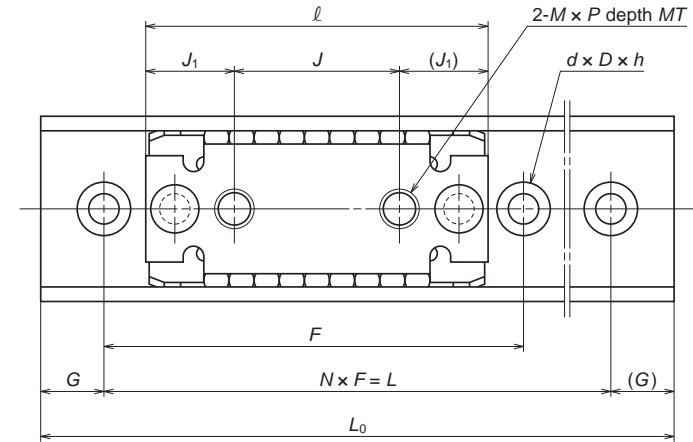
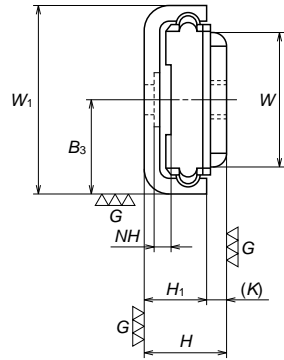
**LL 15 0060 PL K 1 -\*\* PN 0**

Series name	LL	15	0060	PL	K	1	-**	PN	0
Size									
Rail length (mm)									
Ball slide shape code (See page A335)									
Material code : K K: Stainless steel									
Preload code : 0 0 : Clearance									
Accuracy code : PN (PN: Normal grade is only 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**

Series name: LL 15 0060  
 Size: PL  
 Rail length (mm): K 1  
 Ball slide shape code (See page A335): -\*\*  
 Material code: K  
 Preload code: 0  
 Accuracy code: PN  
 Design serial number: 0  
 Number of ball slides per rail: 0



Model No.	Assembly		Ball slide							Height	Pitch	N
	Height	Width	Length	Mounting hole			J <sub>1</sub>	K				
				J	M × pitch	MT						
<b>LL15</b>	H	W <sub>1</sub>	W	ℓ	J	M × pitch	MT	J <sub>1</sub>	K	H <sub>1</sub>	F	N
	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

Remarks:

- LL Series does not have a ball retainer. Be aware that the balls fall out when a bearing is withdrawn from the rail.
- Seal Is not available. Please provide the dust-prevention measures on the equipment.
- Do not use an installation screw on the ball slide which exceeds MT (maximum screw depth allowance) in the dimension table.
- To fix of LL15PL, use M2 × 0.4 cross recessed machine screw for precision instrument.  
 (JCIS10-70 No.0 pan head machine screw No.1)  
 (JCIS: Japanese Camera Industrial Standard)

Rail		Basic load rating					Ball dia.	Weight	
Mounting bolt hole	Length	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment			D <sub>w</sub>	Ball slide (g)	Rail (g)
				M <sub>RO</sub> (N·m)	M <sub>PO</sub> (N·m)	M <sub>VO</sub> (N·m)			
d × D × h	L <sub>0</sub>	C	C <sub>0</sub>	M <sub>RO</sub>	M <sub>PO</sub>	M <sub>VO</sub>	D <sub>w</sub>	Ball slide (g)	Rail (g)
2.4×5×0.4	40	880	785	7	3	3	2	6	9
	60								11
	75								13
	90								16
	120								21

5) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.

1. HA Series

A341

2. HS Series

A355

## A-5-4 High-Precision Machine and High-Precision Measuring Equipment



### A-5-4.1 HA Series



is received by four rows at all times. The number of the row which receives the load is larger than in other linear guides, making this series stronger against shock load.

#### 8. High accuracy at manufacturing

Fixing the measuring rollers is easy thanks to the Gothic arch groove. Ball-groove measuring is accurate and simple. This benefits a highly precise and stable manufacturing.

#### (1) Features

##### 1. High motion accuracy

High motion accuracy is achieved in both narrow and wide ranges by adopting ultra-long ball slides and optimum design features for the ball recirculation component.

##### 2. Ball passage vibration reduced to one-third of our conventional models

Tests show ball passage vibration has been reduced to one-third of our conventional models, dramatically improving straightness in table unit.

##### 3. Installation of rail with greater accuracy

Increased counterbore depth of the rail mounting hole reduces rail deflection, which is caused by bolt tightening when fixing the rail to the base component, to 50% or less. This feature restrains the pitching motion of ball slide whose frequency matches to the mounting hole pitch.

In addition, the length of mounting hole pitch has been reduced by one-half of the conventional models, so the rail can be more accurately installed in position.

##### 4. High rigidity and load capacity with lower friction

High rigidity, high load capacity and low friction are achieved by increasing the number of balls.

##### 5. Compact design

Reduced body size enables more compact machinery.

##### 6. Load distribution four directions

Contact angle is set at 45 degrees in all grooves, dispersing the load 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.

##### 7. Strong against shock load

Load from any direction, vertical and lateral,

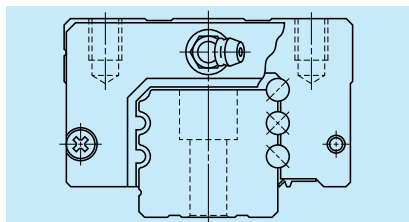


Fig. 1 HA Series

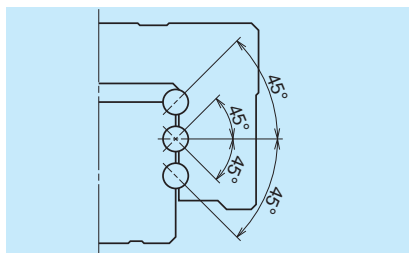


Fig. 2 Super rigidity design

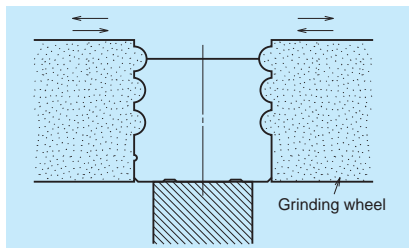


Fig. 3 Rail grinding

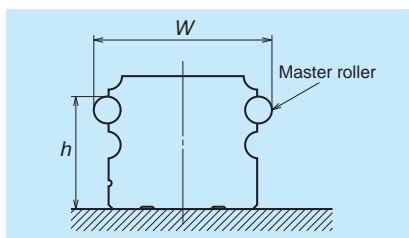


Fig. 4 Measuring groove accuracy

#### Measurement results of ball passage vibration

Ball passage vibration can translate into posture changes in the ball slide which result from ball passage (circulation). In the HA Series, this vibration has been substantially reduced to one-third of conventional models.

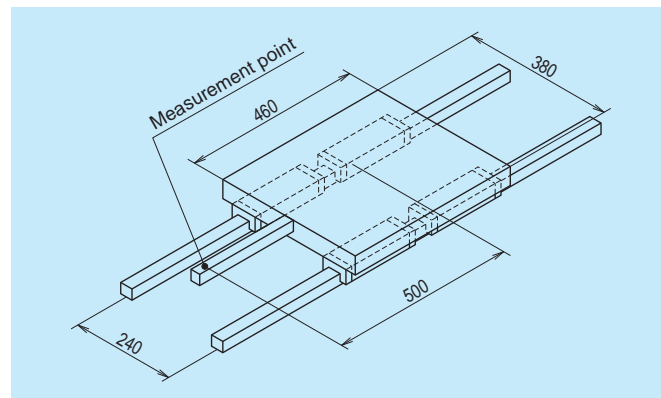
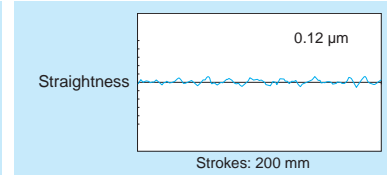
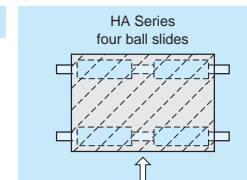


Fig. 5 Schematic view of measurement of ball passage vibration

#### HA Series

Model No.: HA30  
Preload: Z3  
Table dimensions: 460 mm x 380 mm



#### Conventional Series

Model No.: LA30  
Preload: Z3  
Table dimensions: 460 mm x 380 mm

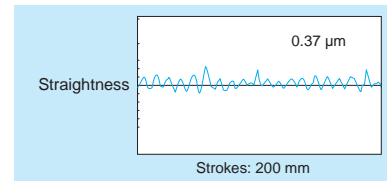
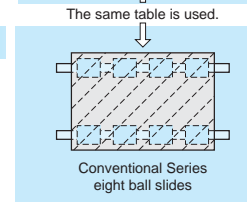


Fig. 6 Measurement results of HA Series and conventional Series

(2) Ball slide shape

Ball slide Model	Shape/installation method	Type
AN		
AL		
EM		

(3) Accuracy and preload

1. Running parallelism of ball slide

Table 1 Unit:  $\mu\text{m}$

Rail over all length (mm) over or less	Preloaded assembly		
	Ultra precision P3	Super precision P4	High precision P5
- 200	2	2	4
200 - 250	2	2.5	5
250 - 315	2	2.5	5
315 - 400	2	3	6
400 - 500	2	3	6
500 - 630	2	3.5	7
630 - 800	2	4.5	8
800 - 1 000	2.5	5	9
1 000 - 1 250	3	6	10
1 250 - 1 600	4	7	11
1 600 - 2 000	4.5	8	13
2 000 - 2 500	5	10	15
2 500 - 3 150	6	11	17
3 150 - 4 000	9	16	23

2. Accuracy standard

Three accuracy grades are available: Ultra precision P3, Super precision P4 and High precision P5.

Table 2 Unit:  $\mu\text{m}$

Characteristics	Ultra precision P3	Super precision P4	High precision P5
Mounting height $H$	$\pm 10$	$\pm 10$	$\pm 20$
Variation of $H$ (All ball slides on a set of rails)	3	5	7
Mounting width $W_2$ or $W_3$	$\pm 15$	$\pm 15$	$\pm 25$
Variation of $W_2$ or $W_3$ (All ball slides on reference rail)	3	7	10
Running parallelism of face C to face A Running parallelism of face D to face B	Refer to Table 1 and Fig. 7		

3. Assembled accuracy

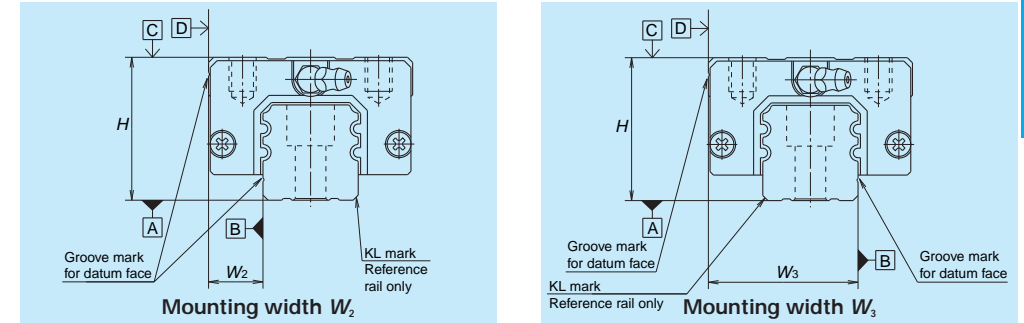


Fig. 7

4. Preload and rigidity

Slight preload Z1 and medium preload Z3 are available for preload, which can be selected for specific applications.

Table 3

Model No	Preload (N)		Rigidity (N/ $\mu\text{m}$ )	
	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) Available length of rail

Table 4 shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grade.

Table 4 Unit: mm

Series	Size	25	30	35	45	55
HA		3960	4000	4000	3990	3960

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

(5) Installation

1. Permissible values of mounting error

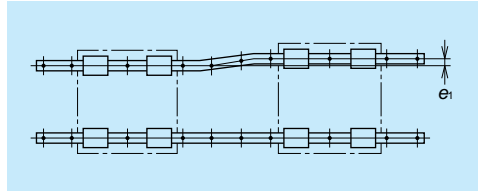


Fig. 8

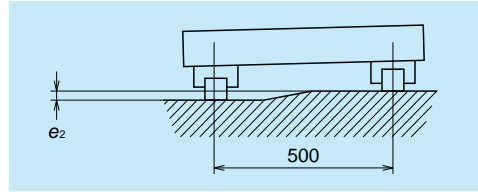


Fig. 9

Table 5

Unit:  $\mu\text{m}$

Value	Preload	Model No.				
		HA25	HA30	HA35	HA45	HA55
Permissible values of parallelism in two rails $e_1$	Z1	20	20	23	26	34
	Z3	15	14	17	19	25
Permissible values of parallelism (height) in two rails $e_2$	Z1,Z3	250 $\mu\text{m}$ /500 mm				

2. Shoulder height of the mounting face and corner radius  $r$

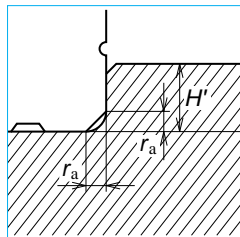


Fig. 10 Shoulder for the rail datum face

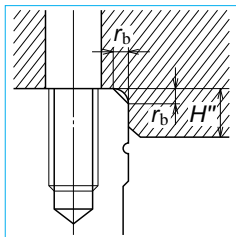


Fig. 11 Shoulder for the ball slide datum face

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 Page A38 and D13 for linear guide lubrication.

1. Types of lubrication accessories

Figure 12 and Table 7 show grease fittings and tube fittings.

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

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

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

Please ask NSK for stainless lubrication accessories.

2. Mounting position of lubrication accessories

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

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

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

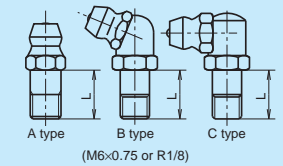
Table 7

Unit: mm

Model No.	Dust-proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
HA25	Standard	5	6*
	With NSK K1	14	13*
	Double seal	10	9*
	Protector	10	9*
HA30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
HA35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
HA45	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
HA55	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17

\*) The ball slide shape is only for AN.

Grease fitting



Tube fitting

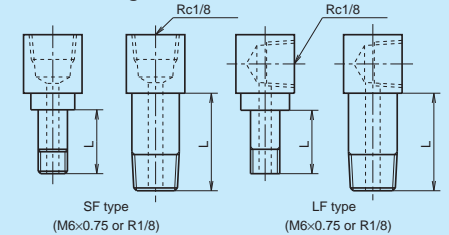


Fig. 12 Grease fitting and tube fitting

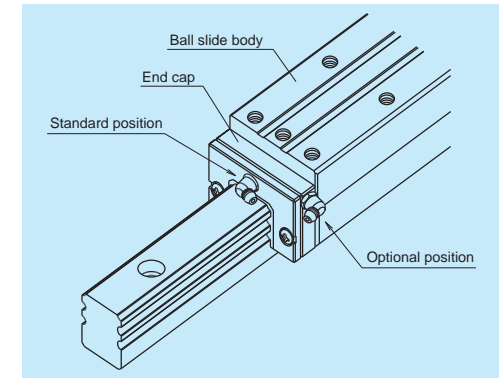


Fig. 13 Mounting position of lubrication accessories

**(7) Dust proof components**

**1. Standard Specification**

To keep foreign matters from entering inside the ball slide, HA Series has an end seal on both ends, bottom seals at the bottom, and an inner seal in inside.

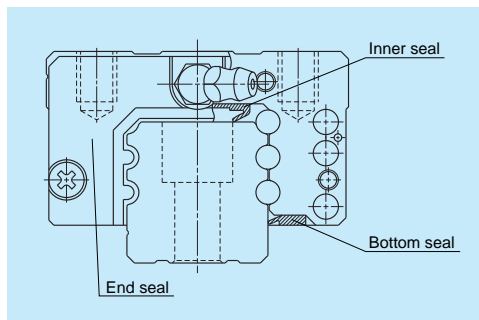


Fig. 14

Table 8 Seal friction per ball slide (maximum value)

		Unit: N				
Series	Size	25	30	35	45	55
HA		17	17	19	21	22

**2. NSK K1™**

• Table 9 shows the dimensions of linear guides equipped with the NSK K1.

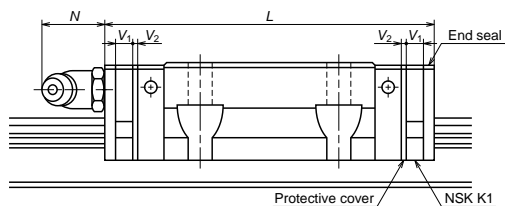


Table 9

Unit: mm

Model No.	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V <sub>1</sub>	Protective cover thickness V <sub>2</sub>	Protruding area of the grease fitting N
HA25	AN, EM	147.8	159.8	5.0	1.0	(14)
HA30	AN, EM	177.2	190.2	5.5	1.0	(14)
HA35	AN, AL, EM	203.6	216.6	5.5	1.0	(14)
HA45	AN, AL, EM	233.4	248.4	6.5	1.0	(15)
HA55	AN,AL, EM	284.4	299.4	6.5	1.0	(15)

Note: Ball slide length equipped with NSK K1 = (Standard ball slide length) + (Thickness of NSK K1, V<sub>1</sub> × Number of NSK K1) + (Thickness of the protective cover V<sub>2</sub> × 2)

**3. Double seal and protector**

For HA series, double seal and protector can be installed only before shipping from the factory. Please consult with NSK.

Table 10 shows the increased thickness of V<sub>1</sub>, and V<sub>2</sub> when end seal and protector are installed.

Table 10

Unit: mm

Model No.	Thickness of end seal: V <sub>1</sub>	Thickness of protector: V <sub>2</sub>
HA25	3.2	3.6
HA30	4.4	4.2
HA35	4.4	4.2
HA45	5.5	4.9
HA55	5.5	4.9

**4. Caps to cover the bolt hole for rail mounting**

Table 12 shows size of the bolts for the each model number as well as reference number of the cap.

Table 12 Caps to cover rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
HA25	M6	LG-CAP/M6	20
HA30, HA35	M8	LG-CAP/M8	20
HA45	M12	LG-CAP/M12	20
HA55	M14	LG-CAP/M14	20

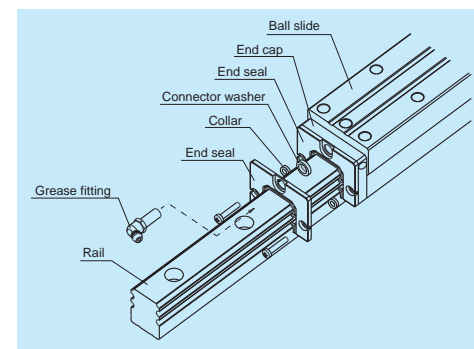


Fig. 15 Double seal

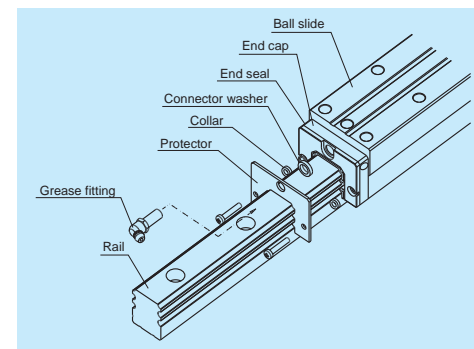


Fig. 16 Protector

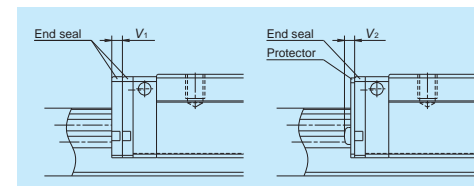
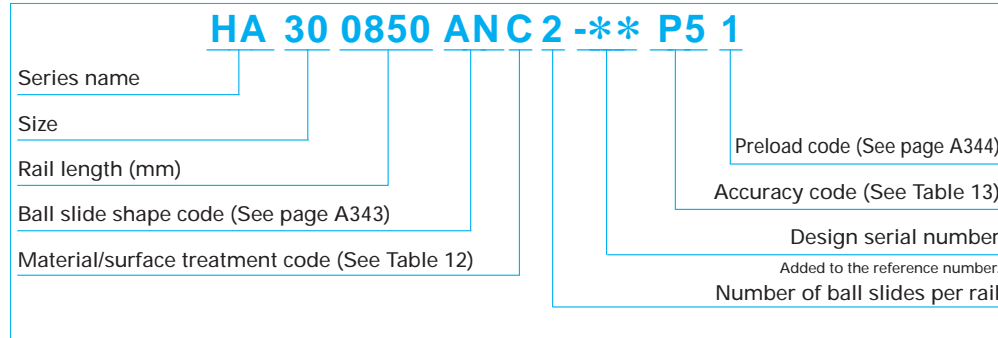


Fig. 17

**(8) Reference number**

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.

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



**Table 12 Material/surface treatment code**

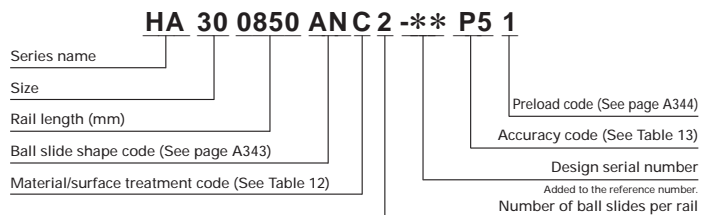
Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
Z	Other, special

**Table 13 Accuracy code**

Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5

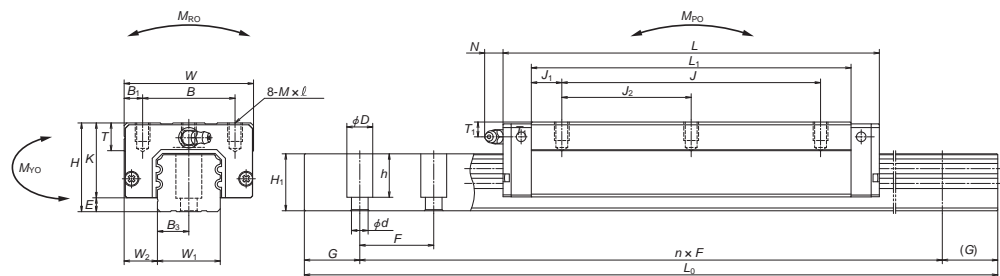
Note: Refer to Page A38 for NSK K1 lubrication unit.

(9) Dimensions



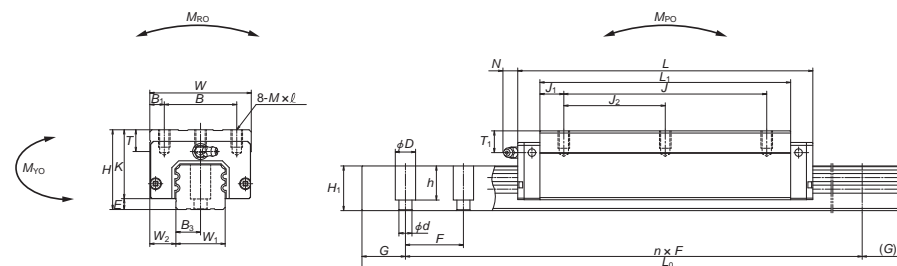
Front view of AL type

Side view of AL type



Front view of AN type

Side view of AN type



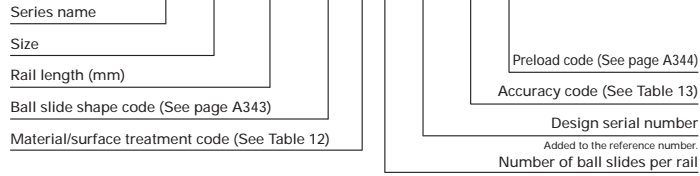
Model No.	Assembly			Ball slide													
	Height <i>H</i>	Width <i>E</i>	Length <i>W<sub>2</sub></i>	Width <i>W</i>	Length <i>L</i>	Mounting hole							Grease fitting				
						<i>B</i>	<i>J</i>	<i>J<sub>2</sub></i>	<i>M</i> × pitch × <i>l</i>	<i>B<sub>1</sub></i>	<i>L<sub>1</sub></i>	<i>J<sub>1</sub></i>	<i>K</i>	<i>T</i>	Hole size	<i>T<sub>1</sub></i>	<i>N</i>
HA25AN	40	5.5	12.5	48	147.8	35	100	50	M6×1.0×10	6.5	126	13	34.5	12	M6×0.75	10	11
HA30AN	45	7.5	16	60	177.2	40	120	60	M8×1.25×11	10	149	14.5	37.5	14	M6×0.75	9.5	11
HA35AN	55	7.5	18	70	203.6	50	140	70	M8×1.25×12 M8×1.25×10	10	173	16.5	47.5	15	M6×0.75	15	8
HA35AL	48												40.5				
HA45AN	70	10	20.5	86	233.4	60	160	80	M10×1.5×16	13	197	18.5	60	17	Rc1/8	20	10
HA45AL	60												50				
HA55AN	80	12	23.5	100	284.4	75	206	103	M12×1.75×18	12.5	245	19.5	68	18	Rc1/8	21	11
HA55AL	70												58				

Remarks: 1) HA Series does not have a ball retainer. Be aware that the balls fall out when a bearing is withdrawn from the rail.

Rail											Basic load rating					Ball dia.	Weight	
Width <i>W<sub>1</sub></i>	Height <i>H<sub>1</sub></i>	Pitch <i>F</i>	Mounting bolt hole <i>d</i> × <i>D</i> × <i>h</i>	<i>B<sub>3</sub></i>	<i>G</i>	Maximum length <i>L<sub>0max</sub></i>	Dynamic <i>C</i> (N)	Static <i>C<sub>0</sub></i> (N)	Static moment			<i>D<sub>w</sub></i>	Ball slide (kg)	Rail (kg/m)				
					(Reference)			<i>M<sub>ro</sub></i> (N·m)	<i>M<sub>po</sub></i> (N·m)	<i>M<sub>vo</sub></i> (N·m)								
23	22	30	7×11×16.5	11.5	20	3 960	54 000	115 000	670	2 060	2 060	3.968	1.2	3.7				
28	28	40	9×14×21	14	20	4 000	79 500	166 000	1 140	3 550	3 550	4.762	1.8	5.8				
34	30.8	40	9×14×23.5	17	20	4 000	111 000	226 000	1 950	5 650	5 650	5.556	3.0 2.6	7.7				
45	36	52.5	14×20×27	22.5	22.5	3 990	147 000	295 000	3 700	8 450	8 450	6.350	6.0 5.0	12.0				
53	43.2	60	16×23×32.5	26.5	30	3 960	232 000	445 000	6 500	15 400	15 400	7.937	9.4 7.8	17.2				

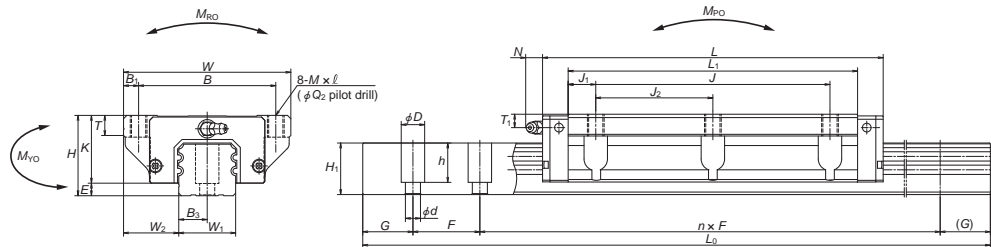
2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating *C* to the dynamic load rating *C<sub>100</sub>* for 100 km rating fatigue life, divide the *C* by 1.26.

**HA 30 0850 EMC 2 -\*\* P5 1**



Front view of EM type

Side view of EM type



Model No.	Assembly			Ball slide															
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole						B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Grease fitting		
						B	J	J <sub>2</sub>	M × pitch × l	Q <sub>2</sub>	Hole size						T <sub>1</sub>	N	
HA25EM	36	5.5	23.5	70	147.8	57	100	50	M8×1.25×10	6.8	6.5	126	13	30.5	11	M6×0.75	6	11	
HA30EM	42	7.5	31	90	177.2	72	120	60	M10×1.5×12	8.6	9	149	14.5	34.5	11	M6×0.75	6.5	11	
HA35EM	48	7.5	33	100	203.6	82	140	70	M10×1.5×13	8.6	9	173	16.5	40.5	12	M6×0.75	8	11	
HA45EM	60	10	37.5	120	233.4	100	160	80	M12×1.75×15	10.5	10	197	18.5	50	13	Rc1/8	10	13	
HA55EM	70	12	43.5	140	284.4	116	206	103	M14×2×18	12.5	12	245	19.5	58	15	Rc1/8	11	13	

Remarks: 1) HA Series does not have a ball retainer. Be aware that the balls fall out when a bearing is withdrawn from the rail.

Unit: mm

Rail							Basic load rating					Ball dia.	Weight	
Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Mounting bolt hole d × D × h	B <sub>3</sub>	G (Reference)	Maximum length L <sub>0max</sub>	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment			D <sub>w</sub>	Ball slide (kg)	Rail (kg/m)
								M <sub>Ro</sub> (N·m)	M <sub>Po</sub> (N·m)	M <sub>Vo</sub> (N·m)				
23	22	30	7×11×16.5	11.5	20	3 960	54 000	115 000	670	2 060	2 060	3.968	1.6	3.7
28	28	40	9×14×21	14	20	4 000	79 500	166 000	1 140	3 550	3 550	4.762	2.6	5.8
34	30.8	40	9×14×23.5	17	20	4 000	111 000	226 000	1 950	5 650	5 650	5.556	3.8	7.7
45	36	52.5	14×20×27	22.5	22.5	3 990	147 000	295 000	3 700	8 450	8 450	6.350	6.6	12.0
53	43.2	60	16×23×32.5	26.5	30	3 960	232 000	445 000	6 500	15 400	15 400	7.937	11	17.2

2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.

## A-5-4.2 HS Series



### (1) Features

#### 1. High motion accuracy

High motion accuracy is achieved in both narrow and wide ranges by adopting ultra-long ball slides and optimum design features for the ball recirculation component.

#### 2. Ball passage vibration reduced to one-third of our conventional models

Tests show ball passage vibration has been reduced to one-third of our conventional models, dramatically improving straightness in table unit.

#### 3. Installation of rail with greater accuracy

Increased counterbore depth of the rail mounting hole reduces rail deflection, which is caused by bolt tightening when fixing the rail to the base component, to 50% or less. This feature restrains the pitching motion of ball slide whose frequency matches to the mounting hole pitch.

In addition, the length of mounting hole pitch has been reduced by one-half of the conventional models, so the rail can be more accurately installed in position.

#### 4. High rigidity and load capacity with lower friction

High rigidity, high load capacity and low friction are achieved by increasing the number of balls.

#### 5. Compact design

Reduced body size enables more compact compact machinery.

#### 6. High load carrying capacity to vertical direction

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

#### 7. High resistance against impact load

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

resistance to the impact load.  
**8. High accuracy at manufacturing**  
 As showing in Fig. 4, fixing the measuring rollers is simple thanks to the Gothic arch groove. This makes easy and accurate measuring of ball grooves.

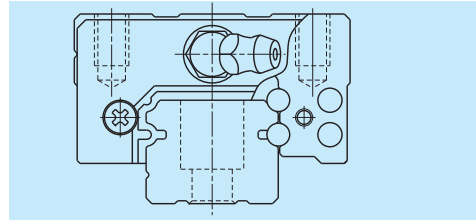


Fig. 1 HS Series

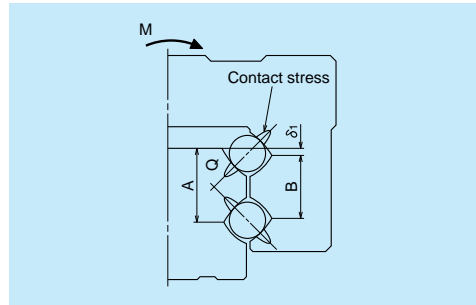


Fig. 2 Enlarged illustration: Offset Gothic arch

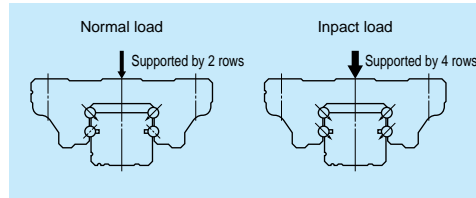


Fig. 3 When load is applied

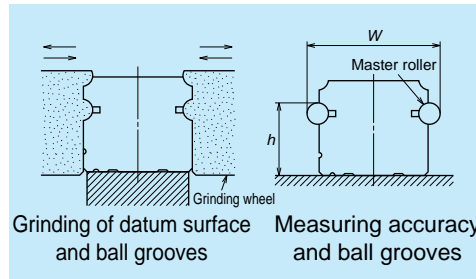


Fig. 4 Rail-grinding and measuring

### Measurement results of ball passage vibration

Ball passage vibration can translate into posture changes in the ball slide which result from ball passage (circulation). In the HS Series, this vibration has been substantially reduced to one-third of conventional models.

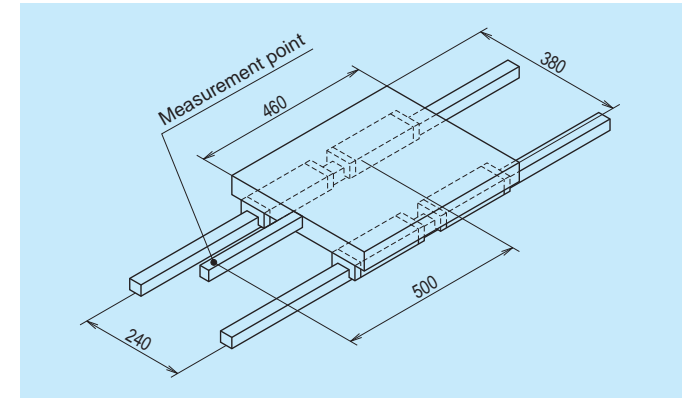


Fig. 5 Schematic view of measurement of ball passage vibration

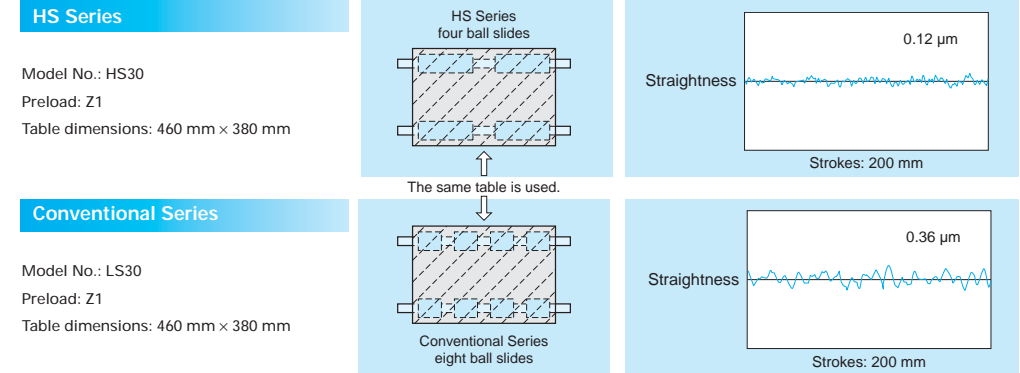


Fig. 6 Measurement results of HS Series and conventional Series



(2) Ball slide shape

Ball slide Model	Shape/installation method	Type
AL		
EM		

(3) Accuracy and preload

1. Running parallelism of ball slide

Table 1 Unit:  $\mu\text{m}$

Rail over all length (mm) over or less	Preloaded assembly		
	Ultra precision P3	Super precision P4	High precision P5
- 200	2	2	4
200 - 250	2	2.5	5
250 - 315	2	2.5	5
315 - 400	2	3	6
400 - 500	2	3	6
500 - 630	2	3.5	7
630 - 800	2	4.5	8
800 - 1 000	2.5	5	9
1 000 - 1 250	3	6	10
1 250 - 1 600	4	7	11
1 600 - 2 000	4.5	8	13
2 000 - 2 500	5	10	15
2 500 - 3 150	6	11	17
3 150 - 4 000	9	16	23

2. Accuracy Standard

Three accuracy grades are available: ultra precision P3, super precision P4 and high precision P5.

Table 2 Unit:  $\mu\text{m}$

Characteristics	Ultra precision P3	Super precision P4	High precision P5
Mounting height $H$	$\pm 10$	$\pm 10$	$\pm 20$
Variation of $H$ (All ball slides on a set of rails)	3	5	7
Mounting width $W_2$ or $W_3$	$\pm 15$	$\pm 15$	$\pm 25$
Variation of $W_2$ or $W_3$ (All ball slides on reference rail)	3	7	10
Running parallelism of face C to face A	Refer to Table 1 and Fig. 7		
Running parallelism of face D to face B	Refer to Table 1 and Fig. 7		

3. Assembled accuracy

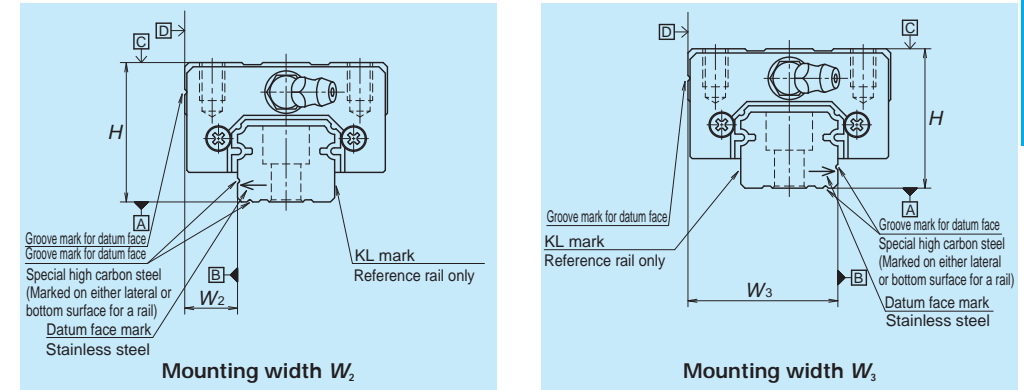


Fig. 7

4. Preload and rigidity

Slight preload Z1 and medium preload Z3 are available for preload, which can be selected for specific applications.

Table 3

Model No.	Preload (N)		Rigidity (N/ $\mu\text{m}$ )	
	Slight preload (Z1)	Medium preload (Z3)	Slight preload (Z1)	Medium preload (Z3)
HS15	98	785	260	530
HS20	147	1 030	305	600
HS25	245	1 620	385	735
HS30	390	2 550	505	965
HS35	590	3 550	610	1 140

(4) Available length of rail

Table 4 shows the limitation of rail length (maximum length). The dimension in parenthesis is for stainless. However, the limitations vary by accuracy grade.

Table 4 Unit: mm

Series	Size	15	20	25	30	35
HS		2000 (1700)	3960 (3500)	3960 (3500)	4000 (3500)	4000 (3500)

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

(5) Installation

1. Permissible values of mounting error

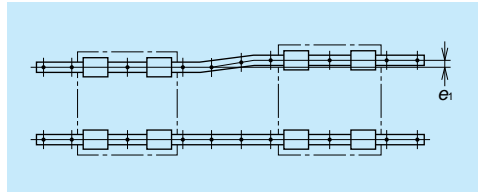


Fig. 8

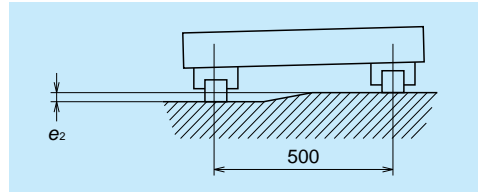


Fig. 9

Table 5

Unit:  $\mu\text{m}$

Value	Preload	Model No.				
		HS15	HS20	HS25	HS30	HS35
Permissible values of parallelism in two rails $e_1$	Z1	18	20	26	31	37
	Z3	12	14	18	22	26
Permissible values of parallelism (height) in two rails $e_2$	Z1, Z3	330 $\mu\text{m}/500 \text{ mm}$				

2. Shoulder height of the mounting face and corner radius r

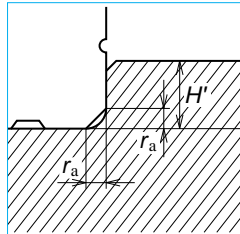


Fig. 10 Shoulder for the rail datum face

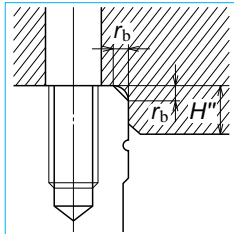


Fig. 11 Shoulder for the ball slide datum face

Table 6 Height of the shoulder and corner radius of the mounting face

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 Page A38 and D13 for linear guide lubrication.

1. Types of lubrication accessories

Figure 12 and Table 7 show grease fittings and tube fittings.

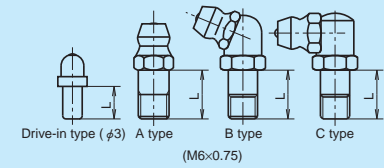
We provide lubrication accessories with extended thread body length (L) for the addition of dust proof accessories such as NSK K1 lubrication unit, double seal and protector.

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

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

Please ask NSK for stainless lubrication accessories.

Grease fitting



Tube fitting

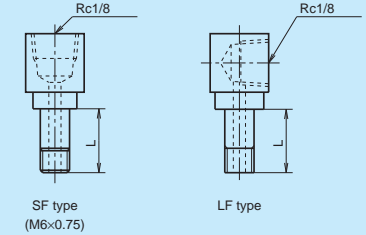


Fig. 12 Grease fitting and tube fitting

2. Mounting position of lubrication accessories

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

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

When using a piping unit with thread of M6x1, you require a connector to connect to a grease fitting mounting hole with M6 x 0.75. The connector is available from NSK.

Table 7

Unit: mm

Model No.	Dust-proof specification	Grease fitting	Tube fitting
		Drive-in Thread body length L	Thread body length L
HS15	Standard	5	-
	With NSK K1	10	-
	Double seal	*	-
	Protector	*	-
HS20	Standard	5	-
	With NSK K1	10	-
	Double seal	8	-
	Protector	8	-
HS25	Standard	5	6
	With NSK K1	12	11
	Double seal	10	9
	Protector	10	9
HS30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
HS35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11

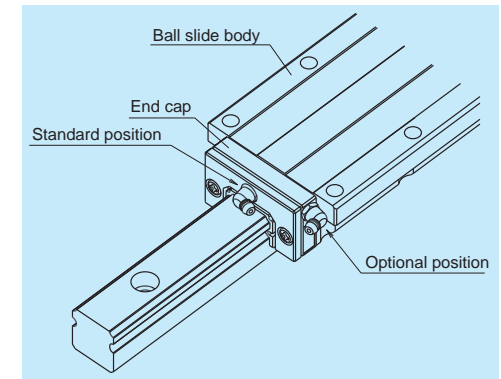


Fig. 13 Mounting position of lubrication accessories

\*) Please contact NSK as a connector is required.

**(7) Dust-proof components**

**1. Standard Specification**

To keep foreign matters from entering inside the ball slide, HS Series has an end seal on both ends.

Bottom seal is equipped on bottom as an option.

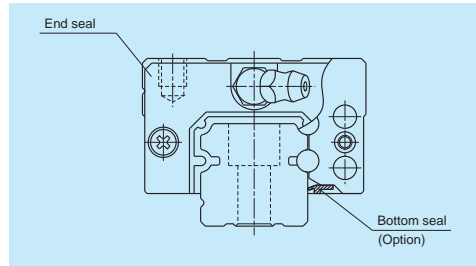


Fig. 14

Table 8 Seal friction per ball slide (maximum): end seal only

		Unit: N				
Series	Size	15	20	25	30	35
HS		3	3	3	3	4

**2. NSK K1™**

Refer to Table 9 for dimension of linear guides equipped with the NSK K1.

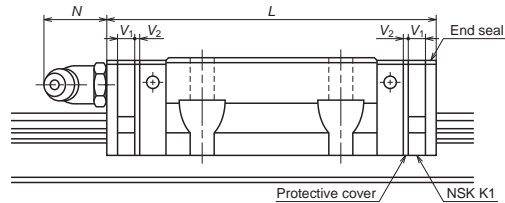


Table 9

							Unit: mm
Model No.	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V <sub>1</sub>	Protective cover thickness V <sub>2</sub>	Protruding area of the grease fitting N	
HS15	AL, EM	106	115.6	4.0	0.8	(5)	
HS20	AL, EM	119.7	130.3	4.5	0.8	(14)	
HS25	AL, EM	148	158.6	4.5	0.8	(14)	
HS30	AL, EM	176.1	188.1	5.0	1.0	(14)	
HS35	AL, EM	203.6	216.6	5.5	1.0	(14)	

Note: Ball slide length equipped with NSK K1 = (Standard ball slide length) + (Thickness of NSK K1, V<sub>1</sub> × Number of NSK K1) + (Thickness of the protective cover V<sub>2</sub> × 2)

**3. Double seal and protector**

For HS series, double seal and protector can be installed only before shipping from the factory. Please consult with NSK.

Table 10 shows the increased thickness of V<sub>1</sub>, and V<sub>2</sub> when end seal and protector are installed.

Table 10

Unit: mm		
Model No.	Thickness of end seal: V <sub>1</sub>	Thickness of protector: V <sub>2</sub>
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 cover the bolt hole for rail mounting**

Table 12 shows size of the bolts for the each model number as well as reference number of the cap.

Table 11 Caps to cover rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
HS15	M3	LG-CAP/M3	20
HS15	M4	LG-CAP/M4	20
HS20	M5	LG-CAP/M5	20
HS25, HS30	M6	LG-CAP/M6	20
HS35	M8	LG-CAP/M8	20

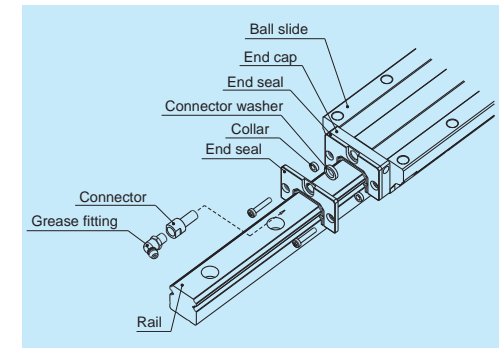


Fig. 15 Double seal

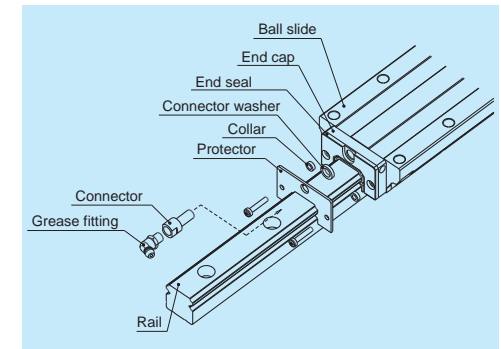


Fig. 16 Protector

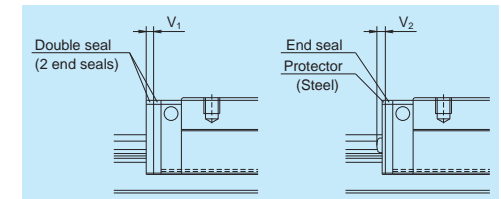
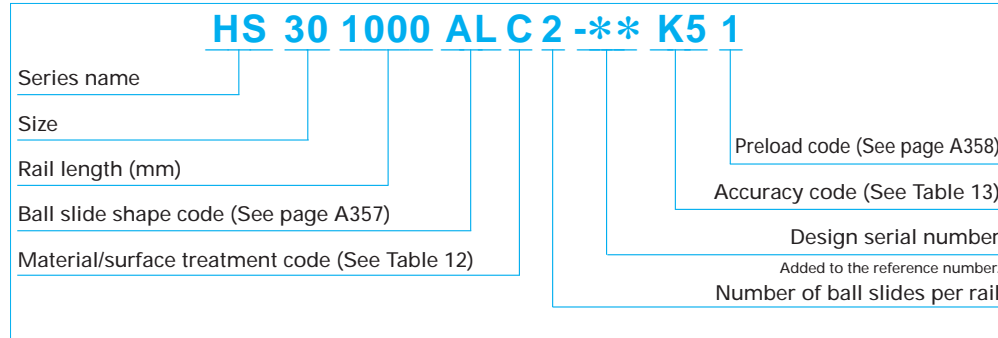


Fig. 17

**(8) Reference number**

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.

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



**Table 12 Material/surface treatment code**

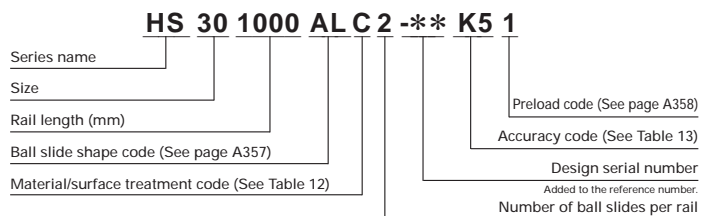
Code	Description
C	Special high carbon steel (NSK standard)
K	Stainless steel
D	Special high carbon steel with surface treatment
H	Stainless steel with surface treatment
Z	Other, special

**Table 13 Accuracy code**

Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5

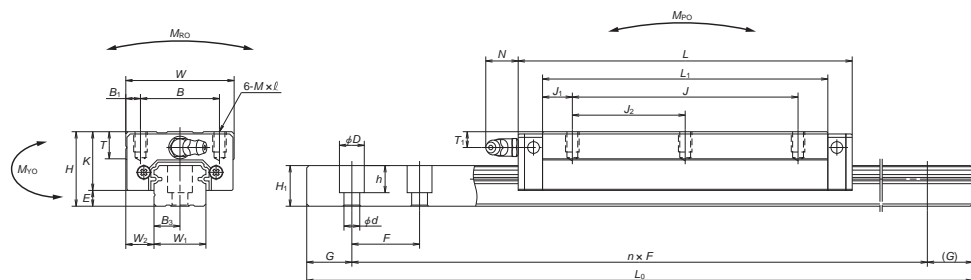
Note: Refer to Page A38 for NSK K1 lubrication unit.

(9) Dimensions



Front view of AL types

Side view of AL type



Model No.	Assembly			Ball slide													
	Height $H$	$E$	$W_2$	Width $W$	Length $L$	Mounting hole							Grease fitting				
						$B$	$J$	$J_2$	$M \times \text{pitch} \times \ell$	$B_1$	$L_1$	$J_1$	$K$	$T$	Hole size	$T_1$	$N$
HS15AL	24	4.6	9.5	34	106	26	60	30	M4×0.7×6	4	89.2	14.6	19.4	10	$\phi 3$	6	3
HS20AL	28	6	11	42	119.7	32	80	40	M5×0.8×7	5	102.5	11.25	22	12	M6×0.75	5.5	11
HS25AL	33	7	12.5	48	148	35	100	50	M6×1×9	6.5	126.4	13.2	26	12	M6×0.75	7	11
HS30AL	42	9	16	60	176.1	40	120	60	M8×1.25×12	10	150.7	15.35	33	13	M6×0.75	8	11
HS35AL	48	10.5	18	70	203.6	50	140	70	M8×1.25×12	10	175.6	17.8	37.5	14	M6×0.75	8.5	11

Remarks: 1) HS Series does not have a ball retainer. Be aware that balls fall out when the ball slider is withdrawn from the rail.  
 2) The external appearance of stainless steel ball slides differ from those of standard material ball slide.

Unit: mm

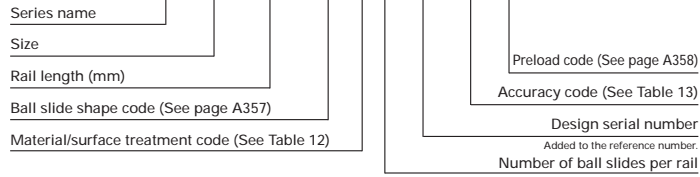
Rail							Basic load rating					Ball dia.		Weight	
Width $W_1$	Height $H_1$	Pitch $F$	Mounting Bolt hole $d \times D \times h$	$B_3$	$G$	Maximum length $L_{max}$ (1) for stainless	Dynamic $C$ (N)	Static $C_0$ (N)	Static moment			$D_w$	Ball slide (g)	Rail (kg/m)	
				(Reference)				$M_{Ro}$ (N-m)	$M_{Po}$ (N-m)	$M_{Vo}$ (N-m)					
15	12.5	30	*3.5×6×8.5 4.5×7.5×8.5	7.5	20	2 000 (1 700)	15 300	40 000	199	395	335	2.778	0.34	1.4	
20	15.5	30	6×9.5×10.5	10	20	3 960 (3 500)	20 400	52 000	350	590	495	3.175	0.52	2.3	
23	18	30	7×11×12	11.5	20	3 960 (3 500)	32 000	78 000	605	1 090	910	3.968	0.85	3.1	
28	23	40	7×11×16	14	20	4 000 (3 500)	51 500	127 000	1 190	2 120	1 780	4.762	1.7	4.8	
34	27.5	40	9×14×20	17	20	4 000 (3 500)	71 500	172 000	1 980	3 350	2 820	5.556	2.5	7.0	

3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating  $C$  to the dynamic load rating  $C_{100}$  for 100 km rating fatigue life, divide the  $C$  by 1.26.

\*) The standard rail mounting bolt hole for HS15 is specified as the hole for M3 (3.5×6×8.5). Please contact us to request a different hole for M4 (4.5×7.5×8.5).

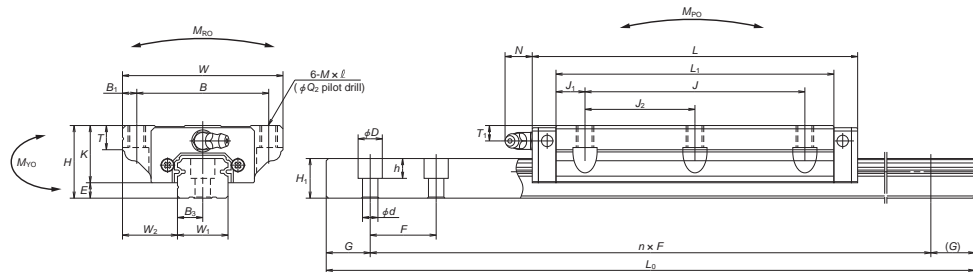
Parenthesized dimensions are applicable to stainless steel products.

**HS 30 1000 EMC 2 -\*\* K5 1**



Front view of EM type

Side view of EM type



Model No.	Assembly			Ball slide														
	Height H	E	W <sub>2</sub>	Width W	Length L	Mounting hole						Grease fitting						
						B	J	J <sub>2</sub>	M x pitch x l	Q <sub>2</sub>	B <sub>1</sub>	L <sub>1</sub>	J <sub>1</sub>	K	T	Hole size	T <sub>1</sub>	N
HS15EM	24	4.6	18.5	52	106	41	60	30	M5x0.8x7	4.4	5.5	89.2	14.6	19.4	8	φ 3	6	3
HS20EM	28	6	19.5	59	119.7	49	80	40	M6x1x9 (M6x1x9.5)	5.3	5	102.5	11.25	22	10	M6x0.75	5.5	11
HS25EM	33	7	25	73	148	60	100	50	M8x1.25x10 (M8x1.25x11.5)	6.8	6.5	126.4	13.2	26	11 (12)	M6x0.75	7	11
HS30EM	42	9	31	90	176.1	72	120	60	M10x1.5x12 (M10x1.5x14.5)	8.6	9	150.7	15.35	33	11 (15)	M6x0.75	8	11
HS35EM	48	10.5	33	100	203.6	82	140	70	M10x1.5x13 (M10x1.5x14.5)	8.6	9	175.6	17.8	37.5	12 (15)	M6x0.75	8.5	11

Remarks: 1) HS Series does not have a ball retainer. Be aware that balls fall out when the ball slider is withdrawn from the rail.  
 2) The external appearance of stainless steel ball slides differ from those of standard material ball slide.  
 3) Parenthesized dimensions are applicable to stainless steel products.

Unit: mm

Rail							Basic load rating					Ball dia.	Weight	
Width W <sub>1</sub>	Height H <sub>1</sub>	Pitch F	Mounting Bolt hole d x D x h	B <sub>3</sub>	G	Maximum length L <sub>0max</sub> (1) for stainless	Dynamic C (N)	Static C <sub>0</sub> (N)	Static moment			D <sub>w</sub>	Ball slide (kg)	Rail (kg/m)
									M <sub>Ro</sub> (N·m)	M <sub>po</sub> (N·m)	M <sub>vo</sub> (N·m)			
15	12.5	30	*3.5x6x8.5 4.5x7.5x8.5	7.5	20	2 000 (1 700)	15 300	40 000	199	395	335	2.778	0.45	1.4
20	15.5	30	6x9.5x10.5	10	20	3 960 (3 500)	20 400	52 000	350	590	495	3.175	0.67	2.3
23	18	30	7x11x12	11.5	20	3 960 (3 500)	32 000	78 000	605	1 090	910	3.968	1.3	3.1
28	23	40	7x11x16	14	20	4 000 (3 500)	51 500	127 000	1 190	2 120	1 780	4.762	2.4	4.8
34	27.5	40	9x14x20	17	20	4 000 (3 500)	71 500	172 000	1 980	3 350	2 820	5.556	3.4	7.0

4) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C<sub>100</sub> for 100 km rating fatigue life, divide the C by 1.26.  
 \*) The standard rail mounting bolt hole for HS15 is specified as the hole for M3 (3.5x6x8.5). Please contact us to request a different hole for M4 (4.5x7.5x8.5).  
 Parenthesized dimensions are applicable to stainless steel products.

# A-6 Other Linear Rolling Guide Products

## A-6-1 Linear Rolling Bushing

### (1) Features

#### 1. Low friction

Low friction owes to its design: Balls come into point contacts with raceway surface: the balls smoothly re-circulate. There is very little stick slip.

#### 2. Low noise

Noise level is low due to the ball retainer which is made of a synthetic resin.

#### 3. High precision

Due to NSK's superb quality control, precision is guaranteed.

#### 4. Dust prevention

Series with seal is available. The seal has small friction, and is highly durable. Highly dust-preventive double-lip system has been adopted.

#### 5. Superb durability

The material of outer sleeve is vacuum degassed, highly pure, and is heat-treated with good expertise.

#### 2. Adjustable clearance type LB-T (Fig. 2)

A part of the outer sleeve is cut open toward the axial direction. Used with a housing which can adjust inside diameter, it makes minute adjustment of the clearance between the linear shaft and the inscribed circle (an imaginary circle that connects the summit of the ball) of linear rolling bushing.



Fig. 2 Adjustable Clearance type LB-T

#### 3. Open type LB-K (Fig. 3)

A cut is made in the outer sleeve and retainer, to a width equivalent to one row of the retainer, to the axial direction. The opening is used to hold this linear rolling bushing by a support or base to prevent a long linear shaft from bending.



Fig. 3 Open type LB-K

### (2) Models

There are three models

#### 1. Standard type LB (Fig. 1)

This model is the most commonly used, and is the only model that comes with a seal and in super precision grade.



Fig. 1 Standard type LB

### (3) Accuracy

#### 1. Accuracy grades

- Standard type LB.....High precision grade S, and super precision grade SP are available.
- Space adjustment type LB-T.....
- Open type LB-K..... } 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 <sup>(1)</sup>				Tolerance/width B		Tolerance/slot distance of retaining rings Bn		Recommended tolerance/ shaft diameter			
		High precision grade S		Super high precision grade SP		High precision grade S Super high precision grade SP	High precision grade S Super high precision grade SP	High precision grade S Super high precision grade SP	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									-6	-14	-4	-9
6	10	0	-8	0	-5					-6	-15	-4	-10
10	18					0	-120	+240	-240	-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 <sup>(1)</sup>				ccentricity <sup>(2)</sup>	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						+12	0	+8	0
6	10	0	-10	0	-7	8	+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

Note: 1) For adjustable clearance type and open type, figures indicate tolerances before the cut is made.

2) Eccentricity means the run-out of offset between the centers of outer sleeve diameter and inscribed circle diameter.

### (4) Composition of Reference Number

Example **LB 35 N K Y S**

Linear rolling bushing	<b>L</b>	<b>B</b>						No code..... No seal
Nominal inscribed circle diameter (linear shaft nominal diameter)			<b>35</b>					D..... Single-side seal
N..... With retaining ring groove				<b>N</b>				DD..... Double-side seal
No code..... Without retaining ring groove					<b>K</b>			Accuracy grade
No code..... Standard type LB						<b>Y</b>		S..... High precision grade
T..... Adjustable clearance type LB-T							<b>S</b>	SP..... Super precision grade
K..... Open type LB-K								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 greases with consistency level of 2 are generally used (e.g. NSK Grease LR3, PS2, and AS2).

② Replenishment

- Sealed linear rolling bushing is designed to be a disposal item. Therefore, a replenishing grease is considered to be not required. However, if replenishment becomes necessary due to dirty environment or wear of the seal, remove the linear bushing from the shaft and replenish lubricant in the same manner as the initial lubricating.
- For items without seal, wipe off old grease from the linear shaft, and apply new grease.
- Intervals of replenishments are every 100 km in a dirty environment, 500 km in a slightly dirty environment, 1000 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.

Fig. 4 indicates dynamic friction coefficient is merely 0.001-0.004. Also, at the speed of under 60 m/min, there is no danger of the temperature rising.

Friction force can be obtained by the following formula.

$$F = \mu \cdot P \dots\dots\dots (1)$$

In this formula:

- F : Friction force (N)
- P : Load (vertical load to the shaft center line) (N)
- $\mu$  : Friction coefficient (dynamic or static)

For a seal type, a seal resistance of 0.3 to 2.40 N is added to the above.

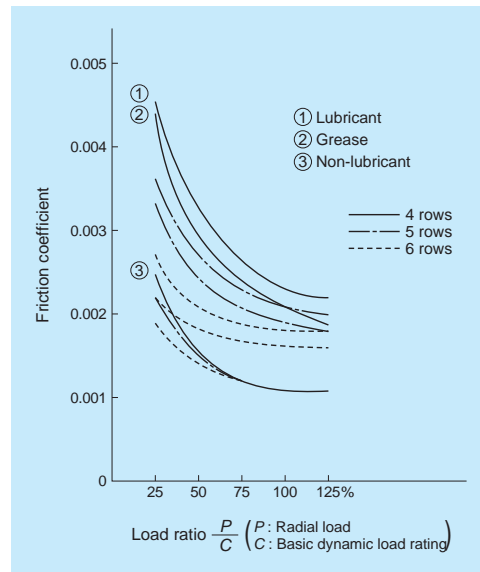


Fig. 4 Dynamic friction coefficient of linear rolling bushing

(6) Range of Conditions to Use

Generally, use under the following conditions.

Please consult NSK when values exceed the ranges given below.

Temperature.....Minus 30°C to plus 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  $\mu$ m. 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<sub>n</sub>*, when load is not 0.1 C, is obtained by the following formula.

$$K_n = K (P/0.1C)^{1/3} \dots\dots\dots (2)$$

In this formula:

- K : Rigidity value in the dimension table (N/ $\mu$ m)
- 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.

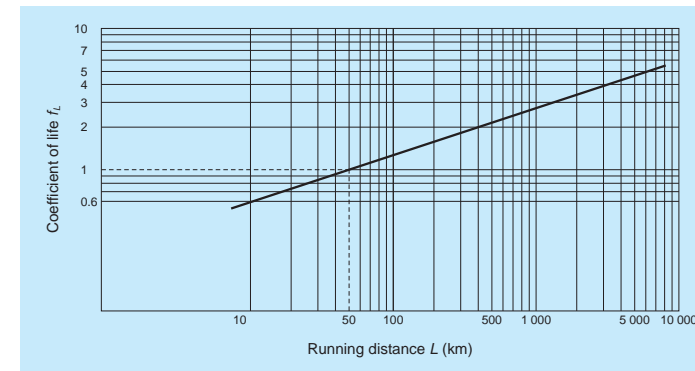


Fig. 5 Relationship between life factor and running distance

(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

$$L = 50 f_L^3 \dots\dots\dots (3)$$

$$f_L = C/P \dots\dots\dots (4)$$

In this formula:

- L : Rated life (km)
- P : Radial load (N)
- f<sub>L</sub>* : Life factor (Refer to Fig. 5)

This formula is used provided that the shaft hardness is HRC58 or higher. Rated life is shorter if the shaft is softer. In this case, find the hardness factor *f<sub>H</sub>* from Fig. 6, and multiply the value.

$$f_L = C \cdot f_H/P \dots\dots\dots (5)$$

Or

$$C = P \cdot f_L/f_H \dots\dots\dots (6)$$

Life in time can be obtained by the following formula, substituting for given stroke length, cycle numbers, and running distance:

$$L_h = (L/1.2 \cdot S \cdot n) \times 10^4 \dots\dots\dots (7)$$

In this formula:

- L<sub>h</sub> : Life hours (h)
- L : Rated life (km)
- S : Stroke (mm)
- n : Cycles per minute (cpm)

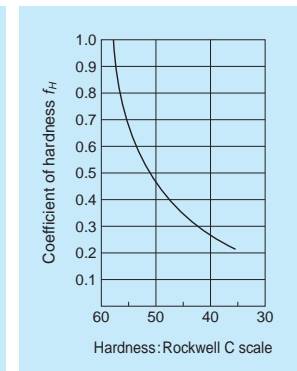


Fig. 6 Hardness factor



## 2. Basic static load rating

It is a load that the total permanent deformation of outer sleeve, ball and shaft, at the contact point, becomes 0.01% of the ball diameter when this load is applied to the rolling bushing. It is understood in general that this is the applicable load limit which causes this much permanent deformation, without hampering operation.

## 3. Calculation example

What is the appropriate rolling bushing size if required life is 5000 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. 5 and Fig. 6,

Life factor  $f_L = 5.6$

Hardness factor  $f_H = 0.65$

Therefore, from Formula (6),

$$C = P \times f_L / f_H \\ = 150 \times 5.6 / 0.65 = 1292 \text{ (N)}$$

Based on the above, select linear rolling bushing LB30NY with shaft diameter of 30 mm, basic dynamic load rating of 1400 N.

## 4. Compensating load rating by ball row position

Load rating of the linear rolling bushing changes by the position of the ball circuit rows.

Permissible load is larger when it is applied to the middle of the ball circuit rows than when it is applied directly above the ball row (Fig. 7).

(Radial clearance set at zero in this case.)

Load ratings in the dimension table are in case "A" when it is applied directly above the ball circuit row. If used as in case "B," the load rating becomes larger (Refer to Fig. 7).

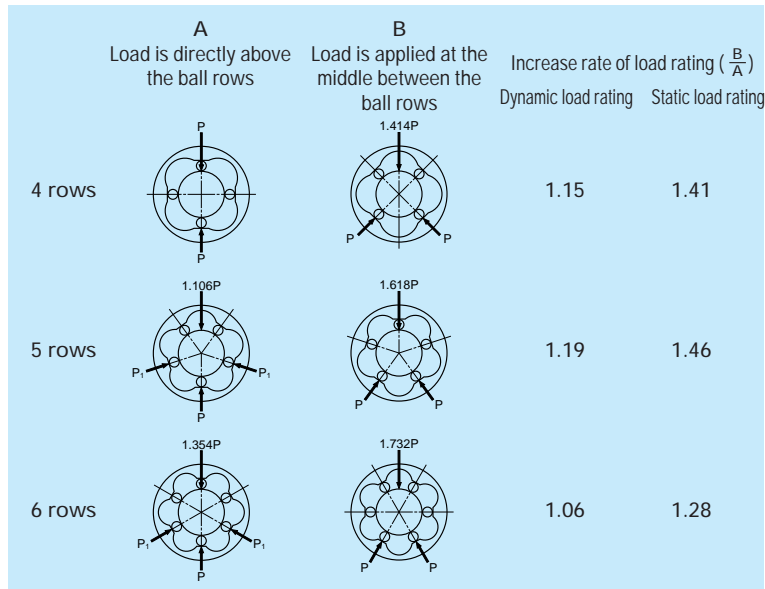


Fig. 7 Increasing rate of load rating by position of ball row (B/A)

## (9) Shaft Specification

Harden the shaft surface, where the balls run, with heat treatment to provide the following values.

- Surface hardness.....HRC58 or over
- Depth of core hardness at HRC50 or higher
  - Depth for LB3 ; 0.3 mm or deeper
  - Depth for LB50 ; 1.2 mm or deeper

Roughness of the surface should be:

- For SP grade, and "the clearance for fit" with the ball bushing less than  $5 \mu\text{m}$  - Less than 0.8 S
- For SP grade with "the clearance" of more than  $5 \mu\text{m}$ , and for S grade - Less than 1.2 S

Bending should be:

- LB3 --  $15 \mu\text{m}/100 \text{ mm}$
- LB50 --  $100 \mu\text{m}/1000 \text{ mm}$

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 in Page A366). For operations which require particular accuracy, select the shaft diameter which creates a clearance in the range of 0 to 0.005 (mm) for example, when assembled with the rolling bushing.

## (10) Dust Proof

Select a linear rolling bushing with seals to prevent moisture or foreign matters, which are floating in the air, from entering.

## (11) Installation

### 1. Combination of shaft and linear rolling bushing

When the linear rolling bushing is installed in a linear motion table for its reciprocating movement, it is necessary to prevent the table from rotating. In general, for this reason, two shafts, installed with two linear rolling bushings on each, are used. Fig. 8 is an installation example.

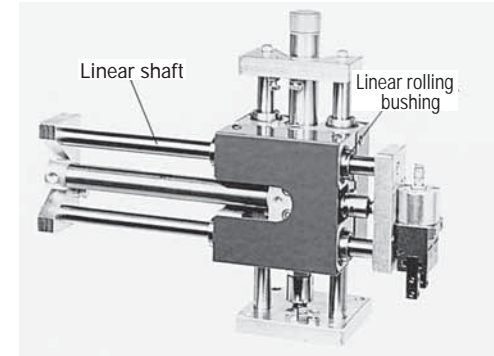


Fig. 8 Installation example

## 2. Installation of linear rolling bushing

### ① Standard type installation

Fig. 9 shows a method using a retaining ring. Linear rolling bushing can also be secured to the housing using a stop plate and/or screw.

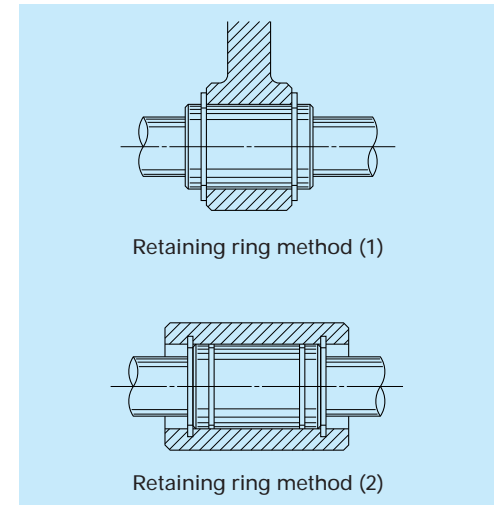


Fig. 9 Installation using retaining rings

- Ⓐ Housing inside diameter should be of a recommended value (Table 2, Page A366). The entire rolling bushing contracts and gives excessive preload if: the inside diameter is small ; the roundness or cylindricity is excessive. This may result in an unexpected failure.
- Ⓑ To install linear rolling bushing, use a tool (Fig. 10) and squeeze it in, or use a holder and lightly pound it.

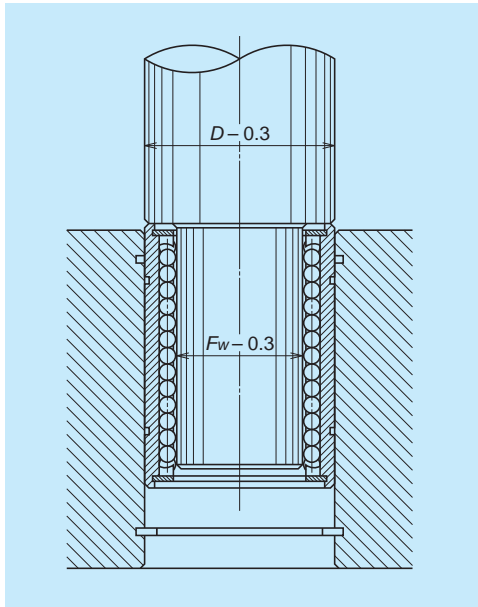


Fig. 10 Tool to install a linear rolling bushing

③ Installation of open type

Use with clearance or with light preload.  
 Keep the tolerance in shaft diameter within the recommended range (Refer to Table 1 in Page A366), so the preload shall not become excessive.  
 (Unlike the adjustable clearance type, clearance cannot be narrowed by rotating the shaft because the state of shaft rotation does not indicate how narrow the space has become. Narrowing clearance requires caution for open type.)

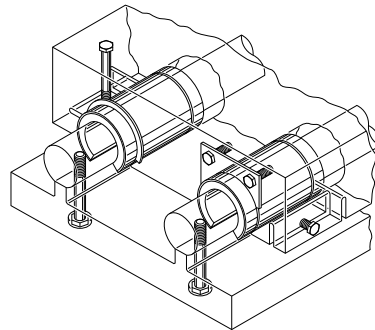


Fig. 11 Installation example of an open type

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 in Page A366). 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.

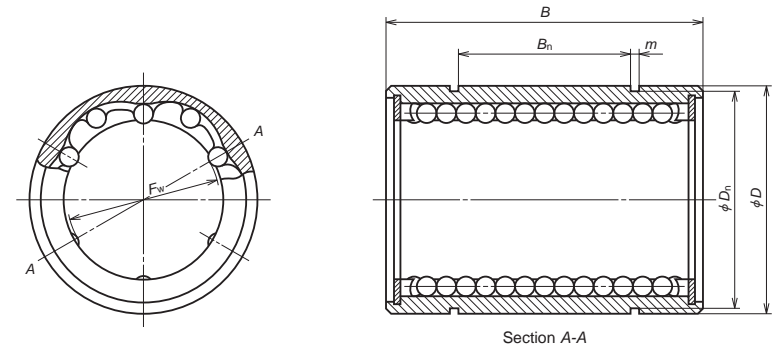
First, loosen the housing until shaft turns freely. Then narrow the clearance gradually. Stop at the point when the shaft rotation becomes heavy. This creates a clearance zero or light preload.

3. Precaution for installing a shaft in the linear rolling bushing

- a) 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.
- b) 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.
- c) Do not use the shaft for rotating movement after the shaft is in the linear rolling bushing. The balls slip and damage the shaft.
- d) Do not twist the shaft after it is in the linear rolling bushing. The pressure scars the shaft.

(12) Dimension tables

Model LB (standard type), no seal



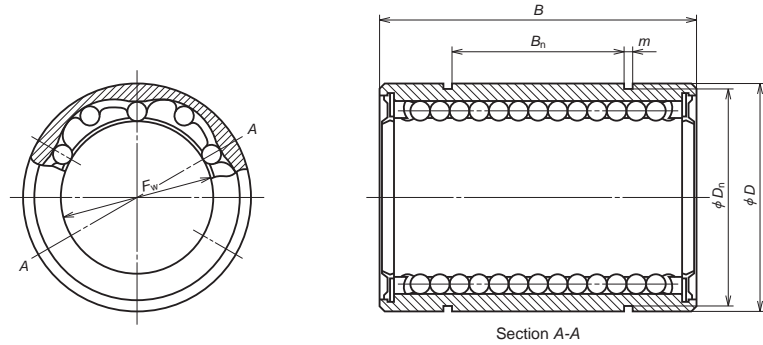
Unit: mm

Model No.	Inscribed circle diameter $F_w$	Outside diameter $D$	Length $B$	Retaining ring groove			Stiffness <sup>(1)</sup> (N/μm)	Number of ball circuit	Weight (kg) (Reference only)	Basic dynamic load rating $C$ (N)	Basic static load rating $C_0$ (N)
				Distance $B_n$	Width $m$	Bottom diameter $D_n$					
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
<sup>(2)</sup> LB8ANY	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	1010
LB25NY	25	40	59	37	1.9	38	35	6	0.267	1000	1960
LB30NY	30	45	64	40	1.9	42.5	41	6	0.305	1400	2500
LB35NY	35	52	70	45	2.2	49	48	6	0.440	1510	2800
LB40NY	40	60	80	56	2.2	57	54	6	0.520	2230	4000
LB50NY	50	80	100	68	2.7	76.5	69	6	1.770	4100	7100

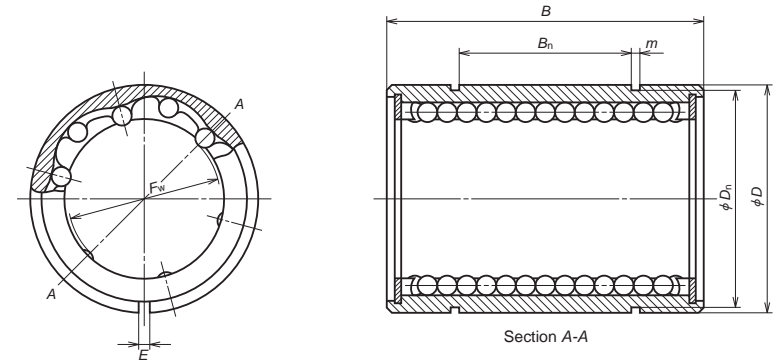
Note (1): Refer to Section (7).

(2): Semi-standard item of which length B is shorter than standard.

Model LB (standard type), with seal



Model LB-T (Adjustable clearance type)



Unit: mm

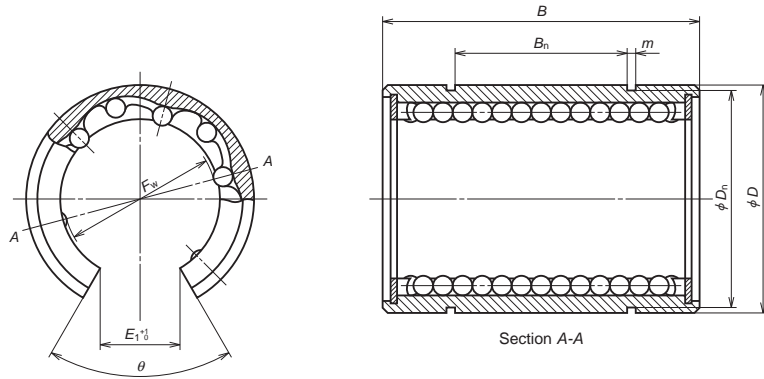
Model No.	Inscribed circle diameter $F_w$	Outside diameter $D$	Length $B$	Retaining ring groove			Number of ball circuit	Weight (kg) (Reference only)	Basic dynamic load rating $C$ (N)	Basic static load rating $C_0$ (N)
				Distance $B_n$	Width $m$	Bottom diameter $D_n$				
LB6NYDD	6	12	19	11	1.15	11.5	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	1010
LB25NYDD	25	40	59	37	1.9	38	6	0.267	1000	1960
LB30NYDD	30	45	64	40	1.9	42.5	6	0.305	1400	2500
LB35NYDD	35	52	70	45	2.2	49	6	0.440	1510	2800
LB40NYDD	40	60	80	56	2.2	57	6	0.520	2230	4000
LB50NYDD	50	80	100	68	2.7	76.5	6	1.770	4100	7100

Unit: mm

Model No.	Inscribed circle diameter $F_w$	Outside diameter $D$	Length $B$	Opening width $E$	Retaining ring groove			Number of ball circuit	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	1010
LB25NTY	25	40	59	2	37	1.9	38	6	0.265	1000	1960
LB30NTY	30	45	64	2	40	1.9	42.5	6	0.302	1400	2500
LB35NTY	35	52	70	3	45	2.2	49	6	0.44	1510	2800
LB40NTY	40	60	80	3	56	2.2	57	6	0.52	2230	4000
LB50NTY	50	80	100	3	68	2.7	76.5	6	1.75	4100	7100

Note (1) Single-seal type is indicated as LB-D.

Model LB-K (Open type)



Unit: mm

Model No.	Inscribed circle diameter $F_w$	Outside diameter $D$	Length $B$	Opening width $E_1$	Opening angle $\theta$	Retaining ring groove			Number of ball circuit	Weight (kg) (Reference only)	Basic dynamic load rating $C$ (N)	Basic static load rating $C_0$ (N)
						Distance	Width	Bottom diameter $D_n$				
LB20NKY	20	32	42	11	60°	27	1.65	30.3	4	0.072	610	1010
LB25NKY	25	40	59	13	50°	37	1.9	38	5	0.220	1000	1960
LB30NKY	30	45	64	15	50°	40	1.9	42.5	5	0.260	1400	2500
LB35NKY	35	52	70	17	50°	45	2.2	49	5	0.370	1510	2800
LB40NKY	40	60	80	20	50°	56	2.2	57	5	0.440	2230	4000
LB50NKY	50	80	100	25	50°	68	2.7	76.5	5	1.480	4100	7100

A-6-2 Crossed Roller Guide

(1) Structure

Rollers with a retainer (hereinafter referred to as "retainer") are assembled in a pair of rails which have a V-shape groove. ( the grooves form a 90-degree angle. Refer to Fig. 1, 2). Rollers are placed crisscrossed, and are able to support load in all directions, including moment loads.

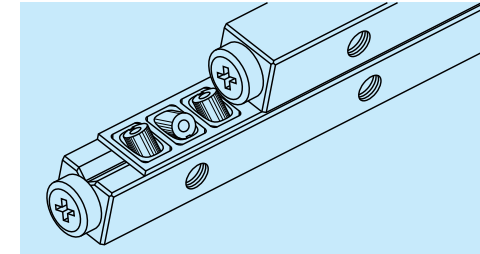


Fig. 1 Structure of crossed roller guide

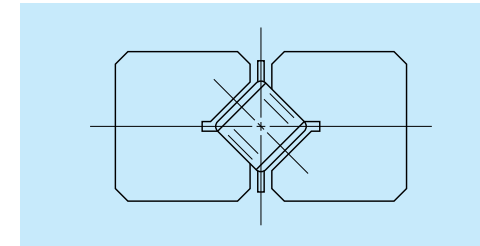


Fig. 2 Cross section of a crossed roller guide

(2) Features

- 1. High rigidity**  
This is attributable to the long contact area between the rollers and their accurately ground rolling surface.
- 2. Superbly smooth movement, low noise**  
The window which directly embraces the roller is made of plastic for smooth and quiet operation, lowering clatter when the retainer and the rollers come into contact.
- 3. Less micro-slip**  
Occasionally, a minute continuous slippage of the retainer to one direction, called "micro-slip," is caused due to installation error of the rail. After years of testing and research, NSK has developed technology to minimize this.
- 4. Easy installation**  
Installation is easy because the rail bending is

minimal, and the bolt hole pitch for installation is precise.

5. Long durability

The material is vacuum-degassed and highly pure, and is hardened by carburized heat treatment for superb resistance to wear and fatigue.

(3) Accuracy

Accuracy grade P5 super precision and high precision grade P6 are available.

Fig. 3 shows parallelism of the roller's rolling surface to the mounting datum face.

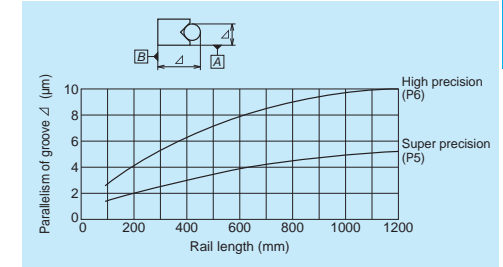


Fig. 3 Parallelism of the roller rolling surface

(4) Rigidity

The number of the load rollers changes by the direction of the load. This is because the rollers are positioned crisscross.

That is, in case of Fig. 4:

The number of load rollers =  $1/2 \times$  total roller number .....(1)

In case of Fig. 5:

The number of load rollers = Total roller number .....(2)

Fig. 6 shows changes in elastic deformation when there are 20 load rollers. If the total number of rollers is other than 20, use the graph in Fig. 7. Obtain the compensation factor which converts the elastic deformation value at time of 20 load rollers into the value when a specific number of rollers are loaded. That is, obtain a compensation factor on the ordinate that correspond to the number of load rollers on the abscissa. Then, multiply this factor by the elastic deformation value (on ordinates) which corresponds to the load (on abscissa) shown in Fig. 6.

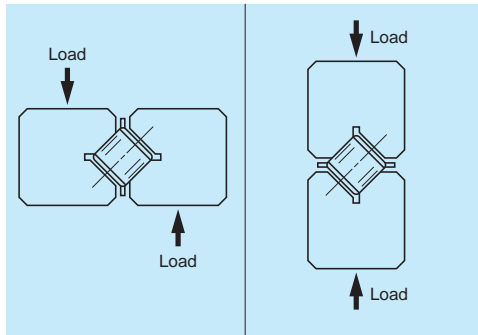


Fig. 4

Fig. 5

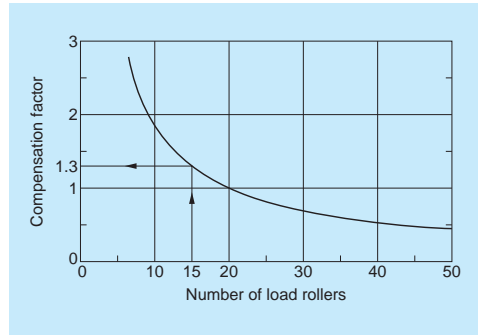


Fig. 7 Compensation factor to obtain elastic deformation

[ Calculation example: Elastic deformation ]

A retainer which contains 30 rollers (roller diameter 6 mm) is installed on both right and left side (Fig. 8). How large is the elastic deformation of the crossed roller guide when a load of 4 kN is applied to the table center?

[Answer]

A load of 2 kN is applied to each side of the crossed roller guide. The elastic deformation value on the ordinate which corresponds to the load 2 kN on the abscissa (in Fig. 6) is:

4.5 μm

This application of load is the same as in Fig. 4. Therefore, the number of load rollers is one-half of 30, or 15. From Fig. 7, the compensation factor on the ordinate which corresponds to 15 rollers on abscissa is:

1.3

Multiply 1.3 by 4.5 μm obtained above. The answer is:

$$4.5 \times 1.3 \doteq 6 \mu\text{m}$$

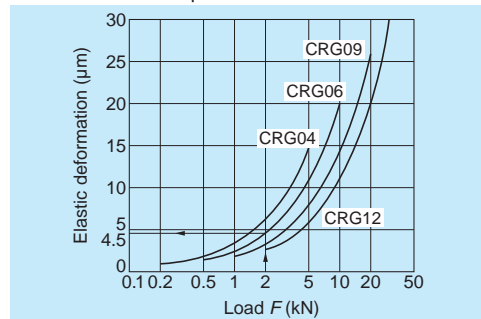


Fig. 6 Elastic deformation with 20 rollers

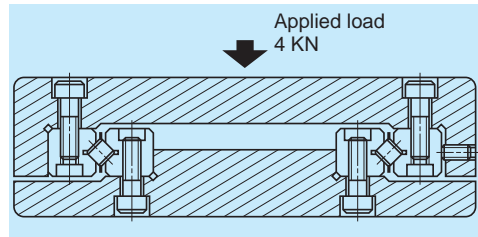


Fig. 8 Example calculation of elastic deformation (illustration)

(5) Friction Force

If installation and lubrication are appropriate, the starting friction coefficient is markedly small as shown below:

$$\mu = 0.005$$

(6) Lengths of Rail and Retainer

The relationship of rail length L with stroke S is as follows:

$$\text{When } S \leq 400 \text{ mm, } L \geq 1.5S \dots\dots\dots (3)$$

$$\text{When } S > 400 \text{ mm, } L \geq S \dots\dots\dots (4)$$

Since the retainer travels a distance of half of the stroke, the retainer length K is:

$$K < L - \frac{S}{2} \dots\dots\dots (5)$$

The retainer does not detach from the rail when condition in Formula (5) is satisfied (Refer to Fig. 9).

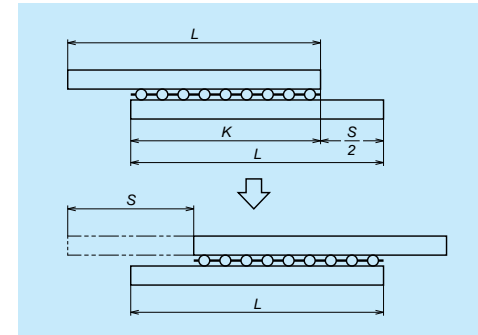


Fig. 9 Relationship of rail and retainer

(7) Lubrication and Dust Proof

For grease lubrication, lithium soap based greases of consistency 1 or 2 are used.

For example: NSK Grease LR 3,  
NSK Grease PS 2,  
NSK Grease AS 2

For oil lubrication, JIS viscosity 32 to 150 is recommended.

When necessary, install a bellows on the rail, or install a seal on the side of the rail to arrest foreign matters and dust as shown in Fig. 10.

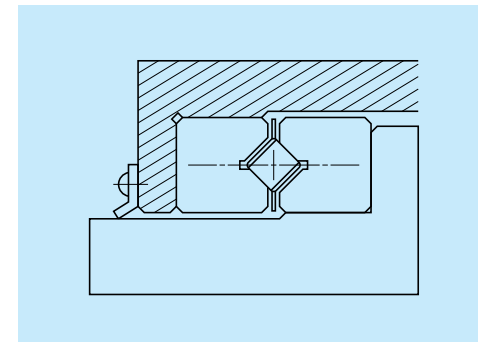


Fig. 10 Dust prevention (example)

(8) Installation

Fig. 11 shows the standard installation procedures.

- ① Secure Rail 1 and 2 to the bed using the fixing bolts. Secure Rail 3 to the table with the bolts. Temporarily secure Rail 4 and loosen the side bolt.
- ② Match the Machine base and the table. Insert the retainer in the roller space. At this time, measure the distance from the rail end to the retainer end with a depth gauge to determine its position. If the roller space is too narrow and the retainer does not go inside, slide Rail 4 toward the side bolt, then insert the retainer.
- ③ Follow the reading of dial gauge which is previously set, and squeeze in all side bolts until they stop rattling. Do not apply excessive force. When the side bolts are tightened, the rollers should be in the vicinity of the bolt position. Then, secure Rail 4 with the fixing bolts. Finally, install a stopper to the rail end.

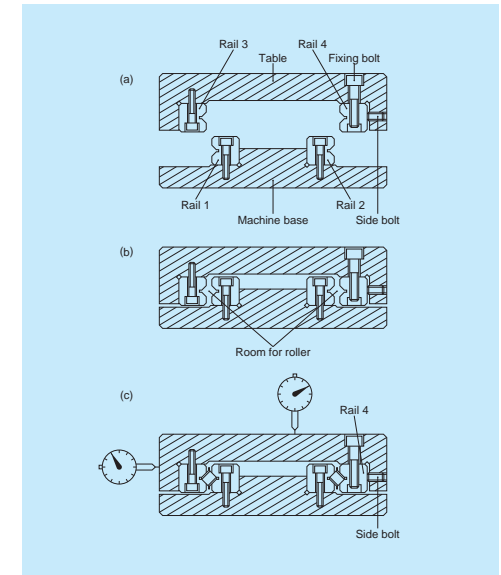


Fig. 11 Standard installation procedures

**[Regarding preload]**

As crossed roller guide has higher rigidity than other linear rolling guides, it does not need preload. It is also difficult to apply preload accurately. Crossed roller guide is usually used without clearance. For highly accurate applications, it is desirable to press the crossed roller guide by means of a bolt over the gib as shown in Fig. 12.

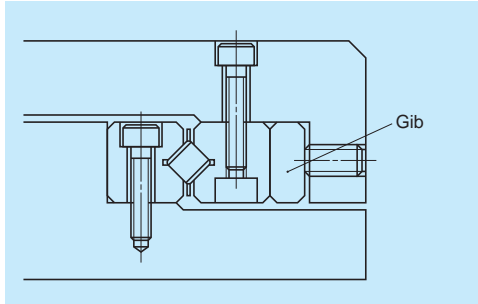


Fig. 12 Tightening using a gib

Therefore,  $C_{15}$  is obtained from the following formula. Rated life (km) is shown in the formula below. In this formula:

$$L = 50 \left( \frac{C_n}{f_w \cdot F_c} \right)^{\frac{10}{3}} \dots\dots\dots(7)$$

$f_w$ : Load factor. 1.0 to 1.2 under smooth operation

$F_c$ : Computed load which applies to the guide (kN)

Please refer to NSK Linear Guide Technical Description for details.

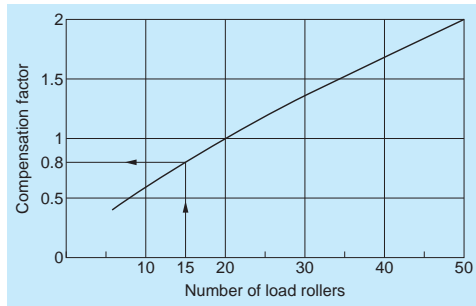


Fig. 13 Compensation factor for basic dynamic load rating

**(9) Basic Static Load Rating**

Basic static load rating becomes larger in proportion to the number of the load rollers "n." Obtain basic static load rating per roller  $C_{01}$ . Then the basic static load rating  $C_{0n}$  when the numbers of rollers is n can be obtained as follows.

$$C_{0n} = n \times C_{01} \dots\dots\dots(6)$$

Values of  $C_{01}$  are shown in the dimension table.

**(10) Basic Dynamic Load Rating and Rated Life**

Basic static load rating is based on a rated traveled distance of 50 km. The dimension table shows the value with 20 load rollers. When the number of load rollers is other than 20, a basic dynamic load rating  $C_n$  can be obtained by multiplying a compensation factor (obtained from Fig. 13.) by C in the dimension table.

(Suffix 'n' is to refer the number of load rollers.)

As an example; Number of load rollers: n = 15.

The compensation factor from Fig. 13 is 0.8.

$$C_{15} = 0.8 \times C$$

**(11) Reference Number and Standard Set for "One-Axis"**

Specifications are indicated as a reference number as shown below.

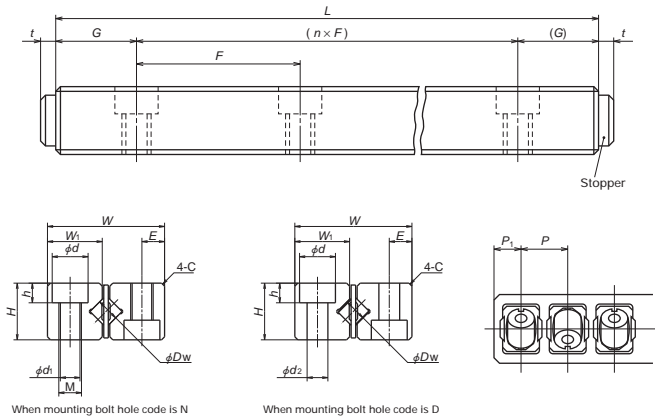
<b>CRG06-380 A P5 N</b>			
Model number	CRG06-380	A	P5 N
Rail length (mm)	380	A	P5 N
Shape of the rail cross section Standard: A    Semi-standard: T	A	P5 N	
		Holes for mounting	Tap hole: N Drill hole: D
		Accuracy grade	P5... Super precision grade P6... High precision grade

**Note (1)** : Semi-standard T, a shape of rail cross section, is available only for CRG04. It is lower in H dimension, and wider in W dimension compared with A.

**Remarks** : Standard set for "one axis" of the guide refers to 4 rails and 2 retainers which usually comprise the guide way for a one axis.

(12) Dimension Table

Crossed roller guide: Model CRG



Model No.	$D_w$	$W$	$H$	$w$	$C$	$E$	$d$	$h$	$d_1$	$d_2$	$M$	$G$	$F$	$t$	$P$	$P_1$	Dynamic load rating $C$ when rollers are 20 (N)	Static load rating $C_{01}$ when roller is one (N)	L	
																			Max length	Saper high precision P5 P6
CRG04...A	4	24	12	11.3	0.5	5	8	4.2	4.3	5	M 5x0.8	20	40	2.3	6.5	3.8	9800	665	200	300
CRG04...T	4	26	10	12.3	0.5	5	8	4.2	4.3	5	M 5x0.8	12/15	38/40	2.3	6.5	3.8	9800	665	200	300
CRG06...A	6	31	15	14.5	0.8	6	9.5	5.2	5.2	5.5	M 6x1	25	50	3.2	9.5	5.8	26700	1510	400	600
CRG09...A	9	44	22	20.7	1	9	11	6.2	6.8	7	M 8x1.25	50	100	4	14	8	72500	3400	600	900
CRG12...A	12	58	28	27.6	1.5	12	14	8.2	8.5	9	M 10x1.5	50	100	5	20	12	130000	6050	900	1200

Remarks: The area which embraces the roller is plastic for the standard retainer. A solid type made of steel plate is available for high temperature resistance.

A-6-3 Roller Pack

(1) Structure

A roller pack comprises a main body which supports load from the guide way block via two rows of rollers; an end cap which changes the direction of the recirculation of rollers at the end of the main body; a side plate which guides the rollers. (Fig. 1). Roller pack is one of the linear rolling guides, where rollers are allowed to re-circulate infinitely.

There is a plate spring attached to a side of roller pack to prevent roller pack from falling out when it is turned upside down after assembly.

Other component of the roller pack is spring pin. Spring pin is on the top surface of the roller pack, and makes installation of wedge block and fitting plate easier.

Wedge block is a unit to provide preload (Fig. 3) to roller pack; a fitting plate (Fig. 2), functioning like a pivot, adjusts misalignment of roller pack automatically. Wedge of wedge block moves up and down, to apply preload, by turning the adjust screw.



Photo 1 Roller pack

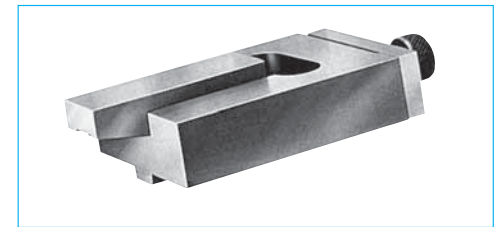


Photo 2 Wedge block

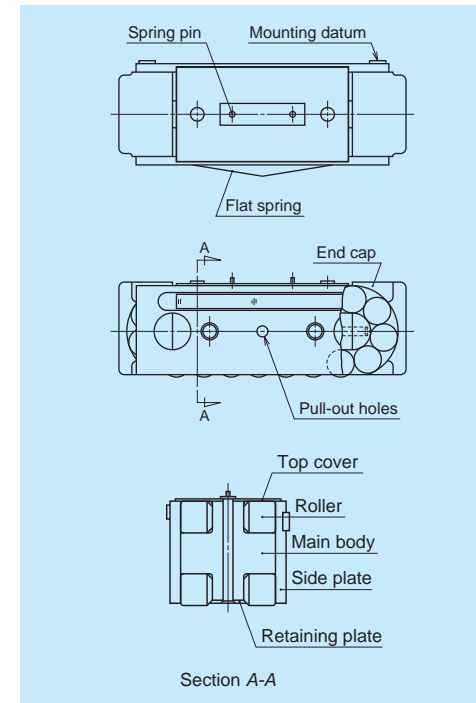


Fig. 1 Roller pack

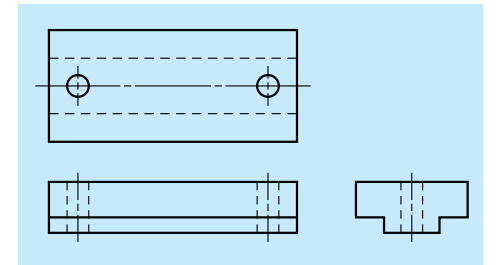


Fig. 2 Fitting plate

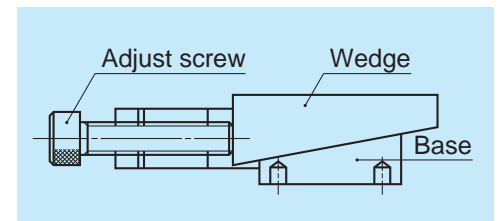


Fig. 3 Wedge block

**(2) Features**

Roller pack has two remarkable characteristics other linear roller guide bearings do not have.

① **No roller skewing**

If the roller is long relative to its diameter, the roller inclines during operation. This phenomenon is called skewing. Skewing causes problems such as sudden rise in friction force. However, a short roller lacks large load carrying capacity. The roller introduced here solved the skewing problem, yet has a large load carrying capacity: short rollers are combined into double rows.

② **Load is applied equally.**

This is due to a "fitting plate," a result of "changed way of conceiving." Installation is quite easy: Merely place the fitting plate through the two holes to spring pins. The stop pins are inserted to holes on the top surface of the roller pack. The contact area between the fitting plate and the main body is made small. This way, the self-alignment is automatically accomplished by elastic contact of both parts.

This distributes an equal load to the rollers, far extending the life, compared to conventional roller linear guides.

Other characteristics include: Easy to provide preload by the wedge block; can be installed to vertical shaft; and reduction in noise level.

**(3) Accuracy**

The height tolerance of roller pack is 10 μm. Roller packs are grouped into a size difference of every 2 μm (corded by A to E) before delivery (Table 1).

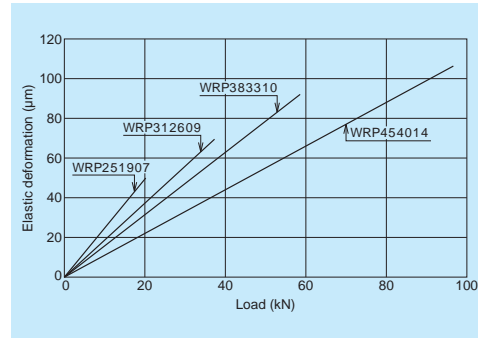
**Table 1 Height Classification**

Unit: μm

Category	Code
over or less	
+3 - +5	A
+1 - +3	B
-1 - +1	C
-3 - -1	D
-5 - -3	E

**(4) Rigidity**

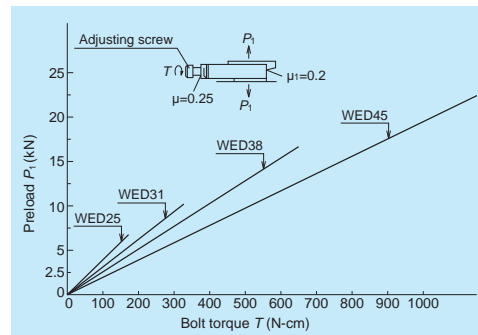
Fig. 4 shows the relationship between load and deformation. This includes deformation caused by contact between: the rollers and main body; the rollers and guide way surface; the main body and fitting plate.



**Fig. 4 Elastic deformation of the roller pack**

**(5) Preload**

Fig. 5 shows conversions of tightening torque of the wedge block adjust screw into preload volume. Use a dial gauge for accurate measurement.



**Fig. 5 Tightening torque of the adjust screw, and preload volume**

**(6) Friction and Lubrication**

**1. Lubricants and volume**

Mineral oils are commonly used. Since roller pack is used under a relatively heavy load, the oil should, ideally, have high viscosity and provide a strong film. Select from JIS viscosity 32-150.

Criteria of oil supply per roller pack Q (cc/h) can be calculated by the following formula.

$$Q \geq S \times 1/4 \dots\dots\dots (1)$$

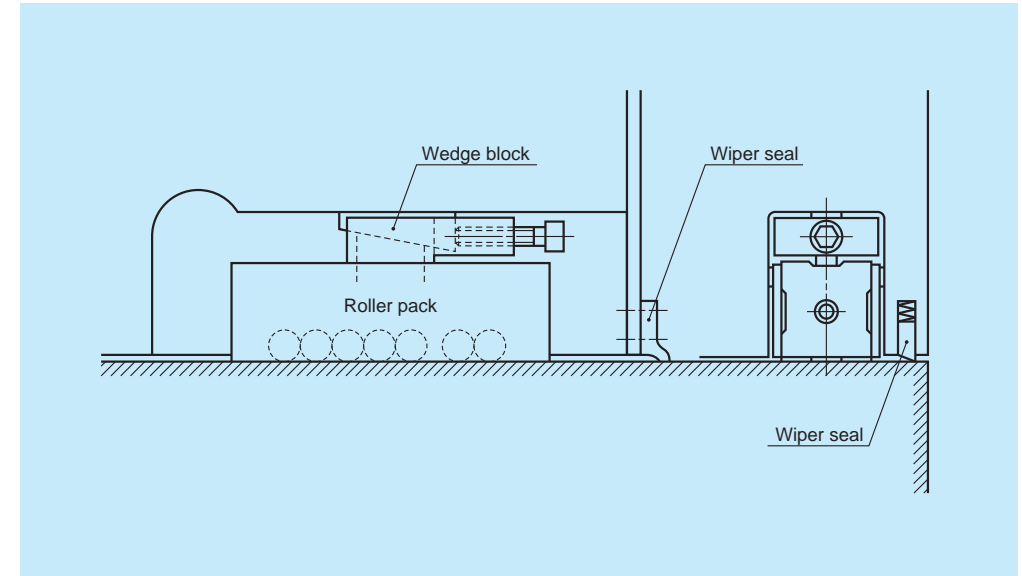
In this formula, S (stroke) is shown in meters. The oil volume, when the stroke is 1 m, per roller pack is more than 0.25 (cc/h). It is more desirable to supply a small amount of oil at short intervals than supplying a large amount at one time. In case of grease lubrication, use a grease of consistency 2. Albania EP2 is widely used.

**2. Friction coefficient**

Starting friction coefficient is significantly small at under 0.005.

**3. Seal**

It is necessary to install a wiper seal to the guide way surface to prevent foreign matters (swarf from cutting, and other dust) from entering the roller pack to enjoy the full benefit of the designed life of it. The material of the seal should have strong resistance to oil and wear. Felt and synthetic rubber (acrylonitril butadiene rubber) are some of the suitable materials. Fig. 6 shows a general method to install the seals.



**Fig. 6 Installation of seal**



**(7) Installation**

**1. Installation and applying preload**

As shown in Fig. 7, it is basic that a fitting plate is installed on the roller pack which receives load, and a wedge block is installed on the roller pack which receives no load, but is only used for preload. All components should be secured with a stop pin, facing toward the direction of movement. To cut costs for processing, it is recommended to divide the pocket (which contains roller pack) into some blocks and secure them with bolts (Fig. 7). Preload is provided by the wedge block. Estimate the actual load beforehand, so the preload shall not be lost when a load is applied. A load variation equivalent to up to two times of the preload volume can be absorbed in this case.

(Take into consideration the life in (8) in determining preload volume.)

**2. Accuracy of way block**

The following is the ideal accuracy specification and installation accuracy of way block as a guide face.

- Hardness by heat treatment : More than HRC58 hardened depth 2 mm or more
- Surface roughness : Less than 1.6 S
- Parallelism as a single unit: Less than 0.010 mm per meter
- Parallelism after installation : Less than 0.020 mm per meter

Please consult NSK when using cast iron or cast steel guide face.

**3. Pocket accuracy**

Accuracy of the pocket in which the roller pack is mounted should satisfy the following conditions.

- Pocket width : Roller pack width + 0.10 mm 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 face to the guide way face and parallelism of the wedge block mounting face to the guide way face : Less than 0.040 mm per 100 mm.

**(8) Rated life**

Rated life L (km) is shown in the following formula. In this formula:

$$L = 50 \left( \frac{C}{f_w \cdot F_c} \right)^{\frac{10}{3}} \dots\dots\dots (2)$$

- C : Basic dynamic load rating (kN)
- f<sub>w</sub> : Load factors. 1.0 to 1.2 at time of smooth operation
- F<sub>c</sub> : Calculated load (kN) applied to the roller pack

**(9) Disassembly**

Remove the roller pack preloaded by the wedge block in the following manner.

- Loosen the adjust screw of the wedge block. Lightly tap the wedge. In case of light preload, the wedge loosens, and the roller pack can be pulled out.
- When pulling, put the bolt in the tap hole at the end of the end cap, and tug the bolt.
- In case of heavy load, the roller pack could not be pulled out by the above method. Hook a tool to the pull-out hole (Fig. 1) on the side plate of the roller pack, and pull out the roller pack.

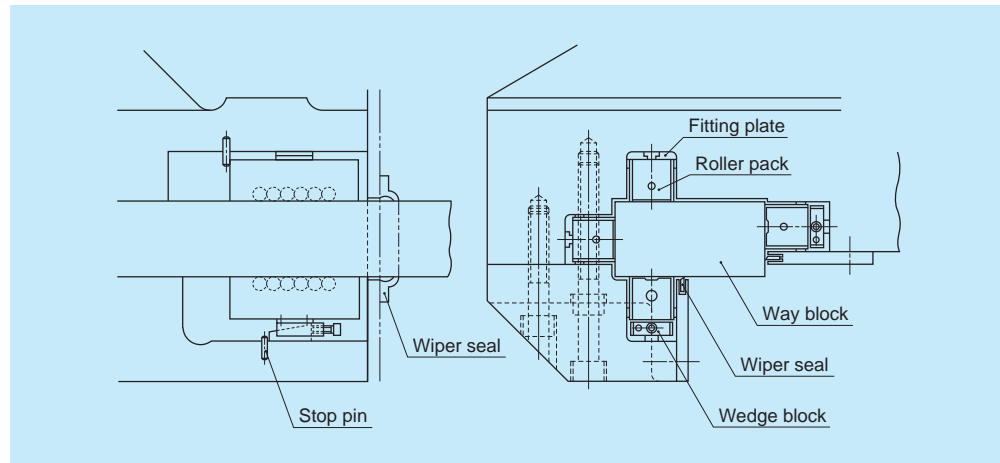
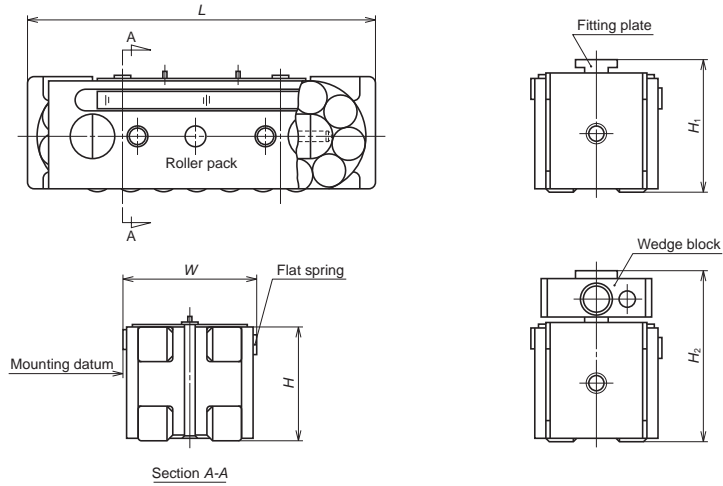


Fig. 7 Design of the roller pack pocket (example)

(10) Dimension Table

Roller pack: Model WRP

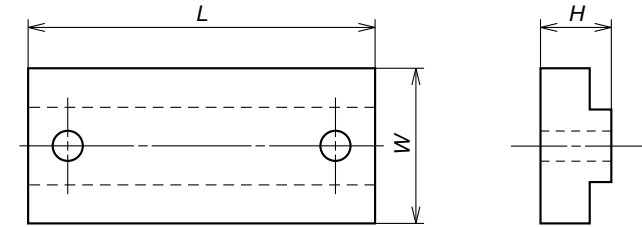


Unit: mm

Model No.	Width <i>W</i>	Height ±0.005 <i>H</i>	Length <i>L</i>	Applicable fitting plate reference No.	Assembled height <i>H</i> <sub>1</sub>	Applicable wedge reference No.	Assembled height <i>H</i> <sub>2</sub>	Basic dynamic load rating <i>C</i> (N)	Basic static load rating <i>C</i> <sub>0</sub> (N)
<b>WRP 251907</b>	25	19	65.5	WFT 25	24	WED 25	31 (30.4 - 31.6)	31000	40500
<b>WRP 312609</b>	31	26	85	WFT 31	31	WED 31	40 (39.4 - 40.6)	57000	73000
<b>WRP 383310</b>	38.1	33.31	104	WFT 38	38.91	WED 38	50.8 (50 - 51.5)	91000	113000
<b>WRP 454014</b>	45	40	138	WFT 45	45	WED 45	60 (59.2 - 60.8)	151000	191000

Remarks : Numbers in the parentheses in column *H*<sub>2</sub> show the adjustable height range of the wedge block.

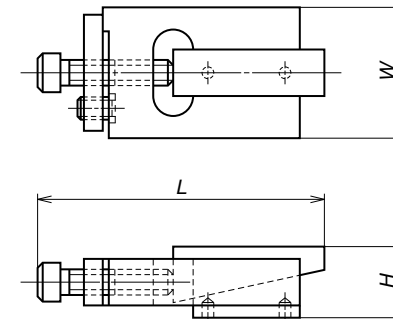
Fitting plate: Model WFT



Unit: mm

Model No.	Width <i>W</i>	Height ±0.01 <i>H</i>	Length <i>L</i>	Applicable Roller pack
<b>WFT 25</b>	10	5	20	WRP 251907
<b>WFT 31</b>	12	5	26	WRP 312609
<b>WFT 38</b>	12.8	5.6	29	WRP 383310
<b>WFT 45</b>	16	5	40	WRP 454014

Wedge block: Model WED



Unit: mm

Model No.	Width <i>W</i>	Height <i>H</i>	Length <i>L</i>	Applicable Roller pack
<b>WED 25</b>	23	12(11.5 - 12.5)	47	WRP 251907
<b>WED 31</b>	28	14(13.5 - 14.5)	63	WRP 312609
<b>WED 38</b>	35	17.47(16.9 - 18.1)	76	WRP 383310
<b>WED 45</b>	40	20(19.2 - 20.8)	95	WRP 454014

Remarks : Numbers in the parentheses in column *H*<sub>2</sub> show adjustable height range of the wedge block.

## A-6-4 Linear Roller Bearings

### (1) Structure

Linear roller bearing comprises: A single row of rollers; the main body which supports load via rollers; the end cap which turns the roller recirculating direction at the end of the main body from the loaded zone to the unloaded zone; a retaining wire which prevents rollers from falling out (Fig. 1). The main body, as the cylindrical roller bearing, has a rib at both sides. The rib guides the rollers to travel correctly, and assists the rollers to circulate infinitely in the bearing in a stable manner. This contributes to the bearing's linear movement without the restriction of travel range.

NSK also developed a highly functional preload pad

(Photo 2) to provide a slight preload to the bearing. The preload pad basically comprises parallel plates and sandwiched Belleville springs, having adjusted its spring rate.

Preloaded pad can be used in a machine tool in the following manner.

When two bearings are installed with one on the top and the other under the way block (the bearings comprise a set), a preloaded pad is used at the bottom bearing. This provides an equal preload to the top and bottom bearings. This way, to a certain extent, the variation in the load and the uneven thickness of the way block can be absorbed.

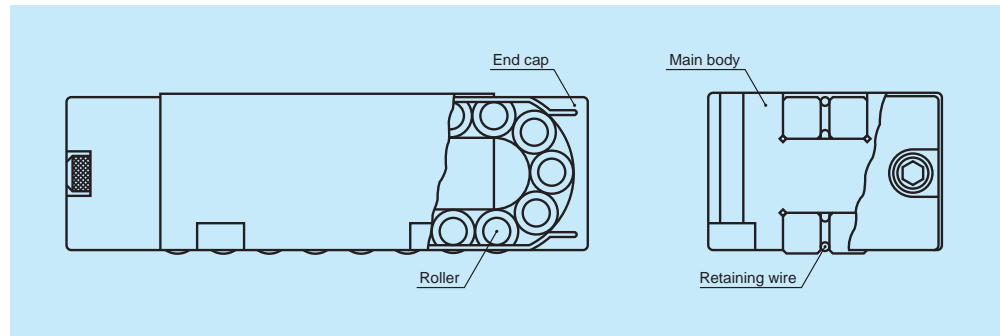


Fig. 1 Linear roller bearing



Photo 1 Linear roller bearing



Photo 2 Preload pad

### (2) Features

In addition to the general features of a roller bearing guide such as no-stick slip, small friction resistance, and easy maintenance, the linear roller bearing has several more advantages.

#### 1. No trouble by roller skewing

Skewing is the inclination of the rollers during operation. It causes friction force to suddenly soar. Skewing is apt to occur when the roller is long relative to its diameter. The proportion of the length and diameter is 1:2 for the products in this series. This is superior to the commonly used 1:3 ratio.

#### 2. Highly reliable

Retaining the rollers without allowing them to fall out of the bearing is a crucial function of the linear roller guide bearing. The simple and highly effective retaining wire has solved the problem for this product series.

#### 3. Compact design

Despite the load carrying capacity, this series is smaller in size than any other models. This contributes to the application which requires compact design.

#### 4. High rigidity

The contact area between the bearing and the mounting surface is large to increase rigidity.

#### (3) Accuracy

The nominal height difference between bearings is 10 μm. The bearings are grouped into every 2 μm, and are coded before delivery (Table 1).

Table 1 Classification of height

			Unit: μm
Category			Code
over 0	-	or less -2	A
-2	-	-4	B
-4	-	-6	C
-6	-	-8	D
-8	-	-10	E

### (4) Rigidity

Fig. 2 shows elastic deformation.

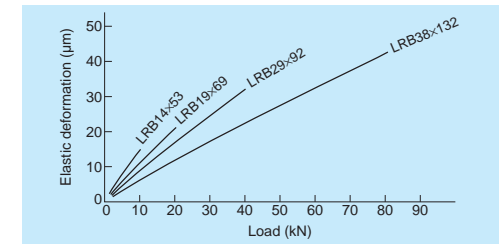


Fig. 2 Elastic deformation

### (5) Friction and Lubrication

#### 1. Lubricants and volume

Mineral oils are used in general. The linear roller bearing is used under relatively heavy load. An oil which has high viscosity and creates a strong oil film is ideal for linear roller guides. Select from JIS viscosity 32 to 150.

General oil supply for a linear roller bearing  $Q$  (cc/h) can be calculated by the following formula.

$$Q \geq S \times 1/4 \dots \dots \dots (1)$$

In this formula,  $S$  (stroke) is shown in meters. Therefore, when the stroke is 1m, the volume of lubricant per roller bearing is more than 0.25 (cc/h). It is recommended to supply a small amount of oil at short intervals rather than supplying a large amount at one time. In case of grease lubrication, a grease of consistency degree 2, such as Albania EP2, is generally used.

#### 2. Friction coefficient

Starting friction coefficient is significantly small at under 0.005.

#### 3. Seal

Install a wiper seal on the way block surface to prevent foreign matters (cutting chip and other contaminant from entering) to realize a full life of the linear roller bearing. The material of the seal should have strong resistance against oil and wear. Felt and synthetic rubber (acrylonitril-butadien rubber) are some of the suitable materials.

**(6) Installation**

Secure the linear roller bearing using four bolts. The bearing main body has four holes for mounting.

Accuracy of way block

The ideal accuracy specification and mounting accuracy of a way block as a guide way surface are as follows.

- Hardness by heat treatment
  - : More than HRC58 hardened depth 2 mm or more
- Surface roughness
  - : Less than 1.6S
- Parallelism as a single unit
  - : Less than 0.010 mm per 1 m
- Parallelism after installation
  - : Less than 0.020 mm per 1 m

Please consult NSK when using cast iron or cast steel guide way.

**(7) Rated life**

Rated life  $L$  (km) is shown in the following formula.

In this formula:

$$L = 50 \left( \frac{C}{f_w \cdot F_c} \right)^{\frac{10}{3}} \dots\dots\dots(2)$$

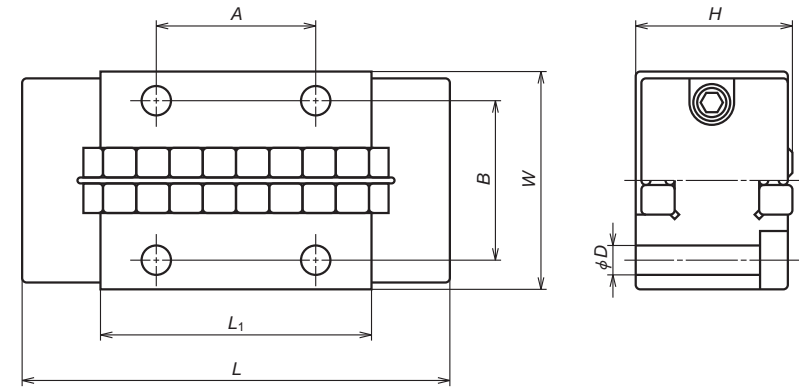
$C$  : Basic dynamic load rating (N)

$f_w$  : Load factor. 1.0 to 1.2 at time of smooth operation

$F_c$  : Calculated load applied on the bearing (N)

**(8) Dimension Table**

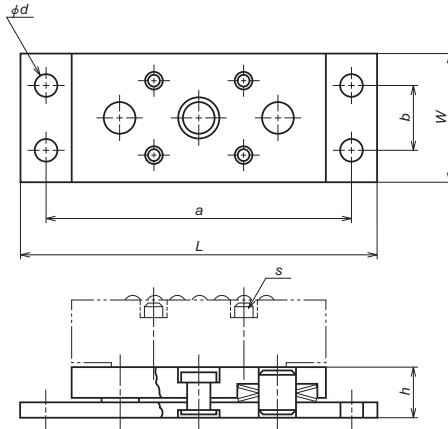
Linear roller bearing Model: LRB



Model No.	Width $W$	Height $H_{0.010}$	Length $L$	$L_1$	Roller Diameter × length	Mounting bolt hole $D$	Bolt hole distance		Basic dynamic load rating $C$ (N)	Basic static load rating $C_0$ (N)
							$A$	$B$		
<b>LRB 14×53</b>	26.5	14.29	52.8	32.8	$\phi$ 4×8	3.4	19	19.3	15400	21900
<b>LRB 19×69</b>	30.5	19.05	68.6	44.6	$\phi$ 5×10	3.4	25.4	23.3	27000	39000
<b>LRB 29×92</b>	41.5	28.58	92.0	59	$\phi$ 7.5×15	4.5	38.1	32.7	57500	76500
<b>LRB 38×132</b>	51.4	38.10	132.0	88	$\phi$ 10×20	5.5	50.8	41.5	119000	159000

Remarks: Bearings are grouped into heights of every 2  $\mu$ m before delivery.

## Preload pad Model: PRP



Unit: mm

Model No.	Applicable linear roller bearing	Height (no-load) $h$ max	Compressed height $h$ min	$h$ min Load when fully compressed (N)	$W$	$L$	$d$	$a$	$b$	$s$ Hex. Socket cap screw
<b>PRP 14×53</b>	LRB 14×53	10.23	9.53	1570	26	72	4.5	62	14	M3×16
<b>PRP 19×69</b>	LRB 19×69	11.53	11.10	2650	30	96	4.5	86	18	M3×19
<b>PRP 29×92</b>	LRB 29×92	13.13	12.70	6450	41	120	4.5	110	27	M3×25
<b>PRP 38×132</b>	LRB 38×132	16.28	15.88	12000	51	157	4.5	147	35	M5×38

# B BLOCK Ball Screw

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# B-1 Selection Guide to NSK Ball Screw

## B-1-1 Features of NSK Ball Screws

### ① Quick delivery

Standard ball screws are in stock for short lead time.

- Precision ball screws with finished shaft end  
PSS Type, MA Type, FA Type, SA Type, KA Type
- Precision ball screws with blank shaft end  
MS Type, FS Type, SS Type

Ball screws for transfer equipment are also available in stock.

- Finished shaft end  
VFA Type, RMA Type
- Blank shaft end  
RMS Type, R Series

### 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 topnotch 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. The Gothic arch has no clearance between the balls and grooves with applying preload, and no backlash can be obtained. As providing controlled rigidity 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.

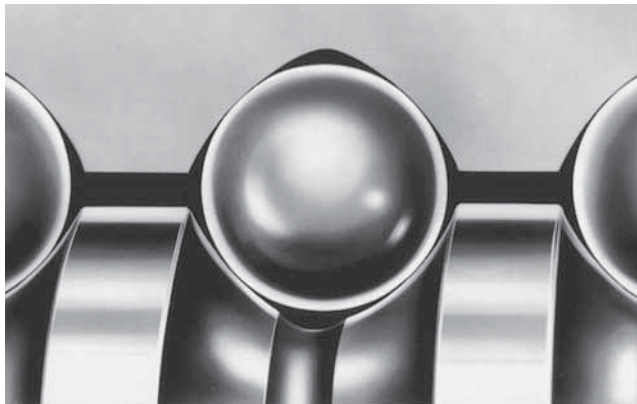


Fig. 1.1 Ball groove profile of NSK ball screw

### ⑥ Smooth movement assures high efficiency

NSK uses the Gothic arc design for the ball grooves. This design prevents the balls from slightly wedging into the groove of the ball nut and screw shaft and causing minute vibration. This phenomenon is common with the circular-arc design used by other manufacturers. The Gothic arc, 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 Optimal units available

Utilizing bearing technology, NSK produces high quality support units ( for light load type to be used for small equipment and heavy load type to be used for machine tools ) which are exclusive for ball screws. These units are standardized and always in stock.

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.

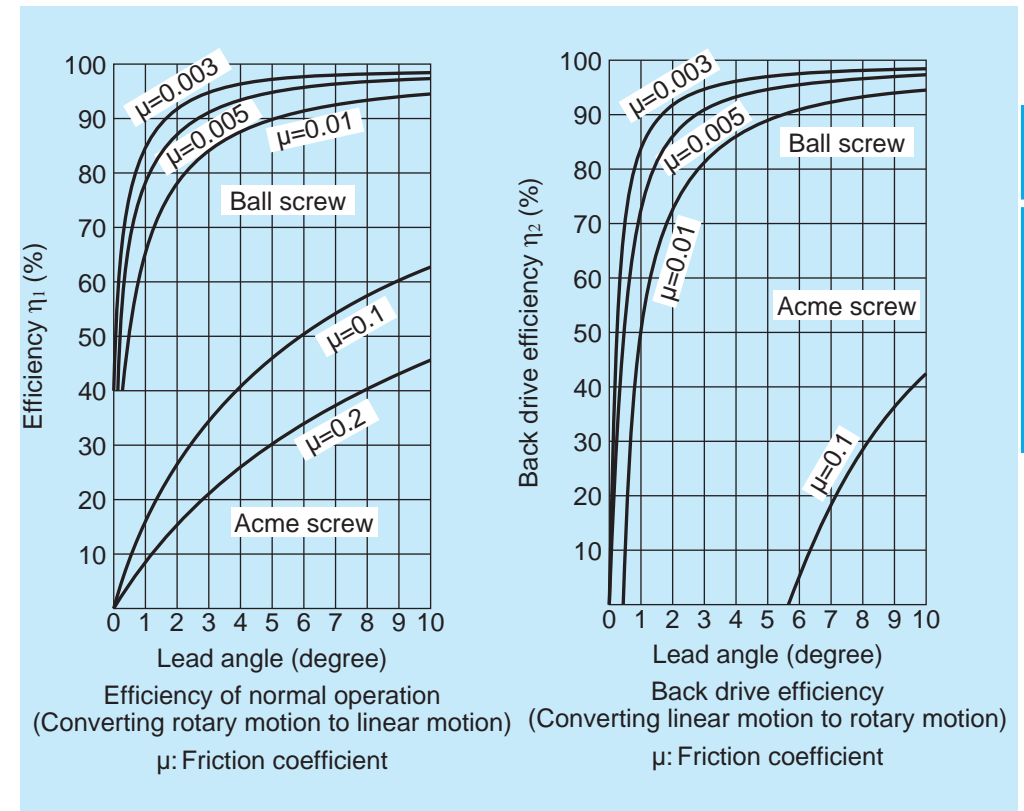


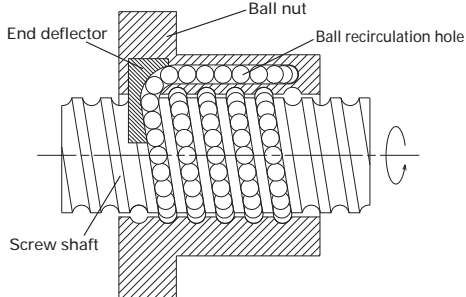
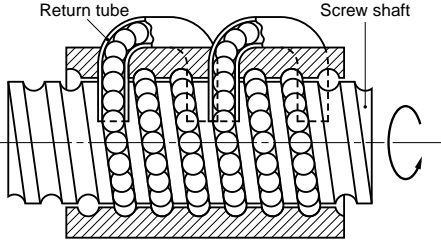
Fig. 1.2 Mechanical efficiency of ball screws

## 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.

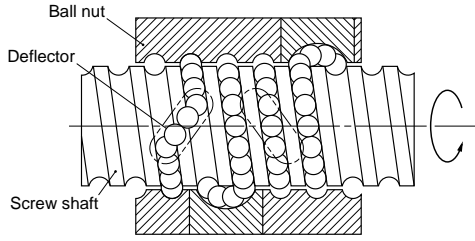
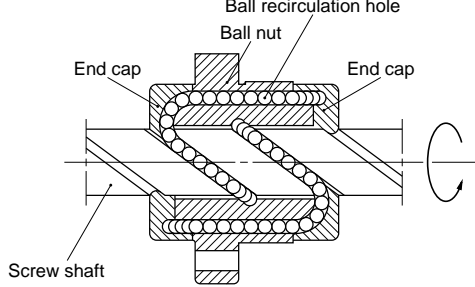
Table 2.1 Ball screw recirculation system

End deflector type	Ball return tube type
	
<p>[Structure]</p> <p>Balls are smoothly picked up in tangential direction at the end of nut, and recirculated via hole in the nut.</p> <p>If the ball is picked up at the middle of the nut, it is called middle deflector type.</p> <p>[Features]</p> <ul style="list-style-type: none"> <li>· Small nut O.D., allows compact design.</li> <li>· Low noise, High speed.</li> </ul>	<p>[Structure]</p> <p>Balls are recalculated through pipe of optimized size, bridging the start and end of recirculation.</p> <p>[Features]</p> <ul style="list-style-type: none"> <li>· Adapt to various specifications. (screw shaft diameter, lead)</li> </ul>

### B-1-2.1 Ball Recirculation System

A ball recirculation system is categorically most important, as well as the preload system, to classify the structure of ball screw.

As shown in Table 2.1, four types of ball recirculation system are used for NSK ball screw.

Deflector type	End cap type
	
<p>[Structure]</p> <p>Balls are recirculated by horseshoe shaped deflector bridging the pitch groove.</p> <p>[Features]</p> <ul style="list-style-type: none"> <li>· Suitable for fine lead ball screws.</li> <li>· Small nut O.D., allows compact design.</li> </ul>	<p>[Structure]</p> <p>Balls are picked up by cap placed at both ends of the nut, and recirculated via hole in the nut.</p> <p>[Features]</p> <ul style="list-style-type: none"> <li>· Suitable for large lead ball screws.</li> <li>· Not universal due to complex recirculation structure.</li> </ul>



**B-1-2.2 Preload system**

There are four systems to apply preload to NSK ball screws depending on the application.

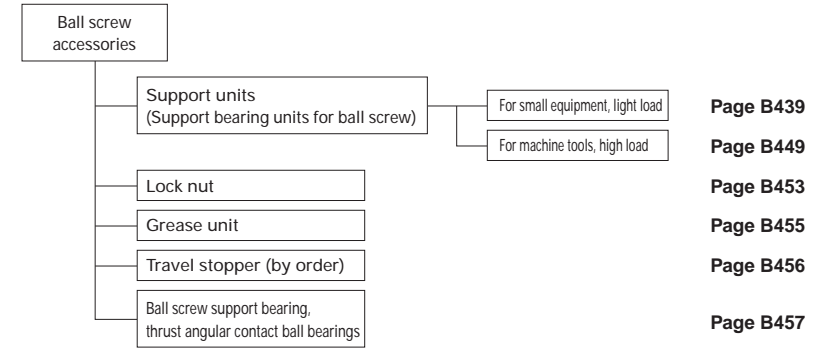
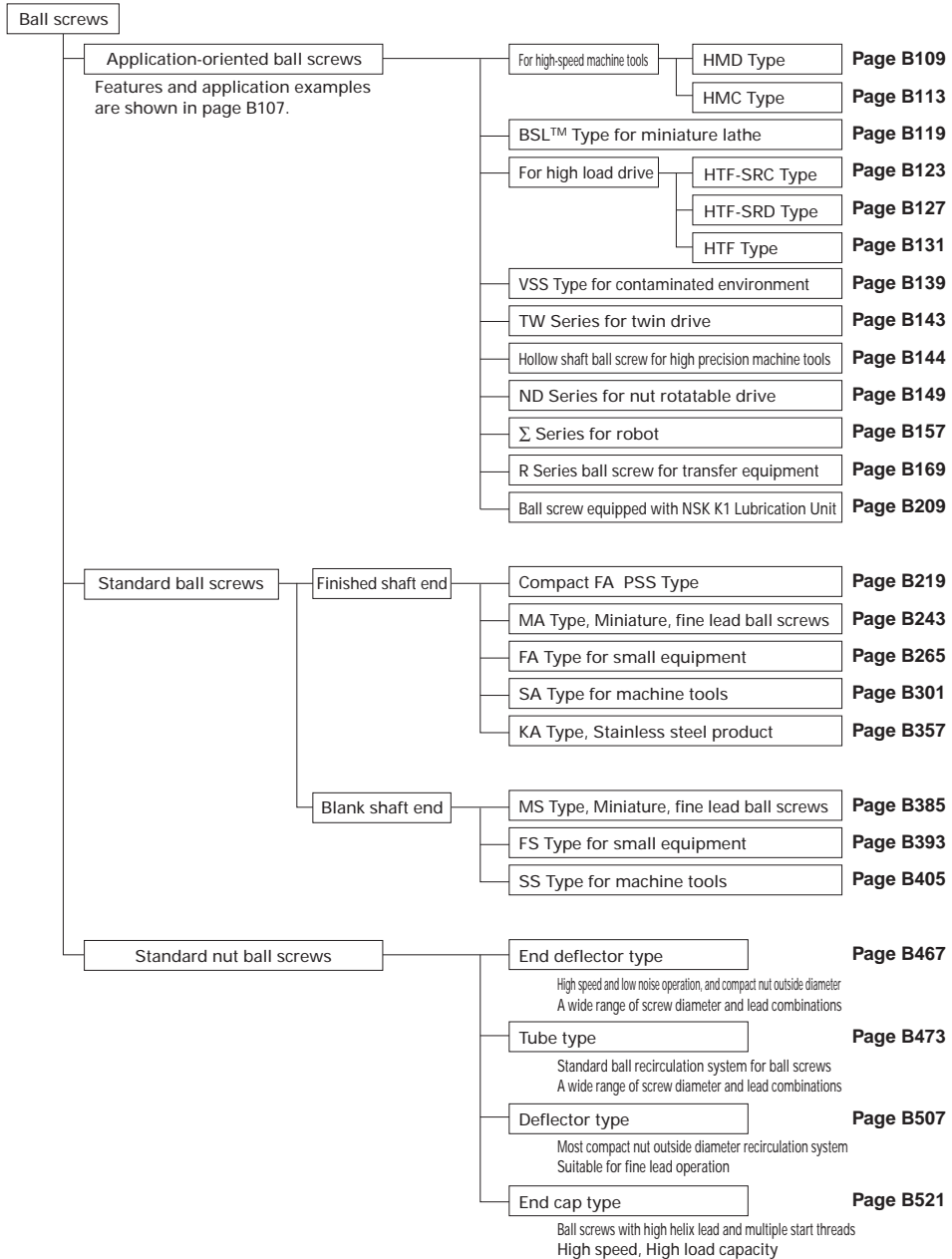
**Table 2.2 Preload system for ball screw**

Preload system	Double nut preload (D Preload)	Offset preload (Z Preload)
Structure		
Description	<p>Uses two nuts, and inserts a spacer between them to apply preload. In general, a spacer is thicker (by the deformation equivalent to the preload) than the actual space between two nuts. On the contrary, a thin spacer is inserted in some cases.</p>	<p>To apply preload, the lead near the center of the nut is enlarged by the volume equivalent to preload (<math>\alpha</math>). Uses a single nut to create a preload similar to D preload. Not using spacer enables compact nut design.</p>
Nut length	Long	Medium
Torque characteristics	Fair	Fair
Rigidity	Excellent	Excellent

Preload system	Oversize ball preload (P Preload)	Spring preloaded double nut (J Preload)
Structure		
Description	<p>Balls slightly larger than the space of the ball groove (over-size balls) are inserted to apply preload by balls' four-point contact. Provide better torque characteristics in the low torque range.</p>	<p>A spring is used as a spacer of D Preload. Must be used with discretion in its varied rigidity by load direction.</p>
Nut length	Short	Long
Torque characteristics	Fair	Excellent
Rigidity	Fair	Poor

## B-1-3 Ball Screw Series

### B-1-3.1 Ball Screw Classification



Lead classification

Classification	Lead ratio $K = \text{lead } l / \text{shaft diameter } d$
Fine	$K < 0.5$
Medium	$0.5 \leq K < 1$
High helix	$1 \leq K < 2$
Ultra high helix	$2 \leq K$

**B-1-3.2 Product externals**

(1) Ball screws

● Application-oriented ball screws

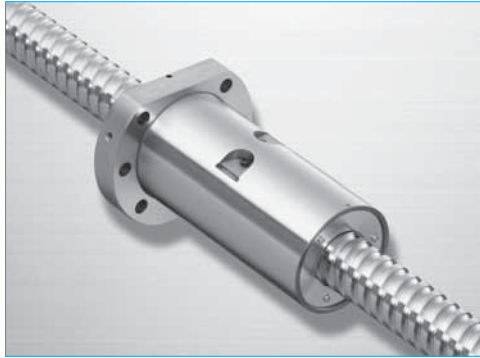


Fig. 3.1 HMD type for high-speed machine tools  
Page B109

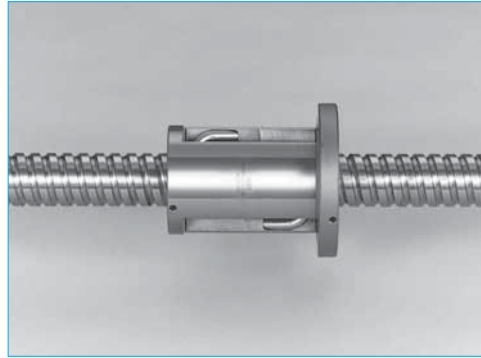


Fig. 3.2 HMC type for high-speed machine tools  
Page B113

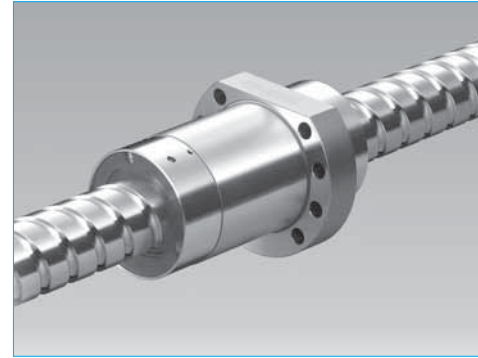


Fig. 3.7 VSS type for contaminated environment  
Page B139

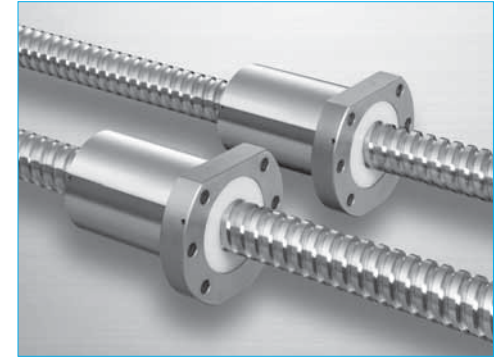


Fig. 3.8 TW series for twin-drive system  
Page B143

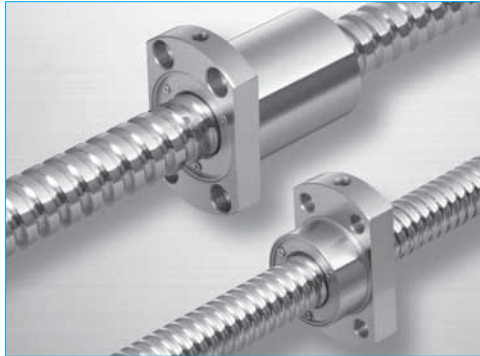


Fig. 3.3 BSL type for miniature lathe  
Page B119

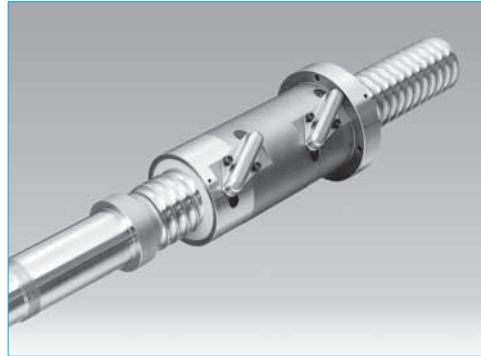


Fig. 3.4 HTF-SRC type for high-load drive  
Page B123

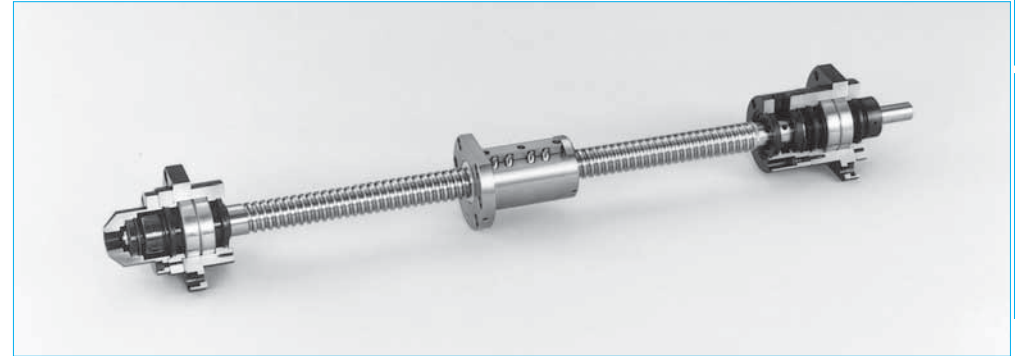


Fig. 3.9 Hollow shaft ball screw for high-precision machine tools  
Page B144

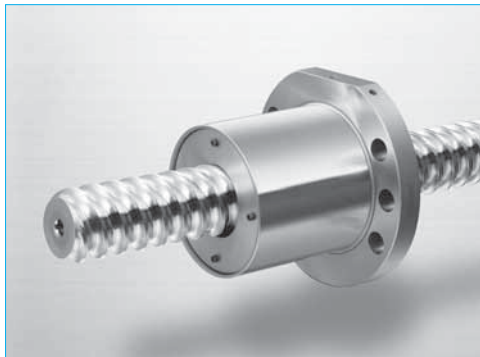


Fig. 3.5 HTF-SRD type for high-load drive  
Page B127

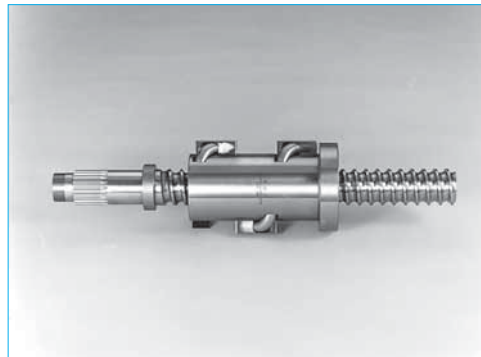


Fig. 3.6 HTF type for high-load drive  
Page B131

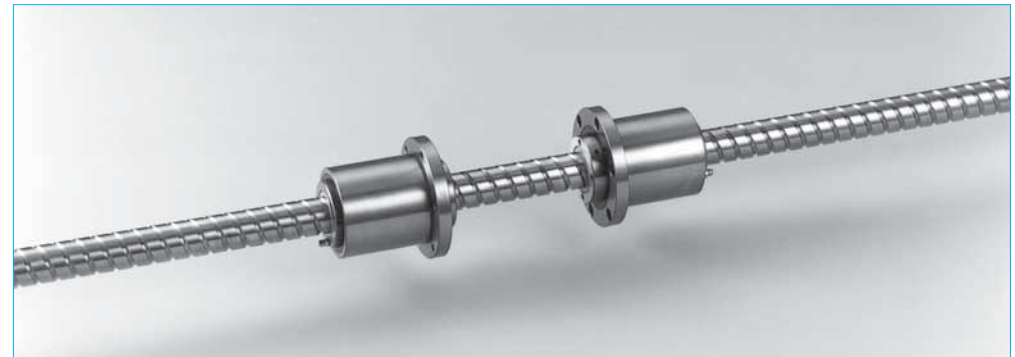


Fig. 3.10 ND series for nut-rotatable drive  
Page B149

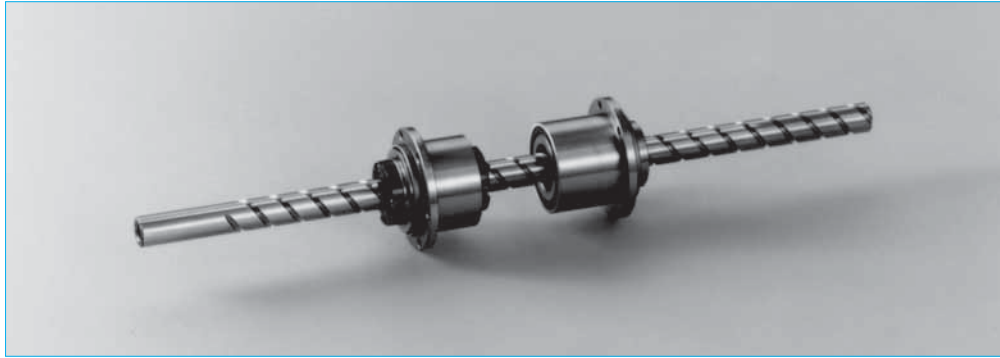


Fig. 3.11 Σ series for robot

Page B157

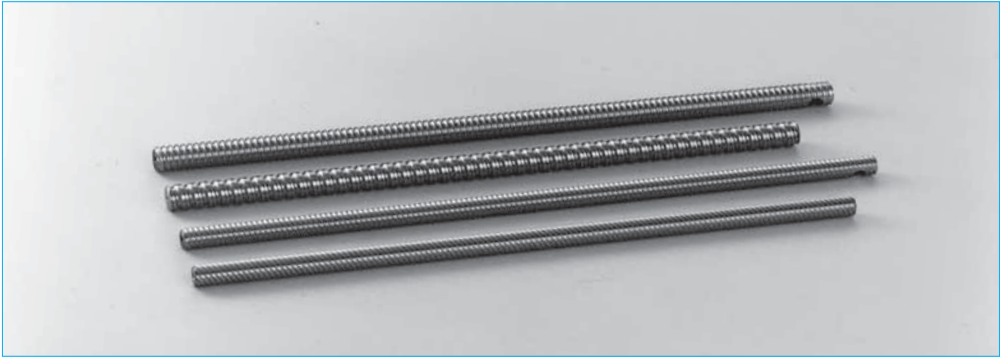


Fig. 3.14 Blank shaft end R series for transfer equipment

Page B169

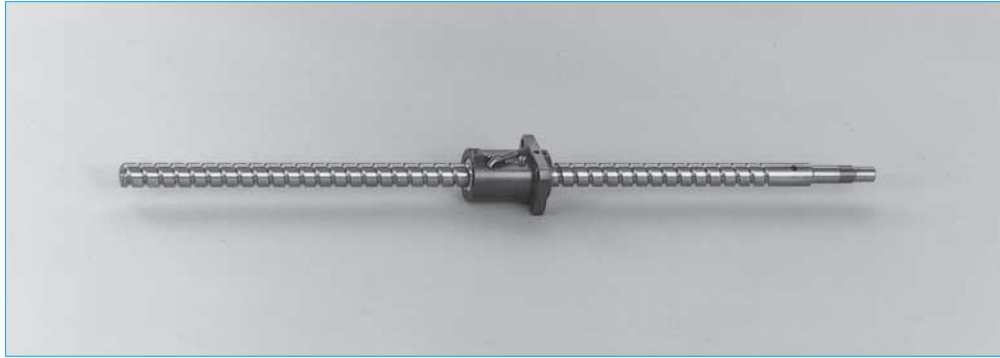


Fig. 3.12 Finished shaft end VFA type for transfer equipment

Page B169

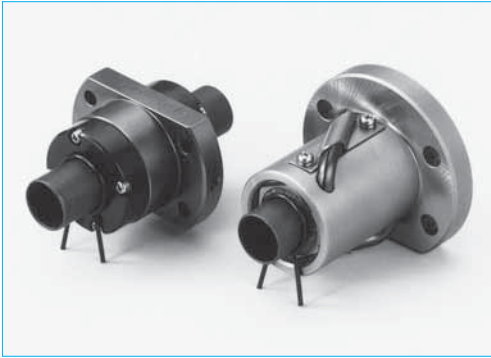


Fig. 3.15 R series nut assembly for transfer equipment

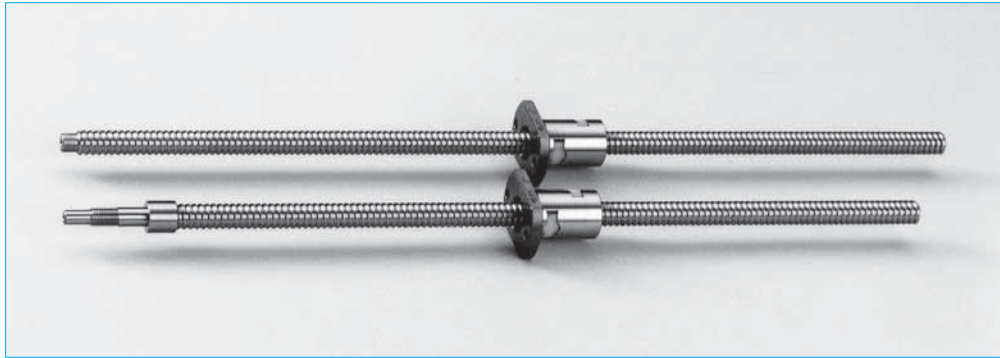


Fig. 3.13 Finished shaft end RMA type and blank shaft end RMS type for transfer equipment

Page B169

●Standard ball screws

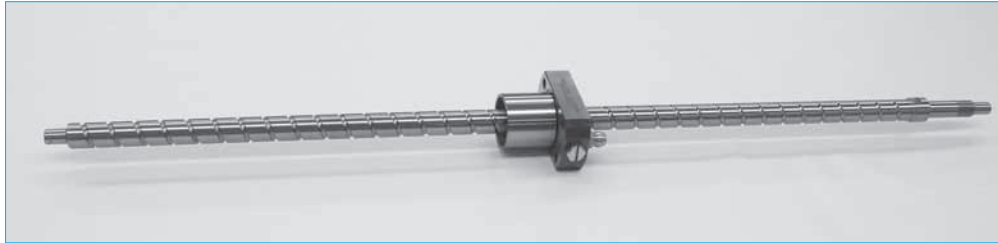


Fig. 3.16 Finished shaft end compact FA PSS type

Page B219

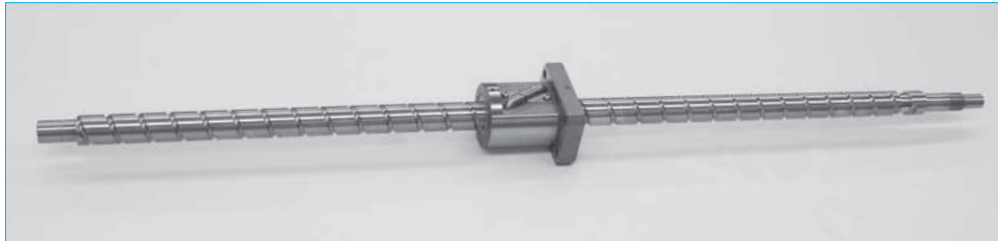


Fig. 3.17 Finished shaft end MA type, FA type, SA type

Page B241

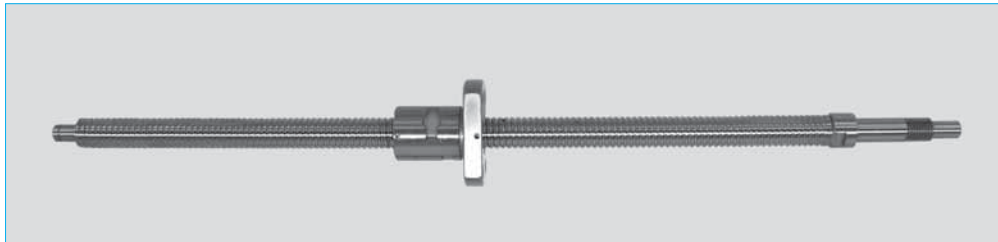


Fig. 3.18 Finished shaft end KA type

Page B357

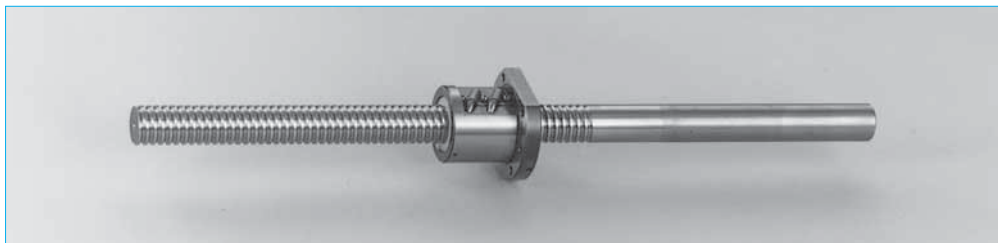


Fig. 3.19 Blank shaft end MS type, FS type, SS type

Page B383

●Standard nut ball screws

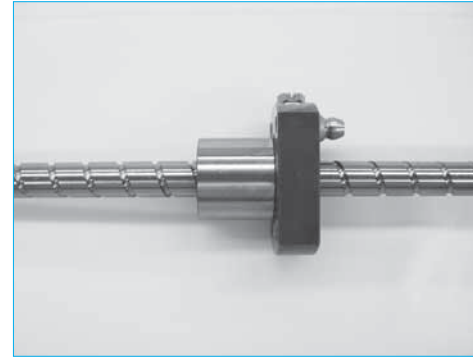


Fig. 3.20 End deflector type

Page B467

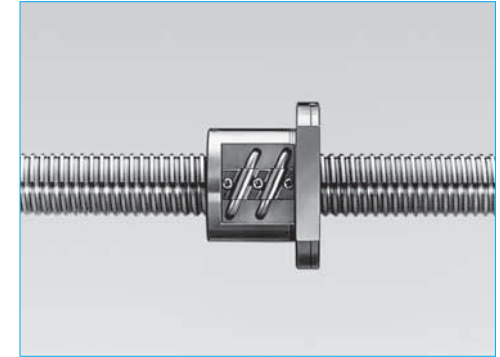


Fig. 3.21 Tube type

Page B473

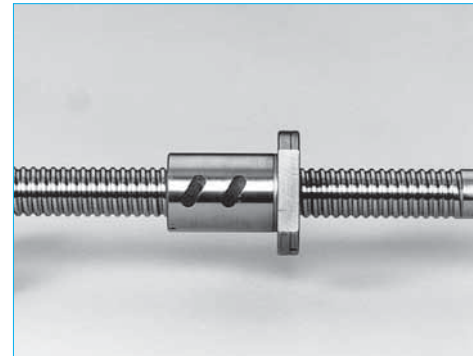


Fig. 3.22 Deflector type

Page B507

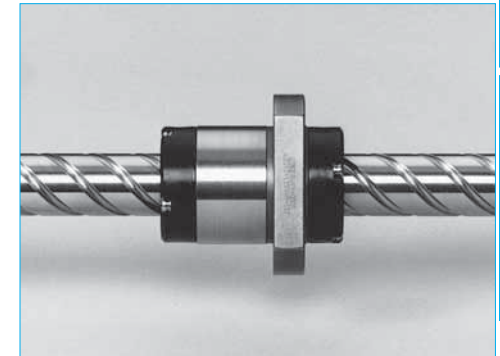


Fig. 3.23 End cap type

Page B521

**(2) Standard accessories**



**Fig. 3.24 Support unit** Page B439  
(For small equipment, light load)



**Fig. 3.25 Low-profile support unit** Page B439  
(For small equipment, light load)



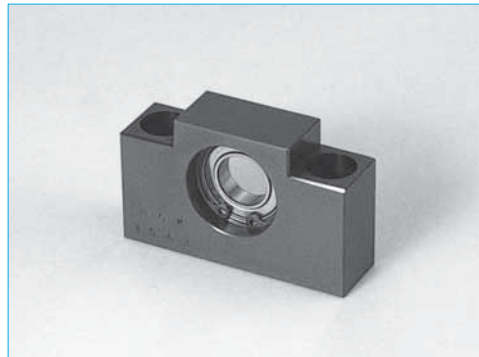
**Fig. 3.29 Lock nuts A type** Page B453



**Fig. 3.30 Lock nuts S type** Page B454



**Fig. 3.26 Support unit** Page B449  
(For machine tools, heavy load)



**Fig. 3.27 Support unit for VFA type** Page B446  
(simple support side)



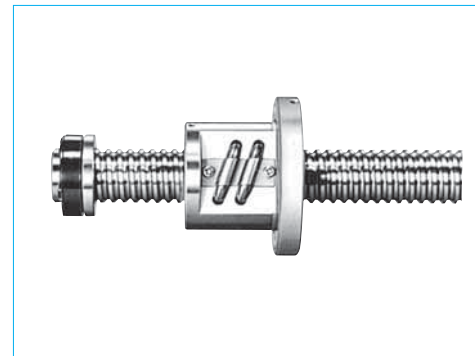
**Fig. 3.31 NSK hand grease pump unit** Page D20



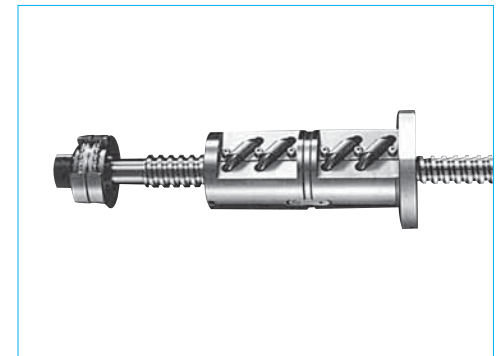
**Fig. 3.32 NSK grease** Page B455, D20



**Fig. 3.28 Support kit for RMA and RMS types** Page B445



**Fig. 3.33 Travel stopper** Page B456  
(by order)



**Fig. 3.34 Ball screw support bearing, thrust angular contact ball bearings** Page B457

## B-1-4 Procedures to Select Ball Screw

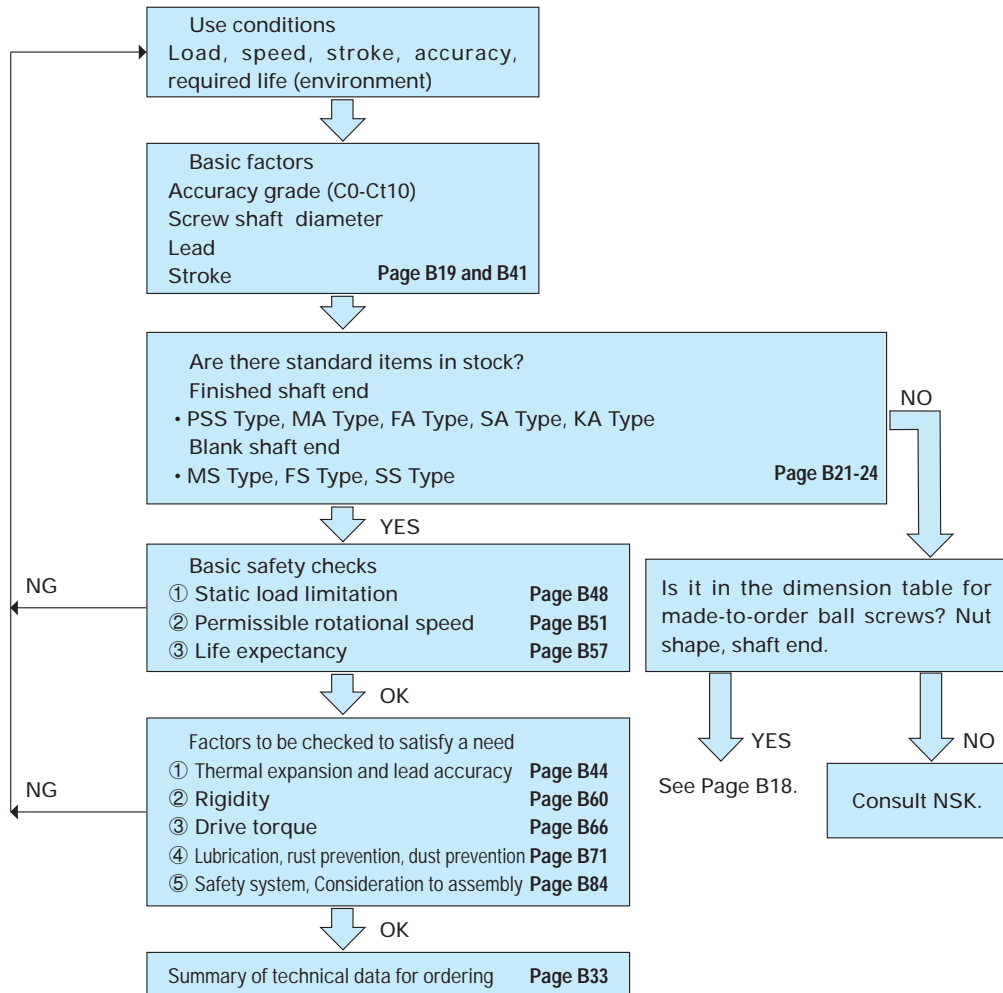
### B-1-4.1 Flow Chart for Selection

When selecting a ball screw, you have to review a variety of use conditions and requirements such as applied loads, speeds, motion strokes, positioning accuracy, required life and operating environment. You require a multiple inspection because some of these conditions force a ball screw to have conflicting characteristics.

#### (1) Standard ball screw

The chart below is one of the selection methods. To take advantage of prompt delivery and reasonable prices, this method focuses on the standardized ball screws that are available in stock.

NSK offers a ball screw selection program, and also has a service to select appropriate items using data file compiled by our knowledge and experience.

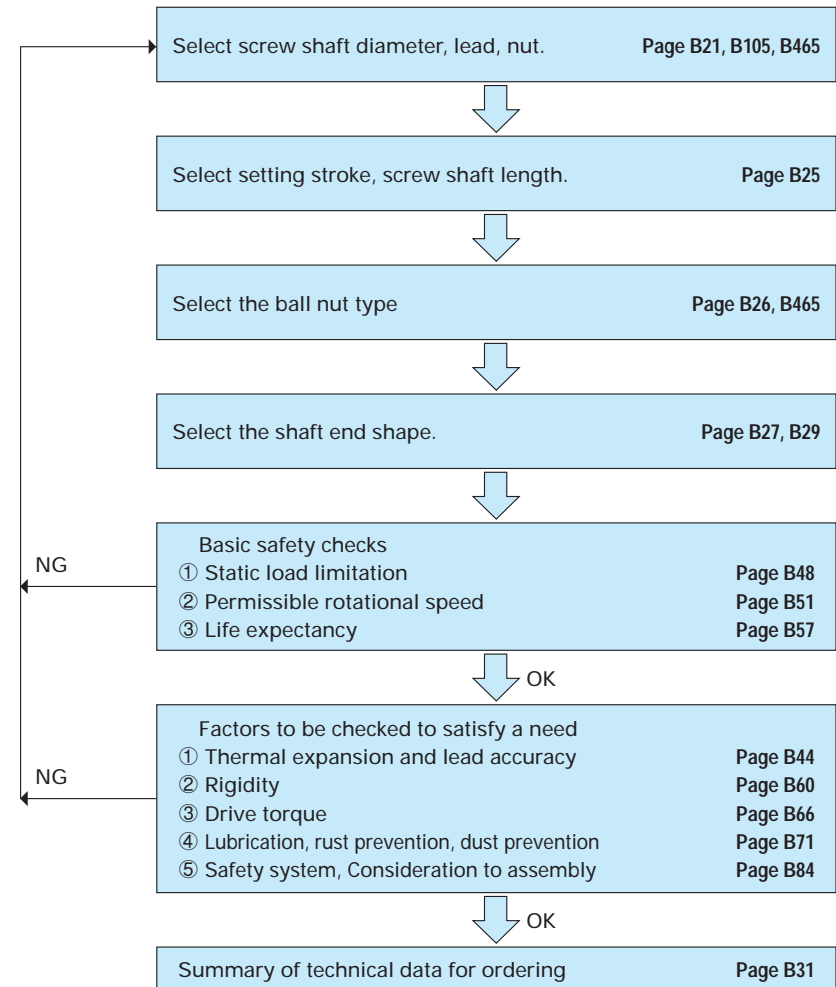


#### (2) Made-to-order ball screws

Dimensions and specifications can be decided individually for the application-oriented ball screws and standard nut ball screws. Procedures are as follows. Refer to the selection exercises on Page B87.

Table 4.4 is "Combinations of screw shaft diameter and leads for basic type ball screw." Please consult

NSK if you require the types that are 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. Circle indicates the range of the accuracy grade in actual use. A double circle indicates accuracy grades most frequently used among cases marked with a 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 B42)

Table 4.1 Accuracy grades of ball screw and their application

Application		NC machine tools																					
		Lathe		Milling machine Boring machine		Machining center		Drilling machine		Jig boring machine		Grinder		Electric discharge machine		Wire cutting Electric discharge machine		Punch press		Laser cutting machine		Woodworking machine	
Name of axis		X	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z
Accuracy grade	C0	○								○	○	○											
	C1	○		○		○				⊙	⊙	○	○	○		○	○						
	C2	○		○	○	○	○					⊙	○	○	○	○	○						
	C3	⊙	○	⊙	○	○	○	○				⊙	⊙	⊙	⊙	⊙	○	○	○	○	○	○	○
	C5	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙							⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
	Ct7								○														○
	Ct10																						○

Application		Semiconductor/associated industry						Industrial robots						Steel mills equipment		Plastic injection molding machine		Three-dimensional coordinate measuring machine		Office machine		Image processing equipment		Nuclear power	
		General industrial machines, Machines for specific use		Lithographic machine	Chemical processing equipment	Wire bonder	Prober	Electric component mounted device	Printed circuit board drilling machine	Cartesian type		Articulate type		SCARA type											
Accuracy grade	C0		○			○																			
	C1		⊙		⊙	⊙		○										⊙		⊙					
	C2				○	⊙	○	○										○							
	C3	○		○		○	⊙	○		○		○										○		○	
	C5	⊙		○		⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙								⊙		⊙	⊙	
	Ct7	⊙		⊙				○	⊙	○	⊙	⊙	⊙								○		⊙		
	Ct10	○		○					○					⊙	○							○		○	

B-1-4.3 Axial Play

Table 4.2 indicates 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 length 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 axial play of Ct10 grade (ball screws for transfer equipment), refer to the R series dimension tables.

Table 4.2 Combinations of accuracy grades and axial play

Axial play	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
<b>C0</b>	C0Z	C0T	—	—	—
<b>C1</b>	C1Z	C1T	—	—	—
<b>C2</b>	C2Z	C2T	—	—	—
<b>C3</b>	C3Z	C3T	C3S	—	—
<b>C5</b>	C5Z	C5T	C5S	C5N	—
<b>Ct7</b>	—	—	C7S	C7N	—

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	80	100	80	100	—
8 - 10	250	200	250	300	—
12 - 16	500	400	500	600	700
20 - 25	800	700	1000	1000	1000
32 - 40	1000	800	2000	1500	1500
50 - 63	1200	1000	2500	2000	2000
80 - 125	—	—	4000	3000	3000

Remarks: 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 partial negative play 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. Lead should be set based on the required running speed, and should give some allowance to the maximum rotational speed of the motor.

**(1) Made-to-order ball screws**

Table 4.4 shows the combinations of screw shaft diameter and leads for made-to-order ball screws. For details, refer to the dimension tables from Page B105 and B465.

**Table 4.4 Combinations of screw shaft diameter and leads for typical ball screw** Unit: mm

Lead Screw shaft diameter	Screw shaft diameter																								
	0.5	1	1.5	2	2.5	3	4	5	6	8	10	12	14	16	20	25	30	32	36	40	50	60	64	80	100
4	D	D																							
6	D	D		D																					
8	D	D	D	D																					
10		D		D	D		T	S			S														
12		D		D	D	D	T	S,T			S,T				S,C		S								
14				D		D		T			T														
15								S			S,T				S,C		S				C				
16				D	D		T	T	T					T,C				C			C				
20				D			T	S,T D,B	T,D B	T	S,T			T	S,T C		S			S,C		S,C			
25				D			T	S,T D,B	T,D B	T,B	S,T D,B			T	S,T C	S,T C	S				S,C			C	
28								T	T		T														
32				D			T	S,T D	T,D	T,D	S,T D,B V,F	S,T B		S,V	S,T V,N	T,N			S,T C,V N					S,C	
36								S,T	T		S,T F	S,F		S,H	S,H										
40				D				T,D	T,D	T,D	S,T D,F	S,T F		S,T H	S,H	S,T H,N	S,H	T,H N	H		S,T C,V N				S
45											S,T F	S,T F		S,H	S,H	S,H	S,H	H	H						
50								T,D	T,D	T,D	S,T D,F	S,T D,F	F	S,T F	S,T D,H	S,T H,N	S,H	T,H N		T,N F	S,T C,V N				S
55											T,F	F	F	F	H	H	H	H							
63									D	D	T,D	D,F	F	F	T,D F	F		F			T,F	T			
80											T,D	T,D	F	T,F	T,D F	F						F			
100											D	T,D		T,F	T,D F	F									
120															F	F	F								
125															T	T									
140																	F	F	F	F					
160																		F	F	F					
200																			F	F					

T: Tube type  
D: Deflector type  
C: End cap type  
S: End deflector type  
H: HMC type, HMD type  
F: HTF-SRC, HTF-SRD, HTF type  
N: ND Series  
B: BSL type  
V: VSS type

**Table 4.5 Screw shaft diameter, lead and standard screw shaft length of R Series** Unit: mm

Screw shaft diameter	Lead	Standard screw shaft length									
		400	500	800	1000	1500	2000	2500	3000	4000	5000
10	3	●		●							
	6	●		●							
12	8	●		●							
	12	●		●							
14	4		●		●						
	5		●		●						
15	20		●		●	●					
16	10		●		●	●					
	16		●		●	●					
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						●		●	●	

(2) Standard ball screw

Table 4.6 and 4.7 show combinations of ball screw shaft diameter and leads, and range of stroke. From these tables, select closest values to the shaft diameter, lead, and stroke which had been selected

previously. Also, confirm detailed specifications and sizes in "Dimensional table of standard ball screw" (Page B217).

Table 4.6 Screw shaft diameter, lead and stroke of standard ball screw

Table 4.6: Matrix showing combinations of shaft diameter (4-50 mm), lead (1-10 mm), and stroke (-50 to -650 mm) for standard ball screws. Includes symbols for different types: PSS (solid circle), MA (open circle), FA (open triangle), SA (open square), MS (open diamond), FS (open inverted triangle), SS (open hexagon).

See Table 4.7 for KA Type in stainless steel product

Table 4.7 Screw shaft diameter, lead and stroke of KA type in stainless steel product Unit: mm

Table 4.7: Matrix showing combinations of shaft diameter (6-20 mm), lead (1-20 mm), and stroke (-150 to -1050 mm) for KA type in stainless steel product. Includes symbols for different types: PSS (solid circle), MA (open circle), FA (open triangle), SA (open square), MS (open diamond), FS (open inverted triangle), SS (open hexagon).

Unit: mm

Table 4.7 (continued): Matrix showing combinations of shaft diameter (6-20 mm), lead (1-20 mm), and stroke (-700 to -3000 mm) for KA type in stainless steel product. Includes symbols for different types: PSS (solid circle), MA (open circle), FA (open triangle), SA (open square), MS (open diamond), FS (open inverted triangle), SS (open hexagon).

**B-1-4.5 Manufacturing Capability for Screw Shaft**

Table 4.8 shows the manufacturing capability for the screw shaft overall length for each accuracy grade. The capability of large ball screw whose shaft diameter exceeds 100 mm is limited due to the

weight. Please consult NSK in such a case. (\*) Also consult NSK if the screw shaft size you desire exceeds the size listed in Table 4.8.

**Table 4.8 Manufacturing capability of screw shaft**

Unit: mm

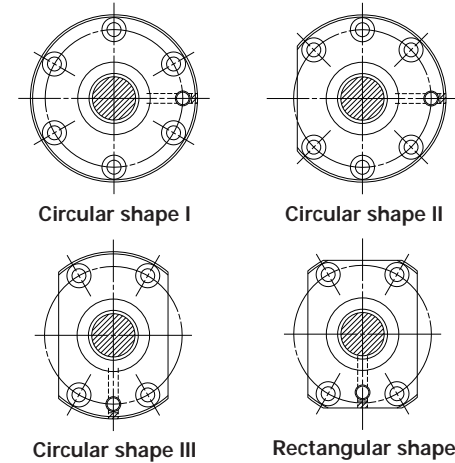
Accuracy grade Screw shaft diameter	C0	C1	C2	C3	C5	Ct7	Ct10
4	90	110	120	140	140	140	—
6	150	180	200	250	250	250	—
8	240	280	340	340	340	340	—
10	350	400	500	500	500	550	800
12	450	500	650	700	750	800	800
14	600	650	750	800	1000	1000	1000
15	600	700	800	900	1250	1250	1500
16	600	750	900	1000	1500	1500	1500
18	—	—	—	—	—	—	1500
20	850	1000	1200	1400	1900	1900	2000
25	1100	1400	1600	1900	2500	2500	2500
28	1100	1400	1600	1900	2500	2500	2500
32	1500	1750	2250	2500	3200	3200	3000(4000)
36	1500	1750	2250	2500	3200	3500	3000
40	2000	2400	3000	3400	3800	4300	4000(5000)
45	2000	2400	3000	3400	4000	4500	4000
50	2000	3200	4000	4500	5000	5750	4000
63	2000	4000	5000	6000	6800	7700	—
80	—	4000	6300	8200	9200	10000	—
*100	—	4000	6300	10000	12500	13500	—
*120	—	—	—	—	—	13500	—
*125	—	—	—	10000	13500	13500	—
*140	—	—	—	—	—	10000	—
*160	—	—	—	—	—	8000	—
*200	—	—	—	—	—	5000	—

**Remarks:** 1. Values in parentheses of Ct10 are applicable to the ultra high helix lead ( $l/d \geq 2$ ). Refer to dimension tables in B203 and following pages for details.  
2. Please note that the range for small leads (3 mm or under) are also limited by the screw length.

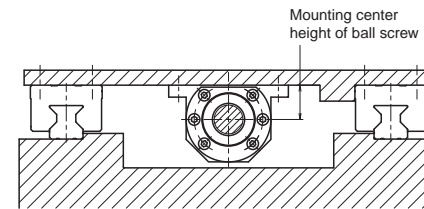
**B-1-4.6 Outside Shapes of Ball Nut**

**(1) Flange shape**

Fig. 4.1 shows the available flange shape. Select the appropriate shape according to the nut installation condition. (Fig. 4.2)



**Fig. 4.1 Flange shape**

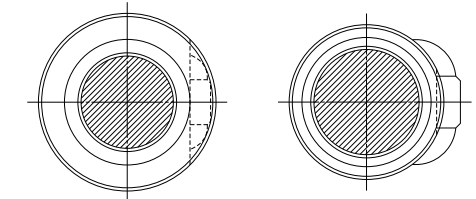


**Fig. 4.2 Installation example**

**(2) Shapes of nut cross section**

Cross-section of nuts are shown in Fig. 4.3. For detailed dimensions, refer to "Dimension table of nut."

- 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 housing because the ball recirculation tube protrudes from the circumference of the nut.



**Fig. 4.3 Shape of the cross section of nut**

B-1-4.7 Shaft End Configuration

(1) Standard shaft end dimensions

Table 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 screw.

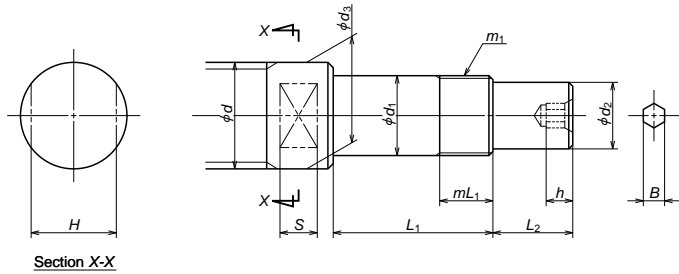


Fig. 4.4 Configuration of standard shaft end (drive side)

Table 4.9 Dimensions of shaft ends (drive side)

Unit: mm

Screw shaft diameter <i>d</i>	Bearing journal		Thread		Drive section		Seal section	Hexagon hole		Wrench flats		Support unit	
	Outside diameter <i>d<sub>1</sub></i>	Length <i>L<sub>1</sub></i>	Nominal spec. <i>m<sub>1</sub></i>	Length <i>mL<sub>1</sub></i>	Outside diameter <i>d<sub>2</sub></i>	Length <i>L<sub>2</sub></i>	Outside diameter <i>d<sub>3</sub></i>	Width across flats <i>B</i>	Depth <i>h</i>	Width across flats <i>H</i>	Length <i>S</i>	Reference No.	
4	6	22.5	M6x0.75	7	4.5	7.5	9.5	—	—	8	4.5	WBK06-01A	WBK06-11
6	6	22.5	M6x0.75	7	4.5	7.5	9.5	—	—	8	4.5	WBK06-01A	WBK06-11
8	8	27	M8x1	9	6	10	11.5	—	—	10	5.5	WBK08-01A	WBK08-11
10	8	27	M8x1	9	6	10	11.5	—	—	10	5.5	WBK08-01A	WBK08-11
12	10	30	M10x1	10	8	15	14	—	—	12	6.5	WBK10-01A	WBK10-11
14	12	30	M12x1	10	10	15	15	4	6	12	6.5	WBK12-01A	WBK12-11
15	12	30	M12x1	10	10	15	15	4	6	12	6.5	WBK12-01A	WBK12-11
16	12	30	M12x1	10	10	15	15	4	6	12	6.5	WBK12-01A	WBK12-11
20	15	40	M15x1	15	12	20	19.5	5	7	17	8.5	WBK15-01A	WBK15-11
	17	81	M17x1	23	12	29	20	5	7	22	10	WBK17DF-31	
25	20	53	M20x1	16	15	27	25	6	8	22	10	WBK20-01	WBK20-11
	20	81	M20x1	23	15	39	25	6	8	22	10	WBK20DF-31	
28	20	53	M20x1	16	15	27	25	6	8	22	10	WBK20-01	WBK20-11
	20	81	M20x1	23	15	39	28	6	8	24	12	WBK20DF-31	
32	25	62	M25x1.5	20	20	33	32	8	10	27	12	WBK25-01	WBK25-11
	25	89	M25x1.5	26	20	51	32	8	10	27	12	WBK25DF-31	
	25	104	M25x1.5	26	20	51	32	8	10	27	12	WBK25DFD-31	
36	30	89	M30x1.5	26	25	61	36	10	12	30	13	WBK30DF-31	
	30	104	M30x1.5	26	25	61	36	10	12	30	13	WBK30DFD-31	
40	30	89	M30x1.5	26	25	61	40	10	12	—	—	WBK30DF-31	
	30	104	M30x1.5	26	25	61	40	10	12	—	—	WBK30DFD-31	
45	35	92	M35x1.5	30	30	63	45	12	14	—	—	WBK35DF-31	
	35	107	M35x1.5	30	30	63	45	12	14	—	—	WBK35DFD-31	
50	40	92	M40x1.5	30	35	78	50	14	18	—	—	WBK40DF-31	
	40	107	M40x1.5	30	35	78	50	14	18	—	—	WBK40DFD-31	

Low-profile support unit is available for compact FA PSS type.

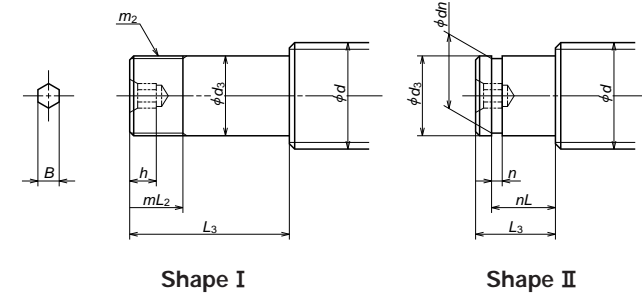


Fig. 4.5 Standard shaft end configuration (opposite to the drive side)

Table 4.10 Dimensions of shaft ends (opposite to the drive side)

Unit: mm

Screw shaft diameter <i>d</i>	Shape	Bearing journal		Thread for lock nut		Retainer ring groove			Hexagonal hole		Support unit	
		Outside diameter <i>d<sub>1</sub></i>	Length <i>L<sub>3</sub></i>	Nominal spec. <i>m<sub>2</sub></i>	Length <i>mL<sub>2</sub></i>	Width <i>n</i>	Groove diameter <i>dn</i>	Groove position <i>nL</i>	Width across flats <i>B</i>	Depth <i>h</i>	Reference No. Numbers in parentheses are bearing reference number.	
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	
	II	20	19	—	—	1.35	19	15.35	6	8	WBK20S-01	
25	I	20	53	M20x1	16	—	—	—	6	8	WBK20-01	WBK20-11
	I	20	81	M20x1	23	—	—	—	6	8	WBK20DF-31	
	II	20	19	—	—	1.35	19	15.35	6	8	WBK20S-01	
28	I	20	53	M20x1	16	—	—	—	6	8	WBK20-01	WBK20-11
	I	20	81	M20x1	23	—	—	—	6	8	WBK20DF-31	
	II	25	20	—	—	1.35	23.9	16.35	8	10	WBK25S-01	
32	I	25	62	M25x1.5	20	—	—	—	8	10	WBK25-01	WBK25-11
	I	25	89	M25x1.5	26	—	—	—	8	10	WBK25DF-31	
36	II	25	20	—	—	1.35	23.9	16.35	10	12	(6205)	
	I	25	89	M25x1.5	26	—	—	—	10	12	WBK30DF-31	
40	II	30	22	—	—	1.75	28.6	17.75	10	12	(6206)	
	I	30	89	M30x1.5	26	—	—	—	10	12	WBK30DF-31	
45	II	35	25	—	—	1.75	33	18.75	12	14	(6207)	
	I	35	92	M35x1.5	30	—	—	—	12	14	WBK35DF-31	
50	II	40	25	—	—	1.95	38	19.95	14	18	(6208)	
	I	40	92	M40x1.5	30	—	—	—	14	18	WBK40DF-31	

(2) Shaft end configuration of R series ball screws for transfer equipment

Table 4.11 and 4.12 show shaft end types for R Series.

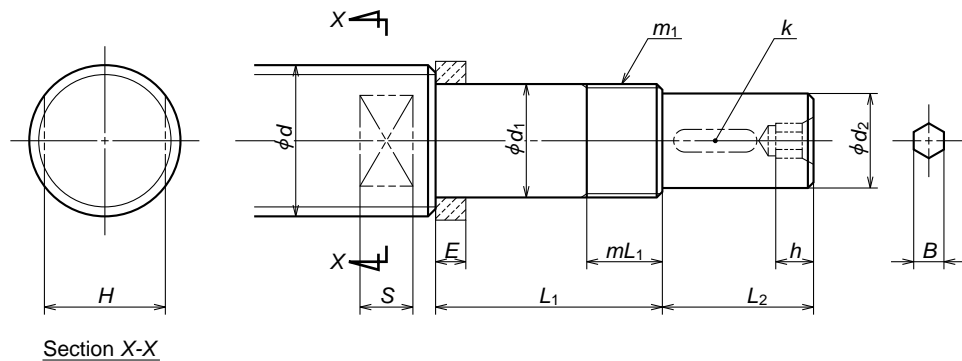


Fig. 4.6 R Series shaft end (drive side)

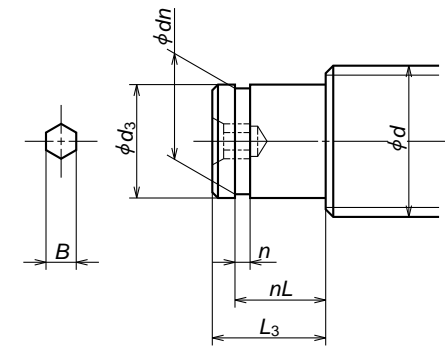


Fig. 4.7 Shaft end configuration of R Series (opposite to the drive side)

Table 4.11 Dimensions of R Series shaft ends (drive side)

Unit: mm

Screw shaft diameter $d$	Bearing journal		Thread for lock nut		Spacer Width $E$	Drive section			Hexagonal hole			Wrench flat		Support unit	
	Outside diameter $d_1$	Length $L_1$	Nominal spec $m_1$	Length $mL_1$		Outside diameter $d_2$	Length $L_2$	Key width $k$	Width across flats $B$	Depth $h$	Width across flats $H$	Length $S$	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	WBK25-01	WBK25-11	
36	25	76	M25×1.5	20	14	20	33	6	8	10	27	12	WBK25-01	WBK25-11	
40	30	89	M30×1.5	26	—	25	61	8	10	12	—	—	WBK30DF-31		
45	35	92	M35×1.5	30	—	30	63	8	12	14	—	—	WBK35DF-31		
50	35	92	M35×1.5	30	—	30	63	8	12	14	—	—	WBK35DF-31		

Note : The dimension  $d_1$  shall be smaller enough than the minor diameter of the ball screw thread to provide sufficient shoulder surface for the spacer.

Refer to "B-II-14 Precautions for Designing Ball Screw (B84 page)".

Table 4.12 Dimensions of R Series shaft ends (opposite to the drive side)

Unit: mm

Screw shaft diameter $d$	Bearing journal		Retaining ring groove			Hexagonal hole		Support unit	
	Outside diameter $d_3$	Length $L_3$	Width $n$	Groove diameter $dn$	Groove position $nL$	Width across flats $B$	Depth $h$	Numbers in parentheses are bearing reference numbers.	
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-01(6205)	
36	25	20	1.35	23.9	16.35	8	10	WBK25S-01(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 number" or "specification number" when inquiring about desired ball screw specifications.

### ◇ Reference number:

Alpha-numeric codes are assigned to each ball screw. When placing order, please use this reference number.

### ◇ Specification number:

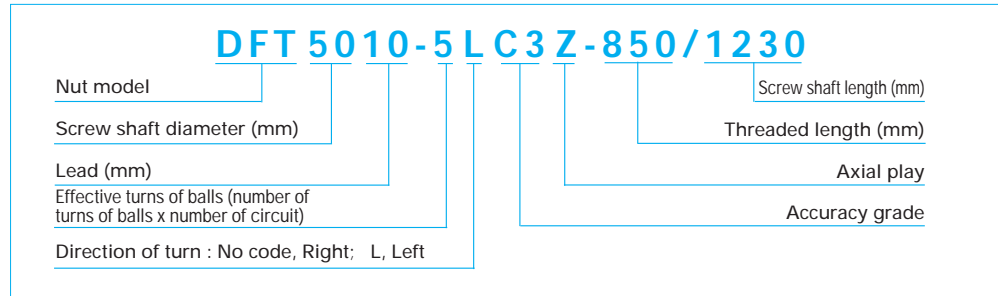
Specification factors are identified by alpha-numeric codes. Codes are for easy explanation of your requirements. (If you do not use these numbers, please itemize your requirements.)

### B-1-5.1 When Ordering Made-to-Order Ball Screws

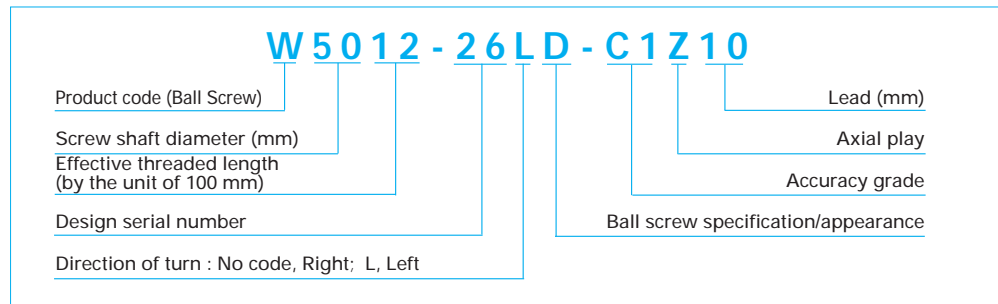
If you would like to discuss technical points regarding specifications, use the NSK ball screw technical data sheet as an aid (Page B36). For

high-load drive ball screws, use the technical sheet for NSK high-load drive ball screw.

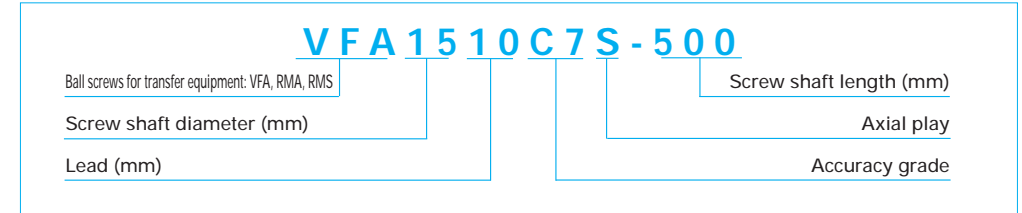
#### (1) Specification number of made-to-order ball screw



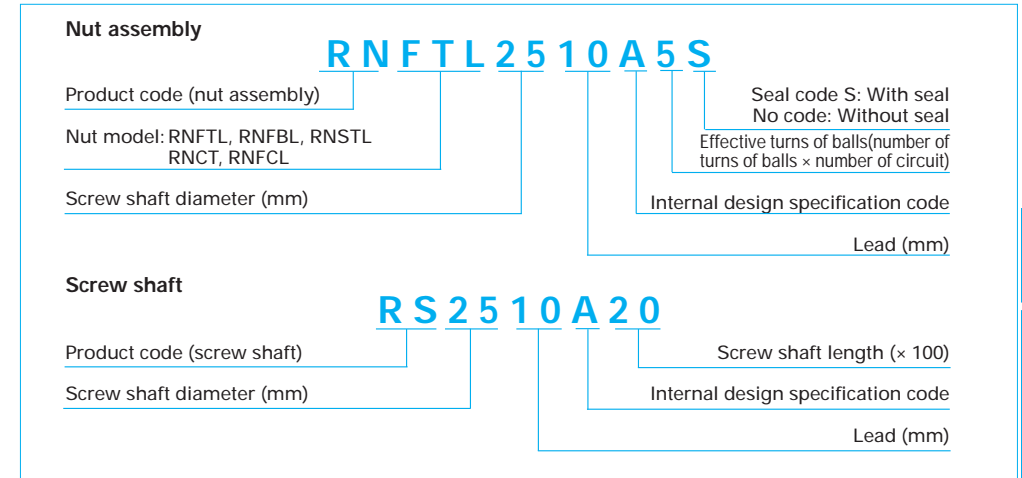
#### (2) Reference number of made-to-order ball screw



#### (3) Reference number of ball screws for transfer equipment with finished shaft end and blank shaft end



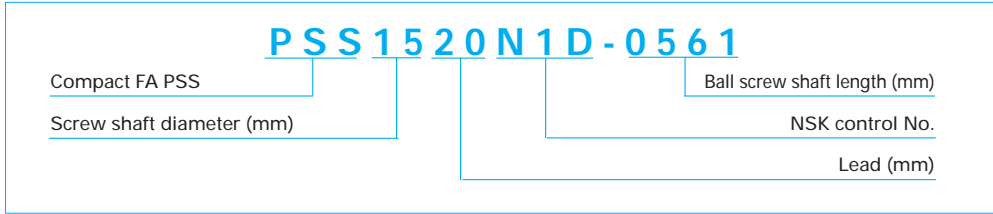
#### (4) Reference number of R series ball screws for transfer equipment



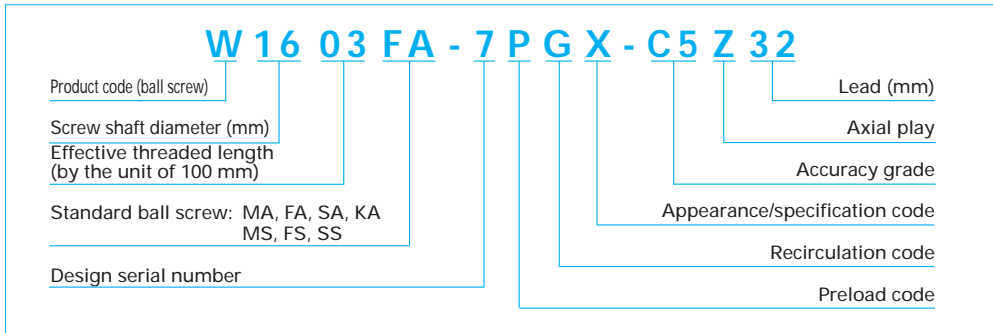
**B-1-5.2 When Ordering Standard Ball Screw**

Find the reference number from the dimension table. Enter the reference number in the "Order Form by Fax" (Page B34). Send the fax to a NSK agency (branch office, sales office, or your local representative.).

**(1) Example of reference number of Compact FA PSS Type**



**(2) Example of reference number of Standard ball screw**



**Fax Order Form**

(Make copies for future orders)

(1) Standard ball screw

Company name : \_\_\_\_\_ Date: Day Month Year

Address : \_\_\_\_\_ Telephone : \_\_\_\_\_

Name of person in charge : \_\_\_\_\_ Section : \_\_\_\_\_

Product name	Specification number	Quantity	Desired delivery date
Precision ball screw			
R Series ball screw Nut			
R Series ball screw Screw shaft			
Support unit			
Lock nut			
Grease unit			

Describe the shaft end configuration if processing is required (blank shaft end ball screw). In this case, specify which ball screw in the above list the shaft end shall be processed. Refer to Page B27 to 30 for shaft end configuration. These pages also show the reference number for support units.

Drive side	
Opposite of drive side	

**NSK Ball Screw Technical Data Sheet (example)**

(2) Made-to-order ball screw

Company name \_\_\_\_\_ Date: Day Month Year \_\_\_\_\_  
 Address \_\_\_\_\_ Telephone \_\_\_\_\_  
 Person in charge \_\_\_\_\_ Section \_\_\_\_\_  
 Machine which uses the ball screw Machining center Model MC- Application Table left/right movement (X axis)  
 Drawing/rough sketch attached? Yes  No

**Use conditions**

Maximum load	9 000 N	20 min <sup>-1</sup>	15 %	Operating conditions	Shaft rotation - Moving nut (Normal operation)
Load in normal use	4 000 N	360 min <sup>-1</sup>	60 %		Shaft rotation - Moving shaft Back drive operation
Minimum load	2 000 N	1 000 min <sup>-1</sup>	25 %		Nut rotation - Moving nut Nut rotation - Moving shaft Oscillation
				Degree of vibration shock	Normal
Maximum rotational speed	1 000 min <sup>-1</sup>			Required life	2 000 h
Lubricant	Grease/oil (Brand name: <i>NSK GRS AS2</i> ) Maker: _____			Motor in use	Company A, Model 1
Seal	Yes	No		Control system	Company B, Model 2 ( resolution: 1µm)
Support bearing	Drive side <i>35TAC62DF</i>	Opposite to drive side <i>35TAC62DF</i>			
Guide way	Rolling Sliding ( <i>RA451500GM2-P4Z3-I</i> )				
Environment	Temperature (Normal temperature in degrees Celsius)	Dust	Humidity	Gas	Liquid (where?) Clean room In vacuum
Schedule for prototype	Day	Month	Year (approx.)	Quantity used	Piece
Date, going in production/Quantity	/Month	/Year	/Lot	per machine	

**Specification factors of the ball screw**

Screw shaft diameter	50 mm	Direction of turn	right	Accuracy grade	C2	Screw shaft length	880 mm	Preload	3000 N
Lead	10 mm	Effective turns of balls		Axial play	0 mm	Overall shaft length	1335 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 (example)**

(2) Made-to-order ball screw

Company name \_\_\_\_\_ Date: Day Month Year \_\_\_\_\_  
 Address \_\_\_\_\_ Telephone \_\_\_\_\_  
 Person in charge \_\_\_\_\_ Section \_\_\_\_\_  
 Machine which uses the ball screw \_\_\_\_\_ Application \_\_\_\_\_  
 Drawing/rough sketch attached? Yes  No

**Use conditions**

Maximum load	N	min <sup>-1</sup>	%	Operating conditions	Shaft rotation - Moving nut Normal operation
Load in normal use	N	min <sup>-1</sup>	%		Shaft rotation - Moving shaft Back drive operation
Minimum load	N	min <sup>-1</sup>	%		Nut rotation - Moving nut Nut rotation - Moving shaft Oscillation
				Degree of vibration shock	
Maximum rotational speed	min <sup>-1</sup>			Required life	
Lubricant	Grease/oil (Brand name: _____ ) Maker: _____			Motor in use	
Seal	Yes	No		Control system	(resolution: _____ )
Support bearing	Drive side	Opposite to drive side			
Guide way	Rolling Sliding ( _____ )				
Environment	Temperature (Normal temperature in degrees Celsius)	Dust	Humidity	Gas	Liquid (where?) Clean room In vacuum
Schedule for prototype	Day	Month	Year (approx.)	Quantity used	Piece
Date, going in production/Quantity	/Month	/Year	/Lot	per machine	

**Specification factors of the ball screw**

Screw shaft diameter		Direction of turn		Accuracy grade		Screw shaft length		Preload	
Lead		Effective turns of balls		Axial play		Overall shaft length		Required torque	
Nut model		Flange type		Nut orientation	Same as shown in the dimension table			Opposite	

Supplemental explanation/requests



# NSK Technical Data Sheet for NSK High-Load Drive Ball Screw

Made-to-order ball screw

Company name:	Date:	NSK sales office
Section:	Person in charge:	
Address:		

Name of machine\*1 : Electric injection molding machine; 30-ton capacity Application\*2 : Clamping axis

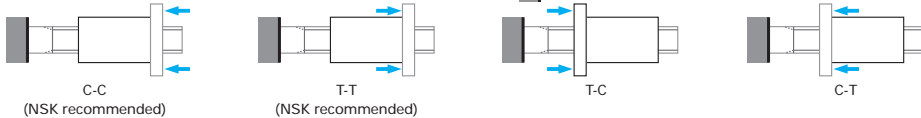
Drawing/rough sketch attached?:  Yes  No

\*1 Please specify capacity of the machine in case of injection molding machine or press.  
\*2 If the application is injection molding machine, please indicate the axis. (Examples: injection axis and clamping axis)

## 1. Use conditions

Operating conditions	<input checked="" type="checkbox"/> Shaft rotation — Moving nut	<input checked="" type="checkbox"/> Normal operation	Degree of vibration/impact	<input type="checkbox"/> Smooth operation without impact
	<input type="checkbox"/> Shaft rotation — Moving shaft	<input type="checkbox"/> Back drive operation		<input checked="" type="checkbox"/> Normal operation
Direction of load*3	<input type="checkbox"/> C-C <input checked="" type="checkbox"/> T-T <input type="checkbox"/> T-C	<input type="checkbox"/> C-T <input type="checkbox"/> Other	Mounting orientation	<input checked="" type="checkbox"/> Horizontal
	(Refer to figures below.)			<input type="checkbox"/> Vertical (Indicate the direction of gravity.)
Lubricant	<input checked="" type="checkbox"/> Grease (Brand name: <i>High-load grease with an extreme pressure additive</i> )	How to replenish lubricant	<input checked="" type="checkbox"/> Grease gun	<input type="checkbox"/> Automatic
Request for oil hole	<input type="checkbox"/> Oil (Maker: )		(      cm <sup>3</sup> /      cycles)	
Necessity of seals	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	NSK S1 necessary?	<input checked="" type="checkbox"/> NSK recommended	<input type="checkbox"/> Not necessary
Environment	Temperature ( 40 deg)	Particles / <input type="checkbox"/> Yes (Size of particle : a) -0.1, b) over 0.1-0.3, c) over 0.3- , d) Ingredient: )	<input checked="" type="checkbox"/> No particle.	
Surface treatment	<input checked="" type="checkbox"/> Not required	<input type="checkbox"/> Low-temperature chrome plating	<input type="checkbox"/> Fluoride low-temperature chrome plating	<input type="checkbox"/> Other
Quantity in mass-production	/Month	/Year	/Lot	Quantity used per machine: 1 pcs./machine

\*3 Please specify loading direction code on the figures below. (Shaft fixed: ■ Main load: ←)



## 2. Specifications

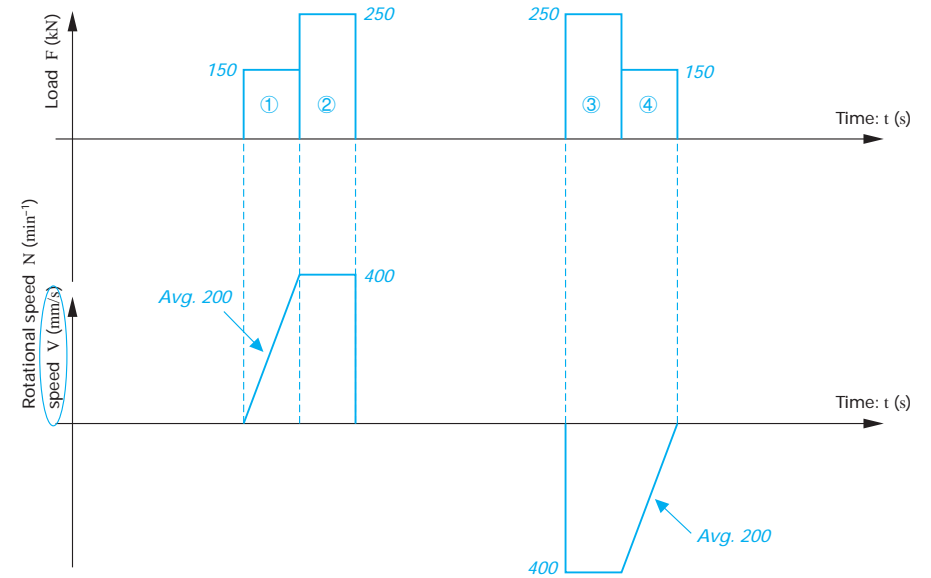
Shaft diameter	φ 140 mm	Lead	32 mm	Accuracy grade	Cl7	Axial play	0.050 or less mm max.
Nut model No.	HTF 14032-7.5-S1	Effective turns of balls	2.5 × 2	Direction of turn	right	Thread length / Overall shaft length	1000 / 1500

Special note / Requests

Please calculate the life as a continuous operation based on "3. Load chart".

# NSK Technical Data Sheet for NSK High-Load Drive Ball Screw

## 3. Load chart



	Axial load* F (kN)	Rotational speed or Average speed N (min <sup>-1</sup> )	V (mm/s)	Time t (s)	Stroke St (mm)	Remarks
1	150		200	0.5	100	
2	250		400	0.5	200	
3	250		400	0.5	200	
4	150		200	0.5	100	
5				Total: 2.0	Total: 600	
6						
7						
8						
9						
10						

Dynamic axial load (MAX.)\*: 250 (kN)      Static axial load (MAX.)\* (at 0 mm/s): (kN)  
Stroke in normal use: 300 (mm)      Maximum stroke: 500 (mm)  
Cycle time: 2.0 (s)      Required life: 2500 (✓ h or □ cycles)

\*If you use multiple ball screws in an axis, fill out the axial load per ball screw.

## 4. Plan to conduct the endurance test of the ball screw?

Actual data on the machine  Yes  N/A

Planning to check endurance (Date: *From the middle of December 2009*)  No (Reason: )

### Endurance of the ball screw

- (1) Mounting accuracy, load conditions, and lubricating conditions are the main factors affecting the ball screw fatigue life. Therefore, we recommend evaluating the influence of those factors on actual use of your machines.
- (2) A temperature rise caused by operational and environmental conditions may reduce the effectiveness of lubricant.

# NSK Technical Data Sheet for NSK High-Load Drive Ball Screw

Made-to-order ball screw

Company name:	Date:	NSK sales office
Section:	Person in charge:	
Address:		

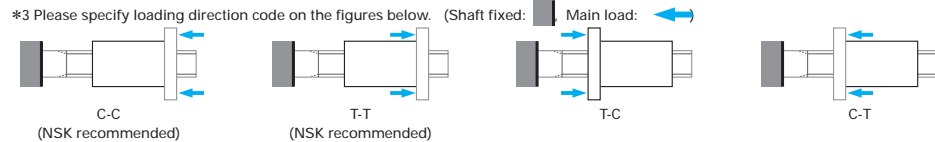
Name of machine\*1 : \_\_\_\_\_ Application\*2 : \_\_\_\_\_

Drawing/rough sketch attached?:  Yes  No

\*1 Please specify capacity of the machine in case of injection molding machine or press.  
 \*2 If the application is injection molding machine, please indicate the axis. (Examples: injection axis and clamping axis)

## 1. Use conditions

Operating conditions	<input type="checkbox"/> Shaft rotation — Moving nut	<input type="checkbox"/> Normal operation	Degree of vibration/impact	<input type="checkbox"/> Smooth operation without impact
	<input type="checkbox"/> Shaft rotation — Moving shaft	<input type="checkbox"/> Back drive operation		<input type="checkbox"/> Normal operation
Direction of load*3	<input type="checkbox"/> Nut rotation — Moving nut	<input type="checkbox"/> C-T <input type="checkbox"/> Other	Mounting orientation	<input type="checkbox"/> Operation associated with impact or vibration
	<input type="checkbox"/> Nut rotation — Moving shaft			<input type="checkbox"/> Oscillation
Lubricant	<input type="checkbox"/> Grease (Brand name: _____) <input type="checkbox"/> Oil (Maker: _____)		How to replenish lubricant	<input type="checkbox"/> Vertical (Indicate the direction of gravity.)
Request for oil hole	<input type="checkbox"/> NSK recommended <input type="checkbox"/> Your request			<input type="checkbox"/> Grease gun <input type="checkbox"/> Automatic
Necessity of seals	<input type="checkbox"/> Yes <input type="checkbox"/> No		NSK S1 necessary?	( _____ cm <sup>3</sup> / _____ cycles)
Environment	Temperature ( _____ deg)	<input type="checkbox"/> Yes (Size of particle : a) -0.1, b) over 0.1-0.3, c) over 0.3- _____, d) Ingredient: _____) <input type="checkbox"/> No particle.		
	Surface treatment			
<input type="checkbox"/> Not required <input type="checkbox"/> Low-temperature chrome plating <input type="checkbox"/> Fluoride low-temperature chrome plating <input type="checkbox"/> Other				
Quantity in mass-production	/Month	/Year	/Lot	Quantity used per machine _____ pcs./machine



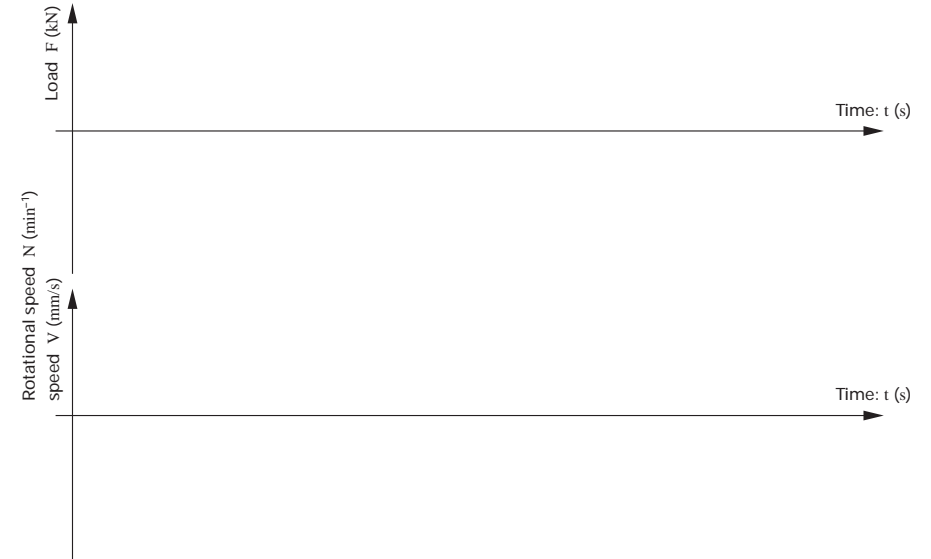
## 2. Specifications

Shaft diameter	φ _____ mm	Lead	_____ mm	Accuracy grade	_____	Axial play	_____ mm max.
Nut model No.	_____	Effective turns of balls	_____	Direction of turn	_____	Thread length /Overall shaft length	_____ / _____

Special note / Requests

# NSK Technical Data Sheet for NSK High-Load Drive Ball Screw

## 3. Load chart



	Axial load* F (kN)	Rotational speed or Average speed N (min <sup>-1</sup> )	V (mm/s)	Time t (s)	Stroke St (mm)	Remarks
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

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 you use multiple ball screws in an axis, fill out the axial load per ball screw.

## 4. Plan to conduct the endurance test of the ball screw?

Actual data on the machine  Yes  N/A

N/A → Planning to check endurance (Date: \_\_\_\_\_) )  
 N/A → No (Reason: \_\_\_\_\_) )

### Endurance of the ball screw

- (1) Mounting accuracy, load conditions, and lubricating conditions are the main factors affecting the ball screw fatigue life. Therefore, we recommend evaluating the influence of those factors on actual use of your machines.
- (2) A temperature rise caused by operational and environmental conditions may reduce the effectiveness of lubricant.

# 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-C5 grades) conforms to the four characteristics specified in JIS Standards. These characteristics are expressed by codes  $ep$ ,  $v_u$ ,  $v_{300}$ , and  $v_{2\pi}$ . Fig. 1.1 explains the definition of each characteristic, and shows allowable value of each. Leads are classified into two categories: C system for

positioning; Ct system for transportation. Table 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.

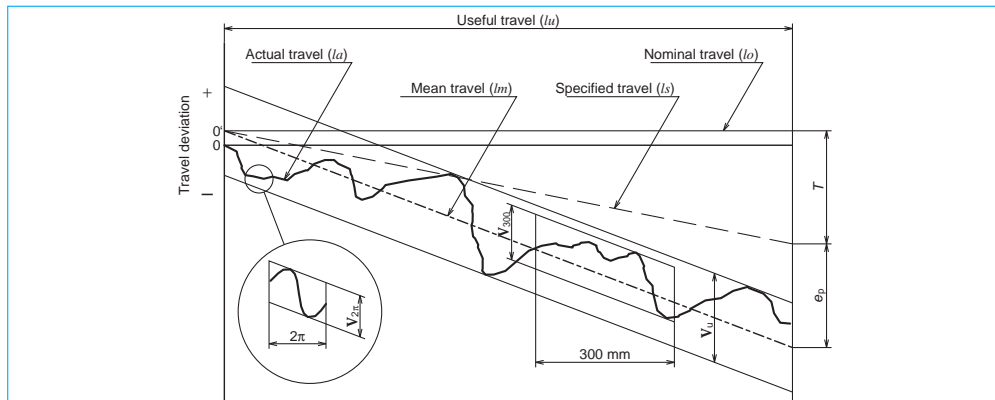


Fig. 1.1 Definition of lead accuracy

Table 1.1 Terminology in lead accuracy

Term	Code	Description	Tolerance
Specified travel	$ls$	The travel compensates the nominal travel for an 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 the errors caused by thermal deformation or deformation by load. This value is determined by tests and experience (See Page B43).	
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 least-squares method or by resembling approximation.	
Tolerance on specified travel	$ep$	Obtained by subtracting the specified travel from the actual mean travel.	Table 1.2
Travel variation	$v_u$ $v_{300}$ $v_{2\pi}$	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. <ul style="list-style-type: none"> <li>• Maximum range relative to the effective length of thread.</li> <li>• Maximum range relative to the length of 300 mm anywhere within the effective length of thread.</li> <li>• Maximum range which corresponds to any single rotation (<math>2\pi rad.</math>) within the effective length of thread.</li> </ul>	Table 1.2 Table 1.3, 1.4 Table 1.3

Table 1.2 Tolerance on specified travel ( $\pm ep$ ) and travel variation ( $v_u$ ) of the positioning (C type) ball screws

Unit:  $\mu m$

Effective thread length mm	Accuracy grade		C0		C1		C2		C3		C5	
	over	or less	$\pm ep$	$v_u$	$\pm ep$	$v_u$	$\pm ep$	$v_u$	$\pm ep$	$v_u$	$\pm ep$	$v_u$
	-	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	1000	8	6	11	8	15	10	21	15	40	27
	1000	1250	9	6	13	9	18	11	24	16	46	30
	1250	1600	11	7	15	10	21	13	29	18	54	35
	1600	2000			18	11	25	15	35	21	65	40
	2000	2500			22	13	30	18	41	24	77	46
	2500	3150			26	15	36	21	50	29	93	54
	3150	4000			30	18	44	25	60	35	115	65
	4000	5000					52	30	72	41	140	77
	5000	6300					65	36	90	50	170	93
	6300	8000							110	60	210	115
	8000	10000									260	140
	10000	12500									320	170

Table 1.3 Tolerance of travel variation relative to 300 mm ( $v_{300}$ ) and one revolution ( $v_{2\pi}$ ) of the positioning (C type) ball screws

Unit:  $\mu m$

Accuracy grade	C0	C1	C2	C3	C5
$v_{300}$	3.5	5	7	8	18
$v_{2\pi}$	2.5	4	5	6	8

Remark  to JIS B1192 standards. Values in other areas are NSK standards.

Table 1.4 Travel variation ( $v_{300}$ ) relative to 300 mm of the transportation (Ct type) ball screws

Unit:  $\mu m$

Accuracy grade	Ct7	Ct10
$v_{300}$	52	210

Remark Tolerance on specified travel ( $ep$ ) of the transportation (Ct type) ball screws is calculated as follows.

$$ep = \frac{2 \cdot lu}{300} \cdot v_{300}$$

### Example of specifying lead accuracy

<Use Conditions>

Nut model: DFT4010-5

Stroke: 1000 mm

Positioning accuracy:  $\pm 0.035$  mm/1000 mm

<Calculation>

Obtain required lead accuracy of a ball screw under these conditions.

① Calculate the length of the thread

$$\begin{aligned} \text{Stroke} + \text{nut length} + \text{margin} &= 1000 + 193 + 100 \\ &= 1293 \text{ (mm)} \cdots \rightarrow 1300 \text{ mm} \end{aligned}$$

② Calculate lead accuracy

From Table 1.2, obtain the tolerance on specified travel relative to the length of thread (1300 mm).

C5 ...  $\pm 0.054/1250 - 1600$

C3 ...  $\pm 0.029/1250 - 1600$

③ Determine lead accuracy

Positioning accuracy is:  $\pm ep < \pm 0.035/1000$  mm

Accuracy grade: C3 grade  $\pm ep = 0.029/\text{length of thread (1300 mm)}$   
 $v_r = 0.018$

### 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 the ball screws. Thermal expansion of a screw shaft is calculated as follows.

$$\Delta L_{\theta} = \rho \cdot \theta \cdot L(\text{mm}) \quad \text{-- (II-1)}$$

In this formula:

$\Delta L_{\theta}$  : Thermal expansion (mm)

$\rho$  : Thermal expansion coefficient ( $12.0 \times 10^{-6} \text{ } ^\circ\text{C}^{-1}$ )

$\theta$  : 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  $\mu\text{m}$  per meter. Ball screw generates more heat when it is used at high speed. This causes elongation of the screw shaft. Although the ball screw lead is ground into high precision, an elongated screw shaft due to high temperature rise may not satisfy required highly accurate positioning.

#### (2) Countermeasures against temperature rise

Countermeasures against temperature rise of the ball screw are:

Hollow shaft cooling is recommended to operate high-speed and high-precision conditions.

① Suppress heat generation

- Do not apply excessive preload to the ball screw and support bearing.
- Select correct lubricant and use it appropriately.
- Use higher helix ball screw lead to lower rotational speed.

② Use forced cooling.

- Use hollow screw shaft, and flow liquid coolant through it. - Refer to hollow ball screws in the section for application-oriented ball screws (Page B144).
- Cool screw shaft surface with lubricant oil or air.

③ Avoid effects of temperature rise on positioning

- Warm up the machine by high speed until temperature rise saturate, then maintain a

stable temperature of ball screw shaft.

- Set pre-tension. (Fig. 1.2)
- Set the negative (minus) target value of specified travel.
- Employ the closed loop control system.

#### (3) How to determine specified travel

In general, the specified travel of 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 occasion, 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 lathe	X	- 0.02 — - 0.05
	Z	- 0.02 — - 0.03
Machining center	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 the temperature rise of 2 to 3°C.

Fig. 1.2 shows the bearing support structure in such occasion.

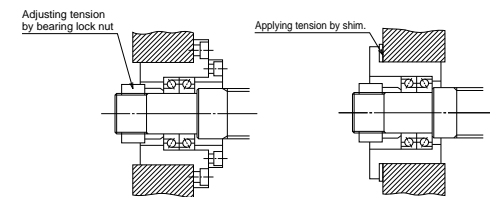
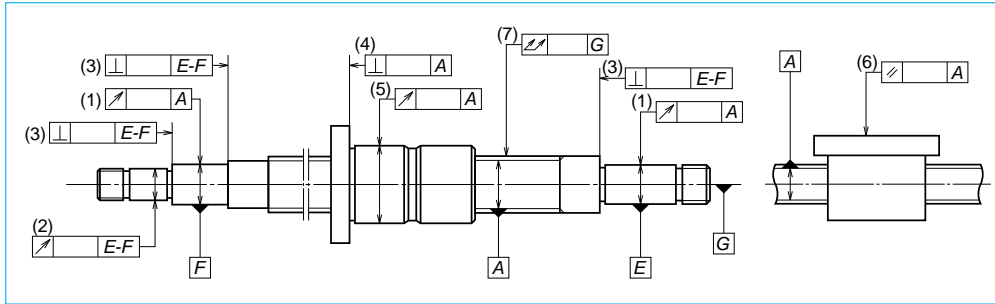


Fig. 1.2 Bearing structure to provide pre-tension

**B-2-1.3 Mounting Accuracy and Tolerance of Ball Screws**

The accuracy related to mount the ball screws is specified in the following seven characteristics (Fig. 1.3). The tolerance is 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 the ball screw installation, refer to "Installation of Ball Screw (1) Centering of the units" (Page B77).



**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) Perpendicularity of the shoulder of support bearing seat relative to the axis of support bearing seat.
- (4) Perpendicularity of the nut flange face, or of the nut end datum face, relative to the axis of screw shaft.
- (5) Eccentricity 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:  $\mu\text{m}$

Accuracy grade		C0						C1						
Nominal diameter (mm)	over	-	8	12	20	32	50	-	8	12	20	32	50	80
	or less	8	12	20	32	50	80	8	12	20	32	50	80	125
Overall length of screw shaft (mm)	over	or less												
	-	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	1000			65	45	30	25		75	55	40	30	25
	1000	1250			85	55	40	30		95	65	45	35	30
	1250	1600			110	70	50	40		130	85	60	45	35
	1600	2000			95	65	45			120	80	55	40	
	2000	2500									100	70	50	
	2500	3150										130	90	
	3150	4000												120

Unit:  $\mu\text{m}$

Accuracy grade		C3						C5							
Nominal diameter (mm)	over	-	8	12	20	32	50	80	-	8	12	20	32	50	80
	or less	8	12	20	32	50	80	125	8	12	20	32	50	80	125
Overall length of screw shaft (mm)	over	or less													
	-	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	1000			95	65	50	40	30		120	85	65	50	45
	1000	1250			120	85	60	45	35		150	100	75	60	50
	1250	1600			160	110	75	55	40		190	130	95	70	55
	1600	2000			140	95	70	50			170	120	85	65	
	2000	2500					120	85	60				150	110	80
	2500	3150					160	110	75				200	140	95
	3150	4000					220	150	100				260	180	120
	4000	5000						200	130					240	160
5000	6300												310	210	
6300	8000													280	
8000	10000													370	

### B-2-1.4 Automatic lead accuracy measuring system of NSK

In response to the demand for high precision in production technology, NSK is the first in the world that developed and uses "Lead Accuracy Measuring System (LAMS)." Lead accuracy is measured by the system that employs a laser interferometer measuring instrument and a personal computer.

Fig. 1.4 shows the lead accuracy measuring system. The inspection date of 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 which are input into a computer are processed into four characteristics readings regarding lead accuracy. (See Page B41.)

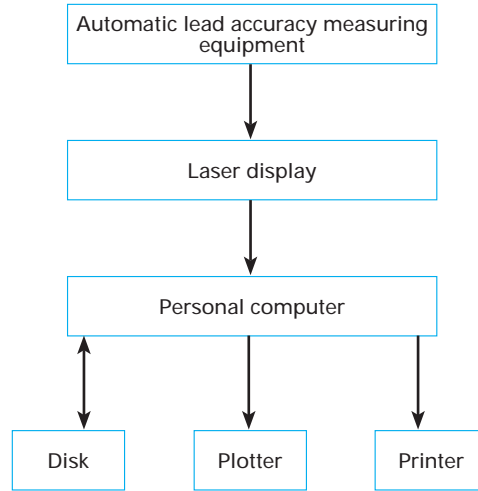


Fig. 1.4 Lead accuracy measuring system

**NSK**

**BALL SCREW INSPECTION DATA**

NSK REF. NO. \_\_\_\_\_

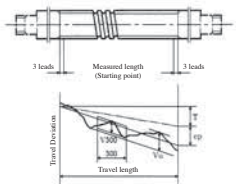
CUSTOMER'S PART NO. \_\_\_\_\_

SERIAL NO. \_\_\_\_\_

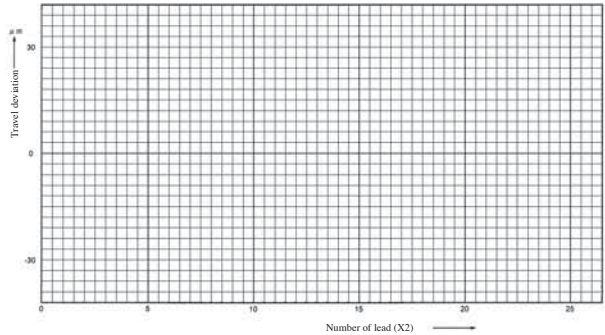
SHAFT NO. \_\_\_\_\_

MEASURING INSTRUMENT: Laser beam type automatic lead measuring instrument.

TEMPERATURE: 20 ± 0.2°C



Nominal lead	± 0.01	mm
Specified travel deviation for compensation	± 0.01	mm
Accuracy	Permissible value	Measured result
Mean travel deviation	± 0.01	± 0.01
Variation over the travel length	± 0.01	± 0.01
Variation within 300mm travel	± 0.01	± 0.01
Preload drag torque	Sum	Sum
Axial play	± 0.01	± 0.01



All dimensions are within specifications.

INSPECTOR: \_\_\_\_\_

DATE: - - -

NSK Ltd. TOKYO, JAPAN

3 leads

Measured length (Starting point)

Travel Deviation

Travel length

Fig. 1.5 Ball screw inspection data

### B-2-2 Static Load Limitation

Ball screw, based on its function, will generally receive axial load only. Ball screw shaft in general is long, so it is necessary to consider 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

$$I = \frac{\pi}{64} d_r^4 \quad (\text{mm}^4) \dots\dots(\text{II-3})$$

$d_r$  : Screw shaft root diameter (mm) [See the dimension table.]

$L$  : Unsupported length (mm) [See Fig. 4.1 and 4.2 'Supporting conditions of screw shaft and nut' in Page B55.)

$m, N$  : Factors determined by the supporting condition of the ball screw shaft

#### 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 axial direction, is calculated as follows.

$$P = \alpha = \frac{N \cdot \pi^2 \cdot E \cdot I}{L^2} = m \frac{d_r^4}{L^2} \times 10^4 \quad (\text{N}) \dots\dots(\text{II-2})$$

In this formula:

$\alpha$  : Safety factor ( $\alpha = 0.5$ )

$E$  : Elastic modulus ( $E = 2.06 \times 10^5 \text{ MPa}$ )

$I$  : Moment of inertia

Table 2.1 Factors of buckling load

Supporting condition	$m$	$N$
Fixed - Fixed support	19.9	4
Fixed - Simple support	10.0	2
Fixed support - Free	1.2	0.25
Simple - Simple support	5.0	1

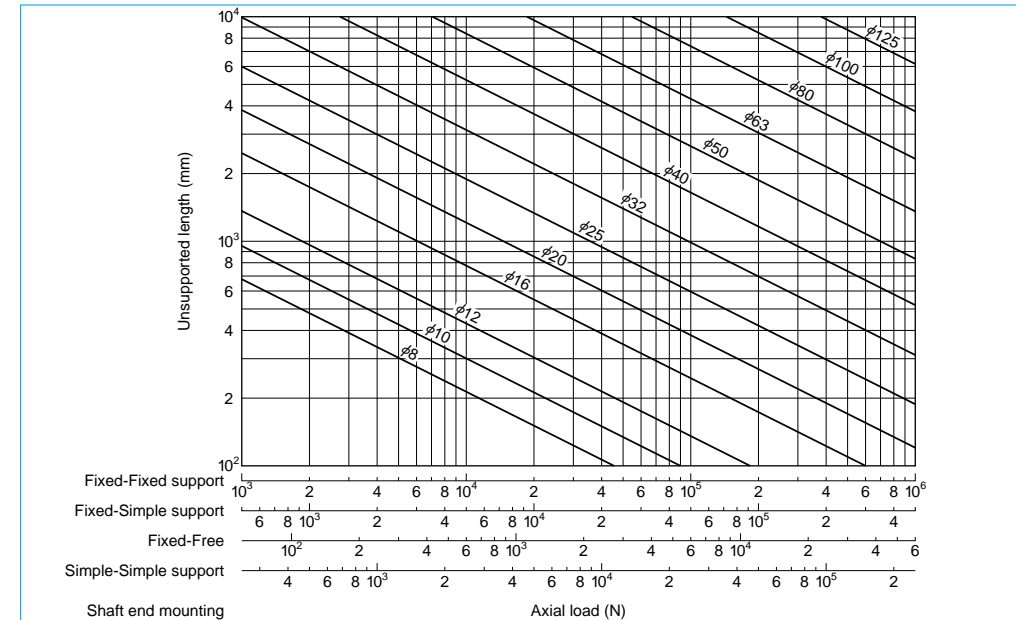


Fig. 2.1 Buckling load

<<Calculation example of buckling load>>

Calculate buckling load under the conditions in Fig. 2.2.

<Use conditions>

Nut model: DFT4010-5

Supporting condition is Fixed - Fixed support (From the supporting condition (ii) in Fig. 4.1 'Supporting conditions of screw shaft and nut' in Page B55.)

Unsupported length  $L = 2000$  mm

Screw shaft root diameter  $d_r = 34.4$  mm (From the dimension table)

<Calculation>

Support condition is Fixed - Fixed support, From Table 2.1 in Page B48

$$N = 4$$

$$m = 19.9$$

By Formula (II-2) in Page B48

$$P = m \frac{d_r^4}{L^2} \cdot 10^4 = 19.9 \times \frac{34.4^4}{2000^2} \times 10^4 = 69667 \text{ (N)}$$

Therefore,

$$\text{Permissible buckling load } P = 69600 \text{ N}$$

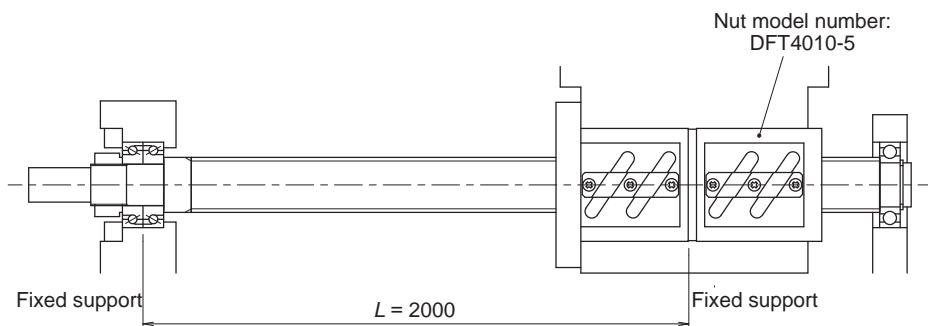


Fig. 2.2 Calculation example of buckling load

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

$$P = \sigma \cdot A = 1.15 d_r^2 \times 10^2 \text{ (N)} \quad \text{(II-4)}$$

In this formula:

$\sigma$  : Allowable stress (= 147 MPa)

A : Cross section area of a screw shaft using root diameter (mm<sup>2</sup>)

$$A = \frac{\pi}{4} \cdot d_r^2 \text{ (mm}^2\text{)} \quad \text{(II-5)}$$

$d_r$  : Screw shaft root diameter (mm)

<<Calculation example of yield load>>

Obtain load in respect to the allowable stress under the conditions in Fig. 2.2.

<Use conditions>

Nut model: DFT4010-5

Screw shaft root diameter  $d_r = 34.4$  (mm)  
(From the dimension table)

<Calculation>

By Formula II-4

$$P = 1.15 d_r^2 \times 10^2 = 1.15 \times 34.4^2 \times 10^2 = 136086 \text{ (N)}$$

Therefore,

$$\text{Permissible load } P = 136000 \text{ N}$$

B-2-2.3 Permanent Deformation of 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 limitation of this disfigurement to containing it within a certain range.

(1) Basic static load rating  $C_{0a}$

Basic static load rating  $C_{0a}$  is a load to axial direction that results in the 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  $C_{0a}$

$P_0$  (allowable axial direction load to limit the permanent deformation) is calculated using  $C_{0a}$ .

$$P_0 = \frac{C_{0a}}{f_s} \text{ (N)} \quad \text{(II-6)}$$

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

<<Calculation example of maximum allowable load>>

Obtain maximum allowable load to the ball groove section under conditions in Fig. 2.2

<Use conditions>

Nut model: DFT4010-5

Basic static load rating  $C_{0a} = 137000$  (N)  
(From the dimension table)

Static permissible load factor  $f_s = 2$   
(normal operation, no vibration impact)

<Calculation>

By Formula II-6, maximum allowable load of the ball groove section

$$P_0 = \frac{C_{0a}}{f_s} = \frac{137000}{2} = 68500 \text{ (N)}$$

### B-2-3 Permissible Rotational Speed

Permissible rotational speed is determined by the feeding speed and ball screw lead. When selecting ball screw, it is important to know the permissible rotational speed.

It is necessary to calculate two items below, and whichever smaller is 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 B54, even both the critical speed of screw shaft rotation and the d·n value are in range of the allowable limit.

#### B-2-3.1 Critical Speed of the Screw Shaft

Calculate the critical speed which is the matching value of the ball screw rotational speed and the natural frequency of the screw shaft. The permissible rotational speed is up to the 80% range of the critical 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 calculation.

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 with 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 "Nut rotatable drive ND Series" in Page B149.)

Calculate the permissible rotational speed based on critical speed  $n_c$  as follows, taking in account "supporting conditions for calculation of buckling load and critical speed" on Page B55.

Fig. 3.1 shows the permissible rotational speeds against critical speed for each shaft diameter.

$$n_c = \alpha \times \frac{60\lambda^2}{2\pi L^2} \sqrt{\frac{E \cdot I \cdot g}{\gamma \cdot A}} = f \frac{d_r}{L^2} \times 10^7 \text{ (min}^{-1}\text{)} \quad (\text{II-7})$$

In this formula:

- $\alpha$  : Safety factor ( $\alpha = 0.8$ )
- E : Elastic modulus ( $E = 2.06 \times 10^5 \text{ MPa}$ )
- I : Moment of inertia of area of screw shaft

$$I = \frac{\pi}{64} d_r^4 \text{ (mm}^4\text{)} \quad (\text{II-3})$$

$d_r$  : Screw shaft root diameter (mm) [See the dimension table.]

g : Acceleration of gravity ( $= 9.8 \times 10^3 \text{ mm/s}^2$ )

$\gamma$  : Specific weight ( $\gamma = 7.65 \times 10^5 \text{ N/mm}^3$ )

A : Cross section area of the screw shaft root diameter ( $\text{mm}^2$ )

$$A = \frac{\pi}{4} d_r^2 \text{ (mm}^2\text{)} \quad (\text{II-5})$$

L : Unsupported length (mm) [See Fig. 4.1, 4.2 'Supporting conditions of screw shaft and ball nut' on Page B55]

f,  $\lambda$  : Factors determined by the supporting condition

Table 3.1 Coefficients of critical speed

Supporting condition	f	$\lambda$
Fixed - Simple support	15.1	3.927
Fixed - Fixed support	21.9	4.730
Fixed support - Free	3.4	1.875
Simple - Simple support	9.7	$\pi$

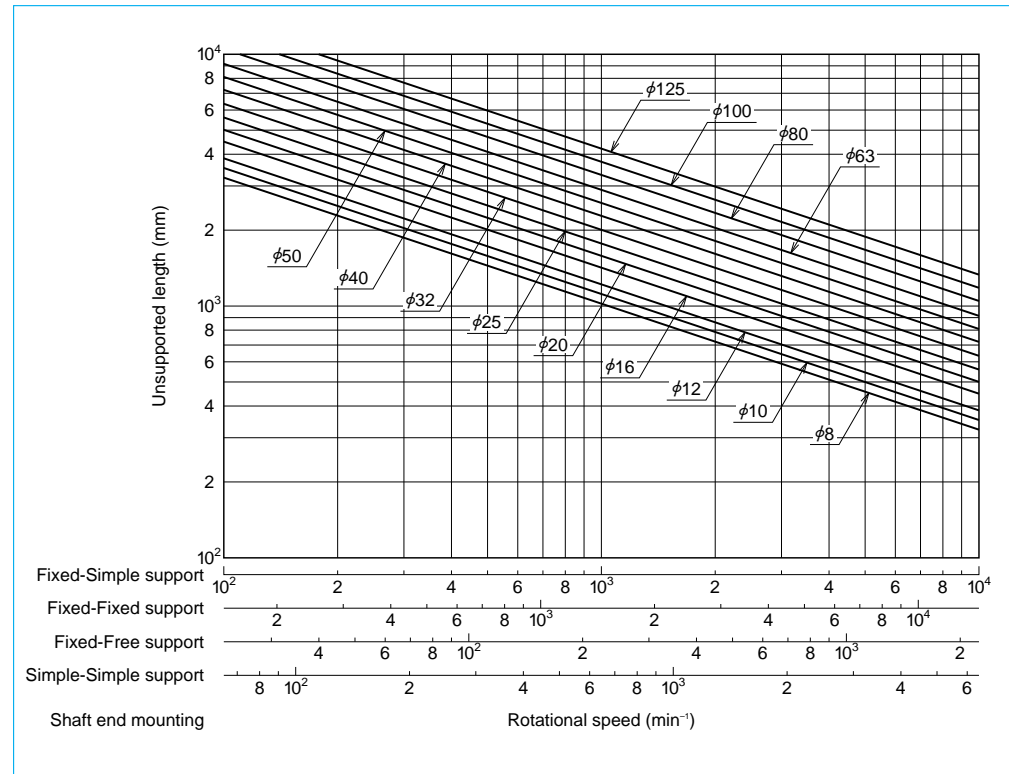


Fig. 3.1 Permissible rotational speeds vs. critical speeds



<<Calculation example of permissible rotational speed to the critical speed>>  
 Calculate the permissible rotational speed to the critical speed under conditions in Fig. 3.2.

<Use conditions>

Nut model: DFT4010-5

Supporting condition is Fixed - Simple support (From the supporting condition (ii) in Fig. 4.1 'Supporting conditions of screw shaft and ball nut.')

Unsupported length  $L = 2000$  mm

Screw shaft root diameter  $d_r = 34.4$  mm (From the dimension table)

<Calculation>

Supporting condition is Fixed-Simple support, from Table 3.1 in Page B51

$$\lambda = 3.927$$

$$f = 15.1$$

By Formula II-7 in Page B51, permissible rotational speed to critical speed is

$$n_c = f \frac{d_r}{L^2} \times 10^7 = 15.1 \times \frac{34.4}{2000^2} \times 10^7 = 1298.6 \text{ (min}^{-1}\text{)}$$

$$n_c = 1290 \text{ min}^{-1} \text{ or under}$$

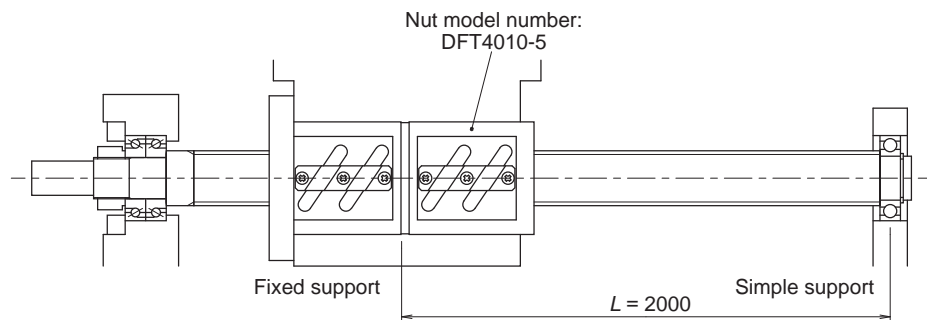


Fig. 3.2 Calculation example of permissible rotational speed to the critical speed

### B-2-3.2 d·n value

An increase of ball orbital speed will increase the collision impact of balls to ball recirculation parts, and thus resulting in damage to them. For this reason, 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 maximum rotational speed of ball screws.

\*Special measure must be taken for high-speed specification products. Please consult NSK.

\*Please consult NSK if the maximum rotational speed or the d·n value exceed the values on the table below, even both the critical speed of screw shaft and the d·n value are in ranges of the allowable limit.

Table 3.2 Criteria of allowable d·n value and maximum rotational speed

Ball screw recirculation system, Series/Type	Allowable d·n value		Criterion of permissible rotational speed [min <sup>-1</sup> ]	
	Standard	High-speed		
Application-oriented ball screws	HMD type for high-speed machine tools	160000 or less	-	4000
	HMC type for high-speed machine tools	100000 or less, 135000 or less <sup>*1</sup>	-	3750
	BSL type for miniature lathe	(180000 or less)	-	4000
	HTF-SRC type for high-load drive	140000 or less, 160000 or less <sup>*1</sup>	-	3225
	HTF-SRD type for high-load drive	120000 or less	-	2400
	HTF type for high-load drive	50000 or less, 70000 or less <sup>*1</sup>	100000 or less	3125
	VSS type for contaminated environment	150000 or less	-	3000
	ND series nut-rotatable ball screws	70000 or less	100000 or less	3000
	Σ series for robot	70000 or less	-	3000
Standard nut ball screws	R series for transfer equipment	50000 or less	-	3000
	End-deflector type	180000 or less	-	5000
	Return tube type	70000 or less	100000 or less	3000
	Deflector type	84000 or less	100000 or less	3000
	End cap type	80000 or less	100000 or less	3000

\*1 Please refer to the explanation of each ball screw for which two allowable d·n values are listed

· HMC type for high-speed machine tools: page B113

· HTF-SRC type for high-load drive: page B123

· HTF type for high-load drive: page B131

## B-2-4 Supporting Conditions for Calculation of Buckling Load and Critical Speed

Fig. 4.1 and 4.2 are typical conditions in supporting ball screw. Use them as reference to calculate buckling load and critical speed.

Please consult NSK if it is necessary to scrutinize calculation due to use conditions, or if boundary conditions are not clear due to special installation.

### [How to read the tables]

Example ii: Buckling load generates between the nut and the left bearings, indicating that the critical speed appears between the nut and the right bearing. Therefore, set L at maximum stroke for each side. Calculate by applying support bearing conditions.

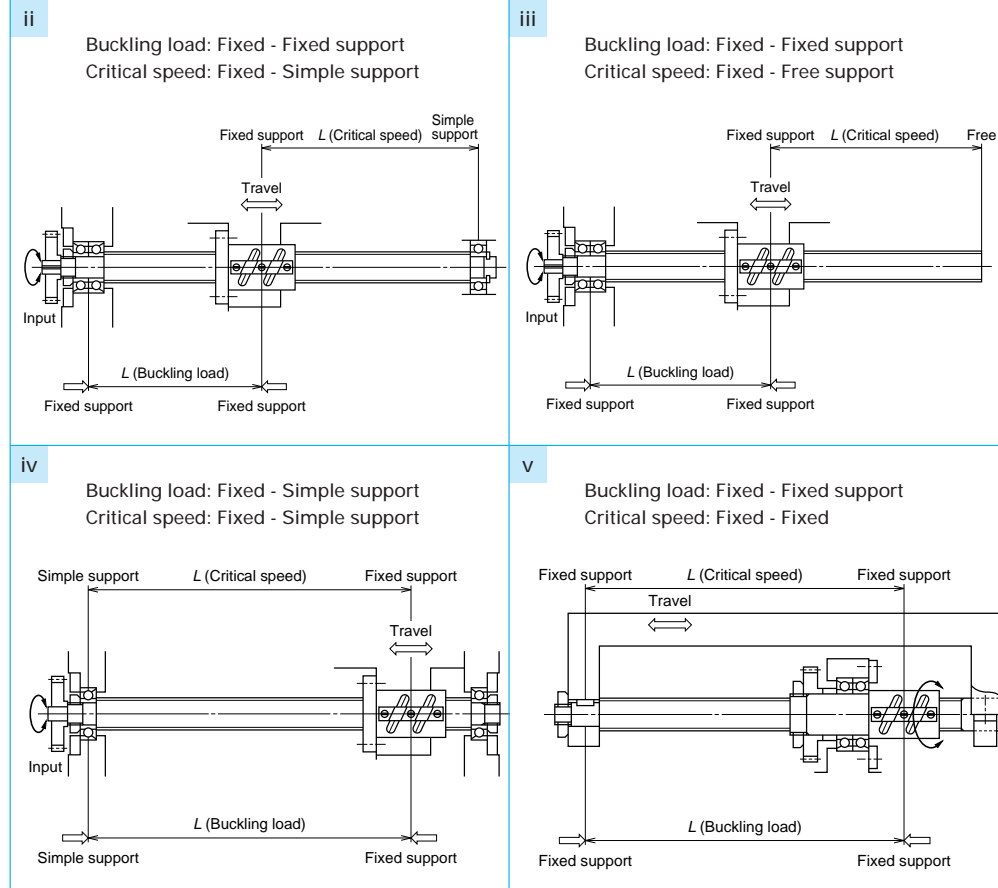


Fig. 4.1 Supporting conditions for screw shaft and ball nut

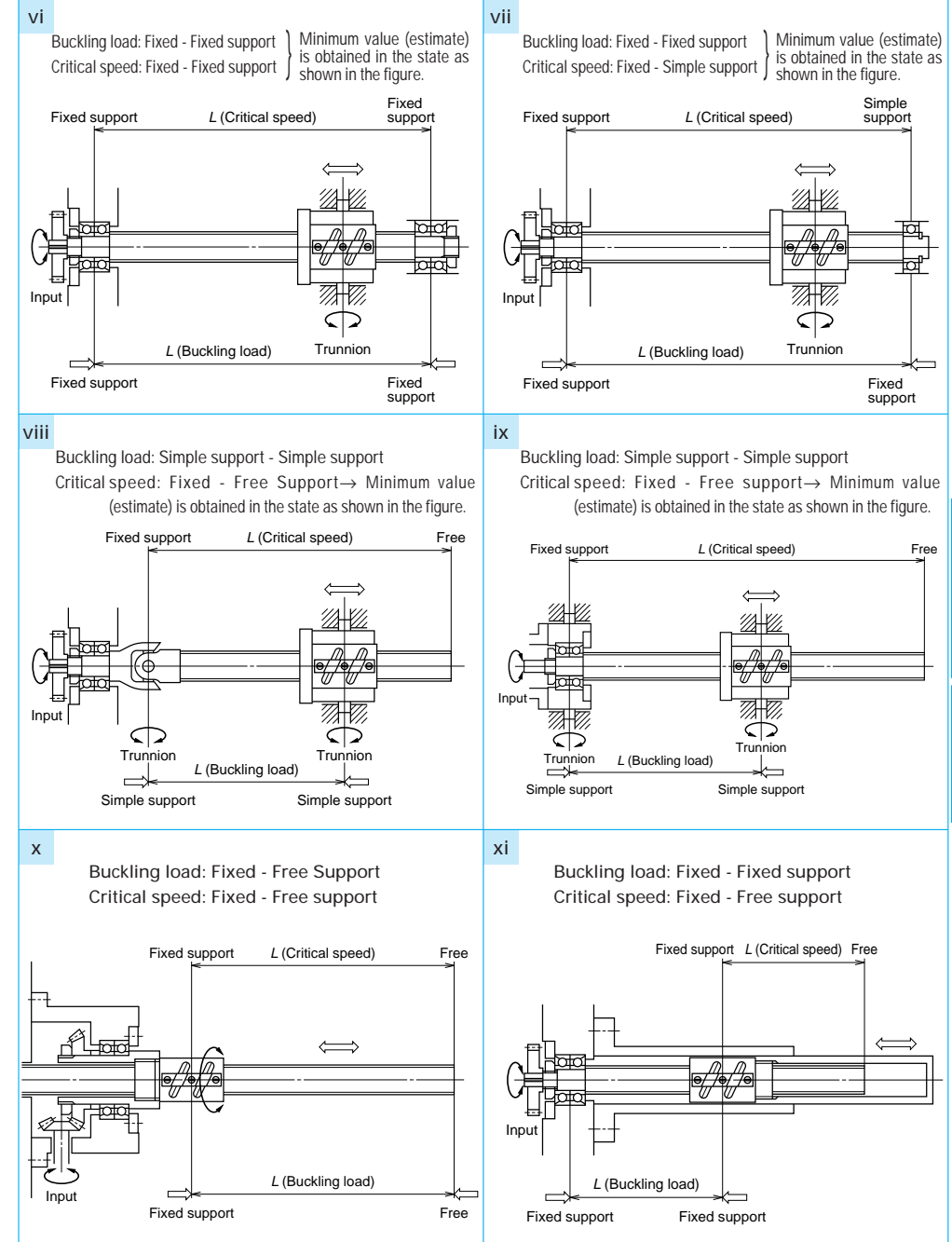


Fig. 4.2 Supporting conditions of screw shaft and ball nut w

## B-2-5 Life (dynamic load limitation)

### B-2-5.1 Life of Ball Screw

Although used in appropriate conditions and is 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 "life of accuracy" caused by deterioration in precision because of wear.

Load coefficients  $f_w$  in operation condition are shown in Table 5.1.

Table 5.1 Load coefficient  $f_w$

Smooth operation without impact	1.0 - 1.2
Normal operation	1.2 - 1.5
Operation associated with impact or vibration	1.5 - 3.0

Setting too long fatigue life requires larger ball screw, and is not economical. Below are the general target values of operating life for machines. (reference)

Table 5.2 General target values of fatigue life

Machine tools	20000 hours
Industrial machines	10000 hours
Automatic control system	15000 hours
Measuring equipment	15000 hours

### B-2-5.2 Fatigue Life

Fatigue life of the ball screw can be estimated by basic dynamic load rating ( $C_a$ ) as is for the rolling bearing.

#### (1) Basic dynamic load rating $C_a$

Basic dynamic load rating is the axial load which allows a 90% of the group of the same ball screws to rotate 1 million times ( $10^6$ rev) under the same condition without causing flaking by rolling contact fatigue.

#### (2) Fatigue life calculation

Fatigue life is defined as a total rotation number in general. It is sometimes indicated by total rolling hours or total running distance. Fatigue life is obtained by the following formula.

$$L = \left( \frac{C_a}{F_a \cdot f_w} \right)^3 \cdot 10^6 \quad \dots (II-8)$$

$$L_t = \frac{L}{60n} \quad \dots (II-9)$$

$$L_s = \frac{L \cdot l}{10^6} \quad \dots (II-10)$$

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 ( $\text{min}^{-1}$ )

$l$  : Lead (mm)

$f_w$  : Load factor (Coefficient by operating condition)

#### (3) Mean load

If the axial load varies often, to calculate a life, obtain a mean load which gives equivalent fatigue life under this varying load conditions.

①When load and 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, Fig. 5.1.

$$F_m = \left( \frac{F_1^3 \cdot n_1 \cdot t_1 + F_2^3 \cdot n_2 \cdot t_2 + \dots + F_n^3 \cdot n_n \cdot t_n}{n_1 \cdot t_1 + n_2 \cdot t_2 + \dots + n_n \cdot t_n} \right)^{\frac{1}{3}} \quad \dots (II-11)$$

$$N_m = \frac{n_1 \cdot t_1 + n_2 \cdot t_2 + \dots + n_n \cdot t_n}{t_1 + t_2 + \dots + t_n} \quad \dots (II-12)$$

Table 5.3 Stepwise operation condition

Axial load (N)	Rotational speed ( $\text{min}^{-1}$ )	Hours of use, or ratio of hours of use
$F_1$	$n_1$	$t_1$
$F_2$	$n_2$	$t_2$
:	:	:
$F_n$	$n_n$	$t_n$

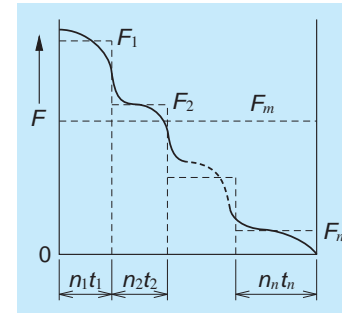


Fig. 5.1 Stepwise load variation

②When the rotational speed is constant, and the load changes linearly, obtain approximate value of the mean load  $F_m$  by the formula below.

$$F_m = \frac{1}{3} (F_{min} + 2F_{max}) \quad \dots (II-13)$$

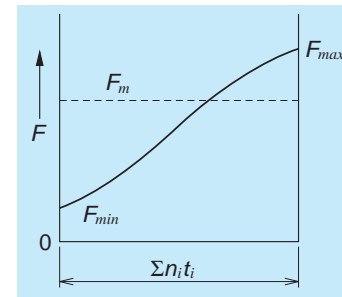


Fig. 5.2 Linear load change

③When rotational speed is constant, and the load changes in sinusoidal pattern, obtain approximate value of the mean load  $F_m$  by the formula below.

When the sine curve is Fig. (a)  
 $F_m \doteq 0.65 F_{max} \quad \dots (II-14)$

When the sine curve is Fig. (b)  
 $F_m \doteq 0.75 F_{max} \quad \dots (II-15)$

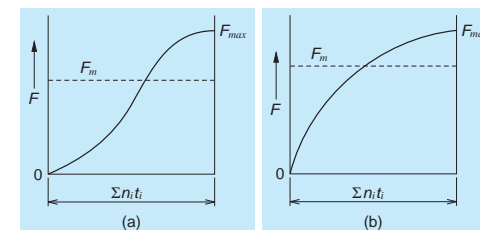


Fig. 5.3 Load changes in sinusoidal pattern

#### (4) Affect of mounting misalignment

If moment load or radial load is applied to the ball screw, it 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 is absorbing the moment load in various areas, and the moment load that generates between the screw shaft and nut is abated.

In general, the following values are recommended as control values for precision grade.

Misalignment in inclination  $\dots 1/2000$  or less  
 Eccentricity  $\dots 20 \mu\text{m}$  or less

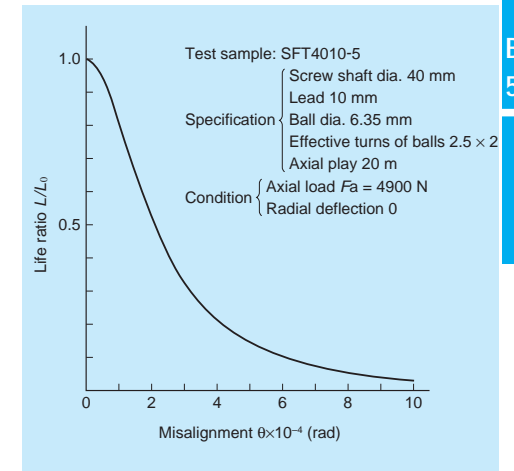


Fig. 5.4 Affects of misalignment

**(5) Effects of heavy load and short stroke**

If the ball screw is used under heavy load and short strokes, such as for drive of plastic injection molding machine and of press machines, the fatigue life may become significantly shorter than the rated fatigue life which is calculated in B-2-5.2.

This decreased life occurs because the heavy load generates large stress (surface pressure) in the contact point of balls and ball grooves of the screw shaft and the nut, adversely affecting the life. In such case, the life calculation should take into account the size of the surface pressure as well as the size of the stroke.

The axial load  $F_{amax}$  during operation and the size of strokes, which affect fatigue life, can be obtained by the following formula.

In such case, the life calculation should take into account the size of the surface pressure as well as the size of the stroke. Please consult with NSK.

$$F_{amax} \geq 0.10C_{0a} \quad \dots (II-16)$$

$$S \leq 4$$

In this formula:

$F_{amax}$  : Maximum load to axial direction during drive (N)

$C_{0a}$  : Basic static load rating (N)

$S$  : Stroke (rev)

$$S = \frac{L_s}{l}$$

$L_s$  : Stroke distance (mm)

$l$  : Lead (mm)

\* Axial load : The load is applied to the axial direction when screw shaft and the nut of ball screw are rotating relatively each other. The rotational speed is irrelevant.

**B-2-5.3 Ball screw and Hardness**

Table 5.4 indicates NSK standard ball screw and their hardness.

**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

\* NSK manufactures special material ball screws for special environments (stainless steel: SUS440C, SUS630). NSK also furnishes surface treatment (Refer to Page D5). Please consult NSK for such request.

**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.

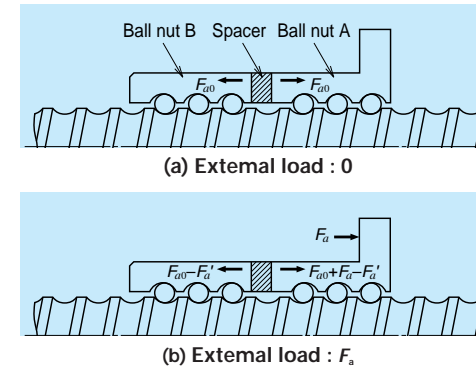
NSK has data of wear accumulated through abundant experience. Please contact NSK for inquiry pertaining to the wear.

**B-2-6 Preload and Rigidity**

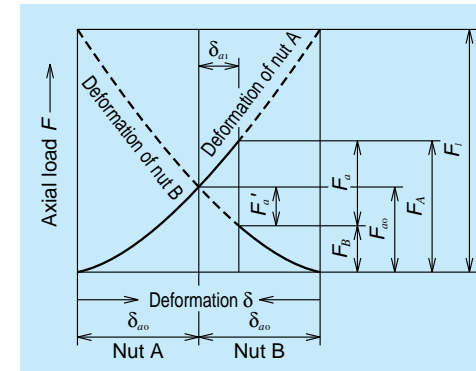
**B-2-6.1 Elastic Deformation of the Preloaded Ball Screw**

**(1) Position preload (D, Z, P preloads)**

Double nut preload ball screw shown in Fig. 6.1.



**Fig. 6.1 Position preload (double-nut)**



**Fig. 6.2 Deformation of A and B nut (position preload)**

Elastic deformation of Nut A and B is already given at time of assembly by the amount of  $\delta_{a0}$  by preload  $F_{a0}$ . When the external load  $F_a$  is added to Nut A, the elastic deformation  $\delta_a$  and  $\delta_b$  of each Nut A and B change as shown in Fig. 6.2,

$$\delta_a = \delta_{a0} + \delta_{a1} \quad \delta_b = \delta_{a0} - \delta_{a1}$$

At this time, the load to each Nut A and B are:

$$F_A = F_{a0} + F_a - F_a'$$

$$F_B = F_{a0} - F_a'$$

It 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 by the external load becomes  $\delta_{a0}$ , and the preload by Nut B disappears.

Assuming that the load when the preload is absorbed is  $F_l$ , the relationship between the axial load and the elastic deformation is as follows. (Fig. 6.2)

$$\delta_{a0} = K \cdot F_{a0}^{2/3} \quad 2\delta_{a0} = K \cdot F_l^{2/3}$$

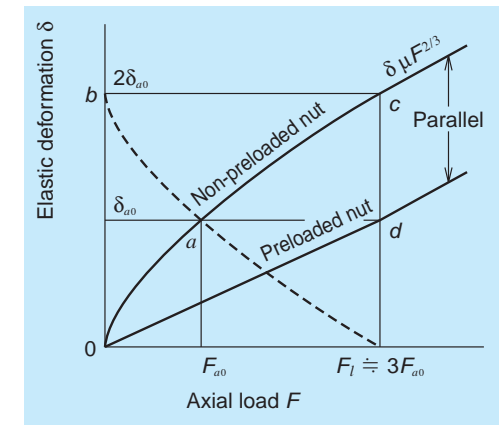
(K: Invariable number)

$$\left[ \frac{F_l}{F_{a0}} \right]^{2/3} = \frac{2\delta_{a0}}{\delta_{a0}} = 2$$

$$F_l = 2^{3/2} \times F_{a0} \doteq 3F_{a0}$$

For this reason, the preload should be about 1/3 of the maximum axial load. Please note that the preload of about 1/3 of the maximum axial load increases heat, and shortens life if it exceeds 10% of  $C_a$ . The criterion for the maximum preload is 0.1  $C_a$ .

Fig. 6.3 shows two types of elastic deformation curves: one is by the 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 of 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 an elastic deformation of the 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 axis of abscissa. For this reason, the elastic deformation by the preload with constant pressure changes along the deformation curve by Nut A. In order to take advantage of the characteristics of the preload with constant pressure, the major external load should be applied in the directions shown by arrows (Fig. 6.4.).

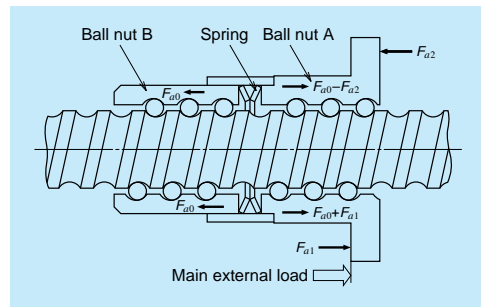


Fig. 6.4 Constant pressure preload (double nut)

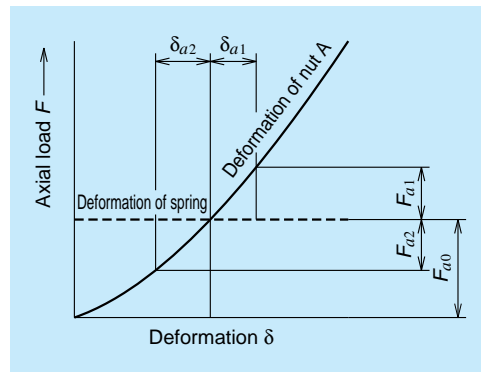


Fig. 6.5 Deformation curve of constant pressure preloaded nut

**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, it requires a good balance in axial rigidities of composing parts of the feed screw system. Also should examine 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.

$$\delta = \frac{F_a}{K_T} \dots\dots\dots \text{(II-17)}$$

$$\frac{1}{K_T} = \frac{1}{K_S} + \frac{1}{K_N} + \frac{1}{K_B} + \frac{1}{K_H} \dots\dots\dots \text{(II-18)}$$

In this formula:

- $\delta$  : Volume of axial elastic deformation of the feed screw system ( $\mu\text{m}$ )
- $F_a$  : Axial load to the feed screw system (N)
- $K_T$  : Axial rigidity of the feed system (N/ $\mu\text{m}$ )
- $K_S$  : Axial rigidity of the screw shaft (N/ $\mu\text{m}$ )
- $K_N$  : Axial rigidity of the nut (N/ $\mu\text{m}$ )
- $K_B$  : Axial rigidity of the support bearing (N/ $\mu\text{m}$ )
- $K_H$  : Axial rigidity of the nut and bearing mounting section (N/ $\mu\text{m}$ )

**(2) Axial rigidity of the screw shaft:  $K_S$**

(a) In case of: Fixed support - Free (axial direction)

$$K_S = \frac{A \cdot E}{x} \times 10^{-3} \dots\dots\dots \text{(II-19)}$$

In this formula:

- $K_S$  : Axial rigidity of the screw shaft (N/ $\mu\text{m}$ )
- $A$  : Cross section area of the screw shaft ( $\text{mm}^2$ )
- $A = \frac{\pi}{4} d_r^2$
- $d_r$  : 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)

$$K_S = \frac{A \cdot E \cdot L}{x(L-x)} \times 10^{-3} \dots\dots\dots \text{(II-20)}$$

In this formula:

- $K_S$  : Axial rigidity of the screw shaft (N/ $\mu\text{m}$ )
- $L$  : Unsupported length (mm)
- $x$  : Axial deformation is maximum at position  $x = L/2$ .

Axial rigidity of the screw shaft can be obtained by the following formula.

$$K_S = \frac{4A \cdot E}{L} \times 10^{-3} \dots\dots\dots \text{(II-21)}$$

**<<Axial rigidity example of calculation (1)>>**

Obtain axial rigidity of the screw shaft under the condition in Fig. 6.6.

<Use conditions>

- Nut model: DFT 4010-5
- From Fig. 6.6: Supporting condition ; Fixed support --Free (axial direction)
- Distance between points of load application  $x = 1200$  mm
- Screw shaft root diameter (From the dimension table)  $d_r = 34.4$  mm

<Calculation>

By Formula II-19, axial rigidity  $K_S$  is :

$$A = \frac{\pi}{4} d_r^2 = \frac{3.14}{4} \times 34.4^2 = 929.4 \text{ (mm}^2\text{)}$$

$$K_S = \frac{A \cdot E}{x} \times 10^{-3} = \frac{929.4 \times 2.06 \times 10^5}{1200} \times 10^{-3} = 159 \text{ (N/}\mu\text{m)}$$

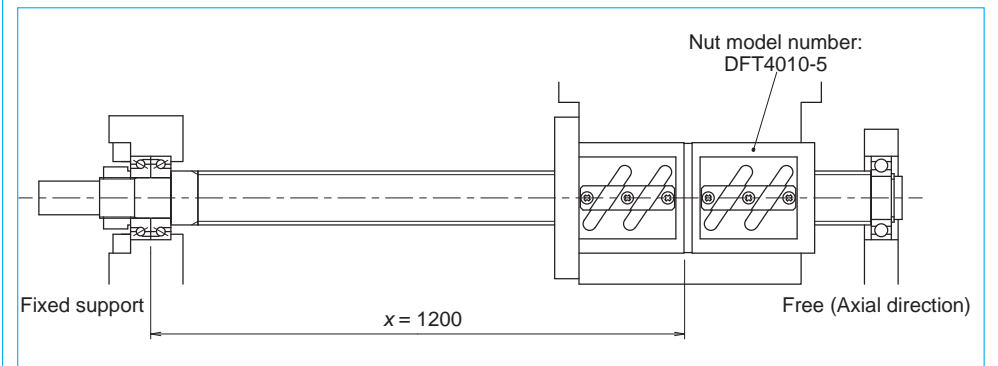


Fig. 6.6 Axial rigidity of the screw shaft calculation example (1)

<<Axial rigidity example of calculation (2)>>

Obtain axial rigidity of the screw shaft under the conditions in Fig. 6.7.

<Use conditions>

Nut model: DFT 4010-5

From Fig. 6.7: Supporting condition:

Fixed - Fixed support (axial direction)

$L = 1200$  mm

Distance between points of load application:

Screw shaft root diameter (From the dimension table)

$dr = 34.4$  mm

<Calculation>

By Formula II-21, axial rigidity  $K_s$  is :

$$A = \frac{\pi}{4} dr^2 = \frac{3.14}{4} \times 34.4^2 = 929.4 \text{ (mm}^2\text{)}$$

$$K_s = \frac{4A \cdot E}{L} \times 10^{-3} = \frac{4 \times 929.4 \times 2.06 \times 10^5}{1200} \times 10^{-3} = 638 \text{ (N/}\mu\text{m)}$$

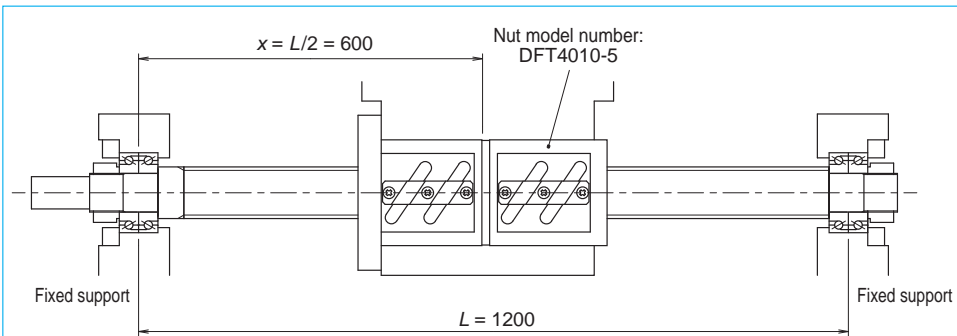


Fig. 6.7 Axial rigidity of the screw shaft calculation example (2)

(3) Axial rigidity of the ball nut :  $K_N$

(a) Rigidity of the nut with axial play

Theoretical rigidity value  $K$  is shown in the dimension table.  $K$  is obtained from the elastic deformation between screw grooves and balls when an axial load which is equivalent to 30% of the basic dynamic load rating  $C_a$  is applied. The criterion for calculation of ball nut rigidity is 80% of the value listed in the table taking into consideration of deformation of the ball nut, etc. Rigidity value  $K_N$  is obtained by the following formula when the axial load " $F_a$ " is not 30% of " $C_a$ ."

$$K_N = 0.8 \times K \left( \frac{F_a}{0.3 C_a} \right)^{1/3} \text{ (N/}\mu\text{m)} \quad \text{(II-22)}$$

In this formula:

$K$  : Rigidity value in dimension tables (N/ $\mu$ m)

$F_a$  : Axial load (N)

$C_a$  : Basic dynamic load rating (N)

(b) Rigidity of preloaded ball nut

Theoretical rigidity  $K$  is shown in each dimension table.  $K$  is obtained from the elastic deformation of the ball rolling surface and the balls when: a preload which is equivalent to 10% of the basic dynamic load rating  $C_a$  ( $P$  Preload. 5% for single-nut oversize ball pre-load system) is applied, followed by an axial load. The criterion for calculation of nut rigidity is 80% of the value listed in the table taking into consideration of 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 " $C_a$ ".

$$K_N = 0.8 \times K \left( \frac{F_{a0}}{\epsilon \cdot C_a} \right)^{1/3} \text{ (N/}\mu\text{m)} \quad \text{(II-23)}$$

In this formula:

$K$  : Rigidity in the dimension tables (N/ $\mu$ m)

$F_{a0}$  : Preload (N)

$\epsilon$  : Basic factor to calculate rigidity ( $\epsilon = 0.1$ . Use 0.05 for  $P$  Preload)

<<Axial rigidity example of calculation (3)>>

Obtain axial rigidity of the nut under the following conditions.

<Use conditions>

Nut model: SFT 4010-5

Axial load:  $F_a = 6000$  N

$F_a$  = Rigidity at 0.3  $C_a$   $K = 706$  N/ $\mu$ m  
(From the dimension table)

<Calculation>

By Formula II-22, axial rigidity  $K_N$  is :

$$\begin{aligned} K_N &= 0.8 \times K \left( \frac{F_a}{0.3 \cdot C_a} \right)^{1/3} \\ &= 0.8 \times 706 \times \left( \frac{6000}{0.3 \times 52000} \right)^{1/3} \\ &= 410 \text{ (N/}\mu\text{m)} \end{aligned}$$

<<Axial rigidity of the screw shaft calculation example (4)>>

Obtain axial rigidity of the nut under the following conditions.

<Use conditions>

Nut model : DFT 4010-5

Preload :  $F_{a0} = 4000$  N

$F_{a0}$  = Rigidity when  $\epsilon C_a$ :  $K = 1388$  N/ $\mu$ m  
(From the dimension table)

Basic factor to calculate rigidity when  $D$  Preload:  $\epsilon = 0.1$

<Calculation>

By Formula II-23

$$\begin{aligned} K_N &= 0.8 \times K \left( \frac{F_{a0}}{\epsilon \cdot C_a} \right)^{1/3} \\ &= 0.8 \times 1388 \times \left( \frac{4000}{0.1 \times 52000} \right)^{1/3} \\ &= 1017 \text{ (N/}\mu\text{m)} \end{aligned}$$

**The criterion of the preload to ball screw**

Nut rigidity increases by a larger preload volume. But excessive preload shortens life, and generates heat. Set the maximum preload about at 0.1  $C_a$  (0.05 for  $P$  Preload). Table 6.1 shows the criteria for preload for different application.

**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 $C_a$ - 0.04 $C_a$
Medium- high-speed machine tools for cutting	0.03 $C_a$ - 0.07 $C_a$
Low to medium-speed systems that require especially high rigidity	0.07 $C_a$ - 0.1 $C_a$

**(4) Axial rigidity of support bearing:  $K_B$**

Rigidity of the combined thrust angular contact ball bearings which is widely used as a support bearing of the ball screw for high-precision equipment can be obtained by the following formula.

$$K_B \doteq \frac{3F_{a0}}{\delta_{a0}} \text{ (N/}\mu\text{m)} \quad \text{(II-24)}$$

In this formula:

$K_B$  : Rigidity of the combined thrust angular contact ball bearings (N/μm)

$F_{a0}$  : Preload of the bearings (N)

$\delta_{a0}$  : Axial elastic deformation by preload (μm)

$$\delta_{a0} \doteq \frac{0.44}{\sin \alpha} \left( \frac{Q^2}{D_w} \right)^{1/3} \text{ (}\mu\text{m)} \quad \text{(II-25)}$$

$$Q = \frac{F_{a0}}{Z} \cdot \sin \alpha$$

$\alpha$  : Contact angle

$D_w$  : Ball diameter (mm)

$Z$  : Number of balls

Refer to Page B457 for data regarding thrust angular contact ball bearings which support high-precision ball screws (TAC Series).

**(5) Axial rigidity of the ball nut and bearing mounting section:  $K_n$**

The effect of rigidity of mounting section on positioning accuracy is big, we recommend incorporating high rigidity of the mounting sections of ball nut and support bearings into the design at the early stage of designing 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 given three points below.

- 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

It is necessary to minimize the thermal error for ever increasing demand for positioning accuracy give three points below.

- Suppress heat
- Forced cooling
- Avoid effect of temperature rise

Refer to "Measures against thermal expansion" on Page B44.

**B-2-7 Friction Torque and Drive Torque**

Operations that use ball screw drives require a motor torque which is equivalent to the total of two:

- Friction torque, i.e. the friction of the ball screw itself
- Drive torque which is required for operation

"brakeaway torque." This torque is 2 to 2.5 times larger than preloaded dynamic (friction) torque which is described below. Starting friction torque quickly diminishes once the ball screw begins to move.

**(2) Dynamic preloaded drag torque (preloaded dynamic friction torque)**

When the ball screw is moving, two types of torque generate: 1. Dynamic friction torque by preload; 2. Friction torque associated with ball recirculation. JIS B1192 sets standard of dynamic preloaded torque, which is the total of these two torque types. They are defined in Fig. 7.1.

The preload dynamic friction torque is calculated by following formula. When screw shaft is rotated as Fig. 7.2 in following measure condition, measuring the nut stop power  $F$  and the distance from action line and right angle direction to the measured screw shaft multiple by it's power value  $F$ .

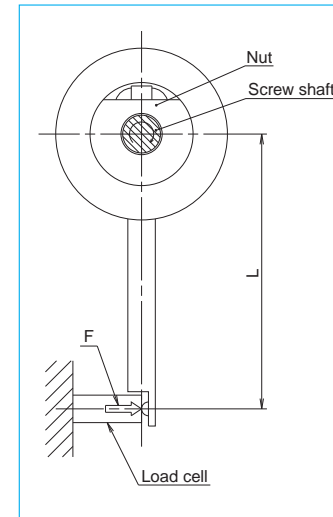
$$T_p = F \cdot L \quad \text{(II-26)}$$

- Measuring rotational speed 100 min<sup>-1</sup>
- Viscosity of lubrication is prescribed in JIS K 2001 ISO VG 68
- Without measurement Seal

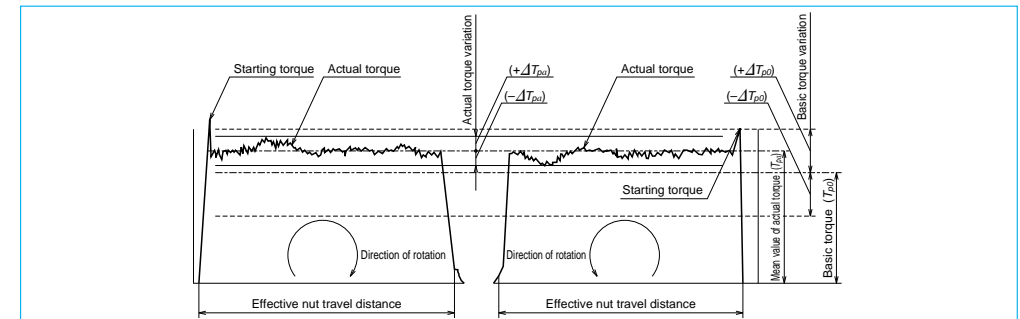
**B-2-7.1 Friction Torque**

**(1) Starting friction torque (Break away torque)**

A large torque is necessary to start ball screw. This is called "starting friction torque" or



**Fig. 7.2 Preload dynamic torque measuring method**



**Fig. 7.1 Definitions of dynamic preloaded drag torque**

**(3) Calculation of basic torque**

Basic torque of preloaded ball screw  $T_{p0}$  can be obtained by the following formula.

$$T_{p0} = K \frac{F_{a0} \cdot I}{2\pi} \doteq 0.014 F_{a0} \sqrt{dm \cdot I} \quad (\text{N} \cdot \text{cm}) \quad (\text{II-27})$$

In this formula:

$F_{a0}$ : Preload (N)

$I$ : Lead (cm)

$K$ : Torque coefficient of ball screw

$$K = \frac{0.05}{\sqrt{\tan\beta}}$$

$\beta$ : Lead angle (deg.)

$d_m$ : Ball pitch circle diameter (cm)

Allowable values of torque variation rate relative to basic torque are regulated as shown in Table 7.1.

**B-2-7.2 Drive Torque**

**(1) Operating torque of the ball screw**

① Normal drive

The torque when converting rotational motion to linear motion (normal operation) is obtained by the following formula.

$$T_a = \frac{F_a \cdot I}{2\pi \cdot \eta_1} \quad (\text{N} \cdot \text{cm}) \quad (\text{II-28})$$

In this formula:

$T_a$ : Normal operation torque (N · cm)

$F_a$ : Axial load (N)

$I$ : Lead (cm)

$\eta_1$ : Normal efficiency ( $\eta_1 = 0.9 - 0.95$ )

② Back-drive operation

The torque when converting linear motion to rotational motion (back-drive operation) is obtained by the following formula.

$$T_b = \frac{F_a \cdot I \cdot \eta_2}{2\pi} \quad (\text{N} \cdot \text{cm}) \quad (\text{II-29})$$

In this formula:

$T_b$ : Reverse operation torque (N · cm)

$\eta_2$ : Reverse efficiency ( $\eta_2 = 0.9 - 0.95$ )

③ Dynamic drag torque of the preloaded ball screw

Operation torque of preloaded ball screw can be obtained by Formula II-27.

**(2) Drive torque of the motor**

① Drive torque at constant speed

Torque which is necessary to drive a ball screw at constant speed resisting to external loads can be obtained by the following formula.

$$T_1 = (T_a + T_{pmax} + T_u) \times \frac{N_1}{N_2} \quad (\text{II-30})$$

In this formula:

$T_a$ : Drive torque at constant speed

$$T_a = \frac{F_a \cdot I}{2\pi \cdot \eta_1} \quad (\text{II-28})$$

$F_a$ : Axial load (N)

The value of  $F_a$  in Fig. 7.3 is:

$$F_a = F + \mu \cdot m \cdot g$$

$F$ : Such as cutting force to axial direction (N)

$\mu$ : 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<sup>2</sup>)

$T_{pmax}$ : 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,  $T_1$  shall be kept under 30% of the motor rating torque.

② Drive torque at acceleration

Accelerating the ball screw resisting axial load requires maximum torque. Drive torque necessary for this occasion can be obtained by the following formula.

$$T_2 = T_1 + J \cdot \dot{\omega} \quad (\text{II-31})$$

$$J = J_M + J_{G1} \left(\frac{N_1}{N_2}\right)^2 \left[ J_{G2} + J_S + m \left(\frac{I}{2\pi}\right)^2 \right] \quad (\text{kg} \cdot \text{m}^2) \quad (\text{II-32})$$

In this formula:

$T_2$ : Maximum drive torque at time of acceleration (N · cm)

$\dot{\omega}$ : Motor's angular acceleration (rad/s<sup>2</sup>)

$J$ : Moment of inertia applied to the motor (kg · m<sup>2</sup>)

$J_M$ : Moment of inertia of the motor (kg · m<sup>2</sup>)

$J_{G1}$ : Moment of inertia of Gear 1 (kg · m<sup>2</sup>)

$J_{G2}$ : Moment of inertia of Gear 2 (kg · m<sup>2</sup>)

$J_S$ : Moment of inertia of the screw shaft (kg · m<sup>2</sup>)

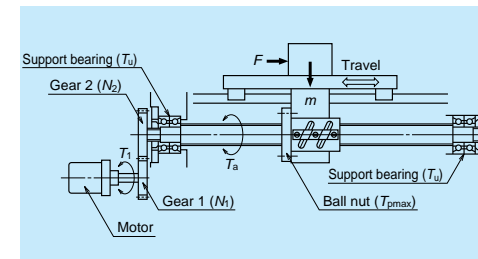
When selecting a motor, it is necessary to examine the maximum torque of the motor relative to maximum drive torque  $T_2$  at time of acceleration of ball screw.

Calculation of the moment of inertia of a cylindrical object (ball screw, gear, etc.), please refer to below.

**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)												
	4000 or under										Over 4000 and 10000 or under		
	Slenderness ratio <sup>(1)</sup> : 40 or less					Slenderness ratio <sup>(1)</sup> : More than 40 and 60 or less					—		
Over	Incl.	Accuracy grade				Accuracy grade				Accuracy grade			
		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	1000	—	±15%	±15%	±20%	—	—	±20%	±25%	—	±25%	±30%	

Remarks 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 which are under 20 N · cm.



**Fig. 7.3 Driving mechanism of ball screw**

Formula for the moment of inertia of a cylindrical object

$$J = \frac{\pi \cdot \gamma}{32} D^4 \cdot L \quad (\text{kg} \cdot \text{cm}^2) \quad (\text{II-33})$$

In this formula:

$\gamma$ : Material density (kg/cm<sup>3</sup>)

$D$ : Diameter of the cylindrical object (cm)

$L$ : Length of the cylindrical object (cm)



### B-2-8 Even Load Distribution in Ball Nut

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 the measures for even load distribution to the balls by an optimal arrangement of the position of ball recirculation circuits. Additionally, a heavier load results in a 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. A, while Table B shows the result of load distribution analysis.

Fig. 8.1 The result of equalization of load distribution

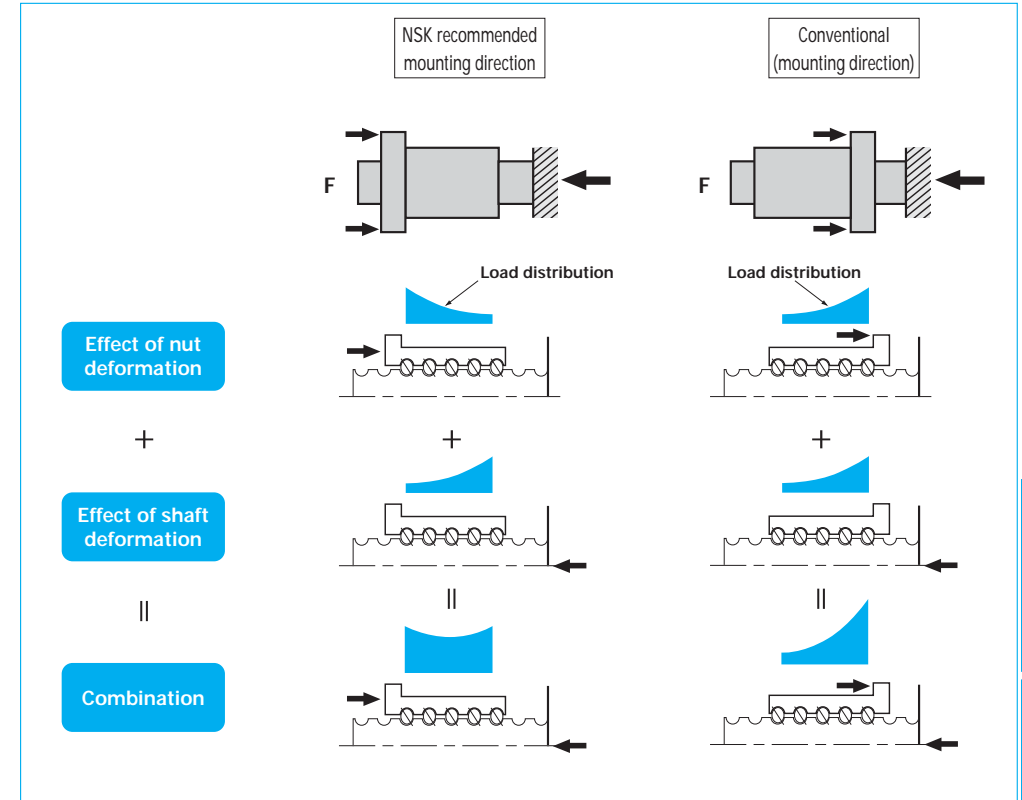
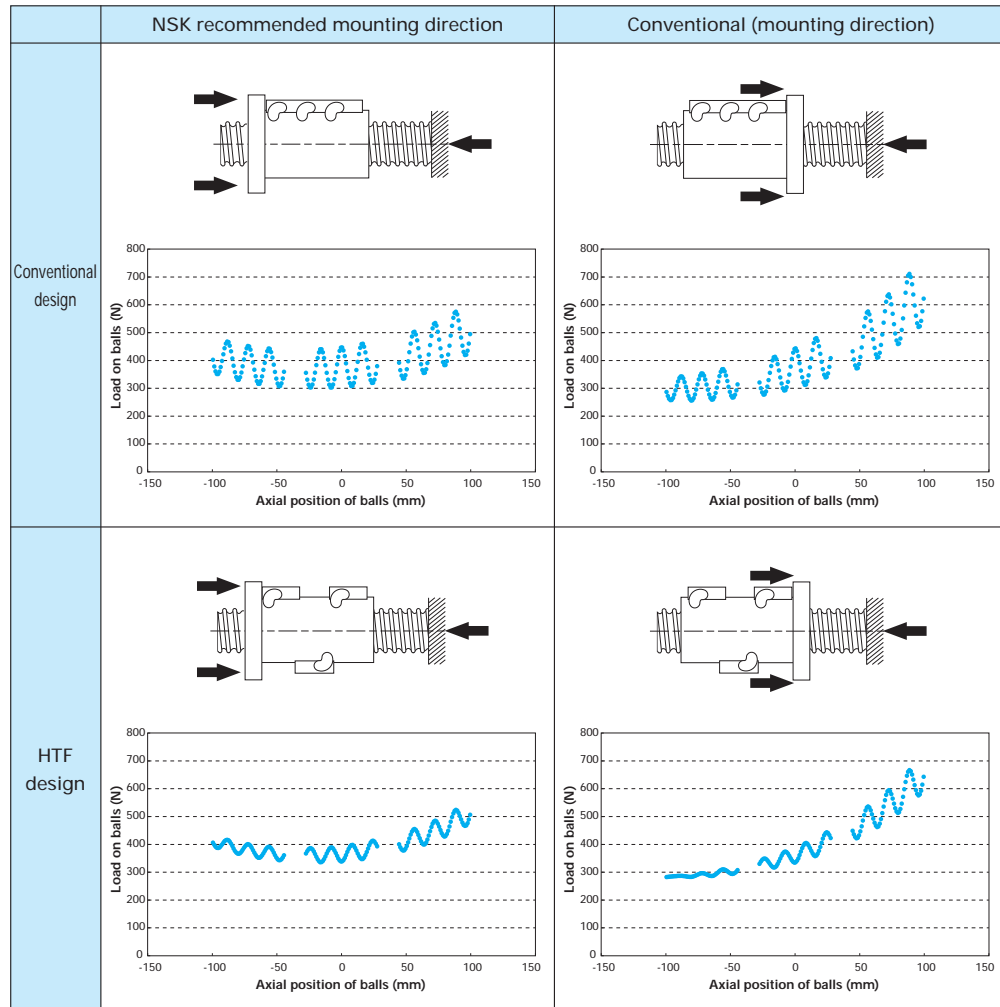


Fig. 8.1 The relationship between acting point of load and load distribution

## B-2-9 Lubrication of Ball Screw

Lithium soap-based grease at viscosity 30 to 140 mm<sup>2</sup>/s (40°C) is used for grease lubrication. Oil with ISO VG 32 to 100 is used for oil lubrication.

In general, lubricants with low base oil viscosity are recommended when the ball screw is used for high speed, and it is important to reduce thermal elongation of the screw shaft. On the other hand, lubricants with high base oil viscosity are recommended when the ball screw is used for low speed, high temperature, with vibration, or under high load.

Please consult NSK about greases for high-load drive and high-temperature applications.

NSK Grease Unit for ball screw lubrication includes:

- 1) Various types of grease in the bellows-tube which can be instantly attached to the grease pump;
- 2) Hand grease pump which is compact and easy to use;
- 3) Nozzles.

Table 9.1 shows NSK greases, and names of other ball screw greases.

Table 9.2 explains checking 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 concerning the replenishing methods.

**Table 9.1 Grease for ball screw**

Product name	Thickener	Base oil	Base oil viscosity mm <sup>2</sup> /s (40°C)	Range of temperature for use (°C)	Application
NSK Grease AS2	Lithium base	Mineral oil	130	-10 - 110	General heavy load
NSK Grease PS2	Lithium base	Synthetic oil combined with mineral oil	15	-50 - 110	Light load
NSK Grease LR3	Lithium base	Synthetic oil	30	-30 - 130	High-speed medium load
NSK Grease NF2	Urea composite type	Synthetic oil combined with mineral oil	27	-40 - 130	Fretting resistant

\*Refer to Page D13 for the nature of NSK greases.

**Table 9.2 Checking lubricant and intervals of replenishment**

Lubricating method	Checking intervals	Check points	Replenish/replacing 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 start to work	Oil level	Specify according to oil consumption

## B-2-10 Dust Prevention for Ball Screw

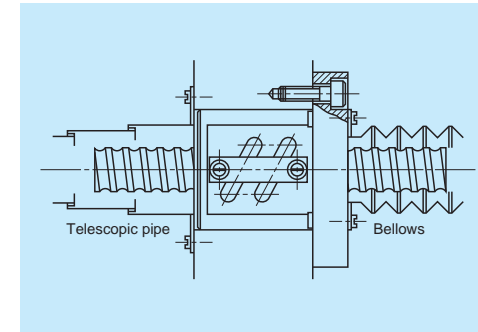
If foreign matters enter inside the ball nut, all screw may wear rapidly, or it may malfunction due to damage of groove or ball recirculation system. Use bellows and telescopic pipe (Fig. 10.1) to keep foreign matters from entering into the feed screw system. Install these items so as

to shut foreign matters completely from the ball screw.

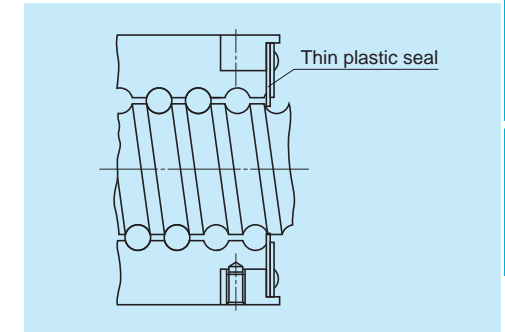
Also it is even more effective to add seal on the ball nut as shown in Fig. 10.2 to 10.6. We provide seals in Table 10.2.

**Table 10.1 Seal**

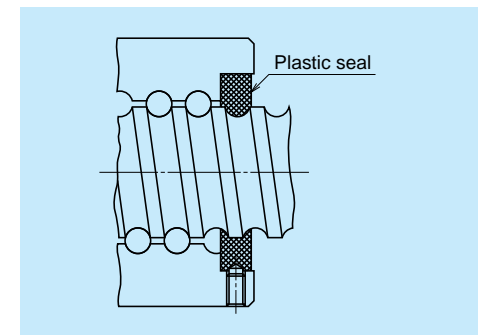
	Sealing capability	Torque	Heat	Application
Thin plastic seal	○	○	○	End deflector type, HMD type, BSL type
Plastic seal	×	◎	◎	Tube type, Deflector type (Seal is not put on the lead of 1mm or smaller.)
Wiper seal	△	×	×	
High performance seal	◎	○	○	VSS type
Brush-seal	△	○	○	For R Series (Seal for those with the shaft diameter of 14 mm or less is plastic seal.)



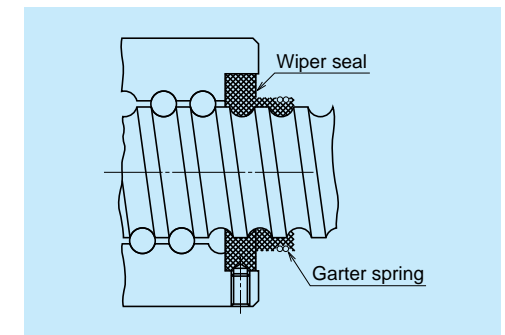
**Fig. 10.1 Dust prevention by telescopic pipe and bellows**



**Fig. 10.2 Thin plastic seal**



**Fig. 10.3 Plastic seal**



**Fig. 10.4 Wiper seal**

## B-2-11 Rust Prevention and Surface Treatment of Ball Screws

### (1) Stainless steel ball screw

Stainless products KA is standard ball screw and available in stock. Please consult NSK if you require 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 purpose.
- Fluoride low temperature chrome plating
  - Fluoroplastic coating is provided following the low temperature chrome plating.
  - Resistance to corrosion is higher than low temperature chrome plating.
- Hard chrome plating
  - Has high hardness. Increases 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 the result of humidity chamber test for antirust characteristics.

However, never apply any organic solvent for degreasing because it has 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 test.

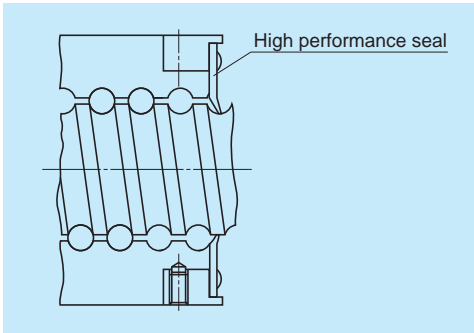


Fig. 10.5 High performance seal

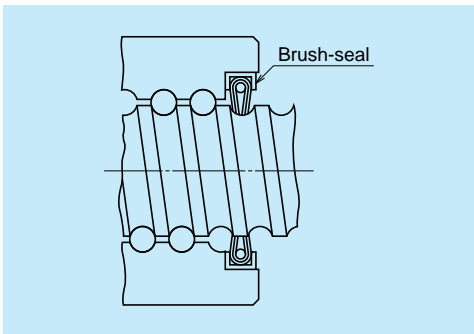


Fig. 10.6 Brush-seal for R Series

## B-2-12 Ball Screw Specifications for Special Environment

### B-2-12.1 Clean Environment

NSK manufactures NSK Clean Grease "LG2 and LGU" for NSK linear guides, ball screws, and Monocarriers which are used under normal temperature and pressure in a clean room.

LG2 and LGU grease are far more superior in stable torque characteristics than the vacuum grease which has been used as a countermeasure against dust generation. LG2 and LGU also have a sufficient durability and dust prevention capability.

### Features of "LG2 and LGU"

- ① Generates less dust than vacuum grease and other general greases. Cleanliness is enhanced by simply switching the grease to LG2 or LGU.
- ② Has extremely low and stable torque characteristics. It is ideal for high speeds.
- ③ Unlike vacuum grease, LG2 and LGU have a nature similar to general grease. Its effect is long-lasting, and sufficiently durable. They greatly contribute to minimize the frequency of maintenance.
- ④ They have an equal capability in rust prevention as general grease, and also is reliable.

When using NSK linear guides, ball screws, or Monocarriers in a clean 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 B455 and D20). Wash to remove adipose substances prior to use.

Refer to Page D8 for detailed nature, functions and characteristics of LG2 and LGU.

### B-2-12.2 Measures for Use under Vacuum

NSK developed MoS<sub>2</sub> / WS<sub>2</sub> 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 liquid crystal display processing equipment.

Lubricants widely used for ball screws in a high vacuum are:

- Vacuum grease which uses base oil of low vapor pressure.
- Solid lubricants such as MoS<sub>2</sub>, WS<sub>2</sub> used mainly for equipment in space.
- Solid lubricants by soft-metal such as gold, silver, or lead film.

When used for semiconductor and liquid crystal display making equipment, the oil of the vacuum grease evaporates and causes environmental contamination. Also, it hinders creation of a super high vacuum. MoS<sub>2</sub> in the state of solid lubricant generates a large volume of dust, and Mo is unsuitable for semiconductors and reformed surface. Therefore, it is not suitable for the processing machines for semiconductor and liquid crystal display.

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, because of a solid lubricant, the film may peel off and stick to surface of ball grooves repeatedly, causing the 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 test data of ball screws for vacuum.

For ball screw specifications for special environment, refer to Page D2.

## B-2-13 Noise and Vibration

### B-2-13.1 Consideration to Lowering 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 screw.

To lower noise level in general, the following points should be taken into consideration.

- ① Use as a large lead as possible to reduce rotational speed.
- ② Use a ball screw with smaller outer diameter as possible.

(It often requires designing for critical dimensions, mandating special specification. Please consult NSK.)

For reference, noise levels by ball screws alone are plotted below. Formula for calculation is also shown below.

① Average value at measuring distance of 400 mm  

$$\text{dB (A)} = 25.2 \{ \log_{10} (D_w \cdot d_m \cdot n \times 10^{-5}) \} + 63.9$$
(II-34)

- ② 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 ( $\text{min}^{-1}$ )

If measuring distance is 1 m, the average noise level is: Various noise levels minus 8 dB (A).

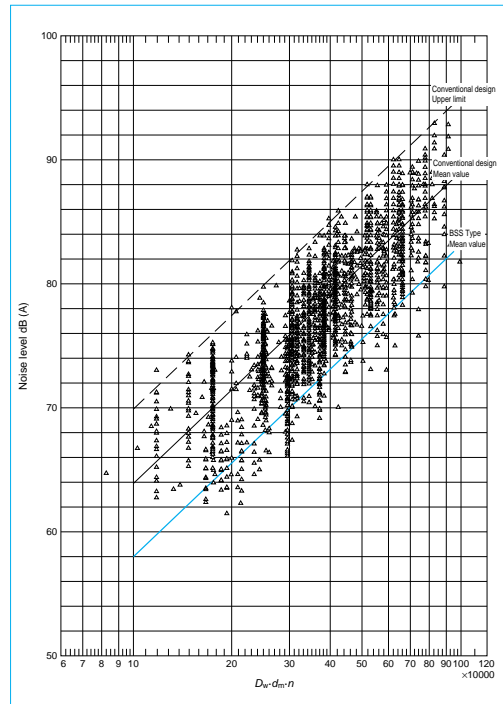


Fig. 13.1 Noise levels of ball screws

<<Example of calculation of noise levels>>

<Use conditions>

Nut model: DFT4010-5

From the dimension table:  $D_w = 6.350$

$d_m = 41$

Maximum rotational speed:  $2000 \text{ min}^{-1}$

<Calculation>

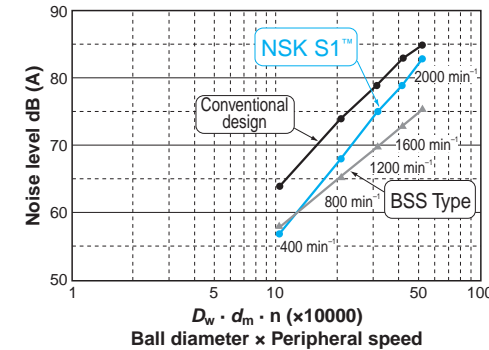
By Formula II-34:

$$\begin{aligned} \text{dB (A)} &= 25.2 \{ \log_{10} (D_w \cdot d_m \cdot n \times 10^{-5}) \} + 63.9 \\ &= 25.2 \{ \log_{10} (6.350 \times 41 \times 2000 \times 10^{-5}) \} + 63.9 \\ &= 82 \text{ dB (A)} \end{aligned}$$

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).

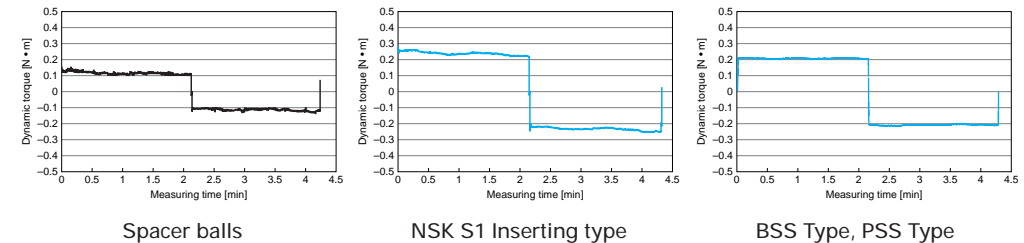
When installed, the noise of ball screw becomes higher by the noise of the machine and characteristics of machine vibration.

By using NSK S1, the noise is reduced and softened compared to conventional ball screws. The BSS type will furthermore reduce and soften the noise.



### B-2-13.2 Consideration to operational characteristics

Smooth motion is achieved by using spacer balls on conventional ball return tube type ball screws. By using NSK S1 the smoothness is further improved. BSS type will achieve the smoothness equivalent to Ball screws with NSK S1.



### B-2-13.3 Consideration to Ball Screw Support System

Ball screw has low radial rigidity because its support span is longer compare to its shaft diameter. It has only small damping capacity, requiring as much support rigidity as possible through design.

Simplify support bearing system to cut costs invites noise and vibration problems. Therefore, the necessity to consideration to ball screw support system of both shaft ends is increasingly becoming important as the machine is operated at higher speeds.

If one shaft end must be left unfixed without 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.

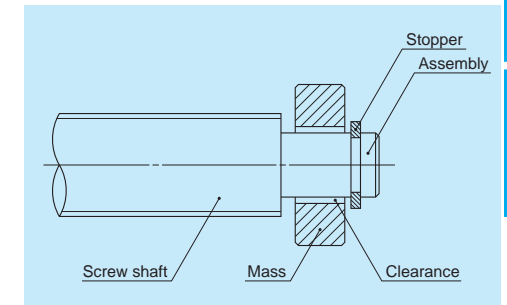


Fig. 13.2 Impact damper (NSK patent)

## B-2-14 Installation of Ball Screw

### B-2-14.1 Installation

Follow the flowchart in Figure 14.1 for installation procedures.

#### (1) Centering of the units

Align the centers of housings for the ball nut and the support bearing to which a ball screw is fixed. The centering is critical for life, smooth operation, and positioning accuracy of a ball screw.

We generally recommend the centering accuracy as follows for a precision grade ball screw.

- Inclination of center line: 1/2 000 or less (Target: 1/5 000 or less)
- Eccentricity: 0.020 mm or less

#### (2) Centering of ball nut housing

Photo 14.1 shows a centering procedure of the ball nut housing. Insert a jig (test bar) that has close fit clearance to a bore of the ball nut housing. Check vertical and horizontal parallelism of the test bar against the guide way (such as linear guides) with the dial indicator, that is fixed on the guide way bearing, and adjust the position of the housing so that the inclination of the center sets in 1/2 000 or less, and then, fix the housing to the table base.

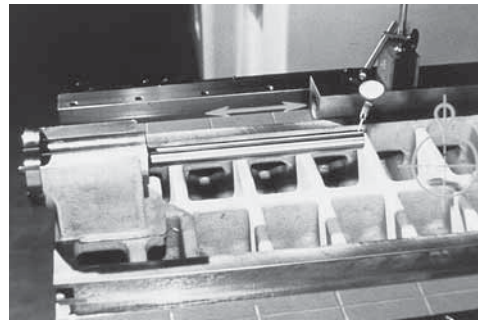


Photo 14.1 Centering of ball nut housing

#### (3) Centering of the housing of support bearing

Photo 14.2 shows a centering procedure of the housing of support bearing. As the same way of the ball nut housing, set the jig (test bar) that has close fit clearance to bore of the housing and adjust the position of the housing so that the aligning inclination sets in 1/2 000 or less, then fix the housing to the table temporarily.



Photo 14.2 Centering of the housing of support bearing

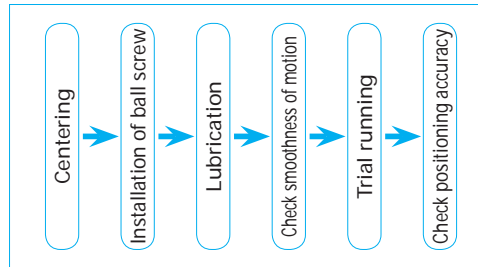


Fig. 14.1 Flowchart of ball screw installation

#### (4) Eccentricity of the housings

Measuring way of eccentricity between the two housings is shown in Figure 14.3. Set the table on the guide way (such as linear guides, etc), and fix a dial indicator on it. Check eccentricity of the test bar of support bearing housing against the test bar of ball nut housing. Adjust position of support unit housing so that the eccentricity gets in 0.020 mm or less, then fix the housing of support bearing.

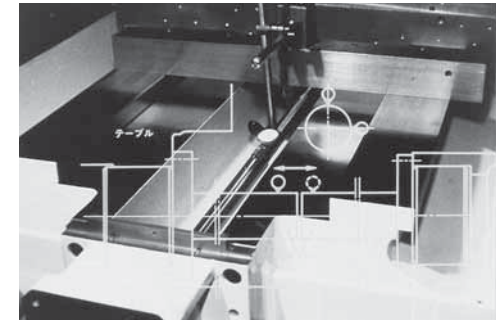


Photo 14.3 Eccentricity of the housings

#### (5) Installation of ball nut

Photo 14.4 shows a procedure for installation of the ball nut to the housing. Wipe off outside of the ball nut and bore of the housing with thin rags. (Applying a small amount of machine oil with low viscosity to both parts is effective in rust prevention.) Insert the ball nut to the housing while holding the ball screw in horizontal position and fix it. Do not handle the ball screw roughly, like hammering ends of the ball screw, because it may induce failure of the ball screw.

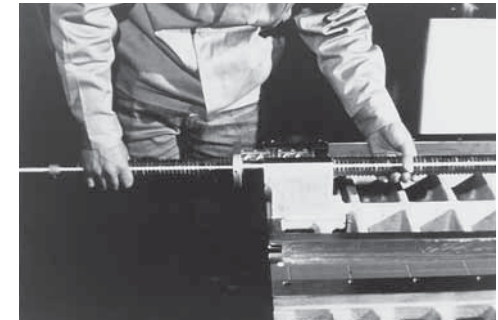


Photo 14.4 Installation of ball nut

#### (6) Installation of support bearings in ball screw

Photo 14.5 shows a procedure for installation of support bearings. Select bearings that have appropriate fitting tolerance to the screw shaft, then install them. We recommend using a special sleeve as shown in the photo not to apply impact to the bearings.

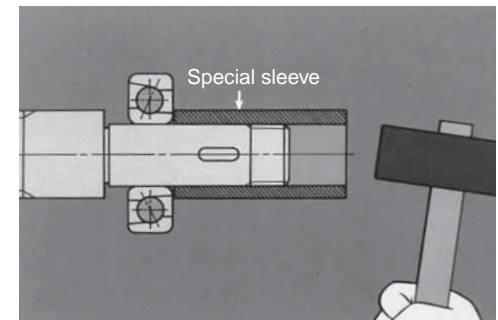


Photo 14.5 Installation of support bearings in ball screw

**(7) Installation of bearings in the housing**

Photo 14.6 shows the procedure for installing the support bearings to the bearing housing. When fixing the bearing with a lock nut, tighten the lock nut with specified tightening torque while checking run-out of screw shaft end. Take measures against loose lock nut. (Refer to assembly procedure of support bearing unit. Page B81)

For easy installation work of ball screws, NSK provides Support Unit (Page B433 to B452) that consists of bearings and Bearing Lock Nuts (Page B453) of which surface run-out is made to a specification.

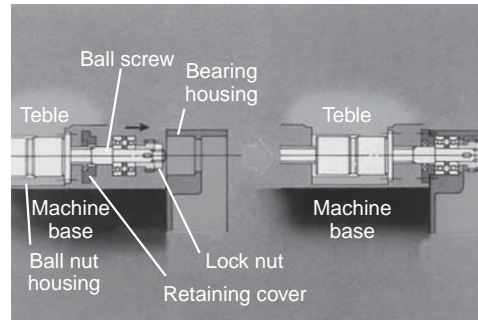


Photo 14.6 Installation of bearings

**(8) Replenish lubrication grease**

Photo 14.7 shows the replenishing procedure of lubrication grease. Applying grease prior to its operation is not necessary when the grease is packed into the ball nut. Please confirm it.

If grease is not used, we apply antirust oil to ball screws when shipping. Wipe off the oil and pack grease fully into the ball nut as shown in the photo.

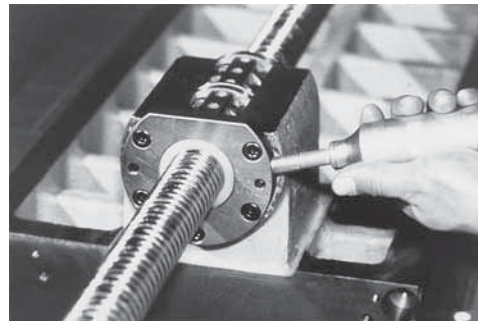


Photo 14.7 Replenish lubrication grease

**(9) Check motion smoothness**

Photo 14.8 shows a checking procedure for motion smoothness. This is to confirm if the table is assembled accurately. Use a torque wrench to measure starting torque of the ball screw for full stroke of the table. Check for abnormality in starting torque as well as unevenness of rotation by feeling.

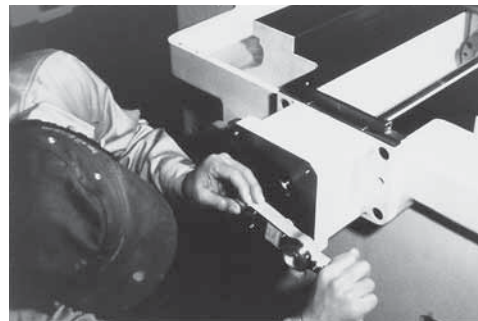


Photo 14.8 Check motion smoothness

**(10) Trial operation**

Photo 14.9 shows a seen of trial operation. Firstly operate the machine slowly and check noise and vibration, then do the same at medium and high speed. Operate the machine continuously for approximately 2 hours as a running in, and check for abnormality meanwhile. Remove over flown grease from the ball nut after a running in.

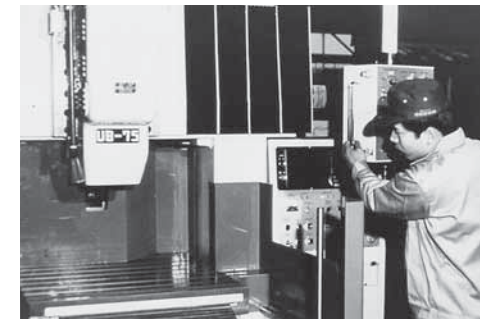


Photo 14.9 Trial operation

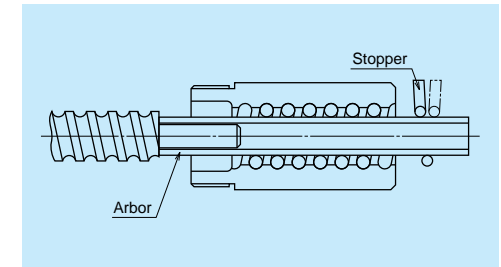


Fig. 14.2 Inserting nut into screwshaft

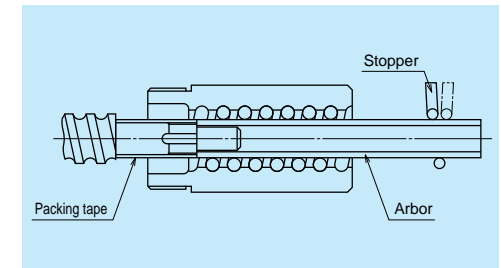


Fig. 14.3 Arbor and shaft end configuration

**B-2-14.2 Inserting R Series Nut into Rolled Screw Shaft**

When delivered, the nut of R series is separated from the screw shaft, and inserted into an arbor shaft. The nut must be inserted to the screw shaft when mounting ball screw.

**(1) Consideration to end configuration of screw shaft**

The balls may fall out during moving the assembled nut from the arbor to the screw shaft if the sizes and shapes of the arbor and the screw shaft 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. 14.2).

If the end face of the arbor cannot connect to the end face of the screw because of configuration of both ends of screw shaft, wrap a tape outside of ball screw shaft so that the layers of tape is

equal with the outside diameter of the arbor (Fig. 14.3).

If there is a key way or a nick along the way, fill such gaps prior to moving the ball nut.

**(2) 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 firmly the screw shaft end against the arbor.

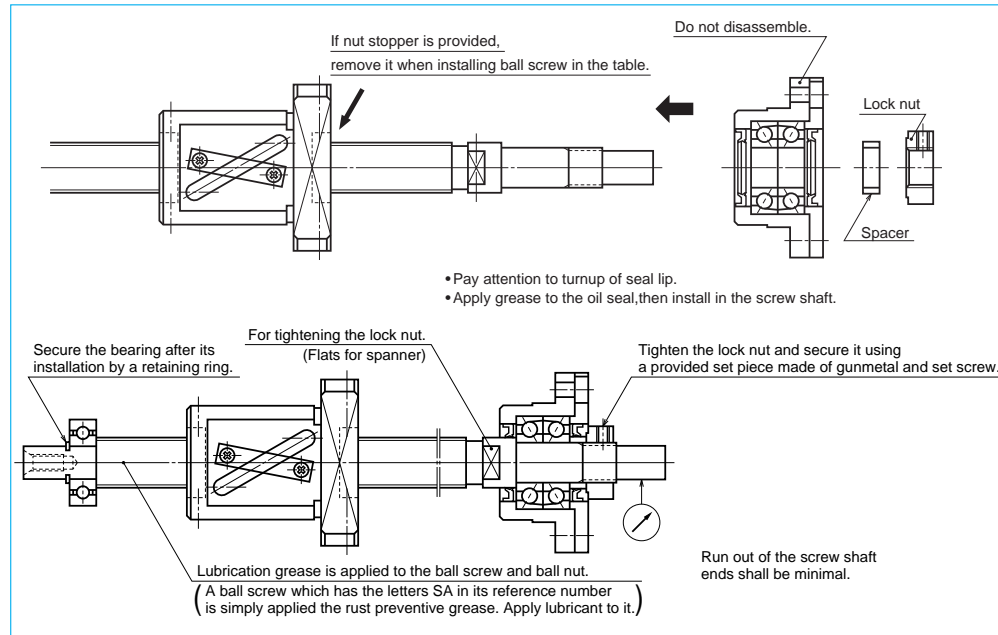
**(3) Moving the nut**

Slide the nut until it lightly touches the shoulder of the ball groove section, and stop it. Turn the ball nut to the direction so that it moves to the ball grooves, while pressing the arbor to the screw shaft. Do not separate the arbor from the screw shaft until the ball groove end appears completely in the ball nut.

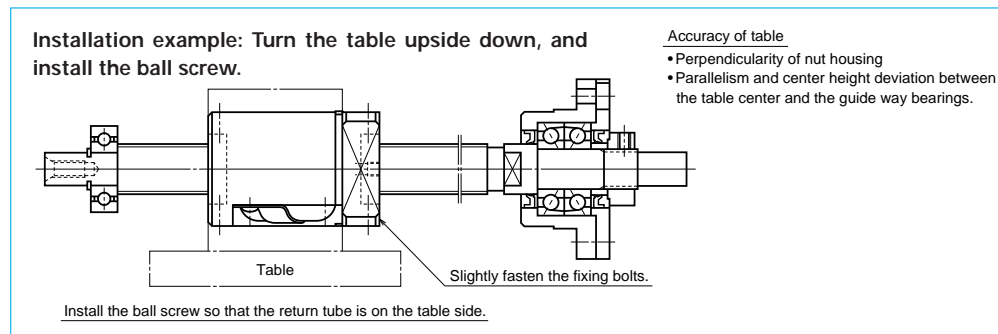
### B-2-14.3 Installation of Ball Screw and Support Unit

The illustrations below show typical installation procedures of a standard ball screw and a support unit.

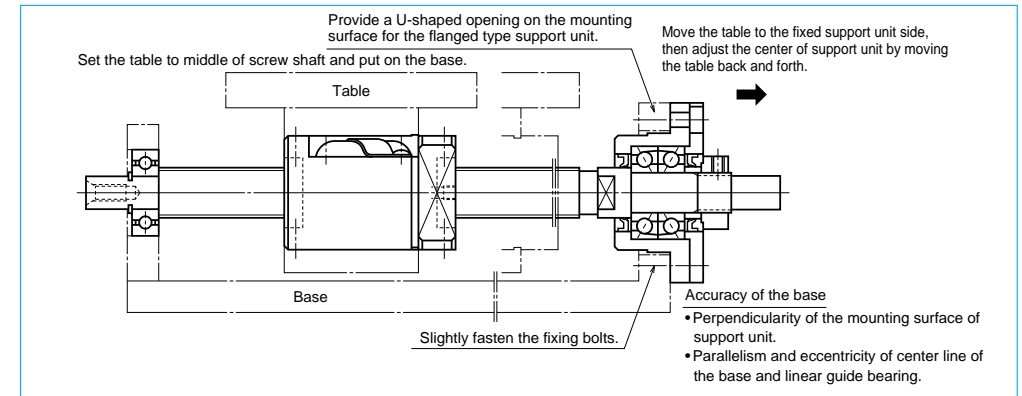
#### (1) Assembly of support unit



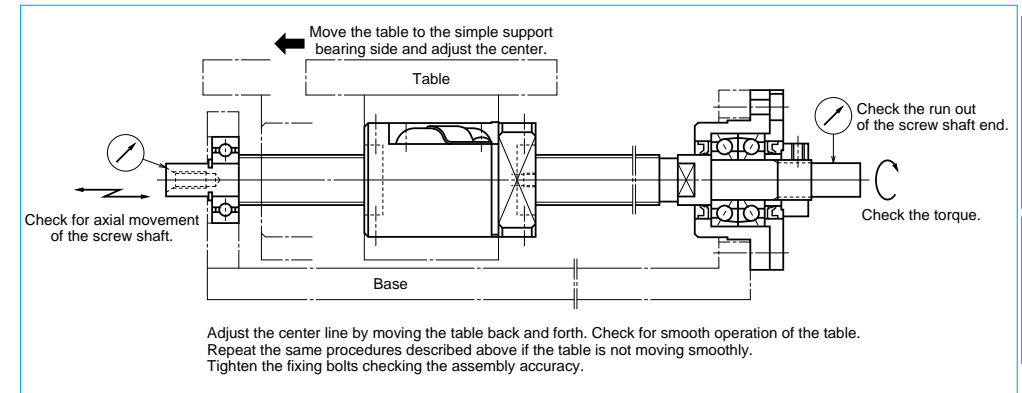
#### (2) Installation of ball nut to the table



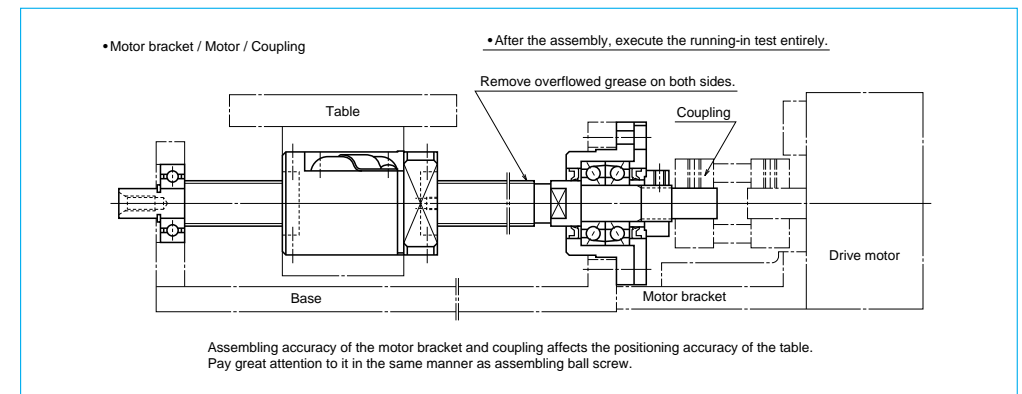
#### (3) Base and the support unit installation on the fixed support side



#### (4) Base and bearing installation on simple support side, and confirming assembling accuracy.



#### (5) Assembly completed.



### B-2-14.4 Shaft End Machining

Shaft end is machined in the following three occasions.

- \* Precision ball screws with blank shaft end.
- \* Ball screws in R Series with blank shaft end.
- \* Additional machining of a completed ball screw

The following are summaries of machining of these shaft ends. For details, please contact NSK.

#### (1) Additional machining of precision ball screw with blank shaft

##### ① Cutting screw shaft

Use a cutting whetstone, etc. to cut the shaft, leaving stock for turning. Keep the nut in the assembled state to the screw shaft, and open only one side of the plastic wrapping bag, expose only the shaft end section to be machined, then cut the screw shaft. This prevents foreign matters from entering to the ball screw section. Do the same for other machining.

##### ② Precautions in cutting shaft end

Outside of the screw shaft is ground with precision. There is a center hole 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).

##### ③ Turning by lathe

Cut to the length, turn shaft end steps, turn thread screw, and provide the center hole. Refer to JIS B1192 which sets standards for shaft end accuracy.

##### ④ Processing by grinding

Apply the same precautions as for cutting for centering, securing nut, and work rest. Grind sections where the bearings and a "Spann ring" are installed.

##### ⑤ Milling processing

Process key way and lockwasher tooth seat.

##### ⑥ Deburring, washing, rust prevention

Wash with clean white kerosene after processing. Apply lubricant for immediate use. For later use, apply rust preventive agent.

[Note]

Contact NSK if nut is accidentally removed.

#### (2) Additional machining of R Series ball screw shaft end

##### ① Cutting screw shaft

Carry out the same process as for Precision ball screw with blank shaft above.

##### ② Annealing the shaft end (Heat the section of the shaft end to be machined with an acetylene torch. Then gradually cool it in ambient atmosphere.)

\* The area not machined loses hardness if exposed to heat. This shortens ball screw life. Cool with water the areas where should not be heated to avoid heat conduction.

##### ③ The following process is the same as Precision ball screw with blank shaft above.

## B-2-15 Precautions for Designing Ball Screw

### B-2-15.1 Safety System

As shown in the illustration on Page B80, 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 B456) is available at NSK.

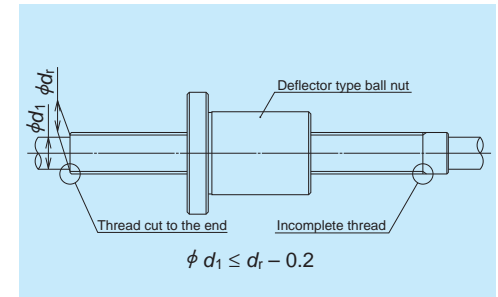


Fig. 15.1 Shaft end of a deflector recirculation system ball screw

### B-2-15.2 Design Cautious to Assembling Ball Screw

#### (1) Cutting through the thread screw to the end

For the deflector, end cap and a part of end deflector ball recirculation system ball screws, one end of the thread screw should be cut through. This is for convenience of assembly for ball nut to the screw shaft (Fig. 15.1).

In this case, the shaft end diameter, where this thread cut through is made, should be 0.2 mm or smaller than the ball groove root diameter " $d_r$ " (See the dimension table). 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, in case 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 in perpendicular to the bearing seat. (Fig. 15.2)

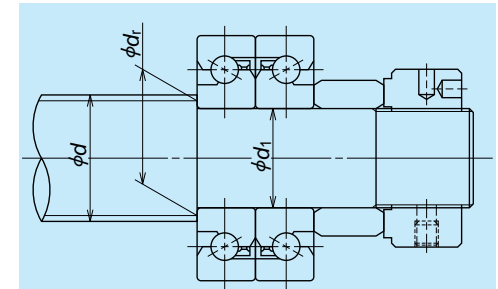


Fig. 15.2 Support bearing and end face (shoulder) for installation

#### (2) Designing screw shaft end and the nut 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. Separation may also deteriorate the ball screw accuracy, or may 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.

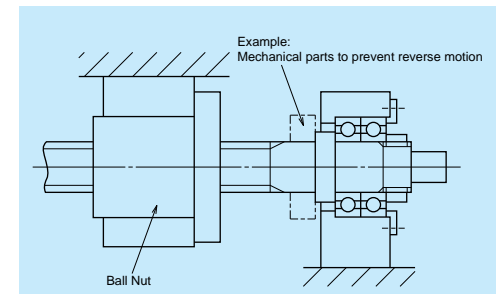


Fig. 15.3 Nut and ball screw are required to be separated when installing in this structure.



### (3) Removing nut from the shaft at time of assembly

If it is unavoidable, use an arbor (Fig. 15.4), keeping the balls in the nut. In this case, the outside diameter of the arbor should be approximately 0.2 to 0.4 mm smaller than the ball groove root diameter "d."

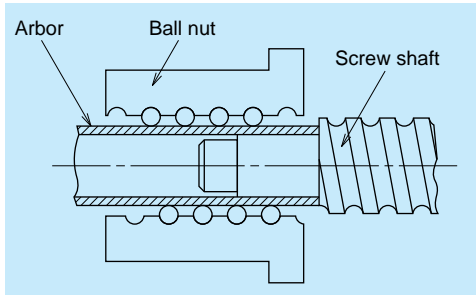


Fig. 15.4 Arbor to install and remove nut

### (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 the centering to be performed.

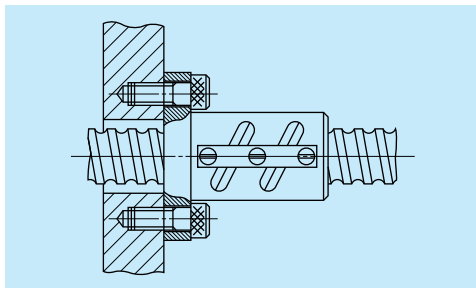
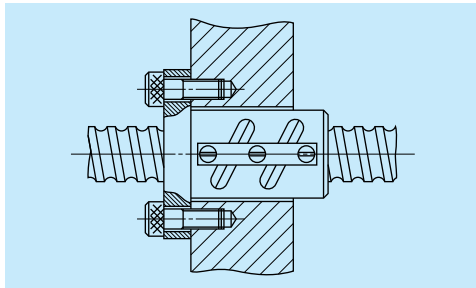


Fig. 15.5 Fixing a ball nut by flange

### (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 Series of R Series ball screw, apply an agent which prevents the nut from loosening.

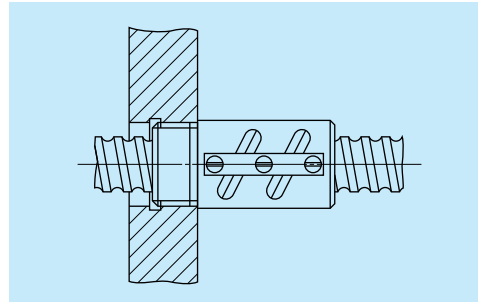


Fig. 15.6 Fixing a ball nut with thread screw

### (6) Installation of brush-seal to the nut

If the brush-seal is installed at the thread screw side of the nut which comes with a thread screw, the brush-seal should be designed to be secured as shown in Fig. 15.7.

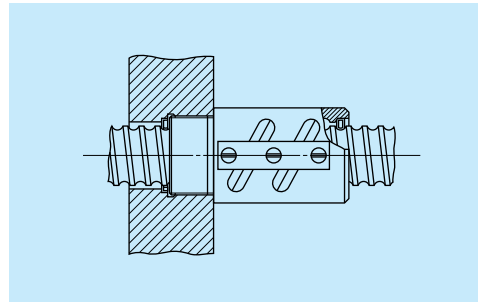


Fig. 15.7 Installation of brush-seal to a ball nut with thread screw

### B-2-15.3 Effective Stroke of Ball Screw

Rigidity of a ball screw which is hardened by the induction hardening may be slightly low at both ends of the screw section. Consider this low hardness prior to determining the length of effective stroke. Please consult NSK for details.

### B-2-15.4 Matching after Delivery

Please inform NSK on the position and size if it is necessary to machine the screw shaft end, or if a knock pin at the nut installation section is needed after delivery.

NSK takes a measure and protects designated spots from heat treatment prior to delivery to make subsequent machining easy.

### B-2-15.5 NSK K1™ Lubrication Unit

When using NSK K1 lubrication unit, be aware of the operating temperature and chemicals that come to contact for keeping the best performance of K1.

Temperature range for use:

Maximum temperature for use; 50°C

Momentary maximum temperature in use; 80°C

Chemicals that should not come to contact:

Do not leave K1 Seal in organic solvent, white kerosene such as hexane, thinner which removes oil, and rust preventive oil which contains white kerosene.

Water-type cutting oil, oil-type cutting oil, grease such as mineral-type AS2 and ester-type PS2 do not damage K1 Seal.

## B-2-16 Ball Screw Selection Exercise

### [Drill 1] High-speed transporting system

#### 1. Design conditions

- Table mass :  $m_1 = 40 \text{ kg}$
- Mass of the transporting item :  $m_2 = 20 \text{ kg}$
- Maximum stroke :  $S_{\text{max}} = 700 \text{ mm}$
- Rapid traverse speed :  $V_{\text{max}} = 1000 \text{ mm/sec}$  (60 m/min)
- Positioning accuracy :  $\pm 0.05/700 \text{ mm}$  (0.005 mm/pulse)
- Repeatability :  $\pm 0.005 \text{ mm}$
- Required life :  $L_t = 25000 \text{ h}$  (5 years)
- Guide way (rolling) :  $\mu = 0.01$  (friction coefficient)
- Drive motor : AC servo motor ( $N_{\text{max}} = 3000 \text{ min}^{-1}$ )

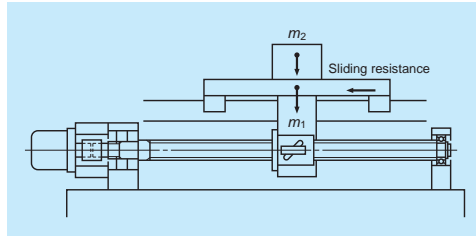


Fig. 16.1 System appearance

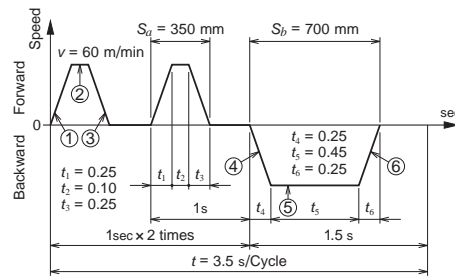


Fig. 16.2 Operating condition

#### 2. Selection of basic factors

##### (1) Selection of accuracy grade and axial play

According to Table 4.1 Accuracy grades of ball screw and their application (B19), accuracy grade of industrial robots cartesian type and other purposes are C5 to C10.

From the following conditions in design, the axial play should be 0.005 mm or less.

Repeatability :  $\pm 0.005 \text{ (mm)}$

Resolution :  $0.005 \text{ mm/pulse}$

According to Table 4.2 Combinations of accuracy grades and axial play (B20), you will require accuracy grade C5 if the axial play is below 0.005 mm. Therefore select accuracy grade C5, and axial play 0 mm (Z preload)

##### (2) Selection of lead

Calculate lead  $l$  based on AC servo motor maximum speed and rapid traverse speed  $V_{\text{max}}$ .

$$l \geq \frac{V_{\text{max}}}{N_{\text{max}}} = \frac{1000 \times 60}{3000} = 20 \text{ (mm)}$$

Select a lead  $l$  of 20 mm or larger.

##### (3) Selection of screw shaft diameter

According to "Table 4.6 Shaft diameter, lead and stroke of standard ball screw" on Page B23, 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 4.6 Screw shaft diameter, lead, and stroke of standard ball screw" on page B23, ball screw with shaft diameter  $d = 15 \text{ mm}$  and lead  $l = 20 \text{ mm}$  meets maximum stroke 700 mm, therefore it is possible to select from standard ball screw. 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 the standard ball screw finished shaft end.

Primary candidate: W1507FA-3PG-C5Z20

#### 4. Checking basic safety

Calculate for the primary candidate.

##### (1) Allowable axial load

① Calculation of allowable axial load

From Fig. 16.2: Acceleration  $\alpha_1$  at accelerating / decelerating is:

$$\alpha_1 = \frac{V_{\text{max}}}{t_1} = \frac{1000}{0.25} = 4000 \text{ (mm/s}^2\text{)} = 4 \text{ (m/s}^2\text{)}$$

Axial load  $F_1$  is:

(At time of acceleration ①④)

$$F_1 = \mu (m_1 + m_2) \times g + (m_1 + m_2) \times \alpha_1 \\ = 0.01 \times (40 + 20) \times 9.80665 + (40 + 20) \times 4 \\ = 246 \text{ (N)}$$

(At time of constant speed ②⑤)

$$F_2 = \mu (m_1 + m_2) \times g = 0.01 \times (40 + 20) \times 9.80665 \\ = 6 \text{ (N)}$$

(At time of deceleration ③⑥)

$$F_3 = -\mu (m_1 + m_2) \times g + (m_1 + m_2) \times \alpha_1 \\ = -0.01 \times (40 + 20) \times 9.80665 + (40 + 20) \times 4 \\ = 234 \text{ (N)}$$

Thus, the maximum axial load  $P$  is 246 N.

② Buckling load

W1507FA-3PG-C5Z20 has distance  $L_a = 804 \text{ mm}$  (per specifications on Page B277), table maximum axial load  $P = 246 \text{ (N)}$ . Supporting condition of screw shaft is Fixed - Simple support, and supporting condition of ball nut is Fixed. Due to the direction of the load, supporting condition is Fixed - Fixed support (Factor  $m = 19.9$ ).

From Formula (II-2) on Page B48:

$$d_r \geq \left[ \frac{P \cdot L_a^2}{m} \times 10^{-4} \right]^{1/4} = \left[ \frac{246 \times 804^2}{19.9} \times 10^{-4} \right]^{1/4} \\ = 5.3 \text{ (mm)}$$

W1507FA-3PG-C5Z20 has dimension  $d_r = 12.2 \text{ mm}$  per dimension chart (Page B277) and therefore meets the condition.

Result: Acceptable

##### (2) Checking allowable value of rotational speed

The permissible rotational speed listed in the dimension table is  $3000 \text{ min}^{-1}$ . Since the motor maximum rotational speed is  $3000 \text{ min}^{-1}$ , the operation is in the range of permissible rotational speed.

Result: Acceptable

##### (3) Checking life expectation

① Mean load  $F_m$ , mean rotational speed  $N_m$   
From calculation of axial load. Rotational speed  $N_i$  and operating time  $t_i$  is:

(At time of acceleration ①④)

$$F_1 = 246 \text{ (N)}$$

$$N_1 = \frac{n}{2} = \frac{3000}{2} = 1500 \text{ (min}^{-1}\text{)}$$

$$t_a = 2 \times t_1 + t_4 = 0.75 \text{ (s)}$$

(At time of constant speed ②⑤)

$$F_2 = 6 \text{ (N)}$$

$$N_2 = 3000 \text{ (min}^{-1}\text{)}$$

$$t_b = 2 \times t_2 + t_5 = 0.65 \text{ (s)}$$

(At time of deceleration ③⑥)

$$F_3 = 234 \text{ (N)}$$

$$N_3 = 1500 \text{ (min}^{-1}\text{)}$$

$$t_c = 2 \times t_3 + t_6 = 0.75 \text{ (s)}$$

Calculation result is shown in Table 16.1

Table 16.1 Axial load and rotational speed

Operating condition	Axial load (N)	Rotational speed (mean) (min <sup>-1</sup> )	Operating time (s)
① ④	$F_1 = 246$	$N_1 = 1500$	$t_a = 0.75$
② ⑤	$F_2 = 6$	$N_2 = 3000$	$t_b = 0.65$
③ ⑥	$F_3 = 234$	$N_3 = 1500$	$t_c = 0.75$

From Formulas (II-11) and (II-12) on Page B57:

$$F_m = \left[ \frac{F_1^3 \cdot N_1 \cdot t_a + F_2^3 \cdot N_2 \cdot t_b + F_3^3 \cdot N_3 \cdot t_c}{N_1 \cdot t_a + N_2 \cdot t_b + N_3 \cdot t_c} \right]^{1/3} \\ = 195 \text{ (N)}$$

$$N_m = \frac{N_1 \cdot t_a + N_2 \cdot t_b + N_3 \cdot t_c}{t} \\ = 1200 \text{ (min}^{-1}\text{)}$$

② Calculation of life expectation

W1507FA-3PG-C5Z20 (Clearance Z) is  $C_a=3870N$   
(From dimension table on Page B277), from  
Formulas (II-8) and (II-9) on Page B57:

$$L_t = \left( \frac{C_a}{F_m \cdot f_w} \right)^3 \times \frac{1}{60N_m} \times 10^6$$

$$= \left( \frac{3870}{195 \times 1.2} \right)^3 \times \frac{1}{60 \times 1200} \times 10^6$$

$$\doteq 62800$$

This grade satisfies the required life.

Result: Acceptable

**5. Check whether the following figures meet requirements**

**(1) Accuracy and axial play**

From the dimension table and the permissible value of lead accuracy on Page B42:

According to Table 1.2:

Accuracy grade: C5

$$e_p = \pm 0.035/800 \text{ (mm)}$$

$$v_u = 0.025 \text{ (mm)}$$

This grade satisfies the required positioning accuracy  $\pm 0.05/700$  mm.

Checking 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 : 3000 min<sup>-1</sup>

Time to reach maximum speed : Under 0.25 sec

① Load (converted to motor axis)

Using Formula (II-32) and (II-33) on Page B68, calculate the moment of inertia whereas  $\gamma$  is density.

(Screw shaft)

$$J_B = \frac{\pi \cdot \gamma \cdot D^4 \cdot L}{32} = \frac{\pi \times 7.8 \times 10^3}{32} \times 1.5^4 \times 80$$

$$= 0.31 \text{ (kg} \cdot \text{cm}^2)$$

(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)

$$J_c = 0.25 \text{ (kg} \cdot \text{cm}^2) \cdots \text{Temporary}$$

(As a whole)

Moment of inertia of the ball screw  $J_L$  is:

$$J_L = J_B + J_w + J_c$$

$$= 0.31 + 6.1 + 0.25$$

$$= 6.7 \times 10^{-4} \text{ (kg} \cdot \text{m}^2)$$

② Driving torque

Assuming that WBK12-01 compact light load type will be used, as recommended for W1507FA-3PG-C5Z20, and moment of inertia of motor  $J_M = 3.1$  (kg · cm<sup>2</sup>) =  $3.1 \times 10^{-4}$  (kg · m<sup>2</sup>).

(At time of constant speed)

Torque which is necessary to drive a ball screw at constant speed resisting to external loads is per Formula (II-30) on Page B68

$$T_1 = T_a + T_{pmax} + T_u$$

in this Formula,  $T_a$  is drive torque at constant speed,  $T_{pmax}$  is upper limit of the dynamic friction torque of ball screw,  $T_u$  is friction torque of the support bearing.

From dimension chart on Page B227  $T_{pmax} = 7.8$  (N · cm) and from Page B444  $T_u = 2.1$  (N · cm)

$$T_a = \frac{F_a \cdot l}{2\pi\eta_1}$$

Using Formula (II-28) on Page B67, Drive torque at constant speed  $T_1$  is:

$$T_1 = \frac{F_a \cdot l}{2\pi \cdot \eta_1} + T_{pmax} + T_u$$

$$= \frac{6 \times 2}{2\pi \times 0.9} + 7.8 + 2.1$$

$$= 12 \text{ (N} \cdot \text{cm)} = 0.12 \text{ (N} \cdot \text{m)}$$

(At time of acceleration)

Drive torque necessary for accelerating the ball screw resisting axial load can be calculated by Formula (II-31) on Page 68

$$T_2 = T_1 + J \cdot \frac{2\pi \cdot n}{60t_1}$$

$$= T_1 + (J_L + J_M) \cdot \frac{2\pi \cdot n}{60t_1}$$

$$= 0.12 + (6.7 \times 10^{-4} + 3.1 \times 10^{-4}) \frac{2\pi \times 3000}{60 \times 0.25}$$

$$= 1.35 \text{ (N} \cdot \text{m)}$$

(At time of deceleration)

Similarly at time of acceleration.

$$T_3 = T_1 - J \cdot \frac{2\pi \cdot n}{60t_3}$$

$$= T_1 - (J_L + J_M) \cdot \frac{2\pi \cdot n}{60t_3}$$

$$= 0.12 - (6.7 \times 10^{-4} + 3.1 \times 10^{-4}) \frac{2\pi \times 3000}{60 \times 0.25}$$

$$= -1.11 \text{ (N} \cdot \text{m)}$$

③ Selection of motor

Selection conditions are as follows.

Maximum rotational speed:  $N_M \geq 3000$  (min<sup>-1</sup>)

Motor rating torque:  $T_M \geq T_{rms}$  (N · m)

( $T_{rms}$ : Effective torque)

Motor's rotor inertia --  $J_M > J_L/3$  or more

Form above: select an AC servo motor with the following specifications.

Motor specifications:

Rating power output:  $W_M = 300$  (W)

Maximum rotational speed:

$$N_M = 3000 \text{ (min}^{-1}\text{)}$$

Rating torque:  $T_M = 1$  (N · m) =  $1 \times 10^2$  (N · cm)

Rotor inertia:  $J_M = 3.1 \times 10^{-4}$  (kg · m<sup>2</sup>) =  $3.1$  (kg · cm<sup>2</sup>)

④ Checking effective torque

Effective torque  $T_{rms}$  can be calculated as follows:

$$T_{rms} = \sqrt{\frac{T_2^2 \times t_a + T_1^2 \times t_b + T_3^2 \times t_c}{t}}$$

$$= \sqrt{\frac{1.35^2 \times 0.75 + 0.12^2 \times 0.55 + 1.11^2 \times 0.75}{3.5}}$$

$$= 0.81$$

and meets  $T_M \geq T_{rms}$ .

⑤ Checking time to reach maximum speed

Time required to reach rapid traverse speed can be calculated as follows whereas  $T_{M'} = 2 \times T_M$

$$t_a = \frac{(J_L + J_M) \times 2\pi \times n}{(T_{M'} - T_1)} \times 1.4$$

$$= \frac{(6.7 \times 10^{-4} + 3.1 \times 10^{-4}) \times 2\pi \times 3000}{(2 \times 1 - 0.12) \times 60} \times 1.4$$

$$= 0.23$$

and meets requirement 0.25 sec or less.

From above: Use W1507FA-3PG-C5Z20

[Drill 2] Processing table for special machines

1. Design conditions

- Table mass:  $m_1 = 1000$  kg
- Mass of the moving item:  $m_2 = 600$  kg
- Maximum stroke:  $S_{max} = 1000$  mm
- Maximum speed:  $V_{max} = 15000$  mm/min
- Positioning accuracy:  $\pm 0.035/1000$  mm (no load)
- \* Attitude accuracy of the table and thermal displacement are not included in the accuracy requirement of the ball screw.
- Repeatability:  $\pm 0.005$  mm (no load)
- Lost motion:  $0.020$  mm (no load)
- Required life expectancy:  $L_t = 20000$  h  
( $16^h \times 250^{days} \times 10^{years} \times 0.5^{rate\ of\ operation}$ )
- Guide way (sliding):  $\mu = 0.15$   
(friction coefficient)
- Processing: Milling and drilling
- Drive motor: AC servo motor  
( $N_{max} = 2000$  min<sup>-1</sup>)

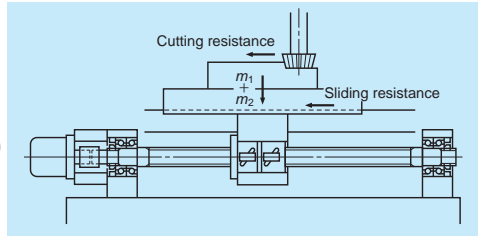


Fig. 16.3 System appearance

Table 16.2 Operating conditions

Operation	Axial load (N)		Feed speed (mm/min)	Use time ratio (%)
	Cutting resistance	Sliding resistance		
Rapid traverse	0	2354	15000	30
Light/medium cutting	4000	2354	500	50
Heavy cutting	8000	2354	100	20

- \* Sliding resistance:  $F_r = \mu (m_1 + m_2) g = 0.15 \times (1000 + 600) \times 9.80665 = 2354$  (N)
- \* Ignore inertia at time of acceleration/deceleration because their time ratios are small.

2. Selection of basic factors

(1) Selection of accuracy grade and axial play

Accuracy grade should be in the range from C1 to C5 according to "Table 4.1 Precision grades of ball screw and their applications" on Page B19. Assuming nut length 200 mm and extra stroke 100 mm, shaft length  $L_0$  is assumed as follows:

$$L_0 = \text{Maximum stroke} + \text{nut length} + \text{margin} \\ = 1000 + (200) + (100) = 1300$$

From "Table 1.2 Tolerance on specified travel and travel variation of the positioning ball screws" on Page B42, the accuracy that satisfies required function is possibly:

Accuracy C3 grade

$$e_p = \pm 0.029/1600 \text{ (mm)}$$

$$v_u = 0.018 \text{ (mm)}$$

Considering importance on the volume of lost motion, select Z code (axial play 0 mm and less) for 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  $I$  is:

$$I \geq \frac{V_{max}}{N_{max}} = \frac{15000}{2000} = 7.5 \text{ (mm)}$$

Larger lead  $I$  would be beneficial for feed speed. But from the view of the control system (resolution), limit the lead  $I$  to 8 mm or 10 mm.

(3) Selection of screw shaft diameter

According to "Table 4.6 shaft diameter, lead and stroke of standard ball screw" on Page B23, shafts whose lead  $I$  is 8 mm or 10 mm are in the range of 10 mm to 50 mm. Placing more importance on rigidity than to the volume of lost motion, select a relatively large size in the range of 32 mm to 50 mm.

(4) Selection of stroke

Select 1000 mm, the maximum stroke in request.

Primary selection:

- Standard ball screw
- Shaft diameter: 32, 36, 40, 45, 50 mm
- Lead: 8, 10 mm
- Stroke: 1000 mm
- grade: C3
- Axial play code: Z

3. Confirmation of standard ball screw

Giving consideration to delivery time and price, select from the standard series. C3 grade chosen in the Primary selection was not found in the standard ball screw. Let us check whether there is a C3 grade among ball screw.

4. Confirmation of made-to-order ball screw

Because standard ball screw does not meet accuracy grade requirement, we will consider made-to-order ball screw which is based on standard ball screw but with accuracy grade C3.

Second selection:

- Made-to-order ball screw
- Shaft diameter : 32, 36, 40, 45, 50 mm
- Lead : 8, 10 mm
- Stroke : 1000 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 of each lead through load conditions. From table 16.2 operating conditions on Page B91, calculate the rotation speed  $N_i$ , as shown in Table 16.3.

$$N_i \geq \frac{V_i}{I}$$

Table 16.3 Load conditions

Operating condition	Axial load (N)	Rotations per minute (min <sup>-1</sup> )		Use time ratio (%)
		$I = 8$	$I = 10$	
Rapid traverse	$F_1 = 2354$	$N_1 = 1875$	$N_1 = 1500$	$t_1 = 30$
Light/medium cutting	$F_2 = 6354$	$N_2 = 62.5$	$N_2 = 50$	$t_2 = 50$
Heavy cutting	$F_3 = 10354$	$N_3 = 12.5$	$N_3 = 10$	$t_3 = 20$

By using Formula (II-11) and (II-12) on Page B57, calculate mean load  $F_m$  and mean rotational speed  $N_m$  as shown below.

$$F_m = \left( \frac{F_1^3 \cdot N_1 \cdot t_1 + F_2^3 \cdot N_2 \cdot t_2 + F_3^3 \cdot N_3 \cdot t_3}{N_1 \cdot t_1 + N_2 \cdot t_2 + N_3 \cdot t_3} \right)^{1/3}$$

$$N_m = \frac{N_1 \cdot t_3 + N_2 \cdot t_2 + N_3 \cdot t_1}{t}$$

Table 16.4 Mean load and mean rotational speed

Lead (mm)	8	10
Mean load $F_m$ (N)	3122	3122
Mean rotational speed $N_m$ (min <sup>-1</sup> )	596	477

Required dynamic load rating  $C_a$  is:

From Formulas (II-8) and (II-9) on Page B57:

$$C_a \geq (60N_m \cdot L)^{1/3} \cdot F_m \cdot f_w \times 10^{-2} (N)$$

Whereas required life expectancy  $L_1 = 20000$  (h),

load coefficient  $f_w = 1.2$  (refer to Page B57),

$$l = 8 \text{ (mm)} \dots\dots\dots C_a \geq 33500 \text{ (N)}$$

$$l = 10 \text{ (mm)} \dots\dots\dots C_a \geq 31100 \text{ (N)}$$

### (2) Selection of the nut

Due to lost motion requirements rigidity will be important, so the nut will be selected as follows.

Table 16.5 shows the dynamic load rating of each specification.

- Standard nut ball screw, tube type
- Model: ZFT, DFT (Pages B475 to B504)
- Number of turns of balls : Select from 2.5 turns 2 circuits or 2.5 turns 3 circuits

From Table 16.5 select item that meets required dynamic load rating  $C_a$  as follows:

Third selection: In the range surrounded by the dotted lines  in Table 16.5

**Table 16.5 Dynamic load rating of each specification**

Screw shaft diameter (mm)	Dynamic load rating $C_a$ : (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	31700	-	46300	-
36	-	-	49300	-
40	34900	-	52000	-
45	-	-	54200	76800
50	38700	54900	57700	81800

### (3) Permissible rotational speed

#### ① Critical speed

Calculate based on rapid traverse speed  $V_{max} = 15000$  mm/min. Ball screw rotational speed at each lead  $N$  is:

$$l = 8 \text{ (mm)} \dots\dots\dots N = 1875 \text{ (min}^{-1}\text{)}$$

$$l = 10 \text{ (mm)} \dots\dots\dots N = 1500 \text{ (min}^{-1}\text{)}$$

Based on Formula (II-7) on Page B51, screw shaft root diameter to meet critical speed requirement is:

$$d_f \geq \frac{n \cdot L_2}{f} \times 10^{-7} \text{ (mm)}$$

In this formula, unsupported length  $L_a$  is:

$$\begin{aligned} L_a &= \text{Maximum stroke} + \text{nut length}/2 + \text{shaft end extra length} \\ &= 1000 + 100 + 200 = 1300 \text{ (mm)} \end{aligned}$$

Supporting condition of screw shaft is Fixed - Fixed support, and supporting condition of ball nut is Fixed. Therefore, supporting condition is Fixed - Fixed support (Factor  $f = 21.9$ )

$$l = 8 \text{ (mm)} \dots\dots d_f \geq 14.5 \text{ (mm)}$$

$$l = 10 \text{ (mm)} \dots\dots d_f \geq 11.6 \text{ (mm)}$$

#### ② $d \cdot n$ value

From Table 3.2 on Page B54, as the  $d \cdot n$  is 70000 or less, screw shaft diameter to meet the  $d \cdot n$  value is:

$$d \leq \frac{70000}{N} \text{ (mm)}$$

$$l = 8 \text{ (mm)} \dots\dots\dots d \leq 37.3 \text{ (mm)}$$

$$l = 10 \text{ (mm)} \dots\dots\dots d \leq 46.7 \text{ (mm)}$$

Based on nut specifications (Page B475-504) select item that meets screw shaft root diameter and screw shaft diameter.

\* Please consult NSK if it is necessary to use at  $d \cdot n > 70000$ .

Fourth selection: In the range surrounded by the solid-lines in Table 16.5

### (4) Rigidity of the ball screw system

Set the lost motion of the ball screw system (screw shaft, nut and support bearing) at 80% of the specified value. Then calculate the system rigidity. The lost motion is:

$$20 \text{ (}\mu\text{m)} \times 0.8 = 16 \text{ (}\mu\text{m)}$$

At this time, the single-direction elastic deformation  $\Delta L$  of the major factors of ball screw system becomes half.

$$\Delta L \leq 8 \text{ (}\mu\text{m)}$$

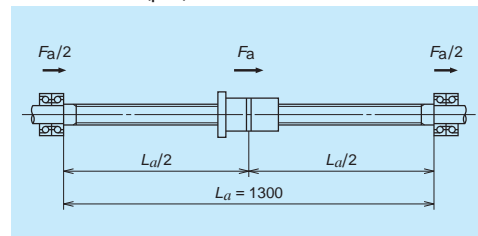


Fig. 16.3 Unsupported length

#### ① Rigidity of the screw shaft $K_s$

Calculate at the screw shaft center where axial deformation becomes the largest. Because supporting condition of screw shaft is Fixed - Fixed support, from Formula (II-21) on Page B62:

$$K_s = \frac{\pi \cdot d_r^2 \cdot E}{L_a} \times 10^{-3} \text{ (N/mm)}$$

Whereas E is Elastic Modulus. From Formula (II-17) on page B61, elastic deformation of the screw shaft  $\Delta L_s$  is

$$\Delta L_s = \frac{F_a}{K_s} = \frac{F_a \cdot L_a}{\pi \cdot d_r^2 \cdot E} \times 10^3 \text{ (}\mu\text{m)}$$

$F_a$ : Sliding resistance

$$\begin{aligned} F_a &= \mu (m_1 + m_2) = 0.15 \times (1000 + 600) \\ &= 2354 \text{ (N)} \end{aligned}$$

Table 16.7 shows the rigidity of screw shaft  $K_s$  and the elastic deformation  $\Delta L_s$ .

#### ② Rigidity of the nut $K_N$

Set about 1/3 of the maximum axial load as the preload value.

$$F_{a0} = \frac{F_{max}}{3} = \frac{10354}{3} = 3452 \rightarrow 3500 \text{ (N)}$$

From Formula (II-23) on Page B64:

Rigidity:

$$K_N = 0.8 \times K \left( \frac{F_{a0}}{\varepsilon \cdot C_a} \right)^{1/3} = 0.8 \times K \left( \frac{3500}{0.1 \cdot C_a} \right)^{1/3} \text{ (N/}\mu\text{m)}$$

$K$ : Theoretical rigidity

From Formula (II-17) on page B62, elastic deformation of the ball nut  $\Delta L_N$  is

$$\Delta L_N = \frac{F_a}{K_N} = \frac{2354}{K_N}$$

Table 16.7 shows the rigidity of nut  $K_N$  and the elastic deformation  $\Delta L_N$ .

#### ③ Rigidity of the support bearing $K_B$

The bearing is thrust angular contact ball bearing for ball screw support (TAC Series). Assume each shaft diameter is as shown in Table 16.6 (Refer to Page B457).

**Table 16.6 Bearing code**

Screw shaft diameter (mm)	Bearing code
32	25TAC62BDF
36	25TAC62BDF
40	30TAC62BDF
45	35TAC72BDF

Refer to Page B461 for rigidity  $K_B$  of each bearing (axial spring modulus). Elastic deformation of bearing  $\Delta L_B$  is:

$$\Delta L_B = \frac{F_a}{2K_B}$$

Table 16.7 shows the rigidity of support bearing  $K_B$  and the elastic deformation  $\Delta L_B$ .

**Table 16.7 Rigidity and elastic deformation**

Nut model number	Screw shaft		Nut		Support bearing		Total $\Delta L$
	$K_s$	$\Delta L_s$	$K_N$	$\Delta L_N$	$K_B$	$\Delta L_B$	
DFT3210-5	347	6.8	839	2.8	1000	1.2	10.8
DFT3610-5	460	5.1	907	2.6			
DFT4010-5	589	4.0	973	2.4	1030	1.1	7.5
DFT4510-5	772	3.0	1050	2.2			
DFT4510-7.5			1375	1.7	1180	1.0	6.2

Choose the most economical ball screw which meets single direction deformation requirement  $\Delta L$  is 8  $\mu\text{m}$  or less.

The selected ball screw:  
 Nut model code : DFT4010-5  
 Shaft diameter : 40 (mm)  
 Lead : 10 (mm)  
 Dynamic load rating : 52000 (N)

### 6. Decision of screw shaft length

Nut reference number DFT4010 has nut length 193 mm and unsupported length  $L_a$  is:

$$\begin{aligned} L_a &= \text{Maximum stroke} + \text{nut length} + \text{margin} \\ &= 1000 + 193 + 100 = 1293 \rightarrow 1300 \text{ mm} \end{aligned}$$

## 7. Checking basic safety

### (1) Permissible axial load

Calculate buckling load for conditions shown in Fig. 16.4 with  $P = 10354$  (N) and  $L_1 = 1210$  (mm)

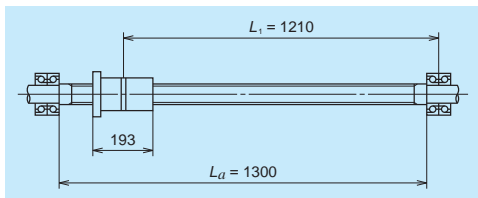


Fig. 16.4 Examination of buckling load

Supporting condition is Fixed - Fixed support, from buckling load calculation Formula (II-2) on Page B48, screw shaft diameter  $d_s$  to prevent buckling

$$d_s \geq \left[ \frac{P \cdot L_1^2}{m} \times 10^4 \right]^{1/4}$$

$$= \left[ \frac{10354 \times 1210^2}{19.9} \times 10^4 \right]^{1/4} = 16.6 \text{ (mm)}$$

From DFT4010-5 specifications (page B493) shaft root diameter is  $d_r = 34.4$  and meets requirement.

Result: Acceptable

### (2) Permissible rotational speed

#### ① Critical speed $n$

From critical speed calculation Formula (II-7) on Page B51,

$$n = f \cdot \frac{d_s}{L_1^2} \times 10^7 = 21.9 \times \frac{34.4}{1210^2} \times 10^7$$

$$\doteq 5140$$

Maximum rotational speed  $N_{max} = 1500$  min<sup>-1</sup> is smaller than critical speed and meets requirement.

Result: Acceptable

#### ② $d \cdot n$ value

$d \cdot n$  value is:

$$d \cdot n = 40 \times 1500 = 60000$$

From Table 3.2 on Page B54,  $d \cdot n$  of tube type is 70000 or less and meets requirement.

Result: Acceptable

### (3) Life $L_t$

Dynamic load rating  $C_a = 52000$  N (See dimension table on page B491), and from Formulas (II-8) and (II-9) on Page B57,

$$L_t = \left[ \frac{C_a}{f_w \cdot F_m} \right]^3 \times 10^6 \times \frac{1}{60 \cdot N_m}$$

$$\doteq 95000$$

and meets required life 20000 (h).

Result: Acceptable

## 8. Check whether the following factors satisfy requirements

### (1) Checking accuracy

#### ① Positioning accuracy

Positioning accuracy  $\pm 0.035/1000$  mm, and therefore from "Table 1.2 Tolerance of specified travel and travel variation" on Page B42:

Accuracy grade : C3

$$e_p = \pm 0.029/1600 \text{ (mm)}$$

$$v_u = 0.018 \text{ (mm)}$$

and meets required positioning accuracy.

#### ② Measures against thermal expansion

Provide pre-tension force equivalent to the elongation of 3°C temperature rise, taking in consideration of the load carrying capacity of bearing. Also, adjust the travel compensation for the specified travel by a volume equivalent to 3°C temperature rise. (Refer to Page B44)

##### (a) Thermal elongation : $\Delta L_o$

From Formula (II-1) on Page B44:

$$\Delta L_o = \rho \cdot \theta \cdot L_o = 12.0 \times 10^{-6} \times 3 \times 1300$$

$$= 0.047 \text{ (mm)}$$

##### (b) Pre-tension force : $F_\theta$

$$F_\theta = \Delta L_o \cdot K_s = \frac{\Delta L_o \cdot E \cdot \pi \cdot d_r^2}{4 L_o}$$

$$= \frac{0.047 \times 2.06 \times 10^5 \times \pi \times 34.4^2}{4 L \times 1300}$$

$$\doteq 6922 \rightarrow 6900 \text{ (N)}$$

Travel compensation :	-0.047/1300 (mm)
Pre-tension force :	6900 (N)
Tension (elongation) volume :	0.047 (mm)

### ③ Selection of support bearing

Assuming that the ratio of basic dynamic load rating of support bearing ( $C_B$ ) and pre-tension force ( $F_\theta$ ) is  $\varepsilon$ , select a bearing which generally satisfies:

$$\varepsilon = F_\theta / C_B < 0.20$$

Design the bearing supporting configuration to which pre-tension force is applied in such way that the axial load is received by the duplex combination or more. Please consult to NSK when one bearing must sustain the pre-tension load.

Table 16.8 Comparison of dynamic load rating and pre-tension force

Bearing reference number	$C_B$ (N)	$\varepsilon$
30TAC62BDF	29200	0.23
30TAC62BDFD	47500	0.14

Selected support bearing: 30TAC62BDFD

### (2) Checking drive torque of motor

Selection of driving motor

<Required specifications>

Motor rotational speed : 1500 min<sup>-1</sup>

Time to reach maximum speed : Under 0.16 sec

(At time of rapid traverse)

#### ① Load (converted to the motor load)

Calculate the moment of inertia of ball screw.

From Formulas (II-32) and (II-33) of Page B68, moment of inertia of ball screw parts  $J$  are calculated as follows, whereas  $\gamma$  is material density and ball screw shaft length  $L_o = 1550$  mm

(Screw shaft)

$$J_b = \frac{\pi \cdot \gamma \cdot D^4 \cdot L_o}{32} = \frac{\pi \times 7.8 \times 10^3}{32} \times 4^4 \times 155$$

$$= 30 \text{ (kg} \cdot \text{cm}^2)$$

(Moving part)

$$J_w = m \times \left[ \frac{I}{2\pi} \right]^2 = 1600 \times \left[ \frac{1}{2\pi} \right]^2$$

$$= 40 \text{ (kg} \cdot \text{cm}^2)$$

(Coupling)

$$J_c = 10 \text{ (kg} \cdot \text{cm}^2) \text{... assumed}$$

(Total)

$$J_L = J_b + J_w + J_c = 30 + 40 + 10$$

$$= 80 \text{ (kg} \cdot \text{cm}^2) \rightarrow 80 \times 10^{-4} \text{ (kg} \cdot \text{m}^2)$$

### ② Driving torque

Necessary torque to drive a ball screw resisting to external loads  $T_1$  can be obtained by Formula (II-29) on Page 66:

$$T_1 = T_A + T_p + T_U$$

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 bearing. From Formula (II-26) on page B66 and Formula (II-27) on B67,  $T_A$  and  $T_p$  are:

$$T_A = \frac{F_a \cdot I}{2\pi \eta_1}$$

$$T_p = 0.014 F_{a0} \sqrt{d_m \cdot I}$$

$$\eta_1 = 0.9$$

Refer to the starting torque value in Table 2.7 on Page B461:

$T_U$  is:

$$T_U = 33 + 33 = 66 \text{ (N} \cdot \text{cm)}$$

So, the required drive torque during rapid traverse and heavy cutting  $T_{11}$  and  $T_{13}$  are:

(At time of rapid traverse)

$$T_{11} = T_{A1} + T_{P1} + T_{U1}$$

$$= \frac{2354 \times 1}{2\pi \times 0.9} + 0.014 \times 3500 \sqrt{4.1 \times 1} + 66$$

$$= 580 \text{ (N} \cdot \text{cm)} \rightarrow 580 \times 10^{-2} \text{ (N} \cdot \text{m)}$$

(At time of heavy cutting)

$$T_{12} = T_{A2} + T_{P2} + T_{U2}$$

$$= \frac{10354 \times 1}{2\pi \times 0.9} + 0.014 \times 3500 \sqrt{4.1 \times 1} + 66$$

$$= 1995 \text{ (N} \cdot \text{cm)} \rightarrow 1995 \times 10^{-2} \text{ (N} \cdot \text{m)}$$

### ③ Selection of the motor

<Selection conditions>

Maximum rotational speed :  $N_M \geq 1500$  (min<sup>-1</sup>)

Motor rating torque :  $T_M > T_1$  (N · m)

Motor's rotor inertia :  $J_M > J_L / 3$  (kg · m<sup>2</sup>)

Based on this, select AC servo motor as below.

Motor specifications	
Rating power output:	$W_M = 1.8 \text{ (kW)}$
Maximum rotational speed:	$N_M = 1500 \text{ (min}^{-1}\text{)}$
Rating torque:	$T_M = 22.5 \text{ (N} \cdot \text{m)}$ $= 22.5 \times 10^2 \text{ (N} \cdot \text{cm)}$
Rotor inertia:	$J_M = 190 \times 10^{-4} \text{ (kg} \cdot \text{m}^2\text{)}$ $= 190 \text{ (kg} \cdot \text{cm}^2\text{)}$

④ Checking time to reach maximum speed:

Required time to reach rapid traverse speed can be calculated as follows, whereas  $T_{M'} = 2 \times T_M$

$$t_a = \frac{(J_L + J_M) \times 2\pi \times N}{(T_{M'} - T_r) \times 60} \times 1.4$$

$$= \frac{(80 \times 10^{-4} + 190 \times 10^{-4}) \times 2\pi \times 1500}{(2 \times 22.5 - 580 \times 10^{-2}) \times 60} \times 1.4$$

$$= 0.15 \text{ (sec)}$$

and meets requirement 0.16 sec or less.

[Drill 3] Cartesian type robot Z axis (vertical axis)

1. Design conditions

- Mass of the traveling item :  $m = 300 \text{ kg}$
- Maximum travel :  $S_{\max} = 1500 \text{ mm}$
- Rapid traverse speed :  $V_{\max} = 10000 \text{ mm/min}$
- Repeatability :  $0.3 \text{ mm}$
- Required life :  $L_t = 24000 \text{ h}$   
 $(16 \text{ hours} \times 300 \text{ days} \times 5 \text{ years})$

Screw shaft supporting condition :

- Nut: Fixed -- Simple support
- Flanged single nut
- Guide way (rolling) :  $\mu = 0.01$  (friction coefficient)
- Drive motor : AC servo motor ( $N_{\max} = 1000 \text{ min}^{-1}$ )
- Environment : Slightly dusty

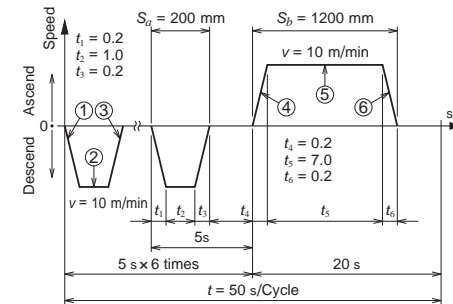


Fig. 16.6 Operating condition

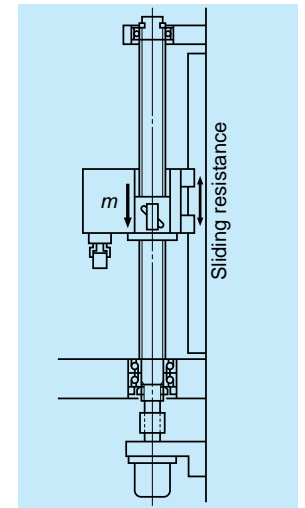


Fig. 16.5 System appearance

2. Selection of basic factors

(1) Selection of accuracy grade

Although this application is not listed in Table 4.1 Accuracy grades of ball screw and their application on page B19, possibility is to use ball screw for transfer equipment R series, because the required repeatability is 0.3 mm that is not very high.

(2) Selection of lead

From the maximum rotational speed of AC motor:

$$l \geq \frac{V_{\max}}{N_{\max}} = \frac{10000}{1000} = 10 \text{ (mm)}$$

Select a lead 10 mm or over.

(3) Selection of screw shaft diameter

According to "Table 4.5 Shaft diameter, lead and standard screw length of R Series" on Page B22, 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 4.5 Screw shaft diameter, lead and standard screw shaft length of R series on page B22, it is possible to select from R series because diameter  $d = 15$  to  $50 \text{ mm}$  and lead  $l = 10 \text{ mm}$  will meet the required maximum stroke 1500 mm.

Primary selection : R Series ball screw for transfer equipment  
 Screw shaft diameter : 15 – 50(mm)  
 Lead : 10(mm)  
 Stroke : 1500(mm)

**3. Confirmation of standard ball screw**

Select from Flanged single nuts of R Series ball screw for transfer equipment.

Second selection : R Series ball screw for transfer equipment  
 Screw shaft diameter : 16, 20, 25, 32, 36  
 40, 45, 50 (mm)  
 Lead : 10 (mm)  
 Stroke : 1500 (mm)

**4. Decision of screw length**

Screw length  $L_o$  is:

$$L_o = \text{Stroke} + \text{nut length} + \text{margin} + \text{shaft end length}$$

$$= 1500 + 100 + 100 + 200 = 1900 \text{ (mm)}$$

Normally,  $L_o/d \leq 70$  is recommended.

Therefore, screw shaft diameter  $d$  is:

$$d \geq \frac{L_o}{70} = \frac{1900}{70} = 27.1 \text{ (mm)}$$

Third selection : R Series ball screw for transfer equipment  
 Shaft diameter: 32, 36, 40, 45, 50 (mm)  
 Lead: 10 (mm)  
 Stroke: 1500 (mm)

**5. Checking basic safety**

**(1) Allowable axial load**

① Calculation of allowable axial load

Accelerating/decelerating time is:

$$\alpha = \frac{V}{60t} = \frac{10 \times 10^3}{60 \times 0.2} = 833 \text{ (mm/s}^2\text{)}$$

$$= 0.833 \text{ (m/s}^2\text{)}$$

$$t = t_1 = t_3 = t_4 = t_6$$

$$\textcircled{1}, \textcircled{6} \quad \dots\dots F_1 = mg - m\alpha$$

$$= 300 \times 9.80665 - 300 \times 0.833$$

$$= 2690 \text{ (N)}$$

$$\textcircled{2}, \textcircled{5} \quad \dots\dots F_2 = mg = 2940 \text{ (N)}$$

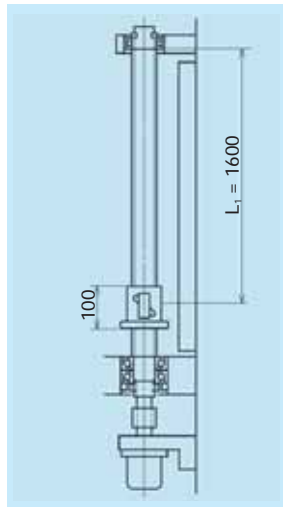
$$\textcircled{3}, \textcircled{4} \quad \dots\dots F_3 = mg + m\alpha = 3190 \text{ (N)}$$

**② Buckling load**

For condition in Fig. 16.7, use values below.

$P = 3190 \text{ N}$ ,  $L_1 = 1600 \text{ mm}$

Bearing supporting condition is common Fixed -- Simple support.



**Fig. 16.7 Checking the buckling load**

From Formula (II-2) on Page B48:

$$d_t \geq \left( \frac{P \cdot L_1^2}{m} \times 10^{-4} \right)^{1/4}$$

$$= \left( \frac{3190 \times 1600^2}{10.0} \times 10^{-4} \right)^{1/4} = 16.8 \text{ (mm)}$$

**(2) Checking permissible rotational speed**

① Critical speed

Use values below.

$$n = 1000 \text{ (min}^{-1}\text{)}, L_1 = 1600 \text{ (mm)}$$

From Formula (II-7) on Page B51:

$$d_r \geq \frac{n \cdot L_1^2}{f} \times 10^{-7} = \frac{1000 \times 1600^2}{15.1} \times 10^{-7}$$

$$= 17 \text{ (mm)}$$

**②  $d \cdot n$  value**

From Table 3.2 on Page B54:

$$d \leq \frac{50000}{n} = \frac{50000}{1000}$$

$$= 50 \text{ (mm)}$$

\* Please consult NSK if  $d \cdot n > 50000$  is required.

**(4) Checking life (dynamic load rating)**

Determine required load carrying capacity from load conditions of Table 16.9.

**Table 16.9 Load conditions**

Operating condition	Axial load (N)	Rotational speed (mean) (min <sup>-1</sup> )	Use time (s)
① <sub>x</sub> ⑥	$F_1 = 2690$	$N_1 = 500$	$t_a = 1.4$
② <sub>x</sub> ⑤	$F_2 = 2940$	$N_2 = 1000$	$t_b = 13.0$
③ <sub>x</sub> ④	$F_3 = 3190$	$N_3 = 500$	$t_c = 1.4$

Calculate mean load  $F_m$  and mean rotational speed  $N_m$  from Formulas (II-11) and (II-12) on Page B57:

Required load carrying capacity is:

$$F_m = \left( \frac{F_1^3 \cdot N_1 \cdot t_a + F_2^3 \cdot N_2 \cdot t_b + F_3^3 \cdot N_3 \cdot t_c}{N_1 \cdot t_a + N_2 \cdot t_b + N_3 \cdot t_c} \right)^{1/3}$$

$$= 2940 \text{ (N)}$$

$$N_m = \frac{N_1 \cdot t_a + N_2 \cdot t_b + N_3 \cdot t_c}{t}$$

$$= 288 \text{ (min}^{-1}\text{)}$$

From Formulas (II-8) and (II-9) on Page B57:

$$C_a \geq (60N_m \cdot L_1)^{1/3} \cdot F_m \cdot f_w \times 10^{-2} \text{ (N)}$$

$$= (60 \times 288 \times 24000)^{1/3} \times 2940 \times 1.2 \times 10^{-2}$$

$$= 26300 \text{ (N)}$$

**(5) Checking static load rating**

$$C_{0a} = F_{\max} \times f_s = 3190 \times 2$$

$$= 6380 \text{ (N)}$$

In consideration of expense:

Fourth selection : R Series ball screw for transfer equipment

Shaft diameter : 32 (mm)  
 Lead : 10 (mm)  
 Stroke :  
 Turns of balls and circuit number : 2.5 × 2  
 Screw length : 2000 (mm)  
 Basic dynamic load rating : 35700 (N)

**6. Selection of nut**

Select a "standard nut with a flange and a seal (Brush-seals contained inside)" based on the necessity as well as on the environmental conditions.

Selected ball screw:

Nut assembly RNFTL3210A5S  
 Screw shaft RS3210A20



## B-2-17 Reference

"NSK Motion & Control (technical journal)" was compiled to introduce NSK products and its technologies. You will find data summaries which are imperative in selecting ball screws in this catalog. If you need detailed technical data, other than described in this catalog, please refer

to "NSK Motion & Control" technical journal. For inquiries and orders, please contact NSK branch offices, sales offices, and representatives assigned at various locations.

**Table 17.1 NSK Motion & Control (technical journal) : Issues relating to ball screws (1980-)**

No.	Issued Date	Title
No.4	Jun. 1998	Recent Technical Trends in Ball Screws
No.8	May. 2000	Ball Screw with Rotating Nut and Vibration Damper
No.9	Oct. 2000	WFA Standard-Stock Ball Screws
No.10	Apr. 2001	High Performance Seals for Ball Screws
No.11	Oct. 2001	Development of NSK S1 Series Ball Screws and Linear Guides
No.11	Oct. 2001	Low Inertia Series of Nut Rotatable Ball Screws
No.13	Oct. 2002	Development of HTF Series Ball Screws for High Load Drive Application
No.13	Oct. 2002	High Lead Precision Rolled Ball Screws
No.14	May. 2003	High Speed and Low Noise Ball Screws HMC-B02 Series
No.15	Dec. 2003	Clean Support Units for Ball Screws
No.16	Aug. 2004	Development of High Speed and Low Noise Ball Screws
No.18	Aug. 2005	S3 Ball Screws: Super Low Noise Ball Screws for Automation Equipment
No.19	Sep. 2006	High-Speed and Low-Noise Ball Screw for Standard Stock - Compact FA Series

## B-2-18 Guide to Technical Services

### (1) CAD data

#### ■Web page

<http://www.jp.nsk.com/app01/en/catalog/>

#### ■CD-ROM

Catalog No.7110 (CD-ROM) contains precision machine components and rolling bearings.

### (2) Telephone consultation with NSK engineers

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

### (3) Additional machining (processing) some part of standard ball screws in stock

NSK processes standard ball screw blank shaft end. NSK also cuts linear guide rails to required length for you. Service is available at NSK processing factories throughout the world. Requests are taken by branch offices and agencies.

## B-2-19 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) Use without lubrication if grease is already applied to the ball screws. Remove dust or swarf if they stuck to the greased surface during handling. Wipe with clean white kerosene, 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 to your application.

(3) Check lubricant after two to three months of operation. Wipe off grease if it is excessively contaminated, and apply sufficient volume of a fresh coat of grease. After the initial check, check and replenish lubricant approximately every year. Check more often if environment requires.

\* Refer to Pages B71 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 ball screw. It invites dust to enter, and lowers precision, or may cause an accident.

(2) User should never reassemble ball screw by himself. Loss of ball screw function is apt to occur if a mistake is made. Please send ball screw to NSK for repair or re-assembly. It will be reworked at the minimum service charge.

(3) Ball screw shaft or nut may fall due to its own weight. Watch out for such falling object. If it falls, the ball groove or ball recirculation component may be damaged and the function might have been lost. Make certain to return such item to NSK for check. There will be the minimum charge for this service.

(4) If recirculation component, shaft outside, or ball groove is scratched or damaged by impact, recirculation operation becomes deficient, and may cause loss of function.

\* Refer to Page B77 for assembling components.



Prevent dust



Rotational speed limitation



Do not overrun



Temperature limitation

### 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 accident such as a fall of the table.

(2) For rotational speed in operation, refer to the applicable section in this catalogue which describes permissible rotational speeds, or to specification drawing furnished by NSK. Exceeding permissible rotational speed damages recirculation components, and may cause the table to fall. A precaution system such as a safety nut is recommended in vertical use of ball screw. Please consult NSK for safety system.

(3) Overrunning ball nut (removed from the ball thread) causes the balls to fall out, damages recirculation components, and dent ball groove, 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 minimum charge 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 unit, the operating temperature should be 50°C or less. (Momentary maximum temperature in use: 80°C)

\* Please read Page B84 before designing.



Store in the correct position

### Storage

(1) Store in the original NSK package. Do not unwrap or tear the inner wrapping if it is not necessary. This allows dust to enter and rust to set in, and may deteriorate functions.

(2) The following position is recommended when storing ball screws.






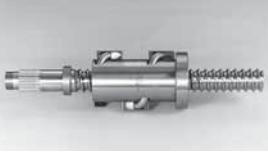


- ① Keep in the NSK original package, and place it flat.
- ② Place flatly on supports; store in a clean area.
- ③ Hang vertically in a clean place.


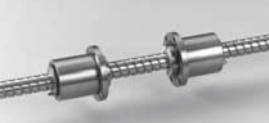
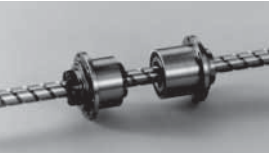




# B-3 Ball Screw Dimension Table

HMD Type for High-Speed Machine Tools	B109
HMC Type for High-Speed Machine Tools	B113
BSL™ Type for Miniature Lathe	B119
For High-Load Drive	
HTF-SRC Type	B123
HTF-SRD Type	B127
HTF Type	B131
VSS Type for Contaminated Environments	B139
TW Series for Twin-Drive Systems	B143
Hollow Shaft Ball Screws	B144
for High-Speed Machine Tools	
ND Series Nut-Rotatable Ball Screws	B149
Σ Series for Robot	B157
Ball Screws for Transfer Equipment	B169
Equipped with "NSK K1™" Lubrication Unit	B209
Special Ball Screws	B215

## B-3-1 Dimension Table and Reference Number of Application-Oriented Ball Screws

◆ Features and application examples of application-oriented ball screws

Application		Shape	Feature	Application	Page
High-Speed Machine Tools	HMD Type		High-speed operation: 64 to 120 m/min Rigidity: 5% greater than the HMC series. High-load carrying capacity: 7% greater than the HMC type New recirculation system reduces the noise level by 5 dB or more compared with the HMC type	High-speed machining center High-speed combined machine tools Die mold processing machine	B109
	HMC Type		High-speed: 40 to 120 m/min Rigidity: 30% greater than existing tube type ball screws High-Load carrying capacity: 14% greater than existing tube type ball screws Noise reduced by small-diameter balls	High-speed machining center High-speed combined machine tools Die mold processing machine	B113
Small Lathe	BSL Type		Compact nut: 50% less ball nut volume than NSK existing products. High-dust protection by thin plastic seal Special high-load capacity ball screw support bearings are available.	Small lathe Multi-axis lathe Small machining center	B119
High-Load Drive	HTF-SRC Type		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 machine Servo press machine Press brake Bending machine	B123
	HTF-SRD Type		High-load capacity High-speed operation by large screw lead: 1600 mm/sec Improved durability by NSK S1™	Clamping axis of injection molding machine Die cast machine Punch press Lifting and lowering device	B127
	HTF Type		High-load capacity Even load distribution to the balls in a ball nut for high-load drive Improved durability by NSK S1™ Provide a wide range of screw diameter and lead combinations.	Injection molding machine Press machine Press fitting machine Lifting and lowering device	B131
For Contaminated Environment	VSS Type		High dust-resistant performance: Reduces particle penetration rate to less than 1/15 (compared with existing plastic seal). More than four times longer service life than existing plastic seal under contaminated environments.	Woodworking machine Laser cutting machine Graphite milling machine Tire molding machine Transfer equipment	B139
Twin-Drive System	TW Series		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 center Combined machine tools Large-size machine tools	B143

Application		Shape	Feature	Application	Page
For High-Precision Machine Tools	Hollow Shaft Ball Screws		Suppress 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 machine High-precision combined machine tools High-precision machining center High-precision lathe	B144
Nut-Rotatable Ball Screws	NDT and NDD Type		Angular contact support bearings are integrated into the ball nut. Two or more ball nuts can be installed in a single ball screw shaft. The NDD type ball screws can surpass the critical speed. A special vibration damper enables long-stroke-high-speed operation.	Woodworking machine Laser cutting machine Electronic component mounting device Liquid crystal display transfer equipment Transfer equipment	B149
Robot	Σ Series		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 an effect for weight saving. The hollow can be used for wiring and piping.	SCALA type robot Electronic-component mounting system	B157
Transfer Equipment	VFA Type		A finished shaft end can be combined with the support unit for immediate use. Flexible stroke as screw shaft outside is used for the simple support bearing seat. The high-helix leads for high-speed operation. The lead accuracy is made to JIS Ct7 grade.	Transfer equipment Actuators Packing/Packaging equipment	B169
	RMA and RMS Type		The RMA type has a finished shaft end. Shaft ends of the RMS type are unprocessed blank. These types can be combined with the NSK support kits for immediate use. JIS Ct7 grade miniature ball screws.	Semiconductor transfer equipment Test/Measuring equipment	B169
	R Series		A wide variety of screw diameters and screw leads combinations (128 combinations) Ball screw shafts and ball nut assemblies are in stock separately. Accuracy grade of JIS Ct10	Transfer equipment Actuators Robot Platform door system Injection molding machine	B169
Equipped with "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 machine Woodworking machine Laser cutting machine Semiconductor/Liquid crystal display manufacturing equipment Food processing/Medical equipment	B209

### B-3-1.1 HMD Type for High-Speed Machine Tools

This product is patented by NSK.

#### 1. Features

- High speed

The permissible rotational speed (d·n value) has greatly increased to 160 000 compared with 135 000 of the HMC type.

- Low noise

Noise reduced by 5 dB or more compared with the HMC type ball screws for high-speed machine tools because of the end-deflector and middle-deflector systems.

- Nut mounting dimensions

The ball nut diameters are the same as those of the HMC type.

#### 2. Specifications

##### (1) Recirculation system

Fig.1 shows the structure of the middle-deflector recirculation system of the HMC type.

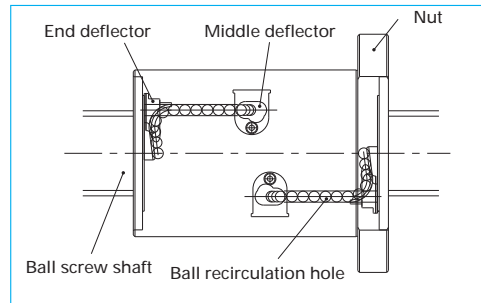


Fig. 1 Structure of middle-deflector recirculation system

##### (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	C3, C5
Axial play	0 mm (Preloaded product)

##### (3) Allowable d·n value and the criterion of maximum rotational speed

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.

Allowable d·n value: 160 000 or less

Criterion of maximum rotational speed

: 4 000 min<sup>-1</sup>

Note: Please also review the critical speed.

See "Technical Description: Permissible rotational speed" (Page B51) for details.

##### (4) Options

- For twin-drive systems (Refer to page B143)

Upon request, the variations in lead accuracy and preload torque between two ball screws of a pair of the TW series are controlled for the further improvement of the reliability.

- Hollow shaft ball screw (Refer to page B144)

The temperature rise and measures against thermal expansion of ball screw driving mechanism are the most challenging for high-speed machine tools. For the HMD type ball screws, we recommend to utilize the hollow for forced cooling system.

##### (5) Seal

Compact, thin plastic seal is available. Nut outside diameter is compact compare with the return tube recirculation system.


#### 3. Design precautions

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B103).

#### 4. Product categories

The HMD type has a model as follows.

Table 2 HMD type product categories

Nut models	Shape	Flange shape	Nut shape	Preload system
EM		Flanged Circular II	Circular	Z Preload (medium preload)

#### 5. Example of model number in dimension tables

A structure of "Model number" and "Reference number for ball screw" are as follows.

##### ◇Model number

**EM 40 20 - 6E**

Nut model : EM      Screw shaft diameter (mm)      Effective turns of balls      Lead (mm)

##### ◇Reference number for ball screw

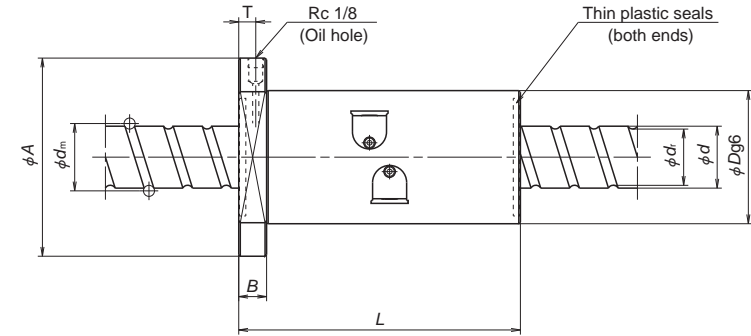
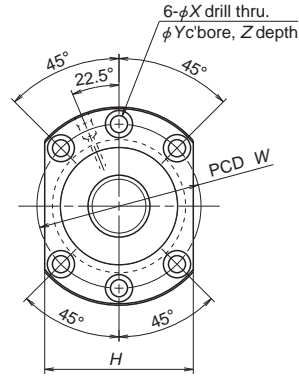
**W 40 07 - \*\* Z M X T - C5 Z 20**

Product code      Screw shaft diameter (mm)      Effective threaded length (in the unit of 100 mm)      NSK design serial number      Preload code: Z: Z preload      Axial play code: Z      Accuracy grade: C3 or C5      Hollow shaft specification      Ball screw specification/appearance      Middle-deflector recirculation system      Lead (mm)

#### 6. Handling Precautions

Maximum operating temperature: 80°C

If using NSK K1, operating temperature should not exceed 50°C. Refer to "Designing Precautions" (Page B84).



Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Basic load rating(N)		Axial rigidity <i>K</i> (N/μm)
						Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	
EM4016-4E	40	16	7.144	41.5	34.1	57100	130000	1020
EM4020-6E		20	6.350	41	34.4	66900	165000	1340
EM4025-6E		25	7.144	41.5	34.1	79100	191000	1370
EM4030-6E		30	7.144	41.5	34.1	79100	191000	1350
EM4516-4E	45	16	7.144	46.5	39.1	59600	145000	1060
EM4520-6E		20	6.350	46	39.4	69100	186000	1470
EM4525-6E		25	7.144	46.5	39.1	82500	213000	1510
EM5016-4E	50	16	7.144	51.5	44.1	61800	160000	1150
EM5020-6E		20	6.350	51	44.4	73200	206000	1600
EM5025-6E		25	7.144	51.5	44.1	85600	235000	1620
EM5030-6E		30	7.144	51.5	44.1	85600	235000	1630
EM6316-4E	63	16	9.525	65	55.2	11100	339000	1600

Remarks 1. The right turn screw is standard. Please consult NSK for left turn screw.  
2. Rigidity listed under the K column is when a 5% dynamic load rating is applied as preload.

Nut length <i>L</i>	Nut dia. <i>D</i>	Ball nut dimensions				Bolt hole size			Bolt hole PCD <i>W</i>	Oil hole position <i>T</i>	Max. feeding speed (m/min)
		Flange dia. <i>A</i>	Flange width <i>B</i>	Flange size <i>H</i>	<i>X</i>	<i>Y</i>	<i>Z</i>				
160	86	128	18	96	11	17.5	11	106	11	64	
150										80	
182										100	
213										120	
160										56	
150	92	134	18	102	11	17.5	11	112	11	70	
182										88	
160										51	
150	98	140	18	107	11	17.5	11	118	11	64	
182										80	
213										96	
170										40	
122	180	28	138	18	26	17.5	150	14	40		

Unit: mm

**B-3-1.2 HMC Type for High-Speed Machine Tools**

This product is patented by NSK.

**1. Features**

- High-speed traveling  
High helix leads of 16 mm to 36 mm are used. Furthermore, the ball recirculation return tube is reinforced to make a high-speed traveling of 40 to 120 m/min. possible.
- High rigidity, high load carrying capacity  
Double start thread increases the number of effective turns of balls, and a smaller ball size increases the number of the balls. Together they contribute to have high rigidity and high load carrying capacity, despite the high helix lead.
- Compact nut  
The size of nut diameter and length were reduced.  
Comparison with current products -- about 50% reduction in volume.

**2. Specifications**

**(1) Recirculation System**

The ball recirculation circuits and grooves are suited for high-speed operation. Structure of recirculation system is shown in Fig. 1.

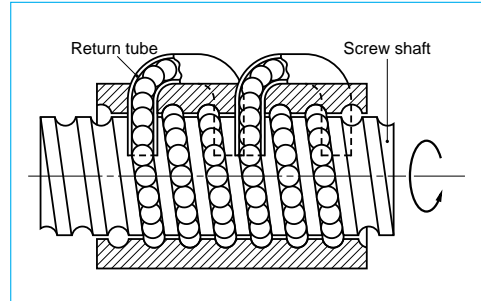


Fig. 1 Structure of return tube recirculation system

**(2) Accuracy grades and axial play**

Standard accuracy grades and axial play are shown in Table 1. Please consult NSK for other grade.

Accuracy grade	C3, C5
Axial play	0 mm (Preloaded)

**(3) Options**

- Equipped with "NSK K1™" lubrication unit  
Optional NSK K1 lubrication unit, molded from resin and impregnated with lubrication oil, is available. Please consult NSK when using NSK K1.
- For twin-drive systems (Refer to page B143)  
Upon request, the variations in lead accuracy and preload torque between two ball screws of a pair of the TW series are controlled for the further improvement of the reliability.
- Hollow shaft ball screw specifications  
The temperature rise and measures against thermal expansion of ball screw driving mechanism are the most challenging for high-speed machine tools. For the HMD type ball screws, we recommend to utilize the hollow for forced cooling system.
- Vertical axis type  
For the vertical axis ball screw, which head load is constantly applied, a high load capacity ball screw is required. A high load capacity type with compact design is available for the nut model I and II in the dimension table. For details, please consult NSK.

**(4) Allowable d·n value and the criterion of maximum rotational speed**

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.

Allowable d·n value: HZC, HDC; 100000 or less  
HZF, HDF; 135000 or less

Criterion of maximum rotational speed: 3750 min<sup>-1</sup>

Note: Please also review the critical speed. See "Technical Description: Permissible rotational speed" (Page B51) for details.

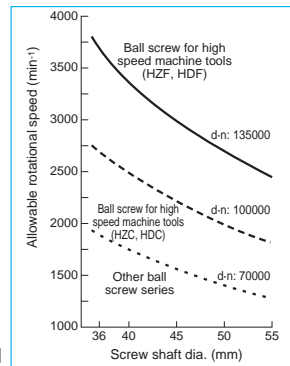


Fig. 2 Comparison of permissible rotational speed

**(5) Other specifications**

For other specifications not listed in the dimension tables such as high-speed, high-load capacity, and NSK K1 installed type, please consult NSK.

**3. Design precautions**

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B103).

**4. Product categories**

HMC type has two different preload systems with several models (Table 2).

Table 2 HMC type product categories

Nut models	Shape	Flange shape	Preload system
HZC HZF		Flanged Circular I	Z preload (medium preload)
HDC HDF		Flanged Circular I	D preload (medium preload)

**7. Example of model number in dimension tables**

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇Model number

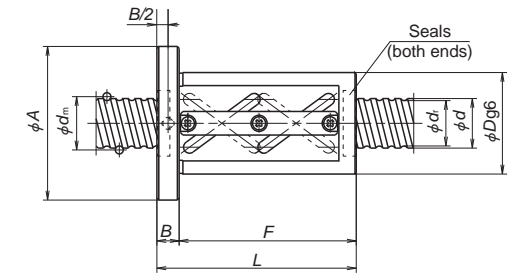
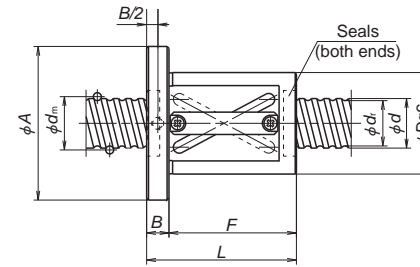
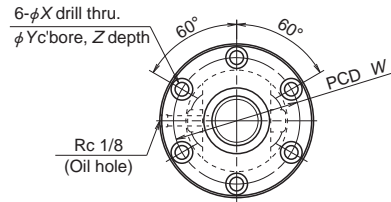
**HZF 36 16 - 5**

Nut model				Effective turns of balls
Screw shaft diameter (mm)				Lead (mm)

◇Reference number for ball screw

**W 36 05 - \*\* Z X T - C5 Z 16**

Product code						Lead (mm)
Screw shaft diameter (mm)						Axial play code: Z
Effective threaded length (in the unit of 100 mm)						Accuracy grade: C3, C5
Design serial number						Hollow shaft ball screw
Preload code : Z, Z preload; D, D preload						Appearance/specification code



Nut model I (Offset preload)

Nut model II (Offset preload)

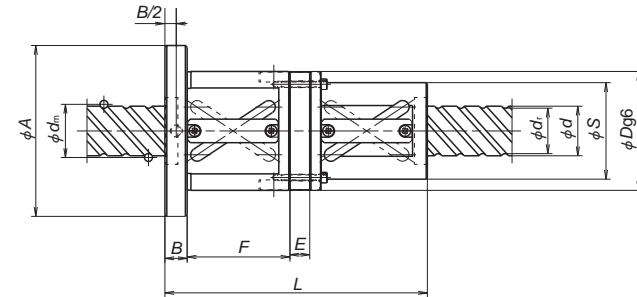
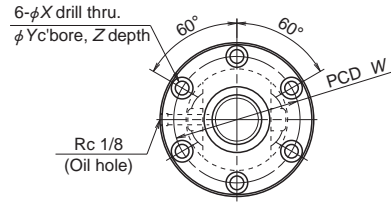
Unit: mm

Model No.	Shaft dia. $d$	Lead $I$	Ball dia. $D_w$	Ball circle dia. $d_m$	Root dia. $d_r$	Effective turns of balls	Nut model	Basic load rating (N)		Axial rigidity $K$ (N/ $\mu$ m)	
								Dynamic $C_a$	Static $C_{0a}$	5% $C_a$	10% $C_a$
HZF3616-5 HZC3616-5 HZF3620-3.5 HZC3620-3.5	36	16	4.7625	36.5	31.7	5	II	40200	102000	1130	1420
		20	6.35	37	30.6	3.5	I	44000	98500	830	1050
HZF4016-5 HZC4016-5 HZF4020-3.5 HZC4020-3.5 HZF4020-5 HZC4020-5	40	16	4.7625	40.5	35.7	5	II	41200	112000	1230	1550
		20	6.35	41	34.6	3.5	I	46100	107000	900	1130
			6.35	41	34.6	5	II	62600	153000	1260	1590
HZF4516-5 HZF4516-7.5 HZF4520-3.5 HZC4520-3.5 HZF4520-5 HZC4520-5 HZF4525-3.5 HZC4525-3.5	45	16	4.7625	45.5	40.7	5	II	43800	127000	1340	1690
						7.5		62100	191000	1960	2470
		20	6.35	46	39.6	3.5	I	47600	120000	990	1240
			6.35	46	39.6	5	II	64700	170000	1380	1740
						3.5	I	56800	137000	1010	1280
HZF5020-3.5 HZC5020-3.5 HZF5020-5 HZC5020-5 HZF5025-3.5 HZC5025-3.5 HZF5025-5 HZC5025-5 HZF5030-3.5 HZC5030-3.5	50	20	6.35	51	44.6	3.5	I	50400	133000	1080	1360
						5	II	68500	191000	1520	1910
		25	7.1438	51.5	44.3	3.5	I	58900	152000	1100	1390
						5	II	80100	216000	1540	1940
		30	7.1438	51.5	44.3	3.5	I	58900	152000	1100	1390
HZF5520-3.5 HZF5520-5 HZF5525-3.5 HZF5525-5 HZF5530-3.5		55	20	6.35	56	49.6	3.5	I	51600	145000	1150
	5						II	70200	208000	1630	2050
	25		7.1438	56.5	49.3	3.5	I	62600	165000	1190	1560
						5	II	85000	238000	1680	2120
						3.5	I	62600	165000	1190	1560

Nut entire length. $L$	Nut dia. $D$	Ball nut dimensions			Bolt hole dimensions			Bolt hole PCD $W$	Max. feeding speed (m/min)
		Flange dia. $A$	Flange width $B$	Nut length $F$	$X$	$Y$	$Z$		
134	78	120	18	116	11	17.5	11	98	60
	71	113						91	44
121	94	136	18	103	11	17.5	11	114	75
	78	120						98	56
134	79	121	18	116	11	17.5	11	99	54
	76	118						96	40
121	96	138	18	103	11	17.5	11	116	67
	82	124						102	50
161	96	138	18	143	11	17.5	11	116	67
	82	124						102	50
134	82	124	18	116	11	17.5	11	102	48
	187	82						128	22
122	98	140	18	104	11	17.5	11	118	60
	88	130						108	44
162	98	140	18	144	11	17.5	11	118	60
	88	130						108	44
141	101	143	18	123	11	17.5	11	121	75
	92	134						112	56
122	101	143	18	104	11	17.5	11	121	54
	95	137						115	40
162	101	143	18	144	11	17.5	11	121	54
	95	137						115	40
141	103	145	18	123	11	17.5	11	123	67
	98	140						118	50
191	103	145	18	173	11	17.5	11	123	67
	98	140						118	50
159	103	145	18	141	11	17.5	11	123	81
	98	140						118	60
122	103	145	18	104	11	17.5	11	123	49
								162	103
141	105	147	18	123	11	17.5	11	125	61
								191	105
159	105	147	18	141	11	17.5	11	125	73

Remarks 1. Ball screws of 32 or 36 mm lead have triple start threads. Others have double start threads.  
 2. Rigidity listed under the 5%Ca column is when a 5% dynamic load rating is applied as preload. Similarly, those listed under the 10%Ca column means a 10% dynamic load rating is applied.





Nut model III (Double nut spacer, preload)  
(the figure indicates use of double start threads)

Model No.	Shaft dia. <i>d</i>	Lead <i>I</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls	Nut model	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)		
								Dynamic <i>C<sub>s</sub></i>	Static <i>C<sub>0a</sub></i>	5% <i>C<sub>s</sub></i>		
										10% <i>C<sub>s</sub></i>	10% <i>C<sub>s</sub></i>	
HDF3620-5 HDC3620-5	36	20	6.35	37	30.6	5	III	59800	138000	1160	1460	
HDF4025-5 HDC4025-5	40	25	7.1438	41.5	34.3	5	III	74000	175000	1320	1660	
HDF4030-5 HDC4030-5		30	7.1438	41.5	34.3	5	III	74000	175000	1320	1660	
HDF4032-7.5 HDC4032-7.5		32	6.35	41	34.6	7.5	III	88700	230000	1920	2420	
HDF4036-4.5		36	6.35	41	34.6	4.5	III	57200	138000	1170	1480	
HDF4525-5 HDC4525-5		45	25	7.1438	46.5	39.3	5	III	77200	197000	1430	1800
HDF4530-5 HDC4530-5			30	7.1438	46.5	39.3	5	III	77200	197000	1430	1800
HDF4532-7.5 HDC4532-7.5	32		6.35	46	39.6	7.5	III	91700	256000	2090	2630	
HDF4536-4.5	36		6.35	46	39.6	4.5	III	59100	155000	1280	1620	
HDF5030-5 HDC5030-5	50		30	7.1438	51.5	44.3	5	III	80100	216000	1540	1940
HDF5032-7.5 HDC5032-7.5		32	6.35	51	44.6	7.5	III	97100	286000	2270	2860	
HDF5530-5 HDC5530-5	55	30	7.1438	56.5	49.3	5	III	85000	238000	1680	2120	
HDF5532-7.5		32	6.35	56	49.6	7.5	III	99500	313000	2420	3050	

Remarks 1. Ball screws of 32 or 36 mm lead have triple start threads. Others have double start threads.  
2. Rigidity listed under the 5%Ca column is when a 5% dynamic load rating is applied as preload. Similarly, those listed under the 10%Ca column means a 10% dynamic load rating is applied.

Nut entire length. <i>L</i>	Ball nut dimensions										Max. feeding speed (m/min)
	Nut dia.		Flange dia. <i>A</i>	Flange width <i>B</i>	Nut length <i>F</i>	Spacer dimensions <i>E</i>	Bolt hole size			Bolt hole PCD <i>W</i>	
	<i>D</i>	<i>S</i>					<i>X</i>	<i>Y</i>	<i>Z</i>		
191	94	76	136	18	77	5	11	17.5	11	114	75
228.5	78	60	120	18	91	13.5	11	17.5	11	98	56
248	98	80	140	18	104	8	11	17.5	11	118	84
265	86	68	128	18	91	13.5	11	17.5	11	106	63
200	98	80	140	18	104	8	11	17.5	11	118	101
228.5	86	68	128	18	91	13.5	11	17.5	11	106	75
248	96	78	138	18	83	4	11	17.5	11	116	108
266	82	64	128	22	109	11	14	20	13	106	80
200	96	78	138	18	83	4	11	17.5	11	116	120
249	101	83	143	18	91	13.5	11	17.5	11	121	75
266	92	74	134	18	91	13.5	11	17.5	11	112	56
248	101	83	143	18	104	8	11	17.5	11	121	90
266	92	74	134	18	104	8	11	17.5	11	112	67
200	98	80	140	18	83	4	11	17.5	11	118	108
249	103	85	145	18	104	8	11	17.5	11	123	81
266	98	80	140	18	104	8	11	17.5	11	118	60
249	101	83	147	22	109	11	14	20	13	123	86
266	95	77	141	22	109	11	14	20	13	117	64
249	105	87	147	18	104	8	11	17.5	11	125	73
266	103	85	149	22	109	11	14	20	13	125	78

### B-3-1.3 BSL Type for Miniature Lathe

#### 1. Features

- Prompt delivery  
Screw shaft configuration and ball nut shape are standardized for prompt delivery.
- High speed and low noise  
Adoption of end-deflector recirculation system realized high-speed operation with low noise.
- Excellent dust resistance  
Thin plastic seal and specially designed ball grooves prevent the entry of foreign matters.

#### 2. Specifications

##### (1) Recirculation system

End-deflector recirculation system has features of high-speed operation with low-noise, and compact ball nut. The structure of recirculation system is shown in Fig.1.

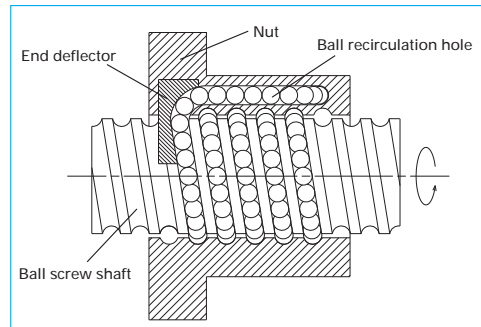


Fig. 1 Structure of end-deflector recirculation system

##### (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	0 mm (Preloaded product)

##### (3) Allowable d·n value and the criterion of maximum rotational speed

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.

Allowable d·n value: 180 000 or less

Criterion of maximum rotational speed : 4 000 min<sup>-1</sup>

Note: Please also review the critical speed.

See "Technical Description: Permissible rotational speed" (Page B51) for details.

##### (4) Options

Optional NSK K1 lubrication unit, molded from resin and impregnated with lubrication oil, supplies fresh oil onto ball rolling surface, ensuring long-term, maintenance-free operation. Please consult NSK when using NSK K1.

#### 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 "dr" specified on the dimension table.


Special bearings which have higher-load carrying capacity are available.

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B103).

#### 4. Product categories

The BSL type has a model as follows.

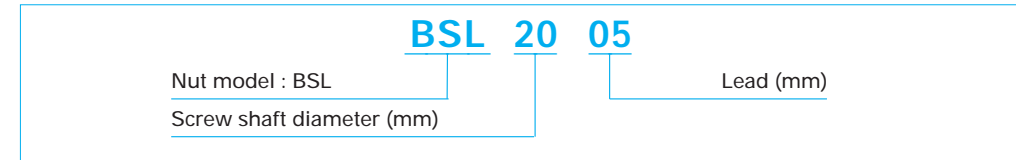
Table 2 BSL type product categories

Nut models	Shape	Flange shape	Preload system
BSL		Circular III	P Preload (Slight preload)

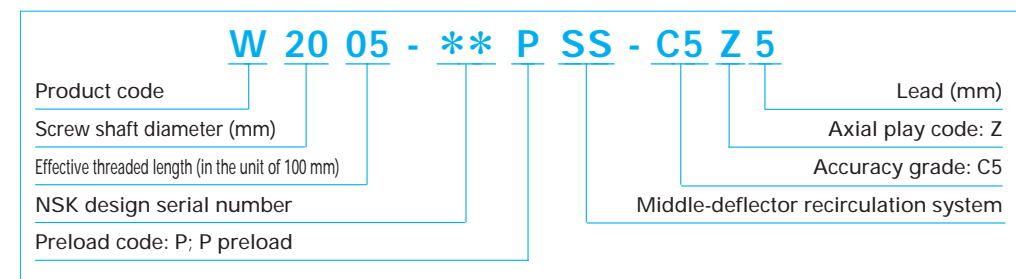
#### 5. Example of model number in dimension table

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇Model number



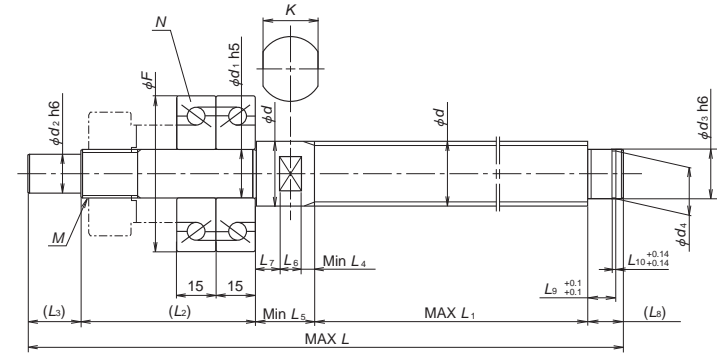
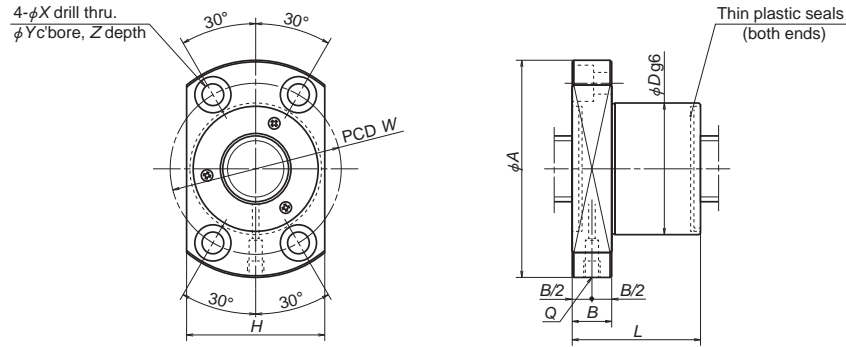
◇Reference number for ball screw



#### 6. Handling Precautions

Maximum operating temperature: 80°C

If using NSK K1, operating temperature should not exceed 50°C. Refer to "Designing Precautions" (Page B84).



Model No.	Main factor						Ball nut dimensions										Oil hole	
	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Basic load rating (N)		External dimensions					Bolt hole dimensions					
						Dynamic	Static	D	A	H	B	L	W	X	Y	Z		Q
d	I	D <sub>w</sub>	d <sub>m</sub>	d <sub>r</sub>	C <sub>d</sub>	C <sub>s</sub>	D	A	H	B	L	W	X	Y	Z	Q	d <sub>i</sub>	
<b>BSL2005</b>	20	5	3.175	20.5	17.2	8920	16300	36	63	38	12	37	49	6.6	11	6.5	M6×1.0	15
<b>BSL2006</b>		6	3.9688	20.5	16.4	11900	20000	40	65	42		45	51					
<b>BSL2505</b>	25	5	3.175	25.5	22.2	9900	20500	40	65	42	12	38	51	6.6	11	6.5	M6×1.0	20
<b>BSL2506</b>		6	3.9688	25.5	21.4	13300	25200	43	69	45		44	55					
<b>BSL2508</b>		8	4.7625	25.5	20.5	17100	30100	46	72	48		55	58					
<b>BSL2510</b>		10	4.7625	25.5	20.5	17100	30100	46	72	48		65	58					
<b>BSL3210</b>	32	10	6.35	33	26.4	27700	51300	61	93	63	18	68	76	9	14	8.5	M6×1.0	25
<b>BSL3212</b>		12	6.35	33	26.4							77						

Remarks 1. The right turn screw is standard. Please consult NSK for left turn screw.  
2. Shaft dimensions are for reference. Shaft length L<sub>1</sub> and shaft entire length L are the maximum length.

Unit: mm

Shaft configuration and dimensions (reference)																				Exclusive bearing N	Basic dynamic load rating C <sub>a</sub>	Permissible axial load (N)
Shaft dimension																	Bearing reference number	F	C <sub>a</sub>			
d <sub>2</sub>	d <sub>3</sub>	d <sub>4</sub>	L	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	L <sub>4</sub>	L <sub>5</sub>	L <sub>6</sub>	L <sub>7</sub>	L <sub>8</sub>	L <sub>9</sub>	L <sub>10</sub>	K	M							
12	15	14.3 <sup>0</sup> <sub>0.11</sub>	500	500	66	20	3	20	8	9	14	10.15	1.15	17	M15×1.0	15TAC47B	47	21900	26600			
							4	21														
15	20	19 <sup>0</sup> <sub>0.21</sub>	700	700	71	27	3	27	10	14	19	15.35	1.35	22	M20×1.0	20TAC62B	62	28500	40500			
							4	28														
							5	29														
20	25	23.9 <sup>0</sup> <sub>0.21</sub>	1000	800	71	33	6	33	12	15	20	16.35	1.35	27	M25×1.5	25TAC62B	62	28500	40500			
							7	34														

B-3-1.4.1 HTF-SRC Type for High-Load Drive

1. Features

● High-speed operation and low noise  
The SRC recirculation system contributes to more than twice the feed speed (d-n value: 140000 and 160000) and the noise level of less than 8 to 10 dB (half to 1/3 of noise) compared with the HTF type.

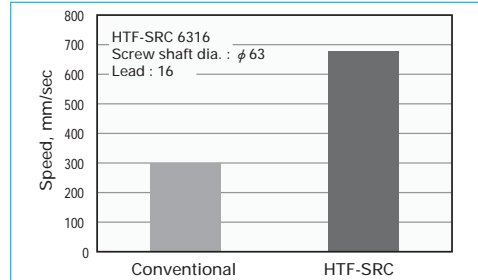


Fig. 1 Feed speed comparison

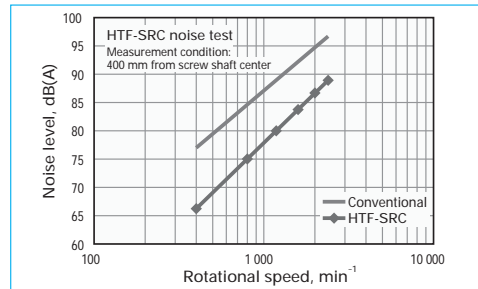


Fig. 2 Noise level comparison

2. Specifications

(1) Recirculation system

The SRC recirculation system picks up balls in the direction they are moving, and contributed high-speed operation with low noise. Structure of recirculation system is as follows.

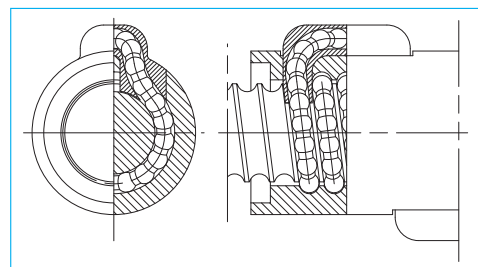


Fig. 3 Structure of SRC recirculation system

(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

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	160000 or less	140000 or less
Criterion of maximum rotational speed	4225 min <sup>-1</sup>	

d-n value : Shaft dia. d[mm] × Rotational speed n[ $\text{min}^{-1}$ ]

Note: Please also review the critical speed. See "Technical Description: Permissible rotational speed" (Page B51) for details.

(4) Ball retaining piece NSK S1™

The NSK S1, resin retainers between the balls, significantly extend ball screw durability to the 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 ball nut circumference.

3. Design Precautions

The HTF-SRC type is designed to distribute the load uniformly to the load balls for high-load drive mechanism. We recommend installing the ball screws in the way shown below for the full use of this characteristic.

In addition, we will make full analysis when you use the HTF-SRC type under extreme conditions such as application of extremely high load or operating in short stroke. Contact NSK about operating conditions. (Refer to page B31)

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 "dr" specified on the dimension table.

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B103).

4. Product categories

The HTF-SRC type has a model as follows.

Table 3 HTF-SRC type product categories

Nut models	Shape	Flange shape	Preload system
HTF-SRC		Flanged Circular I	Non-preload Slight axial play

5. Example of model number in dimension tables

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇Model number

**HTF-SRC 63 20 - 7.5**

Nut model : HTF-SRC	Effective turns of balls
Screw shaft diameter (mm)	Lead (mm)

◇Reference number for ball screw

**W 63 04 - \*\* RC SP - C7 S 20**

Product code	Lead (mm)
Screw shaft diameter (mm)	Axial play code: S, N
Effective threaded length (in the unit of 100 mm)	Accuracy grade: C7 (Ct7)
NSK design serial number	Ball retaining pieces NSK S1 specification
SRC recirculation system	

6. Handling Precautions

Maximum operating temperature: 70°C  
(at outside diameter of ball nut)

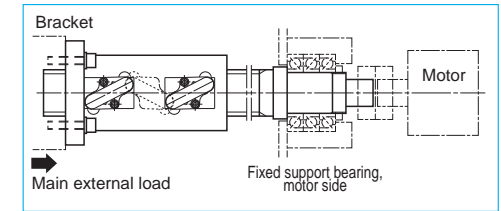
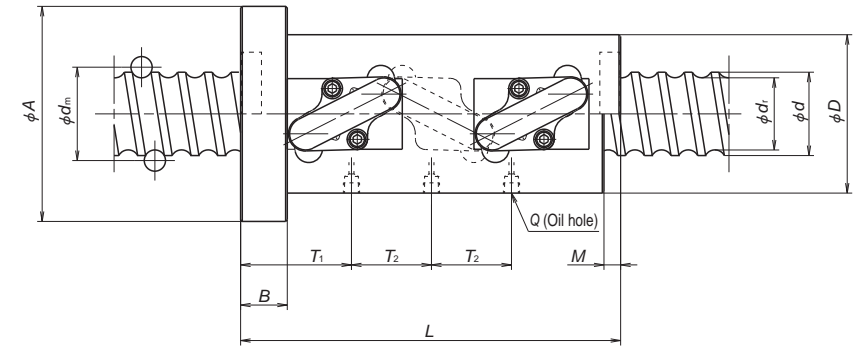
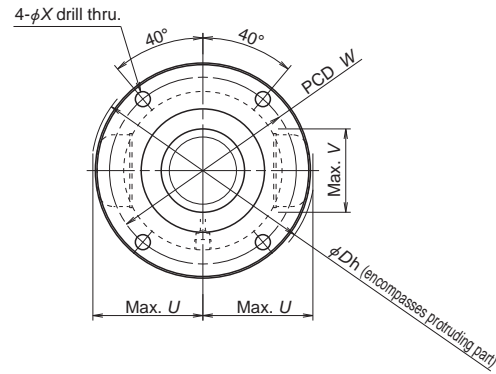


Fig. 4 Recommended installing direction of high-load drive ball screw

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.



Model No.	Shaft dia. <i>d</i>	Lead <i>I</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls × Circuits	Basic load rating (kN)		Allowable axial load (kN)
							Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	
HTF-SRC5014-7.5	50	14	9.525	51.4	41.6	2.5×3	211	623	73.1
HTF-SRC5016-7.5		16	12.7	52	39		306	818	91.1
HTF-SRC6316-7.5	63	16	12.7	65	52	2.5×3	343	1050	119.7
HTF-SRC6316-10.5		16	12.7	65	52	3.5×3	450	1450	167.6
HTF-SRC6320-7.5		20	15.875	65.5	49	2.5×3	457	1280	147.1
HTF-SRC6325-10.5		25	15.875	65.5	49	3.5×3	600	1770	170.0
HTF-SRC8016-10.5	80	16	12.7	82	69	3.5×3	501	1870	221.3
HTF-SRC8020-10.5		20	15.875	82.5	66	3.5×3	671	2300	267.4
HTF-SRC8025-7.5		25	19.05	83	63	2.5×3	632	1960	221.1
HTF-SRC10020-10.5	100	20	15.875	102.5	86	3.5×3	749	2910	345.9
HTF-SRC10025-10.5		25	19.05	103	83		964	3430	408.4
HTF-SRC12020-7.5	120	20	15.875	122.5	106	2.5×3	621	2550	304.6
HTF-SRC12025-10.5		25	19.05	123	103	3.5×3	1040	4200	498.0

- Remarks
1. The right hand screw is the standard. For specifications on left hand screws, contact NSK.
  2. The ball nut length with no seals is shorter by M than that length of a ball nut with seals.
  3. Please consult NSK if load exceeds the allowable axial load.
  4. The allowable axial load is determined in accordance with the mounting conditions of ball screws recommended by NSK (Refer to page B124). If your mounting conditions differ from those provided, please consult NSK.

Unit: mm

Nut length. <i>L</i>	Ball nut dimensions											Max. feeding speed (mm/sec)	
	Nut dia. <i>D</i>	Flange dia. <i>A</i>	Flange width <i>B</i>	Seal width <i>M</i>	Bolt hole PCD <i>W</i>	Bolt hole size <i>X</i>	Protruding tube dimensions			Oil hole <i>Q</i>	Oil hole position		
	<i>D</i>	<i>A</i>	<i>B</i>	<i>M</i>	<i>W</i>	<i>X</i>	<i>U</i>	<i>V</i>	<i>Dh</i>	<i>Q</i>	<i>T<sub>1</sub></i>	<i>T<sub>2</sub></i>	
202	80	114	28	10	97	9	54.5	46	111	M6×1	69	42	750
228	95	129	28	10	112	9	66	50	134	Rc1/8	74.5	48	860
228	105	139	28	10	122	9	72.5	50	148	Rc1/8	74.5	48	680
276	105	139	28	10	122	9	72.5	50	148		74.5	64	680
279	117	157	32	12	137	11	80	62	163		90	60	740
405	117	157	32	12	137	11	81.5	61	167		101.75	100	930
278	120	154	32	10	137	9	80	60	165	Rc1/8	78.5	64	540
339	130	170	32	12	150	11	88	64	180		90	80	590
347	145	185	40	17	165	11	99.5	73	202		111.75	75	730
339	145	185	32	12	165	11	97	78	199	Rc1/8	90	80	470
422	159	199	40	17	179	11	108	79	220		111.75	100	590
287	173	213	40	12	193	11	109.5	88	229	Rc1/8	98	60	390
421	173	213	40	17	193	11	116	92	238		111.25	100	490

**B-3-1.4.2 HTF-SRD Type for High-Load Drive**

This product is patented by NSK.

**1. Features**

- High-speed operation and low noise  
Used with end deflectors, HTF-SRD type ball screws achieve the maximum feed speed of 1600 mm/s. The ball nut body surface is completely round, thus enabling well balanced ball nut rotation.
- Double start thread structure which has more recirculation circuits, and large diameter balls contribute to have high load carrying capacity.
- Low noise and compact design  
End deflector system using a ball scooping mechanism in the direction of screw spiral offers smoother ball recirculation system, thus contributing to less than half the noise level compared with existing ball screws equipped with a return tube.
- Compact, high-performance seal is available.  
Nut outside diameter is compact compare with the return tube recirculation system.
- Also, compact, thin plastic seal is available. Nut outside diameter is compact compare with the return tube recirculation system.

**2. Specifications**

**(1) Recirculation system**

End-deflector recirculation system has features of high-speed operation with low-noise, and compact nut. The structure of recirculation parts are as follows.

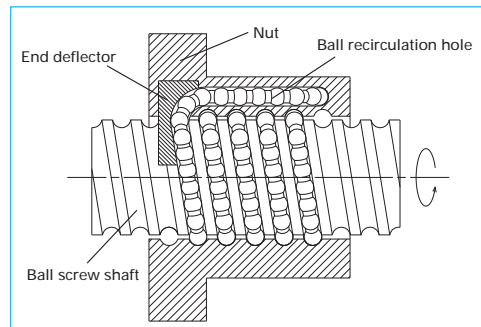


Fig. 1 Structure of End-deflector recirculation system

**(2) Accuracy grade and axial play**

The available standard accuracy 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**

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**

Allowable d·n value	120000 or less
Criterion of maximum rotational speed	2400 min <sup>-1</sup>

d·n value : Shaft dia. d[mm] × Rotational speed n[min<sup>-1</sup>]

Note: Please also review the critical speed. See "Technical Description: Permissible rotational speed" (Page B51) for details.

**(4) Ball retaining piece NSK S1™**

The NSK S1, resin retainers between the balls, significantly extend ball screw durability to the moment load.

**3. Design Precautions**

The HTF-SRD type is designed to distribute the load uniformly to the load balls for high-load drive mechanism. We recommend installing the ball screws in the way shown below for the full use of this characteristic.

In addition, we will make full analysis when you use the HTF-SRD type under extreme conditions such as application of extremely high load or operating in short stroke. Contact NSK about operating conditions. (Refer to page B31)

When designing the screw shaft end, one end

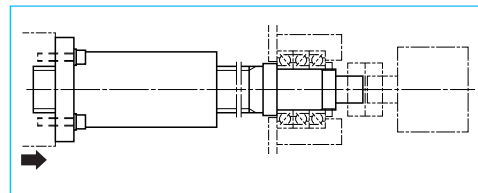


Fig. 2 Recommended installing direction of high-load drive ball screw

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 "dr" specified on the dimension table.


For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and

"Handling Precautions" (Page B103).

**4. Product categories**

The HTF-SRD type has a model as follows.

**Table 3 HTF-SRD type product categories**

Nut models	Shape	Flange shape	Preload system
HTF-SRD		Semicircular III	Non-preload Slight axial play

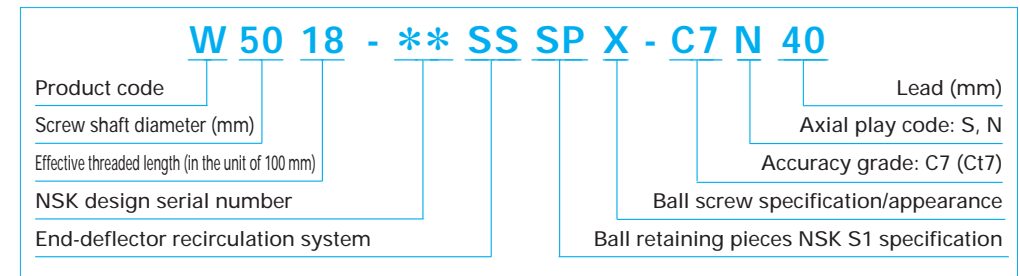
**5. Example of model number in dimension tables**

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇Model number



◇Reference number for ball screw

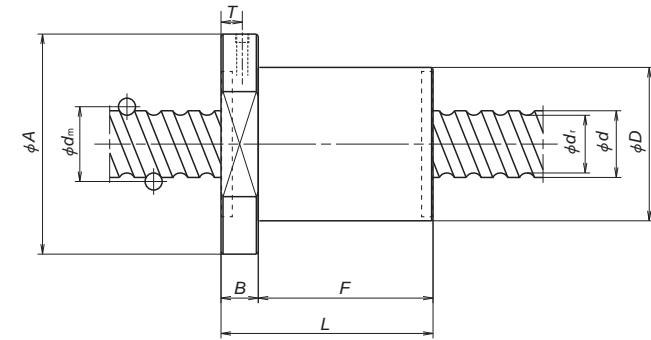
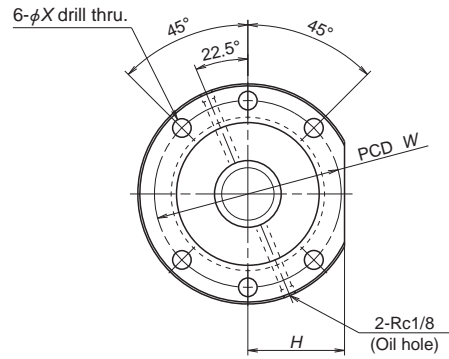


**6. Handling Precautions**

Maximum operating temperature: 70°C (at outside diameter of ball nut)

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.



Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls	Basic load rating (kN)		Allowable axial load (kN)
							Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	
<b>HTF-SRD5040-6E</b>	50	40	12.7	52	39	6	195	491	67.6
<b>HTF-SRD5040-8E</b>		8				255	679	92	
<b>HTF-SRD6332-4E</b>	63	32	15.875	65.5	49	4	233	590	72.6
<b>HTF-SRD6340-6E</b>		40				6	291	768	106.3
<b>HTF-SRD6340-8E</b>						8	381	1060	144.7
<b>HTF-SRD8050-6E</b>	80	50	19.05	83	63	6	401	1180	163.7
<b>HTF-SRD8050-8E</b>						8	526	1630	224.1

Remarks 1. The right hand screw is the standard. For specifications on left hand screws, contact NSK.  
 2. Please consult NSK if load exceeds the allowable axial load.  
 3. The allowable axial load is determined in accordance with the mounting conditions of ball screws recommended by NSK (Refer to page B127). If your mounting conditions differ from those provided, please consult NSK.

Unit: mm

Nut entire length <i>L</i>	Nut dia. <i>D</i>	Ball nut dimensions							Max. feeding speed (mm/sec)
		Flange dia. <i>A</i>	Notch size <i>H</i>	Flange width <i>B</i>	Nut length <i>F</i>	Bolt hole PCD <i>W</i>	Bolt hole size <i>X</i>	Oil hole position <i>T</i>	
159	115	165	72.5	28	131	140	14	16	1600
199					171				
176	140	190	85	32	144	165	14	18	1000
163		200	90		131	170	18		18
203			171						
194	175	250	110	40	154	210	22	18	1250
244					204				

**B-3-1.4.3 HTF Type for high load drive**

This product is patented by NSK.

**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.

- **Abundant diameter / lead combinations**  
Twenty five types of shaft diameter/lead combinations are available. Please consult NSK when you require other combination.

- **Respond to various shaft end configuration**  
Additional ball screw shaft machining is not required. HTF type responds to various shaft ends that convey high torque.

HTF type can be used with: involute spline (JIS B 1603), straight sided spline (JIS B 1601), Key seat, etc.

**2. Specifications**

**(1) Recirculation system**

Structure of recirculation system is shown in Fig. 1.

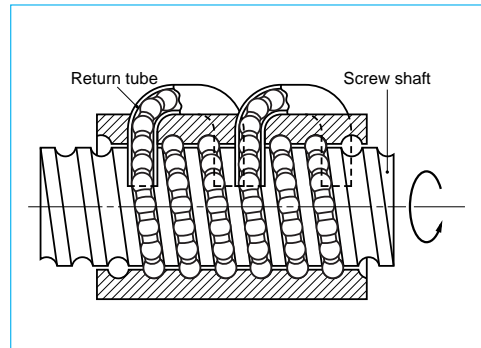


Fig. 1 Structure of return tube recirculation system

**(2) Accuracy grade and axial play**

The allowable 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 under; N, 0.050 mm or under

**(3) Allowable d·n value and the criterion of maximum rotational speed**

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. For higher-speed operation, HTF-SRC type is recommended.

**Table 2 Allowable d·n value and the criterion of maximum rotational speed**

Lead		- 20 mm	25 mm	30 - 32 mm
Allowable	Standard specification	70000 or less	70000 or less	50000 or less
d·n value	High-speed specification	100000 or less	-	-
Criterion of maximum rotational speed		3125 min <sup>-1</sup>		

d·n value: Shaft dia. d [mm]×Rotational speed n [min<sup>-1</sup>]

Note: Please also review the critical speed. See "Technical Description: Permissible rotational speed" (Page B51) for details.

**(4) Ball retaining piece NSK S1™**

The NSK S1, resin retainers between the balls, significantly extend ball screw durability to the 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 ball nut circumference.

**3. Design precautions**

For designing shaft end configuration, you should take into account that the HTF type ball screws are dedicated to high load drive.

The HTF type is designed to distribute the load uniformly to the load balls for high load drive mechanism. (This product is patented by NSK.)


We recommend installing the ball screws in the way shown in Fig. 2 for the full use of this characteristic. In addition, we will make full analysis when you use the HTF type under extreme conditions such as application of extremely high load or operating in short stroke. Contact NSK about operating conditions. (Refer to page B31)

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B103).

**4. Product categories**

The HTF type has a model as follows.

**Table 3 HTF type product categories**

Nut model	Shape	Flange shape	Preload system
HTF		Flanged Circular I	Non-preloaded Slight axial play

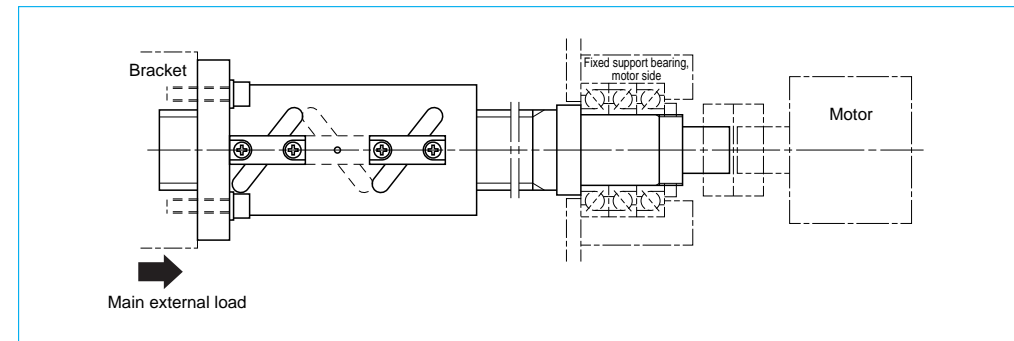


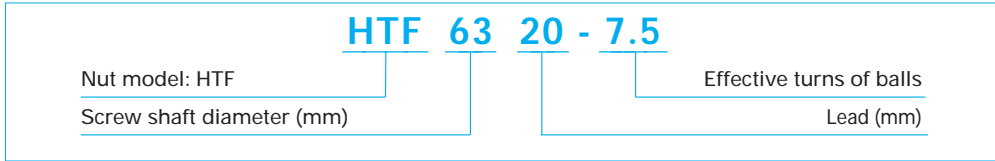
Fig. 2 Recommended installing direction of ball screws for high load drive



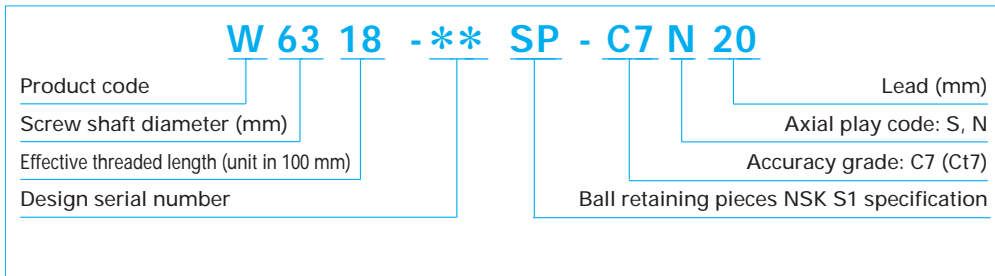
**5. Example of model number in dimension table**

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇Model number



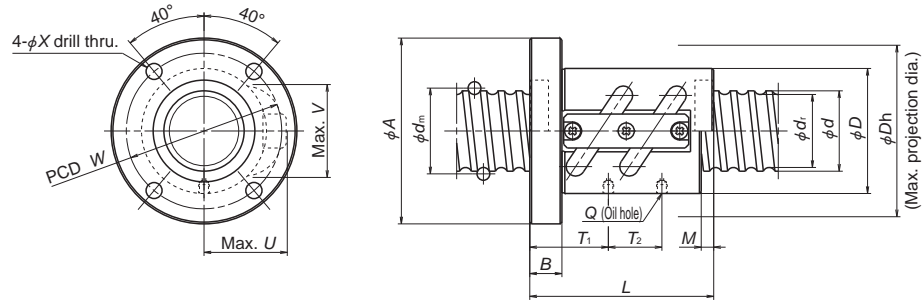
◇Reference number for ball screw



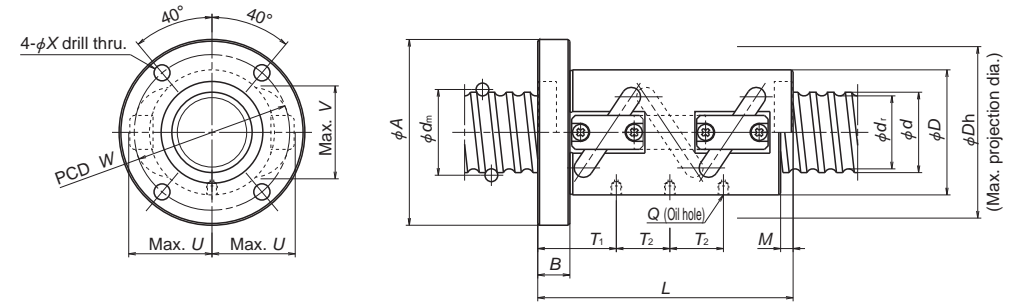
**6. Handling precautions**

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.

Maximum operating temperature: 70°C  
(at outside diameter of ball nut)



Nut model I



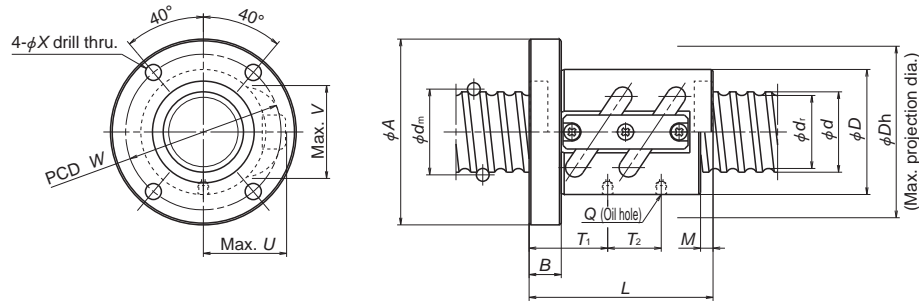
Nut model II

Model No.	Shaft dia. <i>d</i>	Lead <i>I</i>	Ball dia. <i>D<sub>b</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns × Circuits	Nut model	Basic load rating (kN)		Permissible axial load (kN)
								Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	
HTF3210-5	32	10	7.144	33	25.6	2.5×2	I	71	169	20.3
HTF3610-5	36	10	7.144	37	29.6	2.5×2	I	76.9	191	23.4
HTF3612-5		12	7.938	37.25	29			90	228	28.3
HTF4010-7.5	40	10	7.144	41	33.6	2.5×3	II	120	344	39.6
HTF4012-7.5		12	7.938	41.25	33			147	422	48
HTF4510-7.5	45	10	7.144	46	38.6	2.5×3	II	127	386	45.3
HTF4512-7.5		12	7.938	46.25	38			156	473	55
HTF5010-7.5	50	10	7.144	51	43.6	2.5×3	II	133	435	51
HTF5012-7.5		12	7.938	51.25	43			164	525	62
HTF5014-7.5		14	9.525	51.5	41.7			211	623	73.1
HTF5016-7.5		16	12.700	52	39			306	818	91.1
HTF5510-7.5	55	10	7.144	56	48.6	2.5×3	II	139	477	55.7
HTF5512-7.5		12	7.938	56.25	48			171	586	69.1
HTF5514-7.5		14	9.525	56.5	46.7			216	696	81.2
HTF5516-7.5		16	12.700	57	44			319	922	101.9
HTF6312-7.5	63	12	7.938	64.25	56	2.5×3	II	181	668	80.3
HTF6314-7.5		14	9.525	64.5	54.7			233	800	93.5
HTF6316-7.5		16	12.700	65	52			343	1050	119.7
HTF6316-10.5		16	12.700	65	52			450	1450	167.6
HTF6320-7.5		20	15.875	66	49			457	1320	147.3

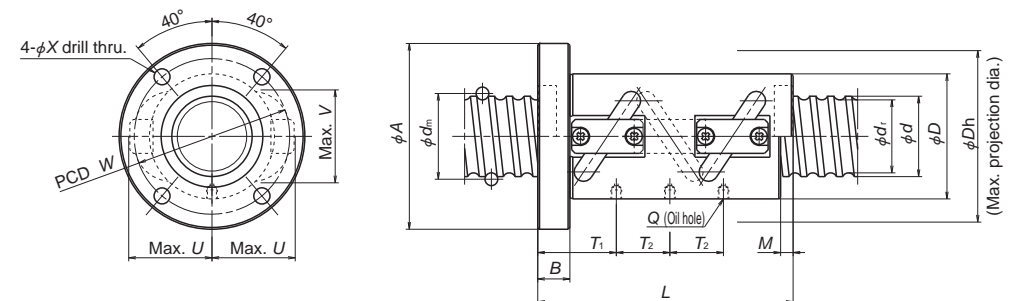
Remarks 1. The right hand screw is the standard. "L" is added to the end of the model code for the left turn screw.  
2. If there is no seal, the nut length is shorter by the lengths of "M" than those with a seal.

Ball nut dimensions													Max. feeding speed (mm/sec)
Nut length <i>L</i>	Nut appearance <i>D</i>	Flange appearance <i>A</i>	Flange width <i>B</i>	Seal dimensions <i>M</i>	Bolt hole PCD <i>W</i>	Bolt hole size <i>X</i>	Tube projecting size			Oil hole	Oil hole positions		
							<i>U</i>	<i>V</i>	<i>Dh</i>	<i>Q</i>	<i>T<sub>1</sub></i>	<i>T<sub>2</sub></i>	
103	58	92	18	7	75	9	40.5	42	82	M6×1	36.5	30	520
103	62	96	18	7	79	9	43	45	87	M6×1	36.5	30	460
123	66	100	22	8	83	9	46.5	46	94		44	36	550
143	66	100	18	7	83	9	45	48	91	M6×1	46.5	30	410
171	70	104	22	8	87	9	47.5	50	96		56	36	500
143	70	104	18	7	87	9	47	52	95	M6×1	46.5	30	370
171	72	106	22	8	89	9	49.5	54	100		56	36	440
143	75	109	18	7	92	9	49	57	99	M6×1	46.5	30	330
171	77	111	22	8	94	9	52	59	105	M6×1	56	36	400
200	80	114	28	10	97	9	55.5	61	112	M6×1	66.5	42	460
223	95	129	28	10	112	9	68	66	137	Rc1/8	73	48	530
143	80	114	18	7	97	9	51.5	62	104	M6×1	46.5	30	300
171	82	116	22	8	99	9	54.5	63	110	M6×1	56	36	360
200	85	119	28	10	102	9	57.5	65	116	M6×1	66.5	42	420
223	99	133	28	10	116	9	70	70	141	Rc1/8	73	48	480
171	92	126	22	8	109	9	58.5	70	118	M6×1	56	36	310
200	94	128	28	10	111	9	61.5	72	124	M6×1	66.5	42	370
223	105	139	28	10	122	9	72.5	76	146	Rc1/8	73	48	420
271	105	139	28	10	122	9	72.5	76	146	Rc1/8	73	64	420
273	117	157	32	12	137	11	83.5	81	168	Rc1/8	88	60	520

3. Please consult NSK if load exceeds the allowable axial load.  
4. The allowable axial load is determined in accordance with the mounting conditions of ball screws recommended by NSK (Refer to page B132). If your mounting conditions differ from those provided, please consult NSK.



Nut model I



Nut model II

Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns × Circuits	Nut model	Basic load rating (kN)		Permissible axial load (kN)
								Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	
HTF8014-7.5	80	14	9.525	81.5	71.7	2.5×3	II	261	1020	121.9
HTF8016-7.5		16	12.7	82	69	2.5×3		382	1340	159
HTF8016-10.5		16	12.7	82	69	3.5×3		501	1870	221.3
HTF8020-7.5		20	15.875	83	66	2.5×3		511	1690	192.6
HTF8020-10.5		20	15.875	83	66	3.5×3		670	2300	272.4
HTF8025-7.5		25	19.05	84	64	2.5×3		663	2020	228.3
HTF10016-7.5	100	16	12.7	102	89	2.5×3	II	423	1710	202.3
HTF10020-7.5		20	15.875	103	86	2.5×3		571	2140	248.6
HTF10025-7.5		25	19.05	104	84	2.5×3		734	2550	293.2
HTF10025-10.5		25	19.05	104	84	3.5×3		962	3490	409.1
HTF12016-7.5	120	16	12.7	122	109	2.5×3	II	457	2050	248.9
HTF12020-7.5		20	15.875	123	106	2.5×3		620	2550	304.7
HTF12025-7.5		25	19.05	124	104	2.5×3		792	3080	358.2
HTF12025-10.5		25	19.05	124	104	3.5×3		1040	4200	505.7
HTF14020-7.5	140	20	15.875	143	126	2.5×3	II	663	3000	360.9
HTF14025-7.5		25	19.05	144	124			842	3610	423.1
HTF14030-7.5		30	22.225	144	121			1050	4110	487.1
HTF14032-7.5		32	25.4	144	118			1270	4740	549.3
HTF16025-7.5	160	25	19.05	164	144	2.5×3	II	909	4140	495.3
HTF16030-7.5		30	22.225	164	141			1120	4760	564.3
HTF16032-7.5		32	25.4	164	138			1330	5370	636
HTF20030-7.5	200	30	22.225	204	181	2.5×3	II	1240	5960	718.8
HTF20032-7.5		32	25.4	204	178			1470	6840	809.4

Remarks 1. The right hand screw is the standard. "L" is added to the end of the model code for the left turn screw.  
2. If there is no seal, the nut length is shorter by the lengths of "M" than those with a seal.

Nut length <i>L</i>	Nut appearance <i>D</i>	Flange appearance <i>A</i>	Flange width <i>B</i>	Seal dimensions <i>M</i>	Ball nut dimensions							Oil hole <i>Q</i>	Oil hole positions		Max. feeding speed (mm/sec)
					Bolt hole PCD <i>W</i>	Bolt hole size <i>X</i>	Tube projecting size			<i>T<sub>1</sub></i>	<i>T<sub>2</sub></i>				
200	116	150	28	10	133	9	72	87	146	M6×1	66.5	42	290		
227	120	154	32	10	137	9	80	92	161	Rc1/8	77	48	330		
275	120	154	32	10	137	9	80	92	161	Rc1/8	77	64	330		
273	130	170	32	12	150	11	89.5	96	181	Rc1/8	88	60	410		
333	130	170	32	12	150	11	89.5	96	181	Rc1/8	88	80	410		
338	145	185	40	17	165	11	102	100	206	Rc1/8	109.25	75	360		
227	145	185	32	10	165		91	109	184		77	48	260		
273	145	185	32	12	165	11	97.5	114	196	Rc1/8	88	60	330		
338	159	199	40	17	179		108.5	118	219		109.25	75	290		
413	159	199	40	17	179		108.5	118	219		109.25	100	290		
227	173	213	32	10	193		104	126	210		77	48	220		
281	173	213	40	12	193	11	111	131	223	Rc1/8	96	60	270		
338	173	213	40	17	193	11	116	135	233	Rc1/8	109.25	75	240		
413	173	213	40	17	193		116	135	233		109.25	100	240		
281	204	250	40	12	226	14	122.5	148	248		96	60	230		
338	204	250	40	17	226	14	127.5	153	258	Rc1/8	109.25	75	200		
411	222	282	50	22	252	18	139	160	281	Rc1/8	134.5	90	170		
465	222	296	70	22	259	22	148	163	299		166.5	96	190		
338	234	280	40	17	256	14	138	173	279		109.25	75	180		
411	234	294	50	22	264	18	148	177	299	Rc1/8	134.5	90	150		
465	234	308	70	22	271	22	152	181	307		166.5	96	160		
411	290	350	50	22	320	18	178	212	359	Rc1/8	134.5	90	120		
465	290	364	70	22	327	22	182	215	367		166.5	96	130		

3. Please consult NSK if load exceeds the allowable axial load.  
4. The allowable axial load is determined in accordance with the mounting conditions of ball screws recommended by NSK (Refer to page B132). If your mounting conditions differ from those provided, please consult NSK.

B-3-1.5 VSS Type 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 of existing standard products.

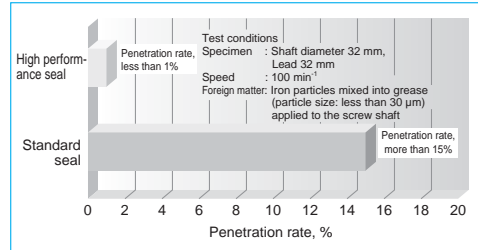


Fig. 1 Particle penetration rate

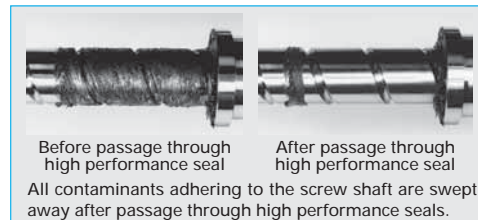


Fig. 2 Contamination before and after particle penetration test

● 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 type extends more than four times longer than our existing type with a standard seal.

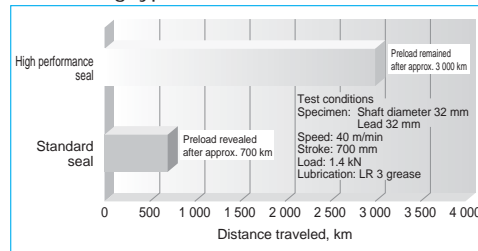


Fig. 3 Extreme durability test results using iron particles

● High speed  
For ultimate smoothness of ball recirculation, the internal ball recirculation system enables high-speed operation at a maximum of d·n

150 000. Large lead specifications allow high-speeds of 150 m/min.

● Low-noise  
Reduces noise level by more than 6 dB compared with our conventional tube-type 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) Recirculation system  
End-deflector recirculation system has features of high-speed operation with low-noise, and compact ball nut. The structure of recirculation system is shown in Fig.4.

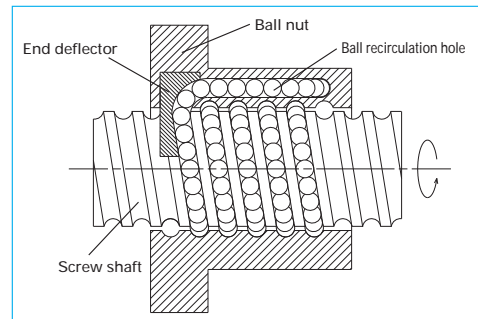


Fig. 4 Structure of end deflector recirculation system

(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

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.  
Allowable d·n value: 150000 or less  
Criterion of maximum rotational speed: 3000 min<sup>-1</sup>  
Note: Please also review critical speed. See

"Technical Description: Permissible rotational speed" (Page B51) for details.

(4) High performance seal  
High performance seal (Japan patents: 3646452, 3692203) with special lip that contacts 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) optional  
Non-contact metal protector that traces the ball screw grooves and safeguards the seal against high-temperature foreign matter.

3. Design precaution

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 "dr" specified on the dimension table.

High performance seals may increase torque, which may in turn increase temperature. Please consult with NSK prior to usage under severe service conditions.

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B103).

4. Product categories

VSS Type has the model as follows.

Table 2 VSS type product categories

Nut model	Shape	Flange shape	Preload system
VSS		Circular II	Non-preload, Slight axial play P preload (light preload)

5. Example of model number in dimension table

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇Model number

VSS 32 10 - 6E

Nut model: VSS      Screw shaft diameter (mm)      Effective turns of balls      Lead (mm)

◇Reference number for ball screw

W 36 12 - \*\* P SS V1 - C5 Z 10

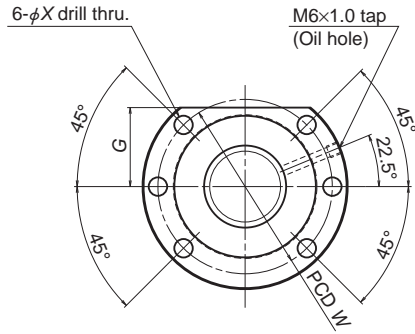
Product code      Screw shaft diameter (mm)      Effective threaded length (in the unit of 100 mm)      Design serial number      Preload code: P ; P Preload      Lead (mm)      Axial play: Z, T, S      Accuracy grade: C5      High performance seal V1      End-deflector recirculation system

6. Handling Precautions

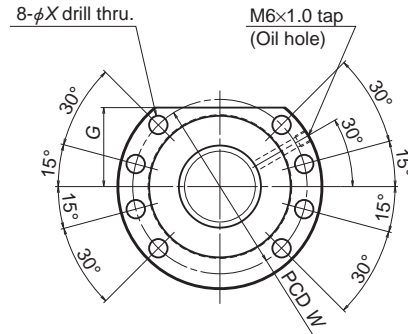
Maximum operating temperature: 50°C  
Maximum momentary operating temperature: 80°C

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.

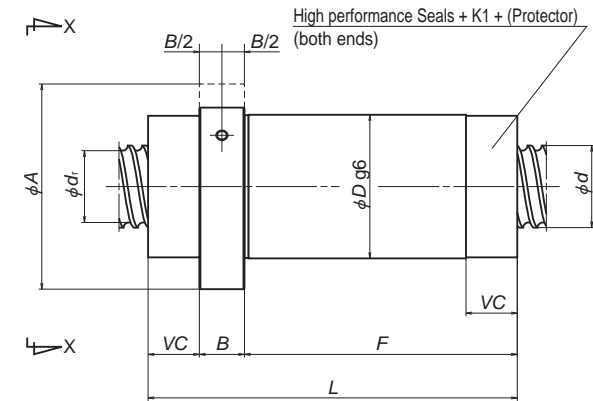
View X-X



Flange TYPE I



Flange TYPE II



Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns	Flange shape	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)
								Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	
<b>VSS3210-6E</b>		10				6	I	43300	111000	682
<b>VSS3216-5E</b>	32	16	5.5563	33	27.5	5		36700	90800	563
<b>VSS3220-5E</b>		20				5		36700	90800	561
<b>VSS3232-4E</b>		32				4		25000	58300	387
<b>VSS4040-4E</b>	40	40	6.35	41	34.4	4	II	33600	83900	472
<b>VSS5050-4E</b>	50	50	6.35	51	44.4	4		37300	105000	559

- Remarks
- The right hand screw is the standard. For specifications on left hand screws, contact NSK.
  - Rigidity in the Table is theoretical value obtained from the elastic deformation between screw groove and ball when the preload is 1.5% of the basic dynamic load rating, and axial load is applied to it. Refer to "Technical Description" (Page B41) if axial load and preload differs from the conditions above, or when considering change in the deformation of the ball nut itself.
  - Products with axial play may have a partially negative play (preloaded condition) depending on screw length. Refer to "Manufacturing range of effective screw length in combination of accuracy grade and axial play. (Page B20)"

Unit: mm

Ball nut dimensions									Maximum shaft length
Nut entire length <i>L</i>	Nut outside diameter <i>D</i>	Flange outside diameter <i>A</i>	Flange width <i>B</i>	Nut length <i>F</i>	Notch size <i>G</i>	Seal installation dimensions <i>VC</i>	Bolt hole PCD <i>W</i>	Bolt hole dimensions <i>X</i>	
132				89.5					2800
150	56	86	18	107.5	34	24.5	71	9	
169				126.5					
122				79.5					
144	70	100	22	94	38.5	27.5	85	9	3800
164	82	118	22	114.5	46	27.5	100	11	5000

### B-3-1.6 TW Series for Twin-Drive Systems

#### (1) Features

Variations in lead accuracy and preload torque between two ball screws, which consists of a unit of TW Series, are controlled, resulting improved travel accuracy and ball screw operating lifetime. Fig. 1 shows measures 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 travel accuracy between the TW Series and conventional model.

#### ● High rigidity and long lifetime

Twin-drive systems are superior to single-drive systems in system rigidity, supporting the design of long-life feeding mechanism even if they make the shaft diameter one size smaller.

● 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 level compared with the existing return tube recirculation system, offering high-speed feeding of up to 1200 mm/min (shaft dia. 40 mm, lead 30 mm, rotational speed 4000 min<sup>-1</sup>).

#### (2) Specifications

**Table 1 Specifications of twin-drive systems**

Recirculation systems	End-deflector recirculation system, Return tube system, Deflector system
Shaft dia.	φ 32 – 63 mm
Lead	10 – 30 mm
Accuracy grade	C5
Screw shaft length	3 m or less

#### (3) Optional specifications

- Hollow shaft ball screw
- Provides high accuracy through the use of forced cooling. Please refer to hollow shaft ball screw (page B144) for more details.

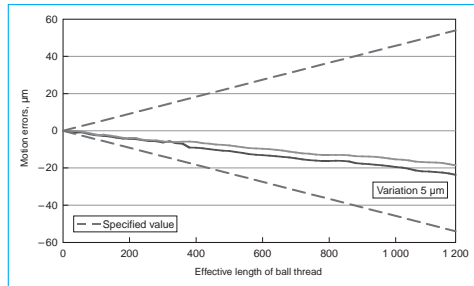


Fig. 1 Example of measured variation in lead accuracy

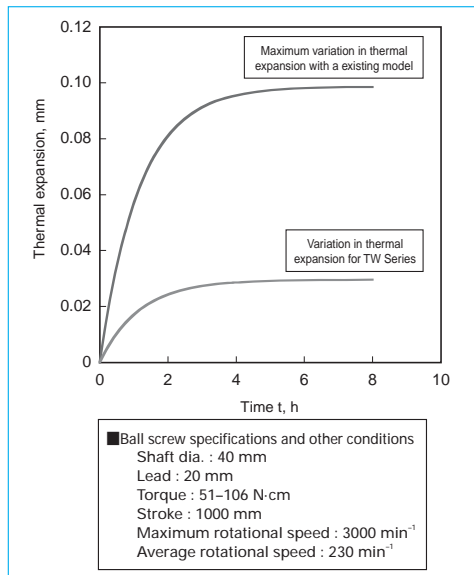


Fig. 2 Calculation example of the variation of thermal expansion

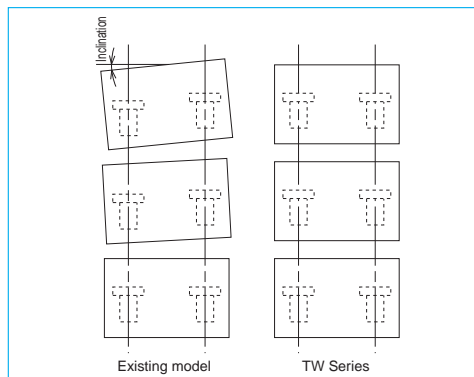


Fig. 3 Schematic diagram of travel accuracy

### B-3-1.7 Hollow Shaft Ball Screw for high accuracy 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 ends configuration (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 of the machine base which is caused by thermal expansion of ball screw. Forced cooling keeps the 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 cuts machine warm-up period.

##### ● Maintains lubricant's effect

Removes heat from the ball screw, deterring lubricant deterioration.

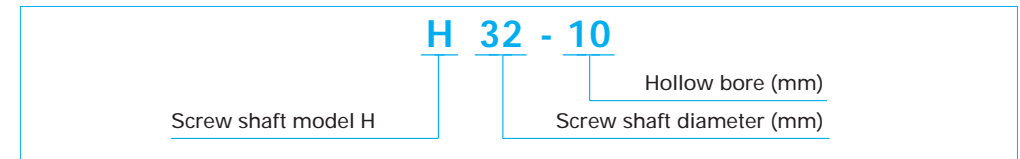
##### ● Easy designing for installation

Use support bearing unit exclusive for NSK ball screws (high load capacity for machine tools, see Page B449) and seal unit (Page B147) to standardized shaft end. This makes designing of mounting ball screw easy.

#### 3. Model example of dimension table

A model number that indicates specification factors is structured as shown below.

◇Example of model



#### 2. Design precautions

Refer to HMC type, end-deflector recirculation system, return tube recirculation system, and deflector recirculation system for ball screw specifications. If the overall ball screw length exceeds 3000 mm, contact NSK. For general precautions regarding ball screw, refer to "Design Precautions" (Page B84) and "Handling precautions" (Page B497).

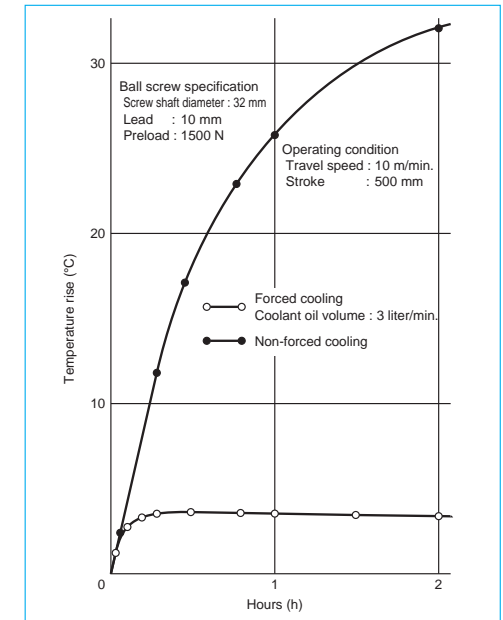
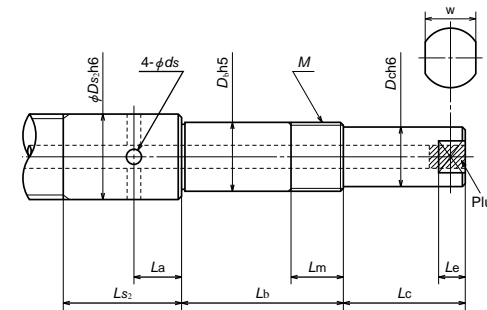
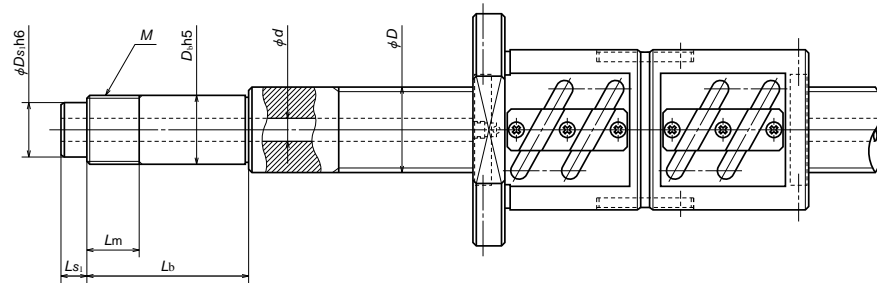
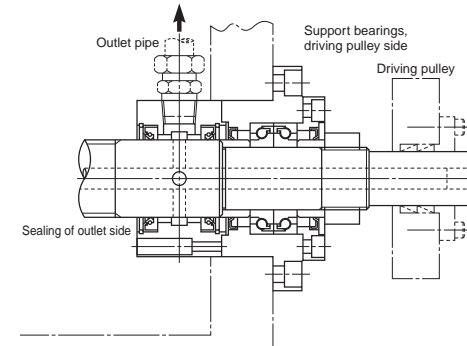
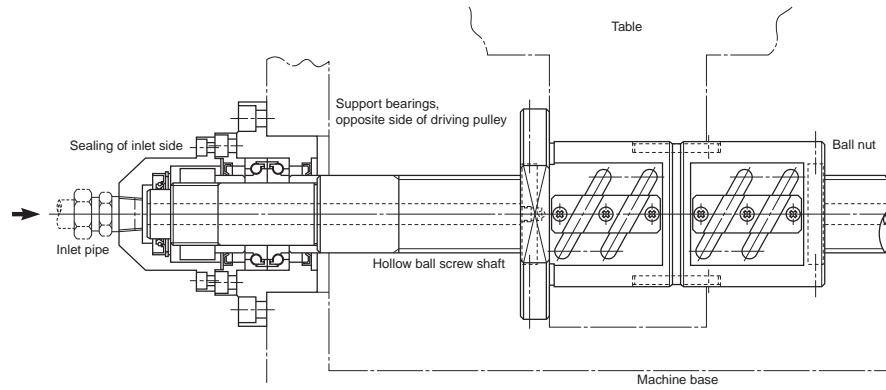


Fig. 1 Effect of forced cooling by hollow shaft ball screw

## 4. Example installation and standard dimensions



Hollow shaft ball screw Model No.	Screw shaft		Bearing seat				Sealing					
	Diameter D	Hollow d	Diameter Db	Lock nut			Inlet		Outlet			
				M	Lm	Lb	Ds <sub>1</sub>	Ls <sub>1</sub>	Ds <sub>2</sub>	Ls <sub>2</sub>	La	ds
<b>H32-10</b>	32	10	25	M25x1.5	26	89	20	15	32	60	25	6
						104						
						119						
<b>H40-12</b>	40	12	30	M30x1.5	26	89	25	15	40	60	25	7
						104						
						119						
<b>H50-15</b>	50	15	40	M40x1.5	30	92	32	15	50	65	27	8
						107						
						122						

Remarks 1. Please consult NSK for other models.

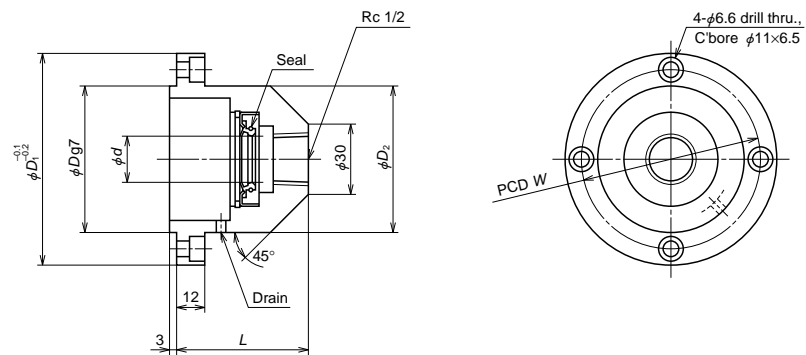
Drive side		Spanner flats		Applicable support unit	Used bearing	Equipped seal unit	
Dc	Lc	w	Le			Shaft end	Shaft outer surface
20	40	17	8	WBK25DF-31 WBK25DFD-31	25TAC62BDFDC10PN7A 25TAC62BDFDC10PN7A (25TAC62BDFFC10PN7A)	WSK20A-01	WSK32B-01
25	50	22	10	WBK30DF-31 WBK30DFD-31	30TAC62BDFDC10PN7A 30TAC62BDFDC10PN7A (30TAC62BDFFC10PN7A)	WSK25A-01	WSK40B-01
35	70	30	13	WBK40DF-31 WBK40DFD-31 WBK40DF-31	40TAC72BDFDC10PN7A 40TAC72BDFDC10PN7A 40TAC72BDFFC10PN7A	WSK32A-01	WSK50B-01

Unit: mm

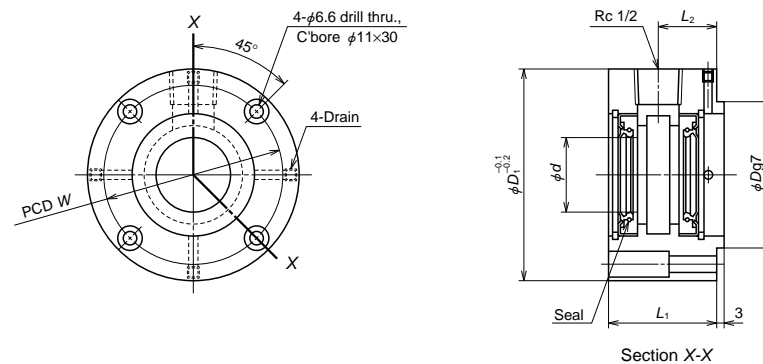
5. Seal units for hollow ball screw shaft (available by order)

This is an exclusive joint for coolant of the hollow ball screw shaft.

A Type  
(for shaft end)



B Type  
(for shaft outer surface)



Unit: mm

Reference number	$d$	$D$	$D_1$	$D_2$	$L$	$W$	Fixing bolt
<b>WSK20A-01</b>	20	57	85	57	56	70	M6
<b>WSK25A-01</b>	25	57	85	57	56	70	M6
<b>WSK32A-01</b>	32	69	95	67	61	80	M6

Unit: mm

Reference number	$d$	$D$	$D_1$	$L_1$	$L_2$	$W$	Fixing bolt
<b>WSK32B-01</b>	32	57	85	46	25	70	M6
<b>WSK40B-01</b>	40	57	85	46	25	70	M6
<b>WSK50B-01</b>	50	69	95	49	27	80	M6

◇ Handling precautions

- Use NSK support unit (high load capacity for machine tools in Page B449) 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-3-1.8 ND Series for Nut-Rotatable Drive**

• This product is patented by NSK.

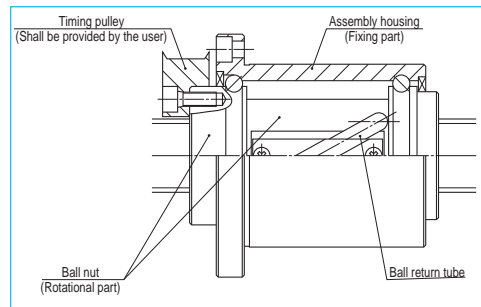
A nut rotatable ball screw is developed as a unit into which angular contact support ball bearings are integrated. It is best suited for an application that requires rotation of the ball nut while the screw shaft is fixed.

**NDT model**

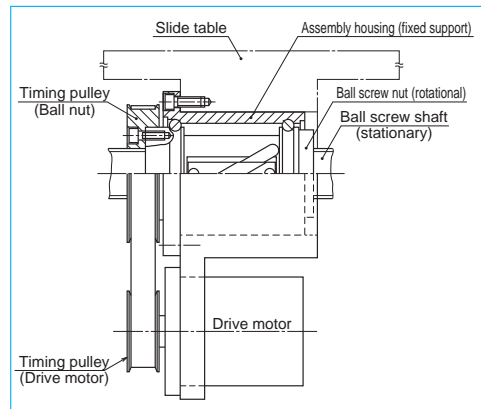
**1. Structure**

Balls are installed between the assembly housing and the ball nut. The outer bearing rings are integrated into the assembly housing and thus, compact design are 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 table**

**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, but yet low rotational speed, is feasible by means of 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.

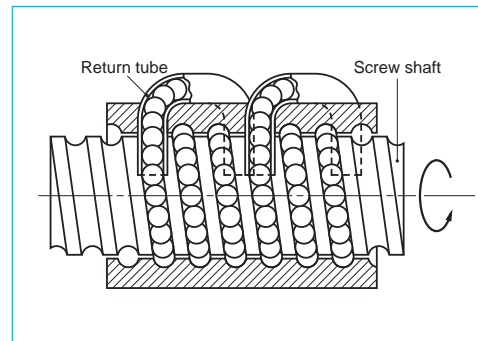
● Low inertia

Compared to the NSK current product (end cap ball recirculation system), rotational inertia was reduced by 16% at most.

**3. Specifications**

**(1) Recirculation system**

The structure of return tube recirculation system is shown below.



**Fig. 3 Structure of ball return tube 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 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**

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.

Note: The basic concept is the same as that of general ball screws. Refer to "Technical Description: Permissible rotational speed" (Page B51).

**Table 3 Allowable d·n value and the criterion of maximum rotational speed**

Allowable d·n value	Standard specification	70000 or less
	High-speed specification	100000 or less
Criterion of maximum rotational speed	3000 min <sup>-1</sup>	

d·n value: shaft dia. d [mm] × Rotational speed n [min<sup>-1</sup>]

● Critical speed *n<sub>c</sub>*

As shown Fig. 4, calculate unsupported length (mm) of *L<sub>1</sub>*, *L<sub>2</sub>*, and *L<sub>3</sub>* (Assumed that the nut section is a fixed support.) Table 4 shows the coefficients "f" of each shaft end mounting condition.

$$n_c = f \cdot \frac{d}{L_i^2} \times 10^7 \text{ (min}^{-1}\text{)} \quad \text{(III-1)}$$

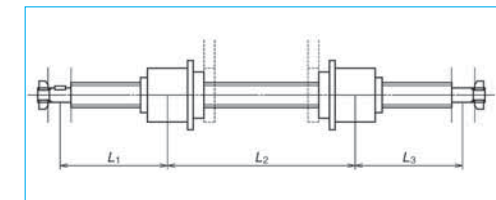
*d*: Screw shaft root diameter [See the dimension table]

*L<sub>i</sub>*: Unsupported length (mm) [See Fig. 4 Unsupported length]

*f*: Factor determined by the ball screw shaft end mounting condition

**Table 4**

Shaft end mounting condition	<i>f</i>
Fixed -- Fixed support	21.9
Fixed -- Simple support	15.1
Fixed -- Free support	3.4



**Fig. 4 Installation example**

**5. Design precautions**

One end of the screw thread should be cut-through. 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 B84) and "Handling Precautions" (Page B103).

**NDD Type: (Incorporating vibration damper)**

An increase in stroke length may restrict required rotational speed of a ball screw due to the issue of critical speed even if there is no problem on d·n limitation.

In such a case, we recommend using NDD Type nut rotatable ball screws equipped with vibration damper.

It will make it possible to operate a ball screw exceeding the critical speed, which is conventionally considered being impossible.

Note: 1) However, NDD Type cannot be used exceeding the d·n limitation. Please consult with NSK in such a case.

2) You cannot rotate the screw shaft of NDD Series.

**1. Structure**

Hollow ball screw shaft has 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 NDT Type.

**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 the issue of critical speed. NDD Type ball screw will make these measures needless.

- Dimensional interchangeability with NDT Type ball screws

The vibration damper is set inside a ball screw shaft, and therefore, there is no difference with existing series in regards to external dimensions. The ball nuts of NDD Type are interchangeable with those of NDT Type.

- Others

Benefits in multiple ball nut on a screw shaft, high feeding speed for long stroke, easy in installation, and low inertia of the ball nuts are the same as NDT Type.

**3. Specification**

Recirculation system, accuracy grade, axial play and preload system are the same as NDT Type.

**4. Design precautions**

They are the same as NDT Type.

**5. Permissible rotational speed**

The d·n value is the same as NDT Type. You don't need to consider the critical speed.

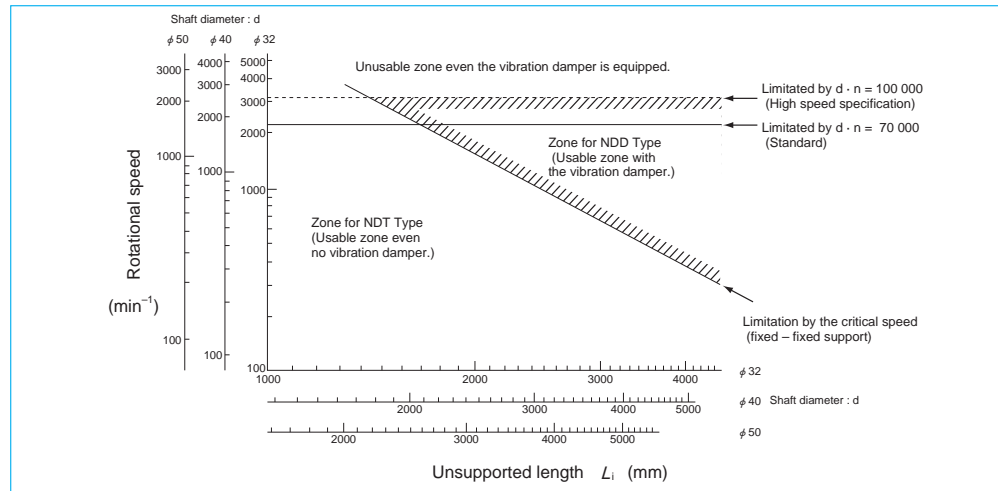


Fig. 5 Type composition to rotational speed and unsupported length

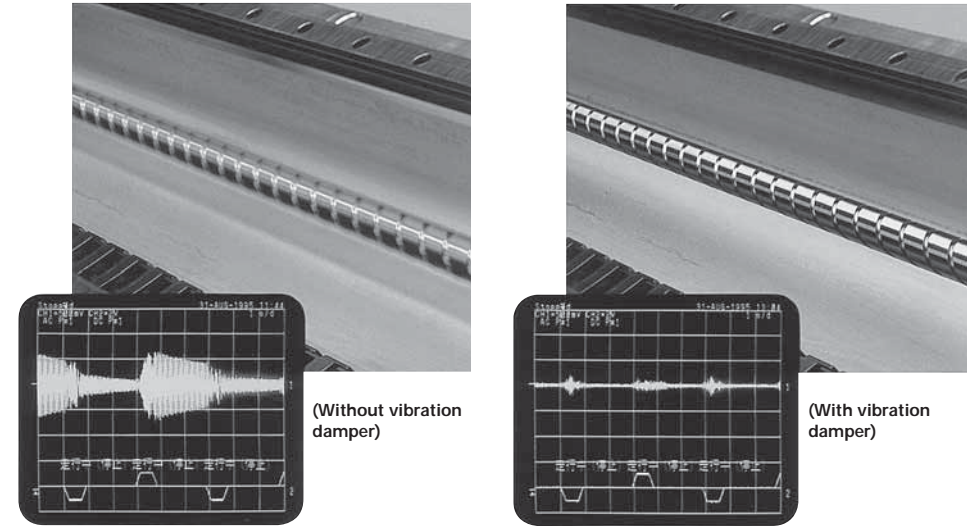


Fig. 6 Vibration of screw shaft when nut is rotating

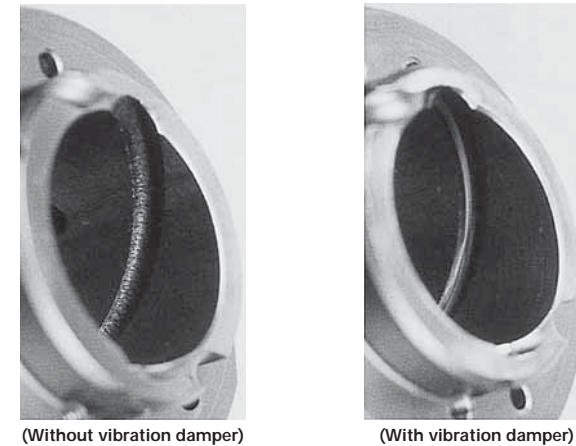


Fig. 7 Effect of vibration damper (results of endurance test)

Calculation example of permissible rotational speed

[Calculation example]

Assume a system which moves two nuts on a shaft as shown at 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  $n$  ( $\text{min}^{-1}$ ) when the lead of the ball screw is 40 mm, and the travel speed is at 60 m/min is:

$$n = \frac{60 \times 10^3}{40} = 1500 \text{ (min}^{-1}\text{)}$$

● Calculate  $d \cdot n$  value

As the  $d \cdot n$  value of standard specification is 7000, therefore, the permissible rotational speed is;

$$n \leq \frac{70000}{40} = 1750 \text{ (min}^{-1}\text{)}$$

● Calculate critical speed

The maximum unsupported length comes between Nut A and B.

$$L_2 = 3300 \text{ (mm)}$$

$$f = 21.9 \text{ (Fixed-Fixed)}$$

$$\text{Root diameter: } d_r = 35.1 \text{ (mm)}$$

Therefore, the permissible rotational speed is;

$$n \leq \frac{21.9 \times 35.1}{3300^2} \times 10^7 = 706 \text{ (min}^{-1}\text{)}$$

The calculation indicates that the  $d \cdot n$  value is at the safe level. But the critical speed exceeds the limitation. However, with a vibration damper, the system can be operated at  $1500 \text{ min}^{-1}$ .

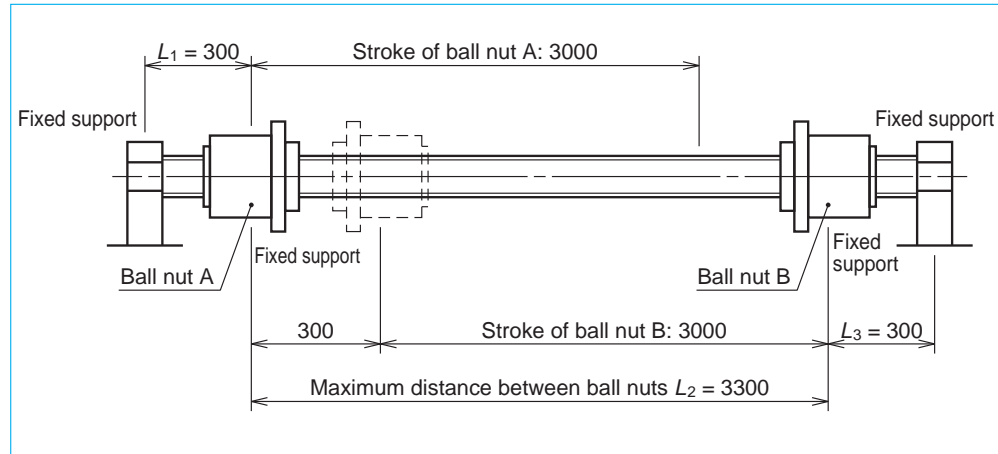


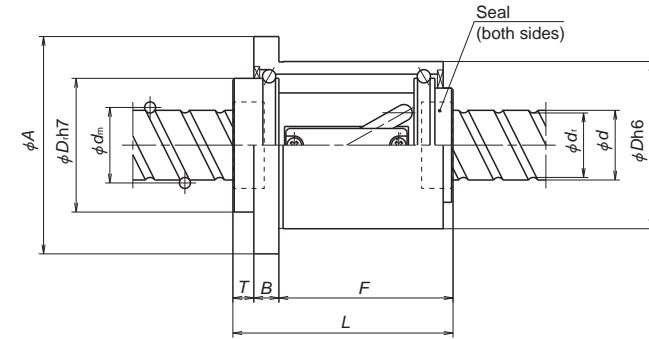
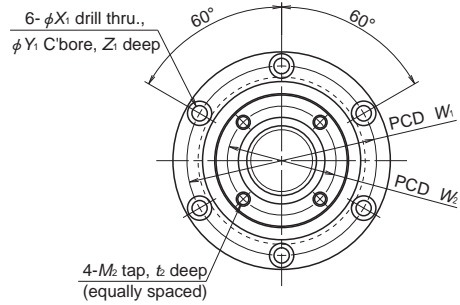
Fig. 8 Calculation example of permissible rotational speed

Example of model number in dimension table

A structure of "Reference number for ball screw" is as follows.

◇Reference number for ball screw

<b>W 40 15 - ** P XU - C5 Z 40</b>	
Product code	Lead (mm)
Screw shaft diameter (mm)	Axial play code: Z, T, S
Effective threaded length (in the unit of 100 mm)	Accuracy grade: C3, C5, C7 (Ct7)
Design serial number	Appearance/specification code ("T" is added for NDD Type)
Preload code: No code, Non-preload; P, P preload	



Unit: mm

Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Moment of inertia, ball nut <i>J</i> (kg·cm <sup>2</sup> )	Ball nut mass <i>W</i> (kg)
							Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>		
NDT NDD 3220-2.5	32	20	4.762	33.25	28.3	2.5×1	17900	41800	6.2	2.9
NDT NDD 3225-2.5		25	4.762	33.25	28.3	2.5×1	17900	41800	6.7	3.2
NDT NDD 3232-1.5		32	4.762	33.25	28.3	1.5×1	11500	24800	6.2	2.9
NDT NDD 3232-3						1.5×2	18900	44600		
NDT NDD 4025-2.5		40	25	6.35	41.75	35.1	2.5×1	28500	70000	19.3
NDT NDD 4032-1.5	32		6.35	41.75	35.1	1.5×1	18400	41200	18.0	5.5
NDT NDD 4032-3						1.5×2	30100	74100		
NDT NDD 4040-1.5	40		6.35	41.75	35.1	1.5×1	18400	41200	19.2	6.0
NDT NDD 4040-3						1.5×2	30100	74100		
NDT NDD 5025-2.5	50	25	7.938	52.25	44.0	2.5×1	42700	109000	45.7	8.5
NDT NDD 5032-2.5		32	7.938	52.25	40.0	2.5×1	42700	109000	48.9	9.4
NDT NDD 5040-1.5		40	7.938	52.25	44.0	1.5×1	27500	66500	45.5	8.5
NDT NDD 5040-3						1.5×2	44900	120000		
NDT NDD 5050-1.5		50	7.938	52.25	44.0	1.5×1	27500	66500	48.7	9.4
NDT NDD 5050-3	1.5×2					44900	120000			

Remarks 1. The right hand screw is the standard. Consult NSK for the left hand screws.  
2. Seal is standard.

Ball nut dimensions													Tap hole PCD <i>W<sub>2</sub></i>
Nut entire length <i>L</i>	Nut outside diameter <i>D</i>	Flange outside diameter <i>A</i>	Flange width <i>B</i>	Nut length <i>F</i>	Projection tube dimensions <i>D<sub>r</sub></i> , <i>T</i>		Bolt hole dimensions <i>X<sub>1</sub></i> , <i>Y<sub>1</sub></i> , <i>Z<sub>1</sub></i>			Bolt hole PCD <i>W<sub>1</sub></i>	Tap hole dimensions <i>M<sub>2</sub></i> , <i>t<sub>2</sub></i>		
107	78	105	12	83	60	12	6.6	11	6.5	91	M6	12	50
120	78	105	12	96	60	12	6.6	11	6.5	91	M6	12	50
107	78	105	12	83	60	12	6.6	11	6.5	91	M6	12	50
136	100	133	15	106	76	15	9	14	8.5	116	M8	16	62
122	100	133	15	92	76	15	9	14	8.5	116	M8	16	62
136	100	133	15	106	76	15	9	14	8.5	116	M8	16	62
140	120	156	18	107	96	15	11	17.5	11	136	M10	18	78
158	120	156	18	125	96	15	11	17.5	11	136	M10	18	78
140	120	156	18	107	96	15	11	17.5	11	136	M10	18	78
158	120	156	18	125	96	15	11	17.5	11	136	M10	18	78

B-3-1.9 Σ Series for Robot

1. Features

Σ Series (NSK's Robotte) is a ball screw with a high-performance spline. It is ideal for various actuators such as the vertical axis of SCALA type robot.

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 a support bearings are also combined to the unit. This allows compact and high-precision design. Hollow shaft is standard to reduce weight. The hollow can be used for wiring and piping. Other components are also designed to be light in weight.

● Low inertia

Because of return tube type ball nut of which outside diameter is decreased, low inertia design is enabled.

It reduces the inertia by 19% of conventional products.

2. Functions

As shown in Fig. 1, the ball screw nut and a spline nut are rotated independently to control rotation value. Thereby the shaft can move in any direction -- linear and rotational. Table 1 shows the relationship between power input and output.

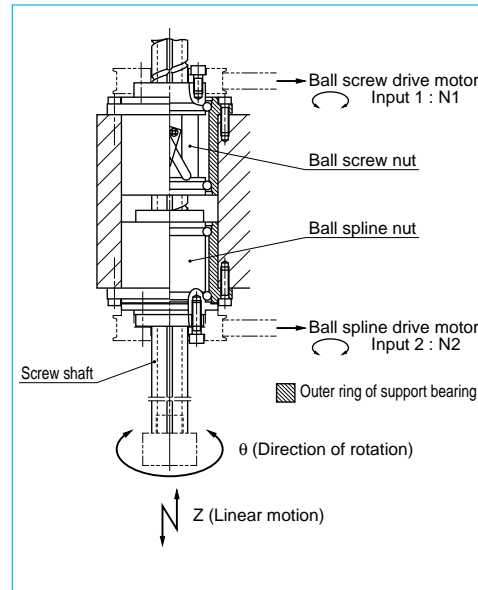


Fig. 1 Example structure of Z axis plus theta axis actuator

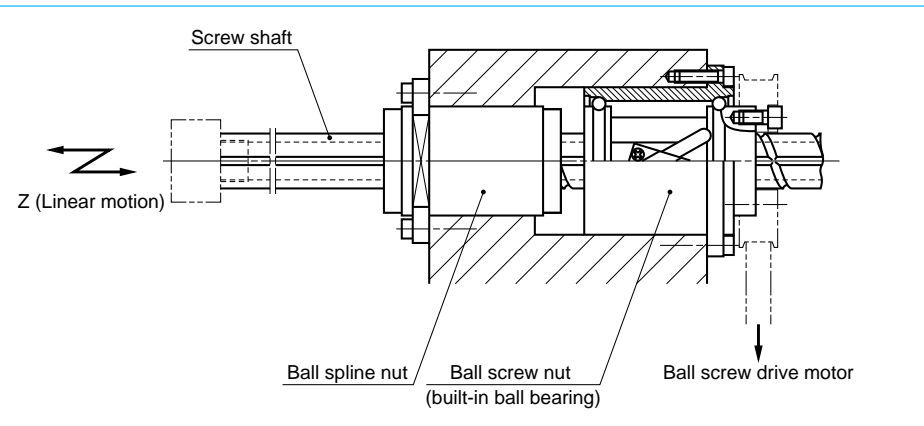


Fig. 2 Example structure of single Z axis unit

Table 1 Power input and output of Σ Series

Shaft movement (output)		Input		Remarks
Z (Up-down movement) (mm/min)	θ (Rotational movement) (min <sup>-1</sup> )	① Ball screw (min <sup>-1</sup> )	② Spline (min <sup>-1</sup> )	
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 N1-N2 × l	Rotate N2	Rotate N1	Rotate N2	N1 ≠ N2

3. Specifications

(1) Recirculation system

A structure of return tube recirculation system is shown below.

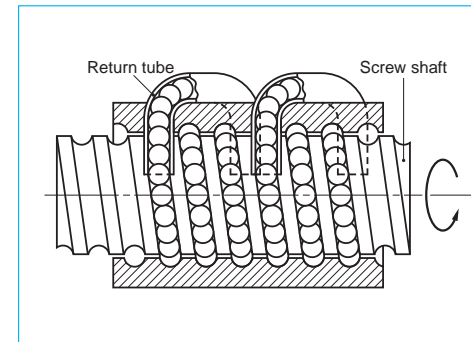


Fig. 3 Structure of return tube recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play for ball screw are as follows. The axial play for 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 and the criterion of maximum rotational speed

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.

Permissible d·n value: 70000 or less

Criterion of maximum rotational speed: 3000 min<sup>-1</sup>

Note: Please also review the critical speed.

For details, see "Technical Description: Permissible rotational speed" (Page B51).

(4) Application

SCALA type and Cartesian type industrial robots, semiconductor manufacturing machines, machines for automobile production facilities, material handling systems, other Z (vertical) axis and Z axis plus theta (rotation) axis actuators.

4. Design precautions

The overall length L can be extended to 25 times of the shaft diameter.

To remove the spline nut from the shaft for assembling, use an arbor as shown in Fig. 4. Avoid removing ball screw nut as much as possible. Refer to root diameter in the dimension table for arbor diameter. (NSK manufactures the arbors on request.)

For general precautions regarding ball screws, refer to "Precautions in Designing" (Page B84) and "Precautions in Handling" (Page B103).

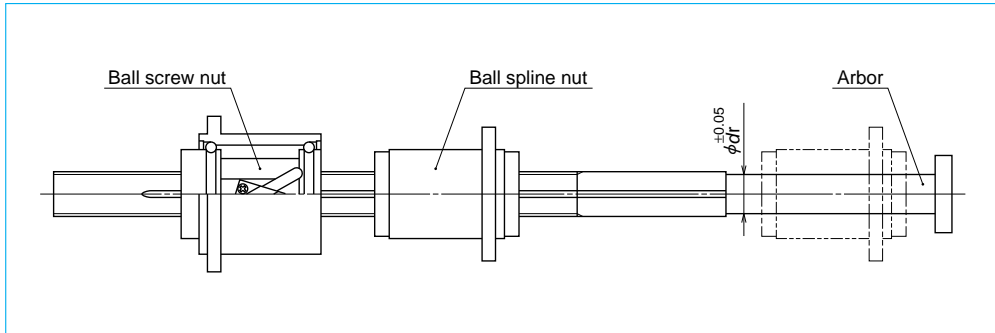


Fig. 4 Removing spline nut

**5. Product categories**

$\Sigma$  Series (NSK's Robotte) is four models with different moving functions and performances are available. Select a standard model if rigidity is important. A compact system is recommended for reducing the weight of machine.

Table 3  $\Sigma$  Series product categories

Model	Appearance	Size	Structure (Movement)
$\Sigma$		Standard	Z+ $\theta$ Unit
$\Sigma Z$		Standard	Z Unit
$\Sigma C$		Compact	Z+ $\theta$ Unit
$\Sigma CZ$		Compact	Z Unit

**6. Load rating and life**

The relationship between load rating of the ball spline section and life is the same as in other NSK liner 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 in up-down direction. (Load is applied to the ball screw nut.)
- T : Torque that is generated to the shaft by Fa.
- 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.
- $\theta$  : Direction of Fr load that changes by shaft rotation.

NSK has life calculation programs which take these factors into account. Please ask NSK for more details.

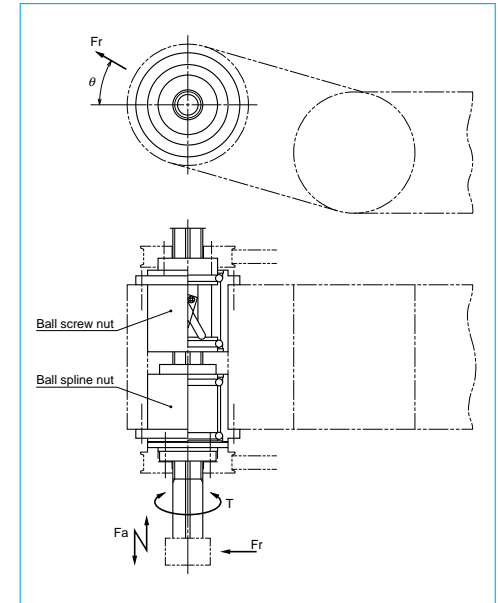


Fig. 5 Example structure of Z axis plus  $\theta$  axis actuator

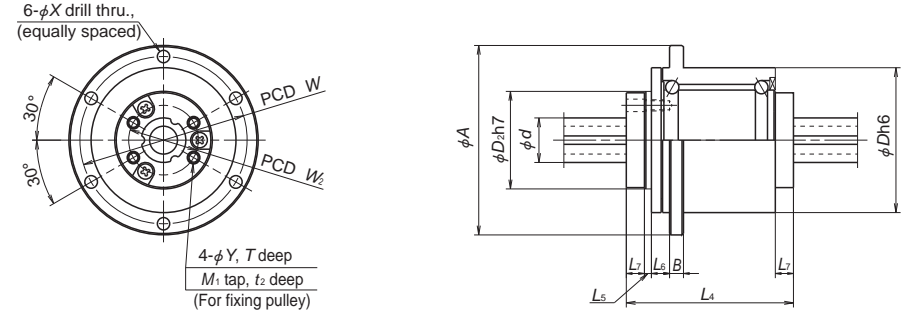
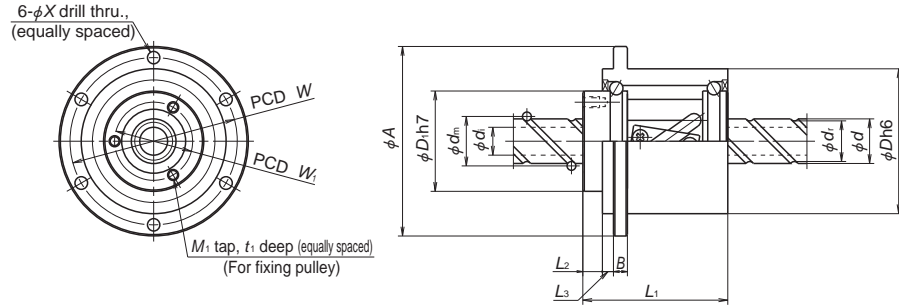
**7. Example of model number in dimension table**

A structure of "Reference number for ball screw" is as follows.

◇Reference number for ball screw

**PW 25 02 - \*\* P T U - C5 Z 20**

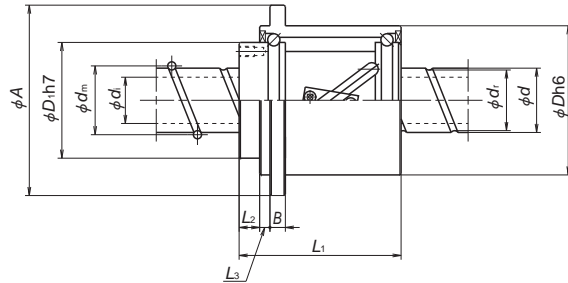
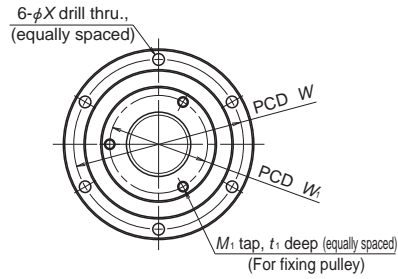
Product code	Screw shaft diameter (mm)	Effective threaded length (unit in 100 mm)	Design serial number	Preload code: No code ; Non-preload	Lead (mm)	Axial play code: Z, T, S	Accuracy grade: C3, C5, C7 (Ct7)	Use support unit	Hollow shaft ball screw specification
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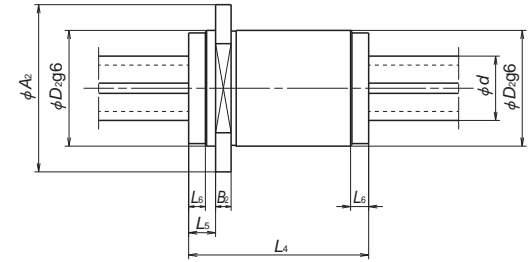
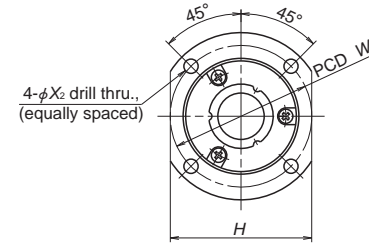
Unit: mm

Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Screw shaft hollow <i>d<sub>i</sub></i>	Ball screw nut															Moment of inertia (kg·cm <sup>2</sup> )
							Basic load rating (N)		Dimensions													
							Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	<i>D</i>	<i>A</i>	<i>B</i>	<i>L<sub>1</sub></i>	<i>L<sub>2</sub></i>	<i>L<sub>3</sub></i>	<i>M<sub>1</sub></i>	<i>t<sub>1</sub></i>	<i>W<sub>1</sub></i>	<i>D<sub>1</sub></i>	<i>W</i>	<i>X</i>		
Σ1610	16	10	3.175	16.75	13.4	(8)	4710	8110	48	64	5	47	7	4	3-M4	6	28	35	56	4.5	0.41	
Σ1632	16	32	3.175	16.75	13.4	(8)	2990	4870	48	64	5	52	7	4	3-M4	6	28	35	56	4.5	0.44	
Σ2010	20	10	3.175	20.75	17.4	(14)	8210	17500	54	70	6	57	8	4	3-M4	6	32	40	62	4.5	0.64	
Σ2020	20	20	3.175	20.75	17.4	(14)	5290	10300	54	70	6	63	8	4	3-M4	6	32	40	62	4.5	0.65	
Σ2040	20	40	3.175	20.75	17.4	(14)	3360	6170	54	70	6	57	8	4	3-M4	6	32	40	62	4.5	0.64	
Σ2510	25	10	3.175	25.75	22.4	(18)	9110	21900	58	74	6	57	8	4	3-M4	6	38	45	66	4.5	1.10	
Σ2520	25	20	3.175	25.75	22.4	(18)	5870	13200	58	74	6	63	8	4	3-M4	6	38	45	66	4.5	1.18	
Σ2525	25	25	3.175	25.75	22.4	(18)	5870	13200	58	74	6	72	8	4	3-M4	6	38	45	66	4.5	1.30	
Σ3220	32	20	3.175	32.75	29.4	(25)	6540	16800	70	95	8	70	10	6	3-M5	10	44	53	82	6.6	2.60	
Σ3232	32	32	3.175	32.75	29.4	(25)	6540	16800	70	95	8	91	10	6	3-M5	10	44	53	82	6.6	3.15	
Σ4020	40	20	3.969	41.0	36.9	(30)	9770	26300	85	110	8	73	10	6	4-M5	10	58	67	96	6.6	5.96	
Σ4040	40	40	3.969	41.0	36.9	(30)	9770	26300	85	110	8	107	10	6	4-M5	10	58	67	96	6.6	7.85	
Σ4520	45	20	3.969	46.0	41.9	(35)	10300	29700	90	115	8	73	10	6	4-M5	10	63	72	101	6.6	7.73	
Σ4540	45	40	3.969	46.0	41.9	(35)	10300	29700	90	115	8	107	10	6	4-M5	10	63	72	101	6.6	10.3	

Mass (kg)	Ball spline nut																			Moment of inertia (kg·cm <sup>2</sup> )	Mass (kg)
	Basic load rating (N)		Basic torque (N·m)		Dimensions																
	Dynamic <i>C<sub>r</sub></i>	Static <i>C<sub>0r</sub></i>	Dynamic <i>C<sub>t</sub></i>	Static <i>C<sub>0t</sub></i>	<i>D</i>	<i>A</i>	<i>B</i>	<i>L<sub>4</sub></i>	<i>L<sub>5</sub></i>	<i>L<sub>6</sub></i>	<i>L<sub>7</sub></i>	<i>Y</i>	<i>T</i>	<i>M<sub>2</sub></i>	<i>t<sub>2</sub></i>	<i>W<sub>2</sub></i>	<i>D<sub>2</sub></i>	<i>W</i>	<i>X</i>		
0.50	5530	7270	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
0.55	5890	8000	65.5	100	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
0.74	6260	8720	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
0.81	6610	9450	91.1	145	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
0.74	6610	9450	91.1	145	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
0.81	6630	9450	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
0.88	7290	10900	125	210	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
1.00	7290	10900	125	210	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
1.46	7630	11600	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
1.83	7950	12400	175	305	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
2.02	10600	14800	290	455	85	110	8	80	4	7.5	8	5.5	8	M5	8	55	65	96	6.6	9.74	2.38
2.85	11200	15900	305	490	85	110	8	80	4	7.5	8	5.5	8	M5	8	55	65	96	6.6	9.74	2.38
2.17	11200	15900	340	550	90	115	8	85	4	7.5	8	5.5	8	M5	8	60	70	101	6.6	12.5	2.56
3.06	11700	17000	360	590	90	115	8	85	4	7.5	8	5.5	8	M5	8	60	70	101	6.6	12.5	2.56



Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Screw shaft hollow <i>d<sub>1</sub></i>	Ball screw nut													
							Basic load rating (N)		Dimensions											
							Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	<i>D</i>	<i>A</i>	<i>B</i>	<i>L<sub>1</sub></i>	<i>L<sub>2</sub></i>	<i>L<sub>3</sub></i>	<i>M<sub>1</sub></i>	<i>t<sub>1</sub></i>	<i>W<sub>1</sub></i>	<i>D<sub>1</sub></i>	<i>W</i>	<i>X</i>
ΣZ1610	16	10	3.175	16.75	13.4	(8)	4710	8110	48	64	5	47	7	4	3-M4	6	28	35	56	4.5
ΣZ1632		32					2990	4870				52								
ΣZ2010	20	10	3.175	20.75	17.4	(14)	8210	17500	54	70	6	57	8	4	3-M4	6	32	40	62	4.5
ΣZ2020		20					5290	10300				63								
ΣZ2040		40					3360	6170				57								
ΣZ2510	25	10	3.175	25.75	22.4	(18)	9110	21900	58	74	6	57	8	4	3-M4	6	38	45	66	4.5
ΣZ2520		20					5870	13200				63								
ΣZ2525		25					5870	13200				72								
ΣZ3220	32	20	3.175	32.75	29.4	(25)	6540	16800	70	95	8	70	10	6	3-M5	10	44	53	82	6.6
ΣZ3232		32					6540	16800				91								
ΣZ4020	40	20	3.969	41.0	36.9	(30)	9770	26300	85	110	8	73	10	6	4-M5	10	58	67	96	6.6
ΣZ4040		40					9770	26300				107								
ΣZ4520	45	20	3.969	46.0	41.9	(35)	10300	29700	90	115	8	73	10	6	4-M5	10	63	72	101	6.6
ΣZ4540		40					10300	29700				107								

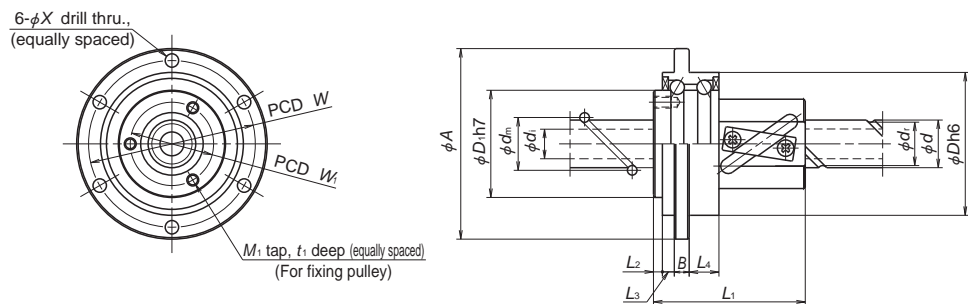


Unit: mm

Moment of inertia (kg·cm <sup>2</sup> )	Mass (kg)	Ball spline nut																	Mass (kg)
		Basic load rating (N)		Basic torque (N·m)		Dimensions													
		Dynamic <i>C<sub>r</sub></i>	Static <i>C<sub>0r</sub></i>	Dynamic <i>C<sub>t</sub></i>	Static <i>C<sub>0t</sub></i>	<i>D<sub>2</sub></i>	<i>A<sub>2</sub></i>	<i>B<sub>2</sub></i>	<i>L<sub>4</sub></i>	<i>L<sub>5</sub></i>	<i>L<sub>6</sub></i>	<i>H</i>	<i>W<sub>2</sub></i>	<i>X</i>					
0.41	0.50	5530	7270	61.5	91.3	35	55	6	60	10.5	6.5	4.5	4.5	4.5	0.35				
0.44	0.55	5890	8000	65.5	100	40	60	6	65	10.5	6.5	50	50	5.5	0.46				
0.64	0.74	6260	8720	86.5	135														
0.65	0.81	6610	9450	91.1	145														
0.64	0.74	6610	9450	91.1	145	45	65	6	70	10.5	6.5	55	55	5.5	0.57				
1.10	0.81	6630	9450	115	185														
1.18	0.88	7290	10900	125	210														
1.30	1.00	7290	10900	125	210														
2.60	1.46	7630	11600	165	285	50	70	6	75	10.5	6.5	60	60	5.5	0.64				
3.15	1.83	7950	12400	175	305														
5.96	2.02	10600	14800	290	455	65	88	8	80	12	8	76	76	6.6	1.20				
7.85	2.85	11200	15900	305	490														
7.73	2.17	11200	15900	340	550	70	93	8	85	12	8	81	81	6.6	1.39				
10.3	3.06	11700	17000	360	590														

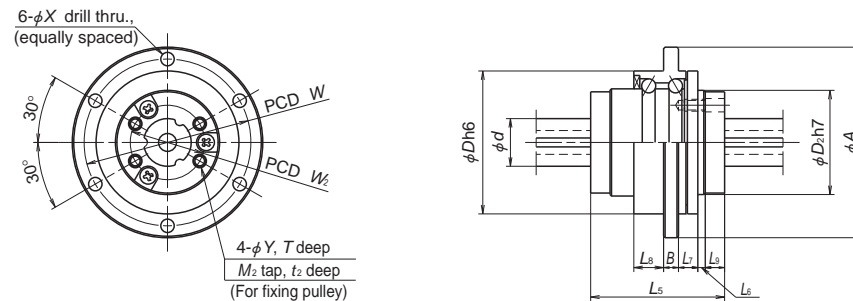


## Σ Series for Robotte



## Σ C Type

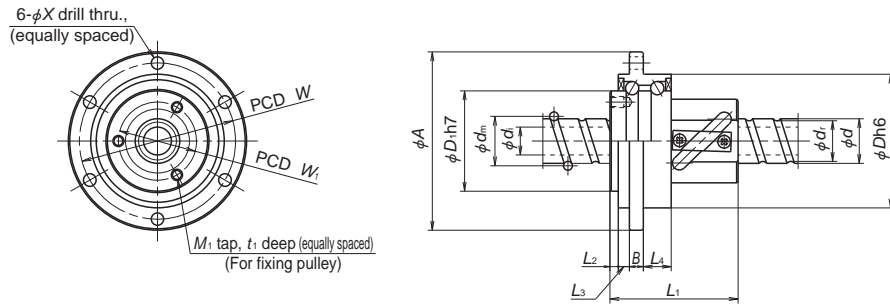
NSK



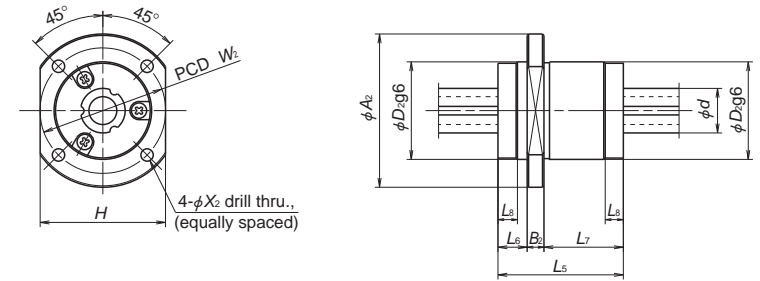
Model No.	Shaft dia. <i>d</i>	Lead <i>I</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Screw shaft hollow <i>d<sub>i</sub></i>	Ball screw nut														Moment of inertia (kg·cm <sup>2</sup> )		
							Basic load rating(N)		Dimensions														
							Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	<i>D</i>	<i>A</i>	<i>B</i>	<i>L<sub>1</sub></i>	<i>L<sub>2</sub></i>	<i>L<sub>3</sub></i>	<i>L<sub>4</sub></i>	<i>M<sub>1</sub></i>	<i>t<sub>1</sub></i>	<i>W<sub>1</sub></i>	<i>D<sub>1</sub></i>	<i>W</i>		<i>X</i>	
ΣC1610	16	10	3.175	16.75	13.4	(8)	4710	8110	48	64	5	46	3	4	10	3-M4	6	28	35	56	4.5	0.40	
ΣC1632	32	2990					4870	51				10			0.43								
ΣC2010	20	10	3.175	20.75	17.4	(14)	8210	17500	54	70	6	56	4	4	10	3-M4	6	32	40	62	4.5	0.63	
ΣC2020		20					5290	10300				63			10								0.65
ΣC2040		40					3360	6170				56			10								0.63
ΣC2510		10					9110	21900				56			10								1.04
ΣC2520	25	20	3.175	25.75	22.4	(18)	5870	13200	58	74	6	63	4	4	10	3-M4	6	38	45	66	4.5	1.13	
ΣC2525		25					5870	13200				71			10								1.24

Unit: mm

Mass (kg)	Basic load rating(N)		Basic torque(N·m)		Ball spline nut														Moment of inertia (kg·cm <sup>2</sup> )	Mass (kg)		
	Dynamic <i>C<sub>r</sub></i>	Static <i>C<sub>0r</sub></i>	Dynamic <i>C<sub>t</sub></i>	Static <i>C<sub>0t</sub></i>	Dimensions																	
	<i>D</i>	<i>A</i>	<i>B</i>	<i>L<sub>5</sub></i>	<i>L<sub>6</sub></i>	<i>L<sub>7</sub></i>	<i>L<sub>8</sub></i>	<i>L<sub>9</sub></i>	<i>Y</i>	<i>T</i>	<i>M<sub>2</sub></i>	<i>t<sub>3</sub></i>	<i>W<sub>2</sub></i>	<i>D<sub>2</sub></i>	<i>W</i>	<i>X</i>						
0.41	4300	5090	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
0.43	4300	5090	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
0.53	4730	5820	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
0.56	5110	6540	70.5	100	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
0.53	5110	6540	70.5	100	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
0.60	5130	6540	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
0.64	5870	8000	100	155	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
0.69	5870	8000	100	155	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



Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Screw shaft hollow <i>d<sub>i</sub></i>	Ball screw nut															
							Basic load rating(N)		Dimensions													Mass (kg)
							Dynamic <i>C<sub>r</sub></i>	Static <i>C<sub>0r</sub></i>	<i>D</i>	<i>A</i>	<i>B</i>	<i>L<sub>1</sub></i>	<i>L<sub>2</sub></i>	<i>L<sub>3</sub></i>	<i>L<sub>4</sub></i>	<i>M<sub>r</sub></i>	<i>t<sub>1</sub></i>	<i>W<sub>1</sub></i>	<i>D<sub>1</sub></i>	<i>W</i>	<i>X</i>	
ΣCZ1610	16	10	3.175	16.75	13.4	(8)	4710	8110	48	64	5	46	3	4	10	3-M4	6	28	35	56	4.5	
ΣCZ1632		32					2990	4870				51										56
ΣCZ2010	20	10	3.175	20.75	17.4	(14)	8210	17500	54	70	6	56	4	4	10	3-M4	6	32	40	62	4.5	
ΣCZ2020		20					5290	10300				63										56
ΣCZ2040		40					3360	6170				56										56
ΣCZ2510	25	10	3.175	25.75	22.4	(18)	9110	21900	58	74	6	56	4	4	10	3-M4	6	38	45	66	4.5	
ΣCZ2520		20					5870	13200				63										56
ΣCZ2525		25					5870	13200				71										56



Unit: mm

Moment of inertia (kg·cm <sup>2</sup> )	Mass (kg)	Ball spline nut																		Mass (kg)
		Basic load rating(N)		Basic torque(N·m)		Dimensions														
		Dynamic <i>C<sub>r</sub></i>	Static <i>C<sub>0r</sub></i>	Dynamic <i>C<sub>t</sub></i>	Static <i>C<sub>0t</sub></i>	<i>D<sub>2</sub></i>	<i>A<sub>2</sub></i>	<i>B<sub>2</sub></i>	<i>L<sub>5</sub></i>	<i>L<sub>6</sub></i>	<i>L<sub>7</sub></i>	<i>L<sub>8</sub></i>	<i>H</i>	<i>W<sub>2</sub></i>	<i>X<sub>2</sub></i>					
0.40	0.41	4300	5090	47.9	63.9	35	55	6	45	10.5	28.5	6.5	45	45	4.5	0.26				
0.43	0.43	4300	5090	47.9	63.9															
0.63	0.53	4730	5820	65.1	90.5	40	60	6	50	10.5	33.5	6.5	50	50	5.5	0.35				
0.65	0.56	5110	6540	70.5	100															
0.63	0.53	5110	6540	70.5	100	45	65	6	55	10.5	38.5	6.5	55	55	5.5	0.44				
1.04	0.60	5130	6540	87.8	125															
1.13	0.64	5870	8000	100	155															
1.24	0.69	5870	8000	100	155															

B-3-1.10 Ball Screws for Transfer Equipment

1. Features

● Transporting mechanism

Ct7 and Ct10 grades series demonstrate high ball screw performance for transporting mechanism of Cartesian type robots and single axis actuators. The following types are categorized ball screw for transfer equipment. VFA and RMA types have finished shaft ends. RMS type, R series of RNFTL, RNFBFL, RNCT, RNFBCL, and RNSTL types have blank shaft ends.

Table 1 Classifications of ball screws for transfer equipment

Finished shaft end	VFA type, RMA type
	RMS type
Blank shaft end	R Series
	RNFTL type, RNFBFL type
	RNCT type, RNFBCL type, RNSTL type

● Interchangeable screw shaft and ball nut

Screw shaft and nut assembly components are sold separately, and randomly-matched. The maximum axial play after assembly is shown in the dimension tables.

2. Specifications

(1) Recirculation system

Fig. 1, 2, and 3 show the structures of ball return tube, deflector, and end cap recirculation systems. Deflector recirculation system has the feature of compact nut outside diameter for small lead. End cap recirculation system is for screws with high helix lead and multiple start threads. Since the leads are in the range larger than 1.3 times of the screw shaft diameter, it is suitable for high-speed operation.

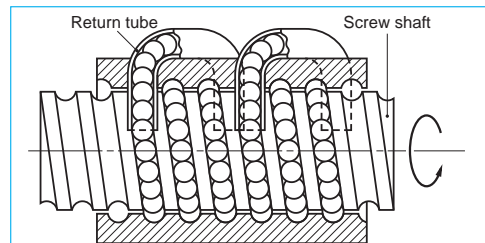


Fig. 1 Structure of return tube recirculation system

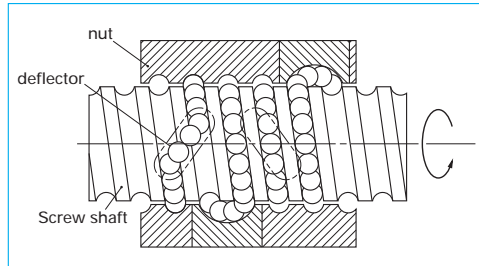


Fig. 2 Structure of deflector recirculation system

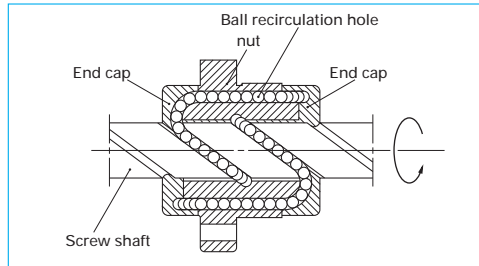


Fig. 3 Structure of end cap recirculation system

(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 type, RMA type, RMS type : Ct7 R Series : Ct10
Axial play	See dimension tables

(3) Allowable d·n value and the criterion of maximum rotational speed

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

Allowable d·n value	50000 or less
Criterion of maximum rotational speed	3000 min <sup>-1</sup>

d·n value: Shaft dia. d [mm] × Rotational speed n [min<sup>-1</sup>]

Note: Please also review the critical speed. See "Technical Description: Permissible rotational speed" (Page B51) for details.

3. Design precautions

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B497).

(1) Nut installation

Nut assembly and the screw shaft are separated at the time of delivery. Refer to "Technical description: Installation of Ball Screw" (page B77) for installation of ball nut assembly.

(2) Shaft end machining

It is necessary to machine screw shaft end of RMS and R series. Refer to "Selection Guide to NSK Ball Screw: Configuration of shaft end" (Page B27) if you use standard support units. Refer to "Technical Description: Shaft end machining" (Page B83) for procedures and precautions.

4. Product categories

Ball screws for transfer equipment have models as follows.

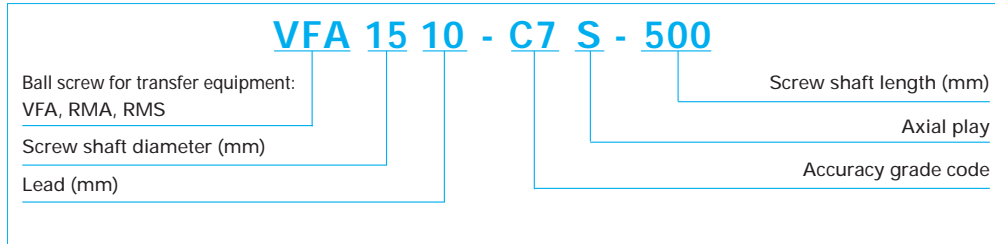
Table 4 Product categories of ball screws for transfer equipment

Nut models	Shape	Flange shape	Recirculation system	Preload system	Page
VFA		Flanged rectangular	Return tube type	Non-preload Slight axial play	B173 - B178
RMA RMS		Flanged Circular III	Deflector type	Non-preload Slight axial play	B179 - B192
RNFTL		Flanged Circular I Projecting tube type	Return tube type	Non-preload Slight axial play	B193 - B196
RNFBFL		Flanged Circular II	Return tube type	Non-preload Slight axial play	B199
RNCT		V-thread (no flange) Projecting tube type	Return tube type	Non-preload Slight axial play	B201
RNFBCL		Flanged Circular III	End cap type	Non-preload Slight axial play	B203 - B206
RNSTL		Square type	Return tube type	Non-preload Slight axial play	B207

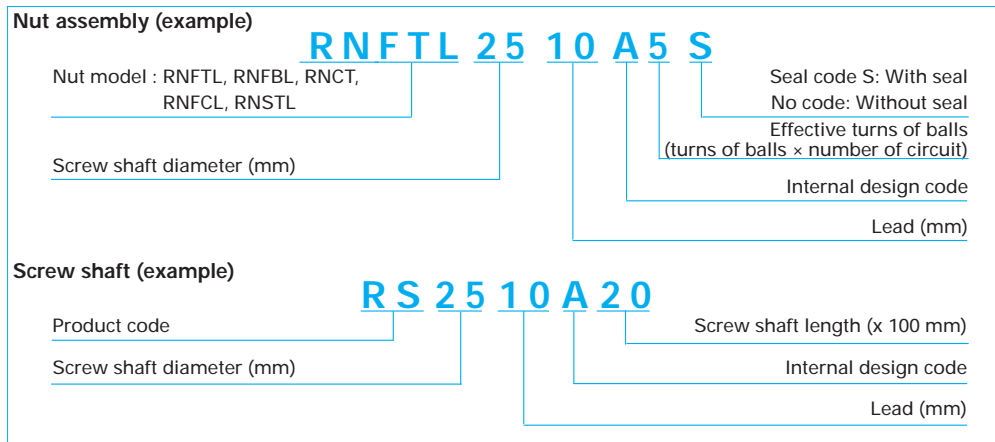
### 5. Example of model number in dimension table

A structure of "Reference number for ball screw" is as follows.

◇Reference number for VFA, RMA, and RMS types



◇Reference number for R series



### 6. Combinations of shaft diameter and lead

Combinations of shaft diameter and lead are shown below.

For details of standard stock products, contact NSK.

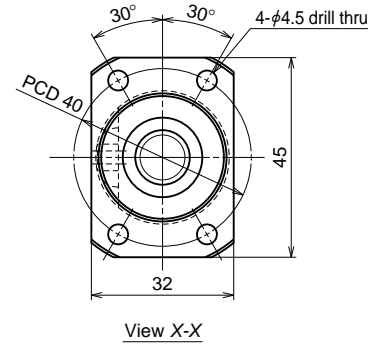
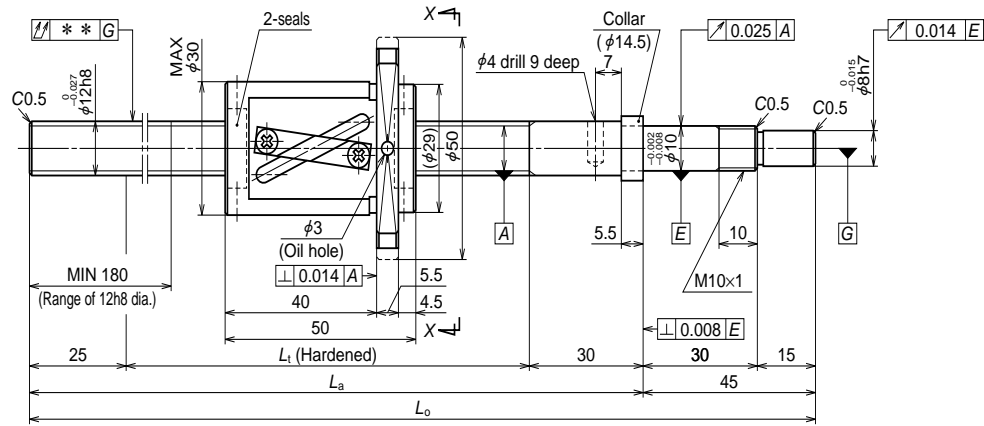
Table 5 Combinations of shaft diameter and lead for VFA, RMA, RMS types

Screw shaft diameter	Lead				
	1	1.5	2	10	20
6	B179, 191				
8	B181, 191	B183, 191	B185, 191		
10			B187, 191		
12			B189, 191	B173	
15				B175	B177

Table 6 Combinations of shaft diameter and lead for R series

Screw shaft diameter (mm)	Lead (mm)															
	3	4	5	6	8	10	12	16	20	25	32	40	50	64	80	
10	○B193 △B201			○B193●B199												
12					○B193●B199		○B197◎B203									
14		○B193●B199 △B201□B207	○B193●B199 △B201□B207													
15									◎B203							
16						○B193		○B197 ◎B203		◎B205						
18					○B193●B199 △B201□B207											
20			○B193●B199 △B201□B207			○B193●B199 □B207		○B197 ◎B203		◎B205						
25			○B193●B199 △B201□B207			○B193●B199 △B201□B207			○B197 ◎B203				◎B205			
28				○B195●B199 △B201□B207												
32						○B195●B199 △B201□B207				○B197 ◎B203				◎B205		
36						○B195●B199 △B201□B207										
40						○B195△B201 ●B199							○B197 ◎B203		◎B205	
45							○B195 △B201□B207									
50								○B195 △B201						◎B203		

○ : RNFTL ● : RNFB △ : RNCT ◎ : RNFL □ : RNSTL



Unit: mm

Ball screw specification		
Shaft dia.xLead / Direction of turn	12×10/Right	
Ball recirculation	Return tube	
Ball dia. / Ball circle dia.	2.381/12.5	
Screw shaft root dia.	10.0	
Effective turns of balls	2.5×1	
Accuracy grade / Axial play code	Ct7/S	
Basic load rating (N)	Dynamic $C_a$	3750
	Static $C_{0a}$	6480
Axial play	0.010 or less	
Dynamic friction torque (N·cm)	1.5 or less	
Spacer ball	None	
Factory pre-packed grease	NSK grease LR3	
Internal spatial volume of nut (cm <sup>3</sup> )	1.4	
Reference of grease replenishing amount	0.7	

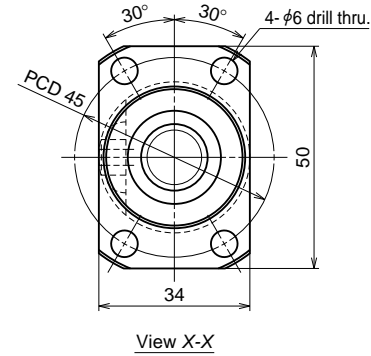
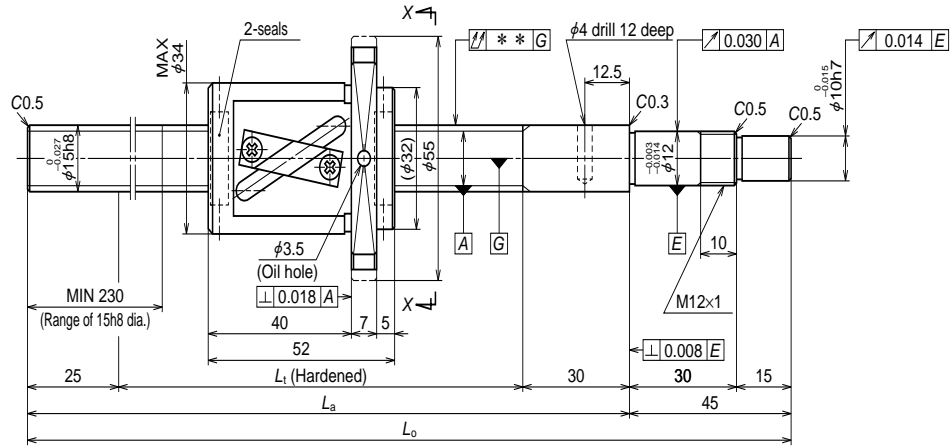
Recommend support units	
WBK10-01A	(Square, fixed side)
WBK12SF-01	(Square, simple side)
WBK10-11	(Round, fixed side)

Unit: mm

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum ( $L_r$ -nut length)	$L_1$	$L_a$	$L_o$
<b>VFA1210C7S-410</b>	250	260	310	365	410
<b>VFA1210C7S-610</b>	450	460	510	565	610

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
$T$	$e_p$	$v_{300}$			Supporting condition	
					Fixed - Simple support	Fixed - Free
0	0.085	0.052	0.100	0.56	3000	3000
0	0.155	0.052	0.160	0.73	3000	1300

- Remarks
1. We recommend NSK support units (page B433). WBK12SF-01 (on the simple support side) supports the ball screw directly on the shaft OD.
  2. NSK grease LR3 is recommended. The amount for grease replenishing should be about 50% of nut internal space capacity. Please refer to page D16 on details.
  3. Permissible rotational speed is determined by a  $d \cdot n$  value and a critical speed. See page B169 and page B51.



Unit: mm

Ball screw specification		
Shaft dia.xLead / Direction of turn	15×10/Right	
Ball recirculation	Return tube	
Ball dia. / Ball circle dia.	3.175/15.5	
Screw shaft root dia.	12.2	
Effective turns of balls	2.5×1	
Accuracy grade / Axial play code	Ct7/S	
Basic load rating (N)	Dynamic $C_a$	7070
	Static $C_{0a}$	12800
Axial play	0.010 or less	
Dynamic friction torque (N·cm)	2.5 or less	
Spacer ball	None	
Factory pre-packed grease	NSK grease LR3	
Internal spatial volume of nut (cm <sup>3</sup> )	2.3	
Reference of grease replenishing amount	1.2	

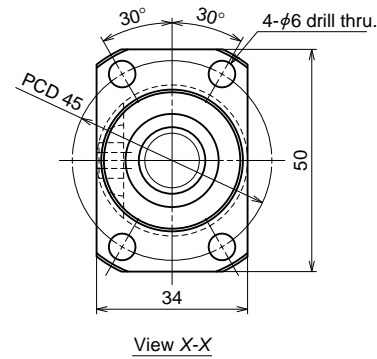
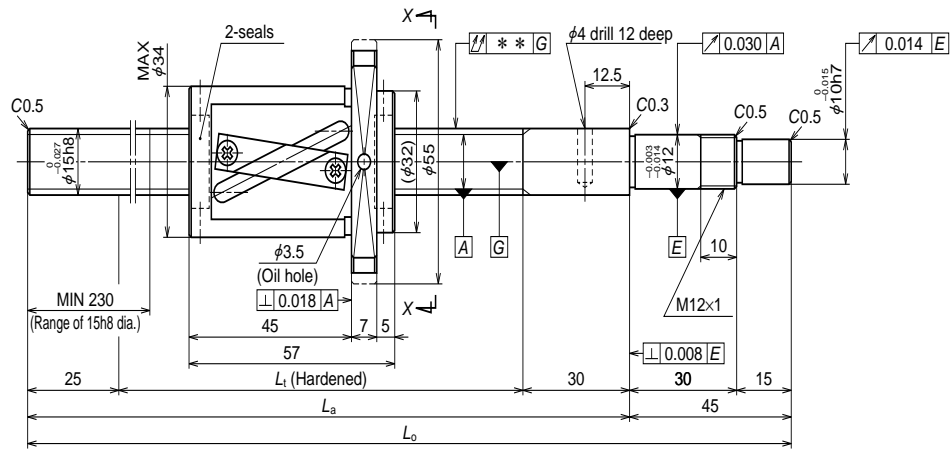
Recommend support units		
WBK12-01A	(Square, fixed side)	
WBK15SF-01	(Square, simple side)	
WBK12-11	(Round, fixed side)	

Unit: mm

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum ( $L_r$ -nut length)	$L_1$	$L_a$	$L_o$
VFA1510C7S-500	300	348	400	455	500
VFA1510C7S-700	500	548	600	655	700
VFA1510C7S-1000	800	848	900	955	1000

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
$T$	$e_p$	$v_{300}$			Supporting condition	
					Fixed - Simple support	Fixed - Free
0	0.120	0.052	0.075	0.89	3000	2600
0	0.195	0.052	0.110	1.1	3000	1150
0	0.310	0.052	0.180	1.5	2340	510

- Remarks
1. We recommend NSK support units (page B433). WBK12SF-01 (on the simple support side) supports the ball screw directly on the shaft OD.
  2. NSK grease LR3 is recommended. The amount for grease replenishing should be about 50% of nut internal space capacity. Please refer to page D16 on details.
  3. Permissible rotational speed is determined by a  $d \cdot n$  value and a critical speed. See page B169 and page B51.



Unit: mm

Ball screw specification		
Shaft dia.xLead / Direction of turn	15×20/Right	
Ball recirculation	Return tube	
Ball dia. / Ball circle dia.	3.175/15.5	
Screw shaft root dia.	12.2	
Effective turns of balls	1.5×1	
Accuracy grade / Axial play code	Ct7/S	
Basic load rating (N)	Dynamic C <sub>a</sub>	4560
	Static C <sub>0a</sub>	7730
Axial play	0.010 or less	
Dynamic friction torque (N·cm)	2.5 or less	
Spacer ball	None	
Factory pre-packed grease	NSK grease LR3	
Internal spatial volume of nut (cm <sup>3</sup> )	2.3	
Reference of grease replenishing amount	1.4	

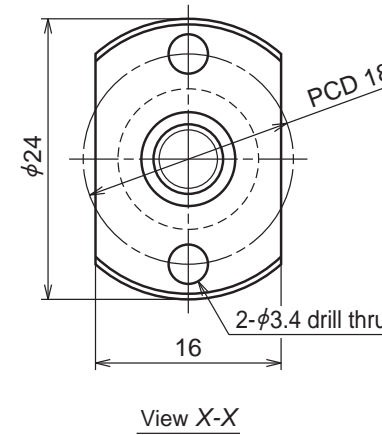
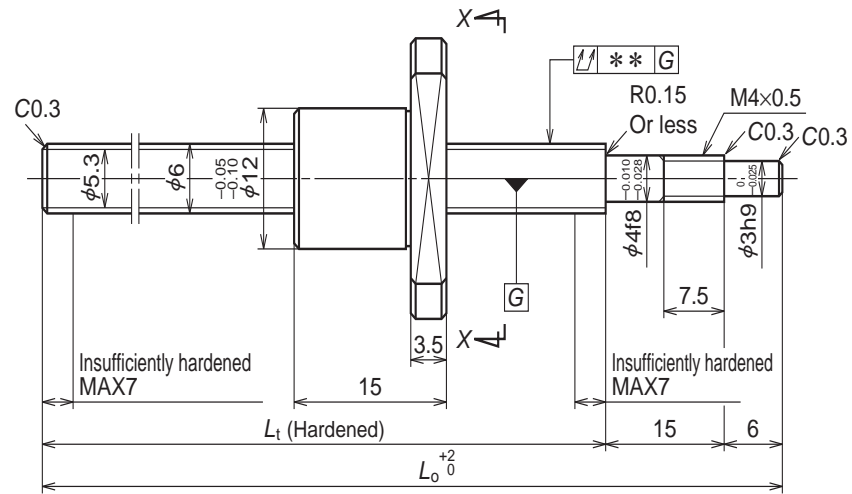
Recommend support units		
WBK12-01A	(Square, fixed side)	
WBK15SF-01	(Square, simple side)	
WBK12-11	(Round, fixed side)	

Unit: mm

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L <sub>r</sub> -nut length)	L <sub>1</sub>	L <sub>a</sub>	L <sub>o</sub>
<b>VFA1520C7S-500</b>	300	343	400	455	500
<b>VFA1520C7S-700</b>	500	543	600	655	700
<b>VFA1520C7S-1000</b>	800	843	900	955	1000

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
T	e <sub>p</sub>	v <sub>300</sub>			Supporting condition	
			Fixed - Simple support			Fixed - Free
0	0.120	0.052	0.075	0.94	3000	2630
0	0.195	0.052	0.110	1.2	3000	1160
0	0.310	0.052	0.180	1.6	2350	510

- Remarks
1. We recommend NSK support units (page B433). WBK12SF-01 (on the simple support side) supports the ball screw directly on the shaft OD.
  2. NSK grease LR3 is recommended. The amount for grease replenishing should be about 50% of nut internal space capacity. Please refer to page D16 on details.
  3. Permissible rotational speed is determined by a d · n value and a critical speed. See page B169 and page B51.



Unit: mm

Ball screw specification		
Shaft dia.xLead / Direction of turn	6×1/Right	
Ball recirculation	Deflector	
Ball dia. / Ball circle dia.	0.800/6.2	
Screw shaft root dia.	5.2	
Effective turns of balls	1×3	
Accuracy grade / Axial play code	Ct7/S	
Basic load rating (N)	Dynamic $C_a$	520
	Static $C_{0a}$	925
Axial play	0.020 or less	
Dynamic friction torque (N·cm)	1.0 or less	
Spacer ball	None	
Factory pre-packed grease	Refer to the remarks 2.	
Recommend support unit		
WBK04R-11	(Round, fixed side)	

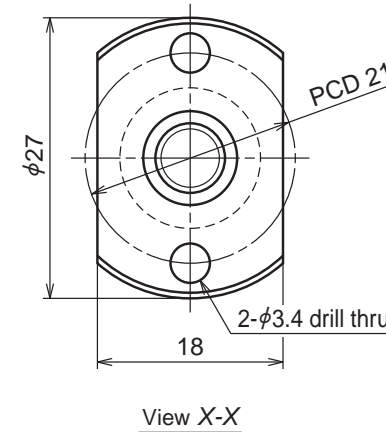
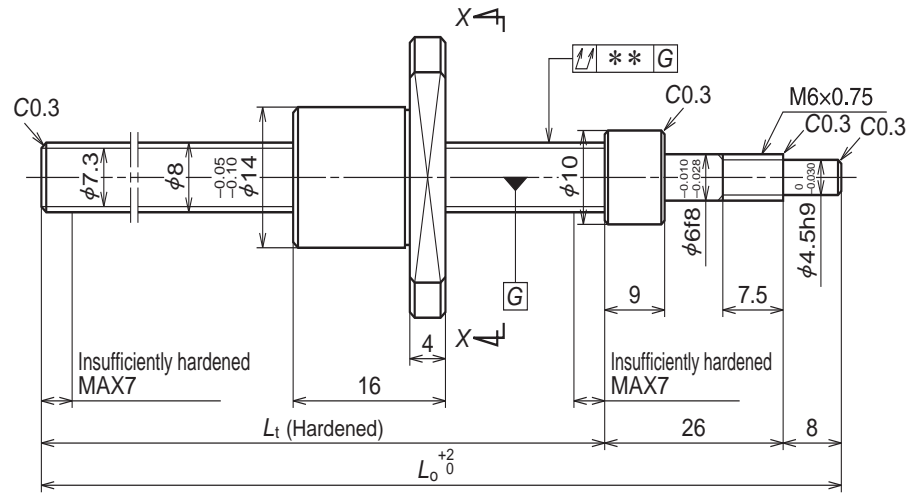
Unit: mm

Ball screw No.	Stroke		Screw shaft length	
	Nominal	Maximum ( $L_t$ -Nut length)	$L_t$	$L_o$
RMA0601C7S-160	100	124	139	160
RMA0601C7S-260	200	224	239	260

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
Target compensation T	Deviation $e_p$	Variation $v_{300}$			
0	0.052	0.052	0.060	0.045	3000
0	0.085	0.052	0.090	0.065	3000

- Remarks
1. We recommend NSK support bearing kit (page B445).
  2. Only rust preventive oil is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to page D13 on details.
  3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B169 and page B51.





Unit: mm

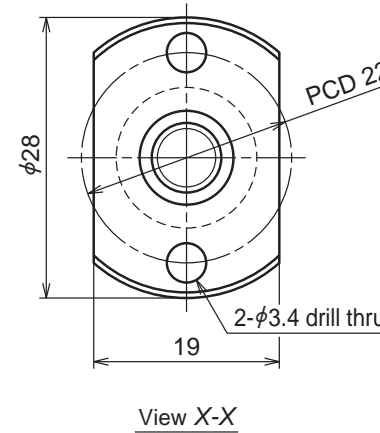
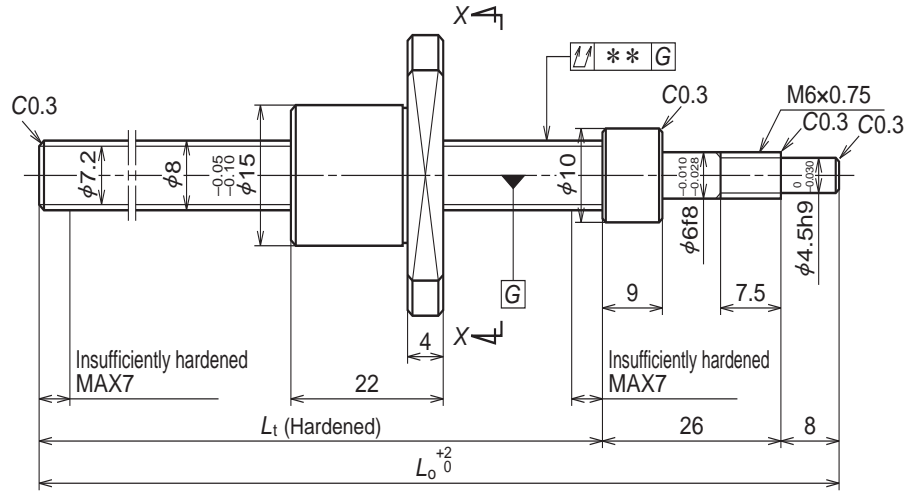
Ball screw specification		
Shaft dia.xLead / Direction of turn	8×1/Right	
Ball recirculation	Deflector	
Ball dia. / Ball circle dia.	0.800/8.2	
Screw shaft root dia.	7.2	
Effective turns of balls	1×3	
Accuracy grade / Axial play code	Ct7/S	
Basic load rating (N)	Dynamic $C_a$	600
	Static $C_{0a}$	1290
Axial play	0.020 or less	
Dynamic friction torque (N·cm)	1.0 or less	
Spacer ball	None	
Factory pre-packed grease	Refer to the remarks 2.	
Recommend support unit		
WBK06R-11	(Round, fixed side)	

Unit: mm

Ball screw No.	Stroke		Screw shaft length	
	Nominal	Maximum ( $L_t$ -Nut length)	$L_t$	$L_o$
<b>RMA0801C7S-180</b>	100	130	146	180
<b>RMA0801C7S-280</b>	200	230	246	280

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
Target compensation $T$	Deviation $e_p$	Variation $v_{300}$			
0	0.052	0.052	0.060	0.085	3000
0	0.085	0.052	0.090	0.12	3000

- Remarks
1. We recommend NSK support bearing kit (page B445).
  2. Only rust preventive oil is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to page D13 on details.
  3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B169 and page B51.



Unit: mm

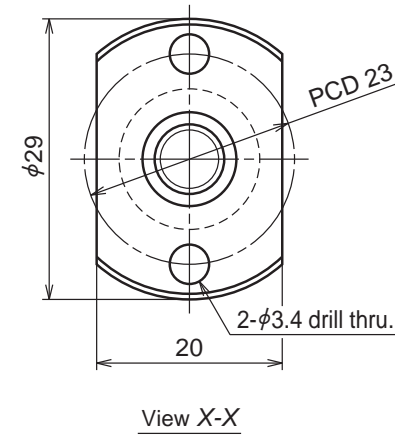
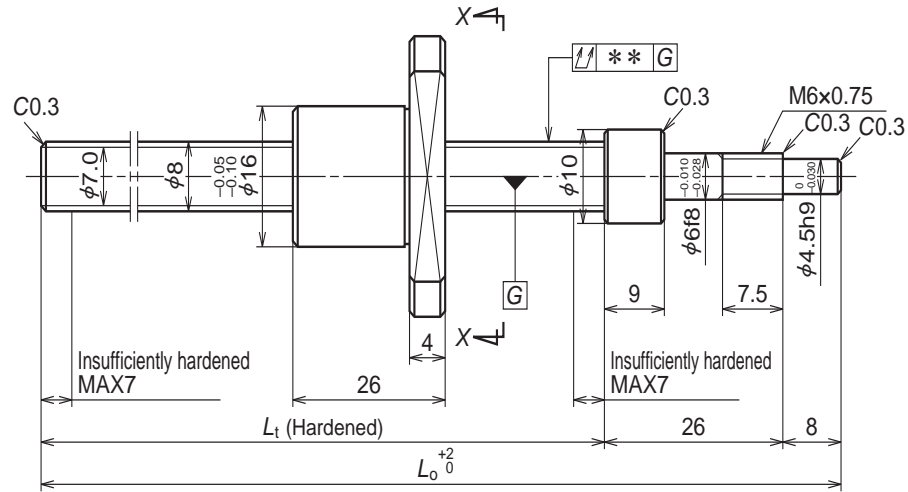
Ball screw specification		
Shaft dia.xLead / Direction of turn	8×1.5/Right	
Ball recirculation	Deflector	
Ball dia. / Ball circle dia.	1.000/8.3	
Screw shaft root dia.	7.0	
Effective turns of balls	1×3	
Accuracy grade / Axial play code	Ct7/S	
Basic load rating (N)	Dynamic $C_a$	810
	Static $C_{0a}$	1590
Axial play	0.020 or less	
Dynamic friction torque (N·cm)	1.0 or less	
Spacer ball	None	
Factory pre-packed grease	Refer to the remarks 2.	
Recommend support unit		
WBK06R-11	(Round, fixed side)	

Unit: mm

Ball screw No.	Stroke		Screw shaft length	
	Nominal	Maximum ( $L_t$ -Nut length)	$L_t$	$L_0$
<b>RMA0801.5C7S-180</b>	100	124	146	180
<b>RMA0801.5C7S-280</b>	200	224	246	280

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
Target compensation T	Deviation $e_p$	Variation $v_{300}$			
0	0.052	0.052	0.060	0.093	3000
0	0.085	0.052	0.090	0.13	3000

- Remarks
1. We recommend NSK support bearing kit (page B445).
  2. Only rust preventive oil is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to page D13 on details.
  3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B169 and page B51.



Unit: mm

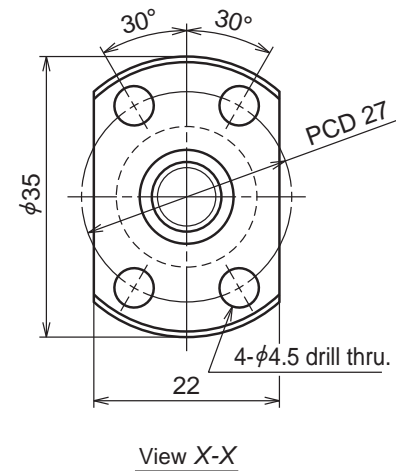
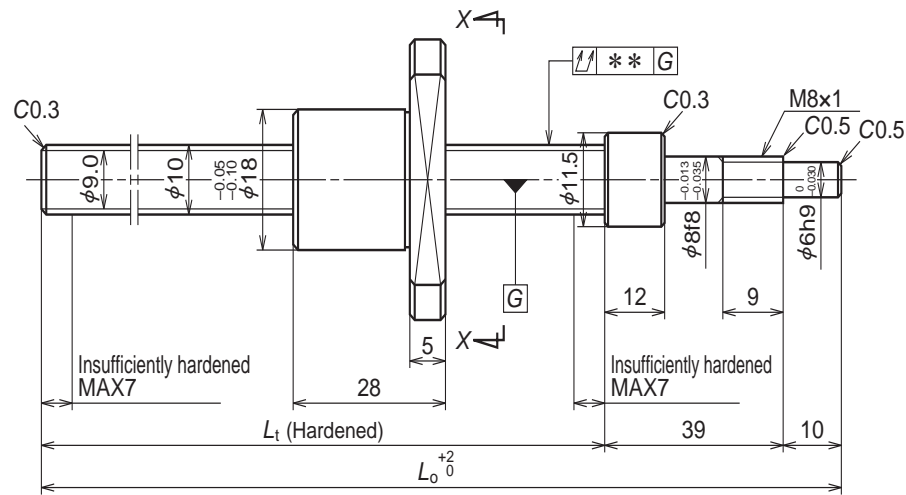
Ball screw specification		
Shaft dia.xLead / Direction of turn	8×2/Right	
Ball recirculation	Deflector	
Ball dia. / Ball circle dia.	1.200/8.3	
Screw shaft root dia.	6.9	
Effective turns of balls	1×3	
Accuracy grade / Axial play code	Ct7/S	
Basic load rating (N)	Dynamic $C_a$	1070
	Static $C_{0a}$	1950
Axial play	0.020 or less	
Dynamic friction torque (N·cm)	1.0 or less	
Spacer ball	None	
Factory pre-packed grease	Refer to the remarks 2.	
Recommend support unit		
WBK06R-11	(Round, fixed side)	

Unit: mm

Ball screw No.	Stroke		Screw shaft length	
	Nominal	Maximum ( $L_t$ -Nut length)	$L_t$	$L_o$
RMA0802C7S-180	100	120	146	180
RMA0802C7S-280	200	220	246	280

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
Target compensation T	Deviation $e_p$	Variation $v_{300}$			
0	0.052	0.052	0.060	0.10	3000
0	0.085	0.052	0.090	0.14	3000

- Remarks
1. We recommend NSK support bearing kit (page B445).
  2. Only rust preventive oil is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to page D13 on details.
  3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B169 and page B51.



Unit: mm

Ball screw specification		
Shaft dia.xLead / Direction of turn	10x2/Right	
Ball recirculation	Deflector	
Ball dia. / Ball circle dia.	1.200/10.3	
Screw shaft root dia.	8.9	
Effective turns of balls	1x3	
Accuracy grade / Axial play code	Ct7/S	
Basic load rating (N)	Dynamic $C_a$	1210
	Static $C_{0a}$	2510
Axial play	0.020 or less	
Dynamic friction torque (N·cm)	1.0 or less	
Spacer ball	None	
Factory pre-packed grease	Refer to the remarks 2.	

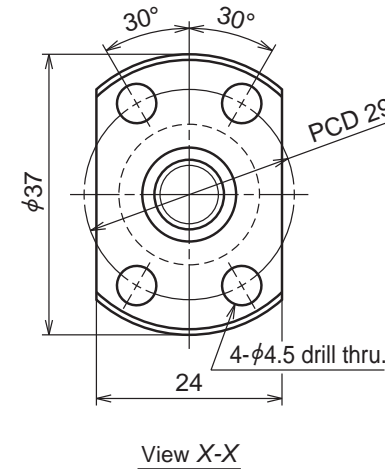
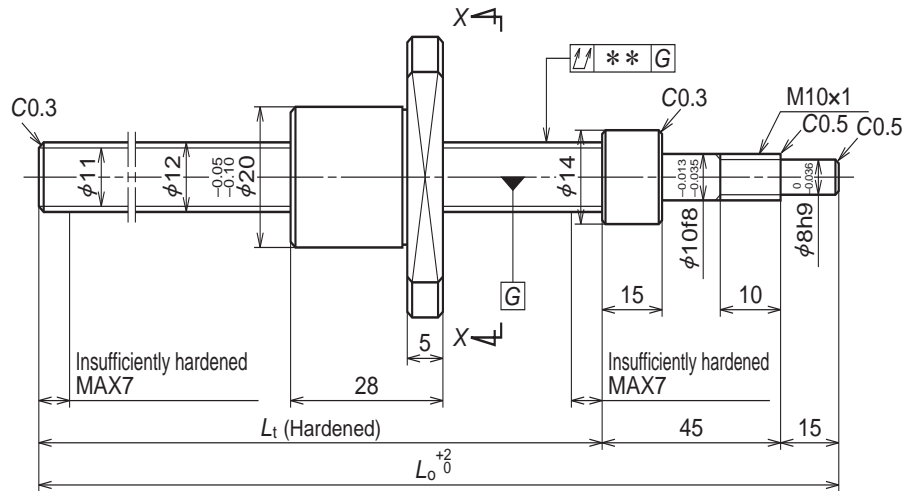
Recommend support unit		
WBK08-01A	(Square, fixed side)	
WBK08-11	(Round, fixed side)	

Unit: mm

Ball screw No.	Stroke		Screw shaft length	
	Nominal	Maximum ( $L_t$ -Nut length)	$L_t$	$L_0$
<b>RMA1002C7S-250</b>	150	173	201	250
<b>RMA1002C7S-350</b>	250	273	301	350

Lead accuracy			Shaft run-out** ↕	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
Target compensation T	Deviation $e_p$	Variation $v_{300}$			
0	0.085	0.052	0.070	0.19	3000
0	0.085	0.052	0.100	0.25	3000

- Remarks
1. We recommend NSK support bearing kit (page B445).
  2. Only rust preventive oil is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to page D13 on details.
  3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B169 and page B51.



Unit: mm

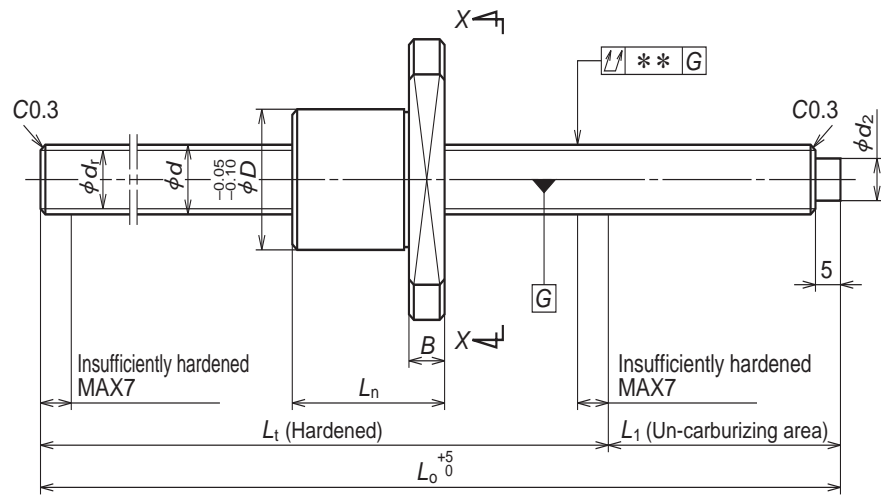
Ball screw specification		
Shaft dia. x Lead / Direction of turn	12×2/Right	
Ball recirculation	Deflector	
Ball dia. / Ball circle dia.	1.200/12.3	
Screw shaft root dia.	10.9	
Effective turns of balls	1×3	
Accuracy grade / Axial play code	Ct7/S	
Basic load rating (N)	Dynamic $C_a$	1350
	Static $C_{0a}$	3190
Axial play	0.020 or less	
Dynamic friction torque (N·cm)	1.0 or less	
Spacer ball	None	
Factory pre-packed grease	Refer to the remarks 2.	
Recommend support unit		
WBK10-01A	(Square, fixed side)	
WBK10-11	(Round, fixed side)	

Unit: mm

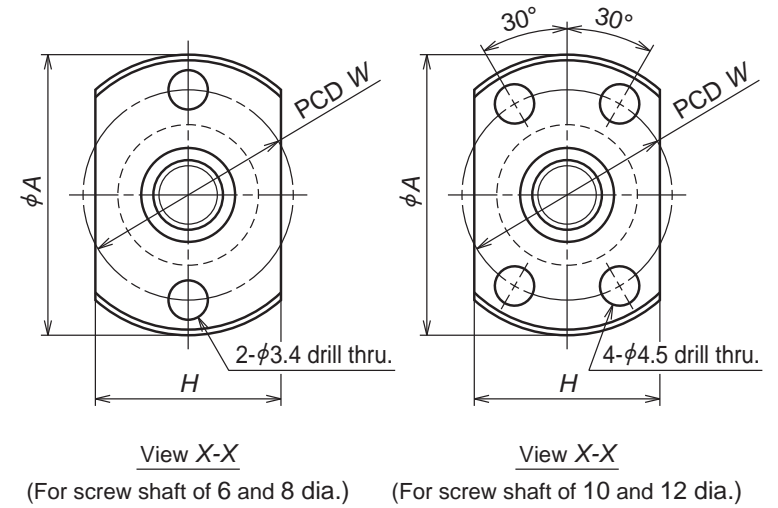
Ball screw No.	Stroke		Screw shaft length	
	Nominal	Maximum ( $L_t$ -Nut length)	$L_t$	$L_o$
<b>RMA1202C7S-250</b>	150	162	190	250
<b>RMA1202C7S-350</b>	250	262	290	350

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
Target compensation $T$	Deviation $e_p$	Variation $v_{300}$			
0	0.060	0.052	0.070	0.26	3000
0	0.085	0.052	0.100	0.34	3000

- Remarks
1. We recommend NSK support bearing kit (page B445).
  2. Only rust preventive oil is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to page D13 on details.
  3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B169 and page B51.



ø6×1, ø8×1, ø8×1.5  
ø8×2, ø10×2, ø12×2

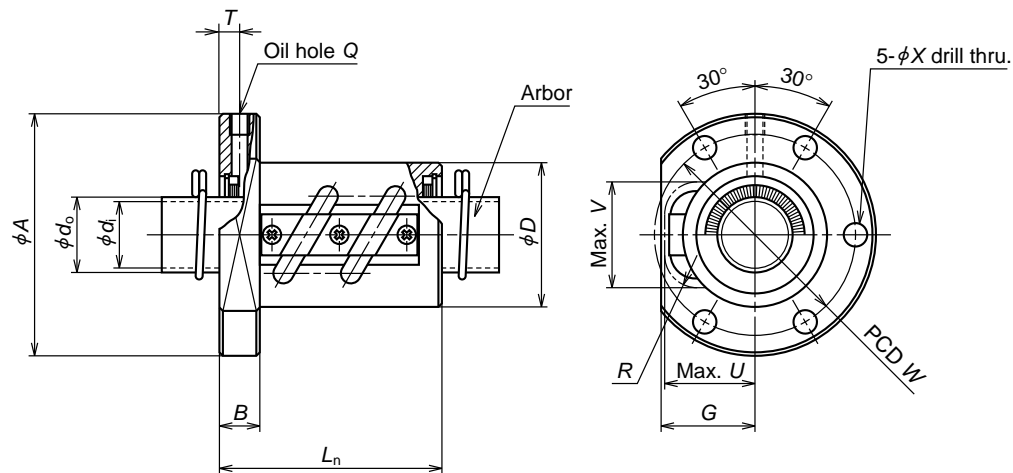


Ball screw No.	Stroke Max. $L_t-L_n$	Shaft dia. $d$	Lead $l$	Ball dia. $D_w$	Ball circle dia. $d_n$	Root dia. $d_r$	Effective turns of balls	Basic load rating (N)		Axial play Max.
								Dynamic $C_a$	Static $C_{0a}$	
<b>RMS0601C7S-300</b>	235	6	1	0.800	6.2	5.3	3	520	925	0.02
<b>RMS0801C7S-300</b>	234	8	1	0.800	8.2	7.3	3	600	1290	0.02
<b>RMS0801.5C7S-300</b>	228		1.5	1.000	8.3	7.2		810	1590	
<b>RMS0802C7S-300</b>	224		2	1.200	8.3	7.0		1070	1950	
<b>RMS1002C7S-350</b>	262	10	2	1.200	10.3	9.0	3	1210	2510	0.02
<b>RMS1202C7S-350</b>	262	12	2	1.200	12.3	11.0	3	1350	3190	0.02

- Remarks
1. We recommend NSK support unit (page B433) or support kit (page B445).
  2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use** Refer to page D13 on details.
  3. Seal is not installed.
  4. Permissible rotational speed is determined by a d-n value and a critical speed. See page B169 and page B51.

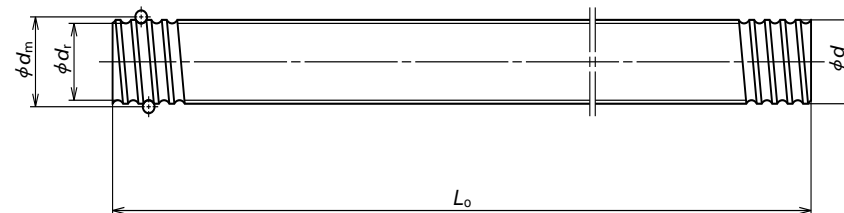
Unit: mm

Nut dimensions						Screw shaft dimensions				Lead accuracy			Shaft run-out** $\uparrow\uparrow$	Mass (Kg)	Permissible rotational speed N (min <sup>-1</sup> )
D	A	H	B	$L_n$	W	Effective thread length $L_t$	Shaft end $L_1$	$d_2$	Overall length $L_0$	Target compensation T	Deviation $e_p$	Variation $v_{300}$			
12	24	16	3.5	15	18	250	50	4	300	0	0.085	0.052	0.09	0.075	3000
14	27	18	4	16	21	250	50	6	300	0	0.085	0.052	0.09	0.13	
15	28	19		22	22									0.14	
16	29	20		26	23									0.15	
18	35	22	5	28	27	290	60	8	350	0	0.085	0.052	0.10	0.25	
20	37	24	5	28	29	290	60	10	350	0	0.085	0.052	0.10	0.35	



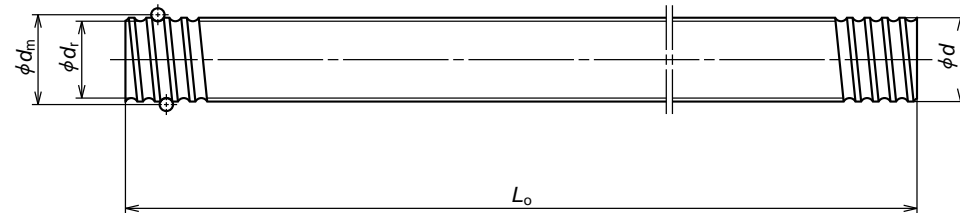
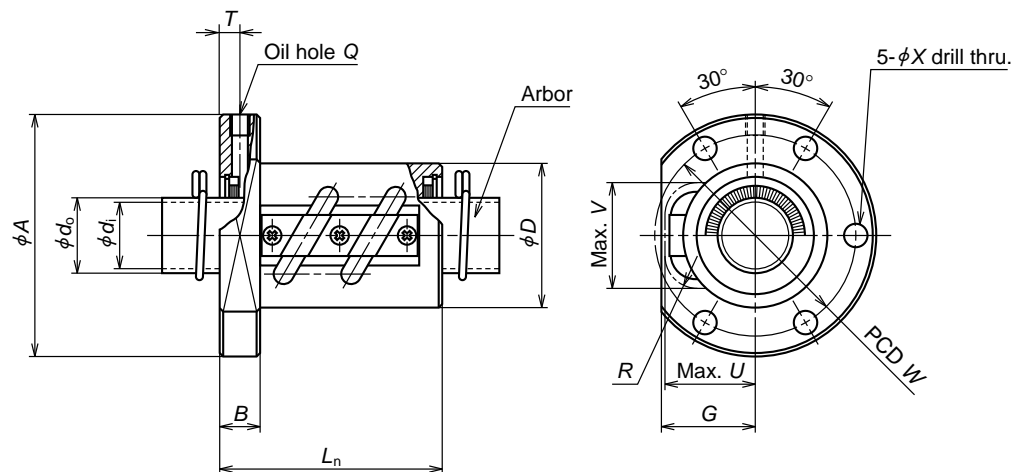
Ball nut No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>b</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>t</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial play Max.	Ball nut dimensions Outside dia. <i>D</i>
							Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>		
RNFTL 1003A3.5	10	3	2.381	10.65	8.1	3.5×1	3780	6730	0.10	20
RNFTL 1006A2.5S	10	6	2.381	10.65	8.1	2.5×1	2830	4810	0.10	20
RNFTL 1208A2.5S	12	8	2.778	12.65	9.6	2.5×1	3730	6560	0.10	25
RNFTL 1404A3.5S	14	4	2.778	14.5	11.5	3.5×1	5370	10800	0.10	25
RNFTL 1405A2.5S	14	5	3.175	14.5	11.0	2.5×1	5260	9720	0.10	30
RNFTL 1610A2.5	16	10	3.175	16.75	13.3	2.5×1	5660	11500	0.10	30
RNFTL 1610A2.5S	16	10	3.175	16.75	13.3	2.5×1	5660	11500	0.10	30
RNFTL 1808A3.5	18	8	4.762	18.5	13.6	3.5×1	13200	25800	0.15	34
RNFTL 1808A3.5S	18	8	4.762	18.5	13.6	3.5×1	13200	25800	0.15	34
RNFTL 2005A2.5	20	5	3.175	20.5	17.0	2.5×1	6360	14200	0.10	40
RNFTL 2005A2.5S	20	5	3.175	20.5	17.0	2.5×1	6360	14200	0.10	40
RNFTL 2010A2.5	20	10	4.762	21.25	16.2	2.5×1	10900	21800	0.15	40
RNFTL 2010A2.5S	20	10	4.762	21.25	16.2	2.5×1	10900	21800	0.15	40
RNFTL 2505A5	25	5	3.175	25.5	22.0	2.5×2	12800	36300	0.10	42
RNFTL 2505A5S	25	5	3.175	25.5	22.0	2.5×2	12800	36300	0.10	42
RNFTL 2510A2.5	25	10	6.35	26	19.0	2.5×1	17500	35200	0.20	44
RNFTL 2510A2.5S						2.5×1	17500	35200		44
RNFTL 2510A5						2.5×2	31800	70300		44
RNFTL 2510A5S						2.5×2	31800	70300		44

Remarks 1. Protruding portion of the tube does not have any interference with the ball nut housing if its dimensions corresponding to U and V are large enough.  
 2. The overall screw shaft length may be slightly longer than nominal length  $L_0$  due to manufacturing tolerance.  
 3. Only ball nut part numbers ending "S" are equipped with seals. External dimensions of nuts with seals are the same as those without.  
 In the side view of the ball nut, view above the centerline shows internal seals, and view beneath the external geometry.  
 Seals for shaft diameters 14 mm or less are made of synthetic resin. Seals for 16 mm diameter or greater are "Brush" seals.



Ball nut dimensions											Nut Mass. (kg)	Arbor		Screw shaft			Shaft mass/m (kg)	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )	
Flange		Length	Bolt hole	Oil hole	Projecting tube			Outside dia.	Bore	Standard length		Screw shaft No.								
A	G	B	L <sub>n</sub>	W	X	Q	T	U	V	R	d <sub>0</sub>	d	L <sub>0</sub>		No.					
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	-	-
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
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
50	19	10	43	40	4.5	M6×1	5.0	19	20	7	0.20	11.5	9.5	500	1000	-	RS1404A	1.02	2.0	1.0
50	22	10	45	40	4.5	M6×1	5.0	22	21	8	0.26	11.0	9.0	500	1000	-	RS1405A	1.00	2.4	1.2
53	23	10	54	41	5.5	M6×1	5.5	23	22.5	8	0.28	13.3	11.3	500	1000	1500	RS1610A	1.37	2.7	1.4
63	27	12	58	49	6.6	M6×1	6.0	27	27	8	0.43	13.6	11.6	500	1000	1500	RS1808A	1.60	5.2	2.6
60	28	10	46	50	4.5	M6×1	5.0	28	27	10	0.42	17.0	14.6	500	1000	2000	RS2005A	2.17	3.5	1.8
67	30	12	59	53	6.6	M6×1	6.0	30	29	12	0.55	16.2	13.8	500	1000	2000	RS2010A	2.18	7.1	3.6
71	28	12	66	57	6.6	M6×1	6.0	28	31	10	0.62	22.0	19.6	1000	2000	2500	RS2505A	3.47	6.5	3.3
80	34	15	62	62	9	M6×1	7.5	34	37	17	0.75	19.0	16.6	1000	2000	2500	RS2510A	3.13	13	6.5
80	34	15	92	62	9	M6×1	7.5	34	37	17								18	9.0	

Remarks 4. Nut assembly with arbor and screw shaft are shipped separately.  
 5. In the portion of the screw shaft reference number indicated by .., enter the value obtained by dividing the standard screw shaft length by 100 mm.  
 6. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.  
 7. The internal spatial volume of nut and standard volume of grease replenishing in the dimension table are the values with seal. The amount for grease replenishing should be about 50% of nut internal space capacity.  
 If there is no seal, spread the screw shaft with grease or move the ball nut by hand while replenishing grease, so the grease permeates all area of nut. Please refer to page D16 for details.



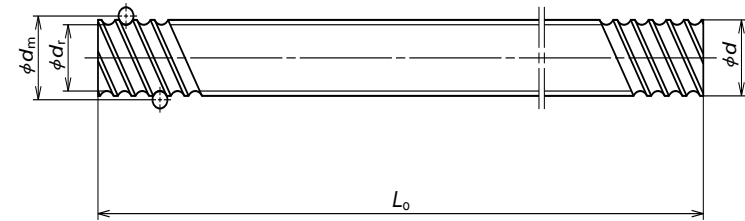
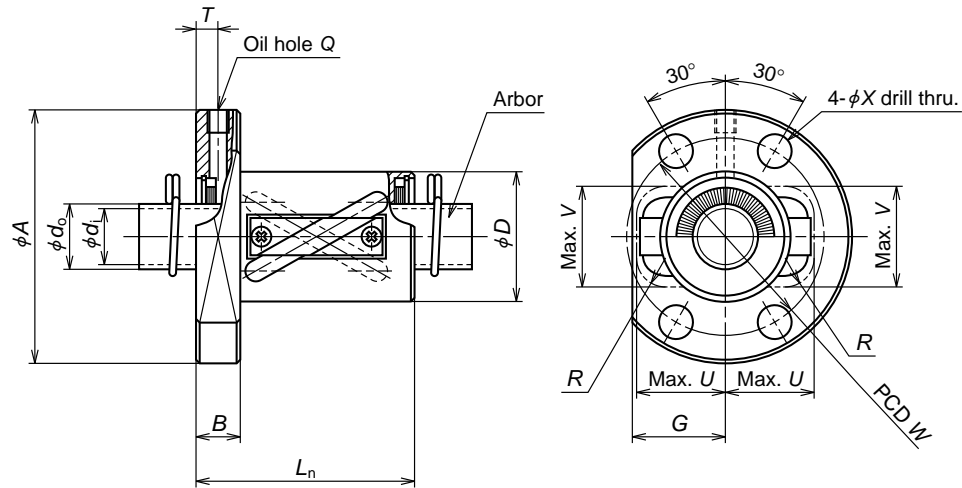
Ball nut No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>b</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>t</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial play Max.	Ball nut dimensions Outside dia. <i>D</i>
							Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>		
RNFTL 2806A2.5 RNFTL 2806A2.5S	28	6	3.175	28.5	25.0	2.5×1	7430	20300	0.10	50
RNFTL 2806A5 RNFTL 2806A5S						2.5×2	13500	40600		
RNFTL 3210A5 RNFTL 3210A5S	32	10	6.35	33.75	27.0	2.5×2	35700	92200	0.20	55
RNFTL 3610A2.5 RNFTL 3610A2.5S	36	10	6.35	37	30.0	2.5×1	21000	51000	0.20	60
RNFTL 3610A5 RNFTL 3610A5S						2.5×2	38100	102000		
RNFTL 4010A7 RNFTL 4010A7S	40	10	6.35	41.75	35.0	3.5×2	53500	164000	0.20	65
RNFTL 4512A5 RNFTL 4512A5S	45	12	7.144	46.5	39.0	2.5×2	49600	147000	0.23	70
RNFTL 5010A7 RNFTL 5010A7S	50	10	6.35	51.75	45.0	3.5×2	59500	205000	0.20	80
RNFTL 5016A5 RNFTL 5016A5S	50	16	9.525	52	42.0	2.5×2	99900	293000	0.23	85

Remarks 1. Protruding portion of the tube does not have any interference with the ball nut housing if its dimensions corresponding to U and V are large enough.  
 2. The overall screw shaft length may be slightly longer than nominal length *L<sub>s</sub>*, due to manufacturing tolerance.  
 3. Only ball nut part numbers ending "S" are equipped with seals. External dimensions of nuts with seals are the same as those without.  
 In the side view of the ball nut, view above the centerline shows internal seals, and view beneath the external geometry.  
 Seals for shaft diameters 14 mm or less are made of synthetic resin. Seals for 16 mm diameter or greater are "Brush" seals.

Ball nut dimensions											Nut Mass. (kg)	Arbor		Screw shaft			Shaft mass/m (kg)	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )	
Flange		Length		Bolt hole		Oil hole		Projecting tube				Outside dia. <i>d<sub>o</sub></i>	Bore <i>d<sub>i</sub></i>	Standard length <i>L<sub>s</sub></i>						Screw shaft No.
A	G	B	L <sub>n</sub>	W	X	Q	T	U	V	R	1000			2000	3000	4000				
79	33	15	55	65	6.6	M6×1	7.5	33	34	10	0.85	25.0	22.6	1000	2000	2500	RS2806A··	4.47	5.9	3.0
79	33	15	79	65	6.6	M6×1	7.5	33	34	10	1.07								8.4	4.2
97	39	18	97	75	11	M6×1	9.0	39	42	17	1.55	27.0	24.6	1000	2000	3000	RS3210A··	5.53	29	15
102	42	18	68	80	11	M6×1	9.0	42	46	17	1.47	30.0	27.6	1000	2000	3000	RS3610A··	6.91	21	11
102	42	18	98	80	11	M6×1	9.0	42	46	17	1.80								33	17
114	44	20	120	90	14	M6×1	10.0	44	50	20	2.49	35.0	31.8	2000	3000	4000	RS4010A··	8.87	42	21
130	47	22	116	100	18	M6×1	11.0	47	55	20	3.07	39.0	35.8	2000	3000	4000	RS4512A··	11.16	49	25
140	52	22	122	110	18	M6×1	11.0	52	59	20	4.06	45.0	41.8	2000	3000	4000	RS5010A··	14.15	53	27
163	57	28	146	125	22	M6×1	14.0	57	63	25	6.42	42.0	38.8	2000	3000	4000	RS5016A··	13.48	94	47

Remarks 4. Nut assembly with arbor and screw shaft are shipped separately.  
 5. In the portion of the screw shaft reference number indicated by ··, enter the value obtained by dividing the standard screw shaft length by 100 mm.  
 6. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.  
 7. The internal spatial volume of nut and standard volume of grease replenishing in the dimension table are the values with seal. The amount for grease replenishing should be about 50% of nut internal space capacity.  
 If there is no seal, spread the screw shaft with grease or move the ball nut by hand while replenishing grease, so the grease permeates all area of nut. Please refer to page D16 for details.





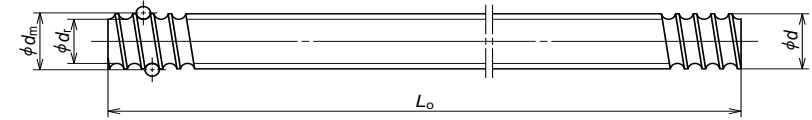
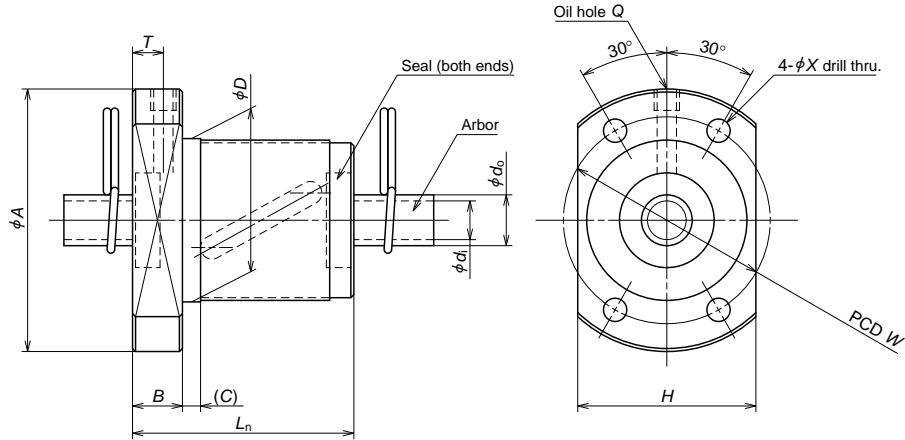
Unit: mm

Ball nut No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial play Max.	Ball nut dimensions Outside dia. <i>D</i>
							Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>		
<b>RNFTL 1212A3</b>	12	12	2.381	12.65	10.1	1.5 × 2	3360	6270	0.10	24
<b>RNFTL 1616A3</b> <b>RNFTL 1616A3S</b>	16	16	2.778	16.65	13.6	1.5 × 2	4880	9650	0.10	30
<b>RNFTL 2020A3</b> <b>RNFTL 2020A3S</b>	20	20	3.175	20.75	17.3	1.5 × 2	7010	15400	0.10	35
<b>RNFTL 2525A3</b> <b>RNFTL 2525A3S</b>	25	25	3.969	26	22.0	1.5 × 2	10500	24100	0.12	45
<b>RNFTL 3232A3</b> <b>RNFTL 3232A3S</b>	32	32	4.762	33.25	28.0	1.5 × 2	15300	37100	0.15	55
<b>RNFTL 4040A3</b> <b>RNFTL 4040A3S</b>	40	40	6.35	41.75	35.0	1.5 × 2	24400	61600	0.20	70

Remarks 1. Protruding portion of the tube does not have any interference with the ball nut housing if its dimensions corresponding to U and V are large enough.  
 2. The overall screw shaft length may be slightly longer than nominal length  $L_n$  due to manufacturing tolerance.  
 3. Only ball nut part numbers ending "S" are equipped with seals. External dimensions of nuts with seals are the same as those without.  
 In the side view of the ball nut, view above the centerline shows internal seals, and view beneath the external geometry.  
 Seals for shaft diameters 14 mm or less are made of synthetic resin. Seals for 16 mm diameter or greater are "Brush" seals.

Ball nut dimensions											Nut Mass (kg)	Arbor		Screw shaft			Shaft mass/m (kg)	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )	
Flange		Length	Bolt hole	Oil hole	Projecting tube			Outside dia. <i>d<sub>o</sub></i>	Bore <i>d</i>	Standard length			Screw shaft No.							
A	G	B	<i>L<sub>n</sub></i>	W	X	Q	T			U		V		R	<i>L<sub>0</sub></i>					
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
55	22	10	50	43	6.6	M6×1	5.0	22	22	7	0.29	13.6	11.6	500	1000	1500	RS1616A··	1.37	2.8	1.4
68	25	12	59	52	9	M6×1	6.0	25	27	8	0.49	17.3	14.9	500	1000	2000	RS2020A··	2.19	4.9	2.5
80	31	12	69	63	9	M6×1	6.0	31	32	10	0.80	22.0	19.6	1000	2000	2500	RS2525A··	3.43	9.1	4.6
100	37	15	84	80	11	M6×1	7.5	37	40	12	1.46	28.0	25.6	1000	2000	3000	RS3232A··	5.71	19	9.5
120	46	18	103	95	14	M6×1	9.0	46	49	15	2.69	35.0	31.8	2000	3000	4000	RS4040A··	8.82	39	20

Remarks 4. Nut assembly with arbor and screw shaft are shipped separately.  
 5. In the portion of the screw shaft reference number indicated by ··, enter the value obtained by dividing the standard screw shaft length by 100 mm.  
 6. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.  
 7. The internal spatial volume of nut and standard volume of grease replenishing in the dimension table are the values with seal. The amount for grease replenishing should be about 50% of nut internal space capacity.  
 If there is no seal, spread the screw shaft with grease or move the ball nut by hand while replenishing grease, so the grease permeates all area of nut. Please refer to page D16 for details.

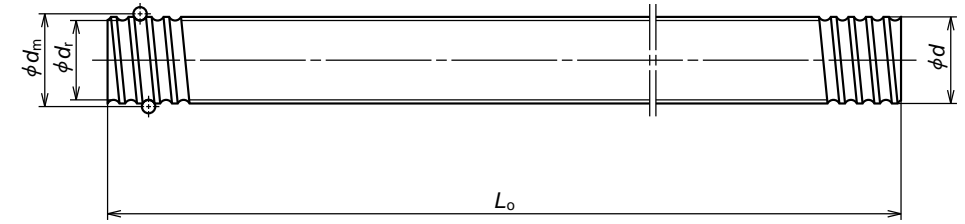
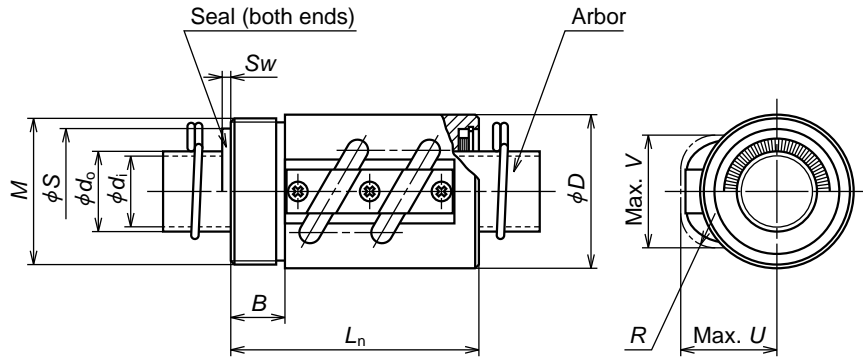


Ball nut No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls × Circuits	Basic load rating (N)		Axial play Max.	Ball nut dimensions
							Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>		Outside dia. <i>D</i>
		<i>L<sub>n</sub></i>	<i>(C)</i>							
RNFBL 1006A2.5S	10	6	2.381	10.65	8.1	2.5×1	2830	4810	0.10	26
RNFBL 1208A2.5S	12	8	2.778	12.65	9.6	2.5×1	3730	6560	0.10	29
RNFBL 1404A3.5S	14	4	2.778	14.5	11.5	3.5×1	5370	10800	0.10	31
RNFBL 1405A2.5S	14	5	3.175	14.5	11.0	2.5×1	5260	9720	0.10	32
RNFBL 1808A3.5S	18	8	4.762	18.5	13.6	3.5×1	13200	25800	0.15	50
RNFBL 2005A2.5S	20	5	3.175	20.5	17.0	2.5×1	6360	14200	0.10	40
RNFBL 2010A2.5S	20	10	4.762	21.25	16.2	2.5×1	10900	21800	0.15	52
RNFBL 2505A2.5S	25	5	3.175	25.5	22.0	2.5×1	7070	18200	0.10	43
RNFBL 2505A5S						2.5×2	12800	36300		
RNFBL 2510A2.5S	25	10	6.35	26	19.0	2.5×1	17500	35200	0.20	60
RNFBL 2510A5S						2.5×2	31800	70300		
RNFBL 2806A2.5S	28	6	3.175	28.5	25.0	2.5×1	7430	20300	0.10	50
RNFBL 2806A5S						2.5×2	13500	40600		
RNFBL 3210A2.5S	32	10	6.35	33.75	27.0	2.5×1	19700	46100	0.20	67
RNFBL 3210A5S						2.5×2	35700	92200		
RNFBL 3610A2.5S	36	10	6.35	37	30.0	2.5×1	21000	51000	0.20	70
RNFBL 3610A5S						2.5×2	38100	102000		
RNFBL 4010A5S	40	10	6.35	41.75	35.0	2.5×2	40100	116000	0.20	76

Remarks 1. The overall screw shaft length may be slightly longer than nominal length *L<sub>0</sub>* due to manufacturing tolerance.  
 2. Nut assembly with arbor and screw shaft are shipped separately.  
 3. In the portion of the screw shaft reference number indicated by ··, enter the value obtained by dividing the standard screw shaft length by 100 mm.

Ball nut dimensions										Arbor		Screw shaft				Shaft mass/sm (kg)	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )
Flange		Length		Bolt hole		Oil hole		Nut Mass (kg)	Outside dia. <i>d<sub>o</sub></i>	Bore <i>d<sub>i</sub></i>	Standard length		Screw shaft No.					
<i>A</i>	<i>H</i>	<i>B</i>	Overall length	<i>W</i>	<i>X</i>	<i>Q</i>	<i>T</i>				<i>L<sub>0</sub></i>							
		<i>L<sub>n</sub></i>	<i>(C)</i>															
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	
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	
50	37	10	40	4	40	4.5	M6×1	5.0	0.25	11.5	9.5	500	1000	RS1404A··	1.02	2.4	1.2	
50	38	10	40	4	40	4.5	M6×1	5.0	0.26	11.0	9.0	500	1000	RS1405A··	1.00	1.9	1.0	
80	60	12	61	4	65	6.6	M6×1	6.0	1.00	13.6	11.6	500	1000	1500	RS1808A··	1.60	5.8	2.9
60	46	10	40	4	50	4.5	M6×1	5.0	0.37	17.0	14.6	500	1000	2000	RS2005A··	2.17	2.8	1.4
82	64	12	61	5	67	6.6	M6×1	6.0	1.05	16.2	13.8	500	1000	2000	RS2010A··	2.18	7.6	3.8
67	50	10	40	4	55	5.5	M6×1	5.0	0.40	22.0	19.6	1000	2000	2500	RS2505A··	3.47	3.5	1.8
			55														4.7	2.4
96	72	15	66	5	78	9.0	M6×1	7.5	1.52	19.0	16.6	1000	2000	2500	RS2510A··	3.13	14	7.0
			96														19	9.5
80	60	12	47	5	65	6.6	M6×1	6.0	0.70	25.0	22.6	1000	2000	2500	RS2806A··	4.47	4.5	2.3
			65														7.6	3.8
103	78	15	67	5	85	9.0	M6×1	7.5	1.72	27.0	24.6	1000	2000	3000	RS3210A··	5.53	20	10
			97														28	14
110	82	17	69	5	90	11.0	M6×1	8.5	1.97	30.0	27.6	1000	2000	3000	RS3610A··	6.91	21	11
			99														29	15
116	88	17	99	5	96	11.0	M6×1	8.5	2.86	35.0	31.8	2000	3000	4000	RS4010A··	8.87	36	18

Remarks 4. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.  
 5. Seal for shaft diameters 14 mm or less are made of synthetic resin. Seal for 16 mm diameter or greater are "Brush" seals.  
 6. The amount for grease replenishing should be about 50% of nut internal space capacity. Please refer to page D16 on details.



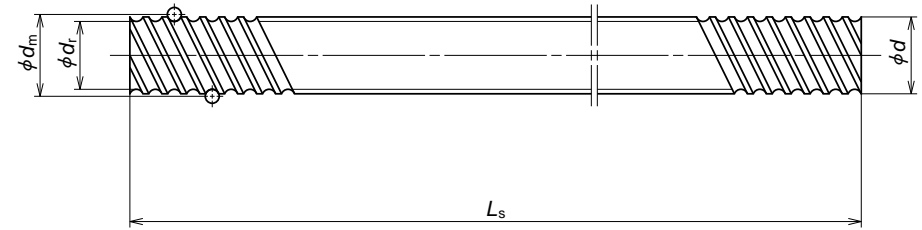
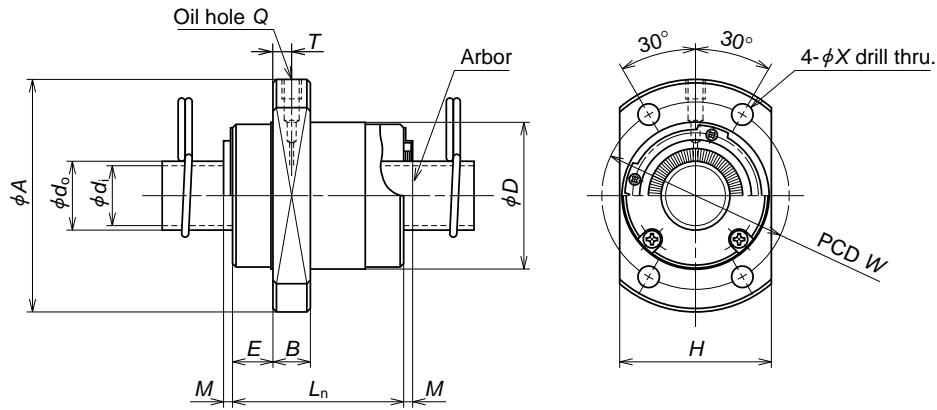
Unit: mm

Ball nut No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>t</sub></i>	Effective turns of balls × Circuits	Basic load rating (N)		Axial play Max.	Ball nut dimensions	
							Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>sa</sub></i>		Outside dia. <i>D</i>	
<b>RNCT 1003A3.5</b>	10	3	2.381	10.65	8.1	3.5 × 1	3780	6730	0.10	20	
<b>RNCT 1404A3.5S</b>	14	4	2.778	14.5	11.5	3.5 × 1	5370	10800	0.10	25	
<b>RNCT 1405A2.5S</b>	14	5	3.175	14.5	11.0	2.5 × 1	5260	9720	0.10	30	
<b>RNCT 1808A3.5</b> <b>RNCT 1808A3.5S</b>	18	8	4.762	18.5	13.6	3.5 × 1	13200	25800	0.15	34	
<b>RNCT 2005A2.5</b> <b>RNCT 2005A2.5S</b>	20	5	3.175	20.5	17.0	2.5 × 1	6360	14200	0.10	40	
<b>RNCT 2505A5</b> <b>RNCT 2505A5S</b>	25	5	3.175	25.5	22.0	2.5 × 2	12800	36300	0.10	42	
<b>RNCT 2510A5</b> <b>RNCT 2510A5S</b>	25	10	6.35	26	19.0	2.5 × 2	31800	70300	0.20	44	
<b>RNCT 2806A5</b> <b>RNCT 2806A5S</b>	28	6	3.175	28.5	25.0	2.5 × 2	13500	40600	0.10	50	
<b>RNCT 3210A5</b> <b>RNCT 3210A5S</b>	32	10	6.35	33.75	27.0	2.5 × 2	35700	92200	0.20	55	
<b>RNCT 3610A5</b> <b>RNCT 3610A5S</b>	36	10	6.35	37	30.0	2.5 × 2	38100	102000	0.20	60	
<b>RNCT 4010A7</b> <b>RNCT 4010A7S</b>	40	10	6.35	41.75	35.0	3.5 × 2	53500	164000	0.20	65	
<b>RNCT 4512A5</b> <b>RNCT 4512A5S</b>	45	12	7.144	46.5	39.0	2.5 × 2	49600	147000	0.23	70	
<b>RNCT 5010A7</b> <b>RNCT 5010A7S</b>	50	10	6.35	51.75	45.0	3.5 × 2	59500	205000	0.20	80	
<b>RNCT 5016A5</b> <b>RNCT 5016A5S</b>	50	16	9.525	52	42.0	2.5 × 2	99900	293000	0.23	85	

Remarks 1. Protruding portion of the tube does not have any interference with the ball nut housing if its dimensions corresponding to U and V are large enough.  
 2. The overall screw shaft length may be slightly longer than nominal length *L<sub>n</sub>*, due to manufacturing tolerance.  
 3. Only ball nut part numbers ending "S" are equipped with seals. External dimensions of nuts with seals are the same as those without.  
 In the side view of the ball nut, view above the centerline shows internal seals, and view beneath the external geometry.  
 Seals for shaft diameters 14 mm or less are made of synthetic resin. Seals for 16 mm diameter or greater are "Brush" seals.

Ball nut dimensions						Nut Mass. (kg)	Seal dimensions		Arbor		Screw shaft			Shaft mass/m (kg)	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )		
V-thread		Length	Projecting tube				Diameter	Thickness	Outside dia.	Bore	Standard length						Screw shaft No.	
<i>M</i>	<i>B</i>		<i>L<sub>n</sub></i>	<i>U</i>	<i>V</i>						<i>R</i>	<i>L<sub>0</sub></i>						
M18 × 1	10	38	15	15	7	0.049			8.1	6.1	400	800		RS1003A··	0.50	1.02	2.7	1.4
M24 × 1	10	43	19	20	7	0.083			11.5	9.5	500	1000		RS1404A··	1.02	2.7	1.4	
M26 × 1.5	10	45	22	21	8	0.15			11.0	9.0	500	1000		RS1405A··	1.00	3.1	1.6	
M32 × 1.5	12	58	27	27	8	0.21	28.5	2.5	13.6	11.6	500	1000	1500	RS1808A··	1.60	6.6	3.3	
M36 × 1.5	12	48	28	27	10	0.28	29.5	2.5	17.0	14.6	500	1000	2000	RS2005A··	2.17	4.8	2.4	
M40 × 1.5	15	69	28	31	10	0.38	34.5	2.5	22.0	19.6	1000	2000	2500	RS2505A··	3.47	8.4	4.2	
M42 × 1.5	15	92	34	37	17	0.49	38.5	2.5	19.0	16.6	1000	2000	2500	RS2510A··	3.13	21	1	
M45 × 1.5	15	79	33	34	10	0.68	37.5	2.5	25.0	22.6	1000	2000	2500	RS2806A··	4.47	9.7	4.9	
M50 × 1.5	18	97	39	42	17	0.79	45.5	2.5	27.0	24.6	1000	2000	3000	RS3210A··	5.53	32	16	
M55 × 2	18	98	42	46	17	0.97	50.5	3.0	30.0	27.6	1000	2000	3000	RS3610A··	6.91	32	16	
M60 × 2	25	125	44	50	20	1.37	54.5	3.0	35.0	31.8	2000	3000	4000	RS4010A··	8.87	51	26	
M65 × 2	30	124	47	55	20	1.42	60.5	3.0	39.0	35.8	2000	3000	4000	RS4512A··	11.16	60	30	
M75 × 2	40	140	52	59	20	2.41	64.5	3.0	45.0	41.8	2000	3000	4000	RS5010A··	14.15	76	38	
M80 × 2	40	158	57	63	25	3.14	68.5	3.0	42.0	38.8	2000	3000	4000	RS5016A··	13.48	114	57	

Remarks 4. Nut assembly with arbor and screw shaft are shipped separately.  
 5. In the portion of the screw shaft reference number indicated by ··, enter the value obtained by dividing the standard screw shaft length by 100 mm.  
 6. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.  
 7. The internal spatial volume of nut and standard volume of grease replenishing in the dimension table are the values with seal. The amount for grease replenishing should be about 50% of nut internal space capacity. If there is no seal, spread the screw shaft with grease or move the ball nut by hand while replenishing grease, so the grease permeates all area of nut. Please refer to page D16 for details.



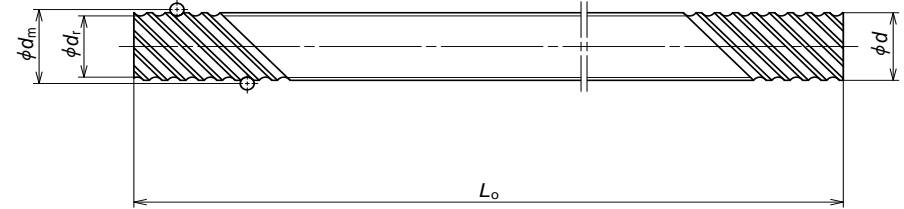
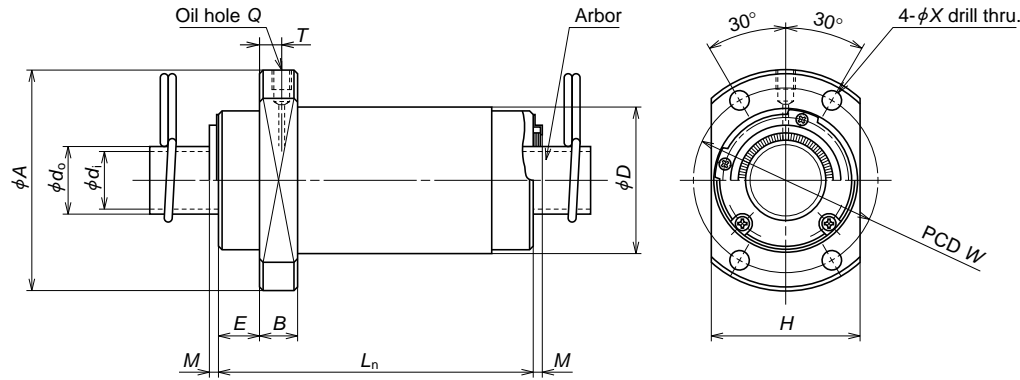
Unit: mm

Ball nut No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls × Circuits	Basic load rating (N)		Axial play Max.	Ball nut dimensions	
							Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>sa</sub></i>		Outside dia. <i>D</i>	
RNFCL 1212A3 RNFCL 1212A6	12	12	2.381	12.65	10.1	1.7 × 2 1.7 × 4	3740 6780	6640 13300	0.10	26	
RNFCL 1520A3 RNFCL 1520A6S	15	20	3.175	15.5	12.2	1.7 × 2	6730	12300	0.10	33	
RNFCL 1616A3 RNFCL 1616A3S RNFCL 1616A6 RNFCL 1616A6S	16	16	2.778	16.65	13.5	1.7 × 2 1.7 × 4	5430 9860	10400 20800	0.10	32	
RNFCL 2020A3 RNFCL 2020A3S RNFCL 2020A6 RNFCL 2020A6S	20	20	3.175	20.75	17.3	1.7 × 2 1.7 × 4	7810 14200	16500 33000	0.10	39	
RNFCL 2525A3 RNFCL 2525A3S RNFCL 2525A6 RNFCL 2525A6S	25	25	3.969	26	22.0	1.7 × 2 1.7 × 4	11700 21200	25800 51500	0.12	47	
RNFCL 3232A3 RNFCL 3232A3S RNFCL 3232A6 RNFCL 3232A6S	32	32	4.762	33.25	28.0	1.7 × 2 1.7 × 4	17100 31000	40500 81000	0.15	58	
RNFCL 4040A3 RNFCL 4040A3S RNFCL 4040A6 RNFCL 4040A6S	40	40	6.35	41.75	35.0	1.7 × 2 1.7 × 4	27200 49300	67900 136000	0.20	73	
RNFCL 5050A3 RNFCL 5050A3S RNFCL 5050A6 RNFCL 5050A6S	50	50	7.938	52.25	44.0	1.7 × 2 1.7 × 4	40600 73700	106000 212000	0.25	90	

- Remarks
1. The overall screw shaft length may be slightly longer than nominal length  $L_s$  due to manufacturing tolerance.
  2. Nut assembly with arbor and screw shaft are shipped separately.
  3. In the portion of the screw shaft reference number indicated by .., enter the value obtained by dividing the standard screw shaft length by 100 mm.
  4. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.
  5. The entire length of the nut becomes longer by "2 x M" for those with a seal. The seal is "Brush" seal.

Ball nut dimensions										Nut Mass. (kg)	Arbor		Screw shaft			Shaft mass (kg)	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )	
Flange		Length			Bolt hole		Oil hole		Outside dia. <i>d<sub>o</sub></i>		Bore <i>d<sub>i</sub></i>	Standard length			Screw shaft No.				
<i>A</i>	<i>H</i>	<i>B</i>	<i>E</i>	<i>L<sub>n</sub></i>	<i>M</i>	<i>W</i>	<i>X</i>	<i>Q</i>		<i>T</i>		<i>L<sub>s</sub></i>							
44	28	6	9	30	—	35	4.5	M3 × 0.5	3.0	0.12	10.1	8.1	400	800		RS1212A..	0.74		
51	35	10	11	45	—	42	4.5	M6 × 1	5.0	0.28	12.2	10.2	500	1000	1500	RS1520A..	1.15	3.3	1.7
53	34	10	10	38	—	42	4.5	M6 × 1	5.0	0.23	13.5	11.5	500	1000	1500	RS1616A..	1.37	2.6	1.3
62	41	10	11.5	46	—	50	5.5	M6 × 1	5.0	0.37	17.3	14.9	500	1000	2000	RS2020A..	2.19	4.4	2.2
74	49	12	13	55	—	60	6.6	M6 × 1	6.0	0.62	22.0	19.6	1000	2000	2500	RS2525A..	3.43	8.2	4.1
92	60	12	16	70	—	74	9	M6 × 1	5.5	1.10	28.0	25.6	1000	2000	3000	RS3232A..	5.71	16	8.0
114	75	15	19.5	85	—	93	11	M6 × 1	6.5	2.09	35.0	31.8	2000	3000	4000	RS4040A..	8.82	32	16
135	92	20	21.5	107	—	112	14	M6 × 1	7.0	3.90	44.0	40.8	2000	3000	4000	RS5050A..	13.81	64	32

- Remarks
6. The internal spatial volume of nut and standard volume of grease replenishing in the dimension table are the values with seal. The amount for grease replenishing should be about 50% of nut internal space capacity. If there is no seal, spread the screw shaft with grease or move the ball nut by hand while replenishing grease, so the grease permeates all area of nut. Please refer to page D16 for details.



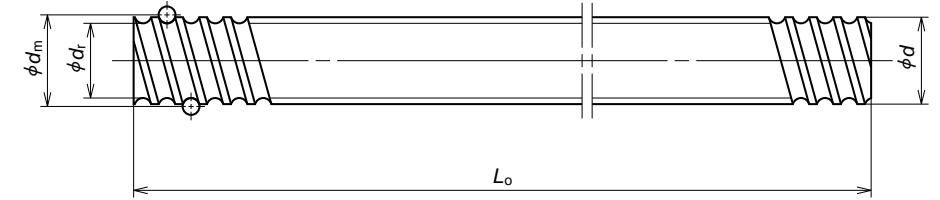
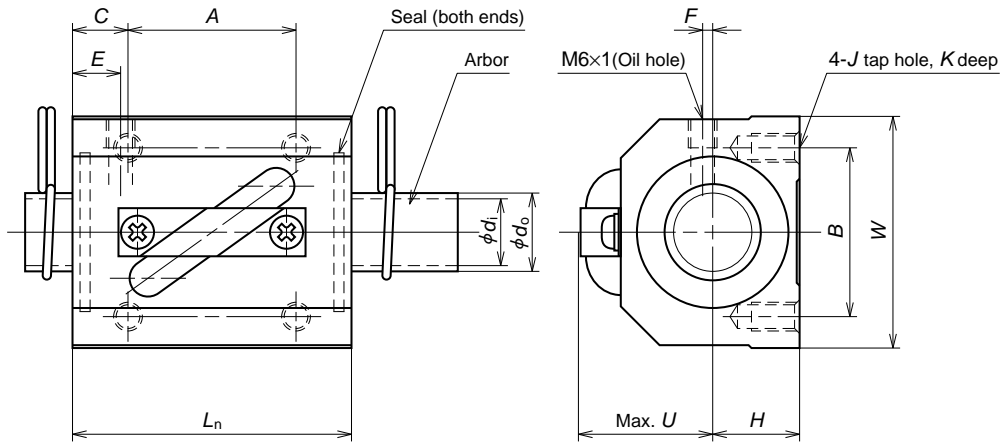
Unit: mm

Ball nut No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial play Max.	Ball nut dimensions	
							Dynamic <i>C<sub>d</sub></i>	Static <i>C<sub>sa</sub></i>		Outside dia. <i>D</i>	
RNFCL 1632A2 RNFCL 1632A2S RNFCL 1632A3 RNFCL 1632A3S RNFCL 1632A6 RNFCL 1632A6S	16	32	2.778	16.65	13.5	0.7 × 4 1.7 × 2 1.7 × 4	4600 5430 9860	8460 10400 20800	0.10	32	
RNFCL 2040A2 RNFCL 2040A2S RNFCL 2040A3 RNFCL 2040A3S RNFCL 2040A6 RNFCL 2040A6S	20	40	3.175	20.75	17.3	0.7 × 4 1.7 × 2 1.7 × 4	6610 7810 14200	13600 16500 33000	0.10	38	
RNFCL 2550A2 RNFCL 2550A2S RNFCL 2550A3 RNFCL 2550A3S RNFCL 2550A6 RNFCL 2550A6S	25	50	3.969	26	22.0	0.7 × 4 1.7 × 2 1.7 × 4	9870 11700 21200	21200 25800 51500	0.12	46	
RNFCL 3264A3 RNFCL 3264A3S RNFCL 3264A6 RNFCL 3264A6S	32	64	4.762	33.25	28.0	1.7 × 2 1.7 × 4	17100 31000	40500 81000	0.15	58	
RNFCL 4080A3 RNFCL 4080A3S RNFCL 4080A6 RNFCL 4080A6S	40	80	6.350	41.75	35.0	1.7 × 2 1.7 × 4	27200 49300	67900 136000	0.20	73	

- Remarks
- The overall screw shaft length may be slightly longer than nominal length  $L_0$  due to manufacturing tolerance.
  - Nut assembly with arbor and screw shaft are shipped separately.
  - In the portion of the screw shaft reference number indicated by ··, enter the value obtained by dividing the standard screw shaft length by 100 mm.
  - Items in stock do not have surface treatment. For details of standard stock products, contact NSK.
  - The entire length of the nut becomes longer by "2 × M" for those with a seal. The seal is "Brush" seal.

Ball nut dimensions										Nut Mass. (kg)	Arbor		Screw shaft				Shaft mass/m (kg)	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )	
Flange		Length			Bolt hole		Oil hole		Outside dia. <i>d<sub>e</sub></i>		Bore <i>d<sub>i</sub></i>	Standard length			Screw shaft No.					
A	H	B	E	<i>L<sub>n</sub></i>	M	W	X	Q		T		<i>L<sub>0</sub></i>								
50	34	10	10	34 66 66	— — —	41	4.5	M6 × 1	5.5	0.21 0.33 0.33	13.5	11.5	500	1000	1500	RS1632A··	1.34	2.4	1.2	
58	40	10	11	41 81 81	— — —	48	5.5	M6 × 1	5.5	0.31 0.53 0.53	17.3	14.9	500	1000	1500	2000	RS2040A··	2.15	4.1	2.1
70	48	12	13	50 100 100	— — —	58	6.6	M6 × 1	7.0	0.53 0.91 0.91	22.0	19.6	1000	2000	2500	RS2550A··	3.37	6.3	3.2	
92	60	12	15.5	126 — —	— — —	74	9	M6 × 1	7.5	1.76	28.0	25.6	1000	2000	3000	4000	RS3264A··	5.63	7.0	2.1
114	75	15	19	158 — —	— — —	93	11	M6 × 1	10.0	3.44	35.0	31.8	2000	3000	4000	5000	RS4080A··	8.69	12	2.1

- Remarks
- The internal spatial volume of nut and standard volume of grease replenishing in the dimension table are the values with seal. The amount for grease replenishing should be about 50% of nut internal space capacity. If there is no seal, spread the screw shaft with grease or move the ball nut by hand while replenishing grease, so the grease permeates all area of nut. Please refer to page D16 for details.



Ball nut No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls × Circuits	Basic load rating (N)		Axial play Max.	Ball nut dimensions Length <i>L<sub>n</sub></i>
							Dynamic <i>C<sub>d</sub></i>	Static <i>C<sub>st</sub></i>		
							<b>RNSTL 1404A3.5S</b>	14		
<b>RNSTL 1405A2.5S</b>	14	5	3.175	14.5	11.0	2.5×1	5260	9720	0.10	38
<b>RNSTL 1808A3.5S</b>	18	8	4.762	18.5	13.6	3.5×1	13200	25800	0.15	56
<b>RNSTL 2005A2.5S</b>	20	5	3.175	20.5	17.0	2.5×1	6360	14200	0.10	38
<b>RNSTL 2010A2.5S</b>	20	10	4.762	21.25	16.2	2.5×1	10900	21800	0.15	58
<b>RNSTL 2505A2.5S</b>	25	5	3.175	25.5	22.0	2.5×1	7070	18200	0.10	35
<b>RNSTL 2510A5S</b>	25	10	6.35	26	19.0	2.5×2	31800	70300	0.20	94
<b>RNSTL 2806A2.5S</b>	28	6	3.175	28.5	25.0	2.5×1	7430	20300	0.10	42
<b>RNSTL 2806A5S</b>						2.5×2	13500	40600		67
<b>RNSTL 3210A2.5S</b>	32	10	6.35	33.75	27.0	2.5×1	19700	46100	0.20	64
<b>RNSTL 3210A5S</b>						2.5×2	35700	92200		94
<b>RNSTL 3610A2.5S</b>	36	10	6.35	37	30.0	2.5×1	21000	51000	0.20	64
<b>RNSTL 3610A5S</b>						2.5×2	38100	102000		96
<b>RNSTL 4512A5S</b>	45	12	7.144	46.5	39.0	2.5×2	49600	147000	0.23	115

Remarks 1. The overall screw shaft length may be slightly longer than nominal length *L<sub>o</sub>* due to manufacturing tolerance.  
 2. Nut assembly with arbor and screw shaft are shipped separately.  
 3. In the portion of the screw shaft reference number indicated by .., enter the value obtained by dividing the standard screw shaft length by 100 mm.

Unit: mm

Width		Center height		Ball nut dimensions							Nut Mass. (kg)	Arbor		Screw shaft				Shaft mass (kg)	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )
<i>W</i>	<i>H</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>J</i>	<i>K</i>	<i>E</i>	<i>F</i>	<i>U</i>	Outside dia. <i>d<sub>o</sub></i>		Bore <i>d<sub>i</sub></i>	Standard length <i>L<sub>o</sub></i>		Screw shaft No.					
34	13	22	26	8	M4	7	7	3	20	0.20	11.5	9.5	500	1000	RS1404A..	1.02	1.6	0.8		
34	13	22	26	8	M4	7	7	3	21	0.20	11.0	9.0	500	1000	RS1405A..	1.00	1.8	0.9		
48	17	35	35	10.5	M6	10	8	3	26	0.31	13.6	11.6	500	1000	1500	RS1808A..	1.60	3.4	1.7	
48	17	22	35	8	M6	9	6	2	27	0.24	17.0	14.6	500	1000	2000	RS2005A..	2.17	2.5	1.3	
48	18	35	35	11.5	M6	10	10	2	28	0.35	16.2	13.8	500	1000	2000	RS2010A..	2.18	6.3	3.2	
60	20	22	40	6.5	M8	10	6	0	27	0.31	22.0	19.6	1000	2000	2500	RS2505A..	3.47	2.6	1.3	
60	23	60	40	17	M8	12	10	0	32	1.32	19.0	16.6	1000	2000	2500	RS2510A..	3.13	18	9.0	
60	22	18	40	12	M8	12	8	0	32	0.65	25.0	22.6	1000	2000	2500	RS2806A..	4.47	3.5	1.8	
60	22	40	13.5	1.04						7.0								3.5		
70	26	45	50	9.5	M8	12	10	0	38	1.12	27.0	24.6	1000	2000	3000	RS3210A..	5.53	18	9.0	
70	26	60	50	17						1.75								27	14	
86	29	45	60	9.5	M10	16	11	0	41	1.76	30.0	27.6	1000	2000	3000	RS3610A..	6.91	18	9.0	
86	29	60	60	18						2.64								27	14	
100	36	75	75	20	M12	20	13	0	46	1.22	39.0	35.8	2000	3000	4000	RS4512A..	11.16	47	24	

Remarks 4. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.  
 5. The entire length of the nut becomes longer by "2 x M" for those with a seal. The seal is "Brush" seal.  
 6. The amount for grease replenishing should be about 50% of nut internal space capacity. Please refer to page D16 on details.

### B-3-1.11 Equipped with "NSK K1™" Lubrication Unit

This product is patented by NSK Ltd.

#### 1. Features

"NSK K1™" is a new, efficient lubrication unit. Equipped with "NSK K1™", the ball screws demonstrate a 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 Seal can provide sufficient lubrication in the environment where grease is undesirable as well as in the environment where high cleanliness is required.

[ex.] Food processing/medical equipment, liquid crystal 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 environment

In environment where oil- and grease-absorbing dust is produced, long-term efficiency in lubrication and prevention from foreign inclusions 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

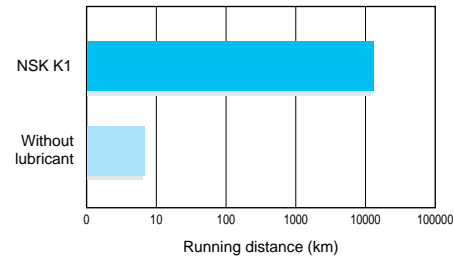
Sample, testing conditions and test result are shown in Table 1 and Fig. 1.

Without lubricant, operation became impossible after running 8.6 km. With NSK K1 alone, it was possible to continue running exceeding 10000 km.

NSK conducts various tests under different conditions. Please consult NSK.

**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 <sup>-1</sup> (80 m/min)
Stroke	600 mm



**Fig. 1 Duration test results on ball screws without lubricant**

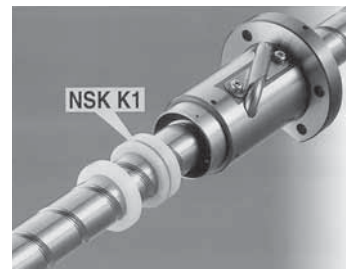
#### 2. Specifications

##### (1) Structure

The structure makes it possible to have a stable contact between the NSK K1 and outside of a ball screw with moderate force by a garter spring which fits onto outside of the NSK K1.

NSK K1 is installed between the ball screw nut and the labyrinth seal. The overall nut length is slightly longer than Standard ball screw.

Combination 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

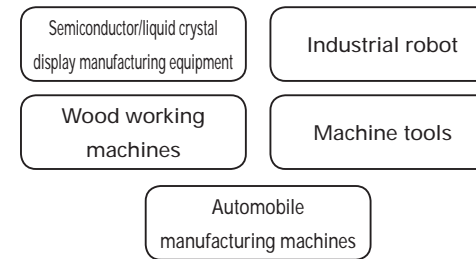
Accuracy grade, clearance and preload specifications remain unchanged. There is a slight increase in torque due to the equipped NSK K1.

##### (3) Overall nut length after equipped with NSK K1™

The nut length become longer than standard ball screw after equipped with NSK K1. The nut length after equipped K1 shown in page B211 to 214 for each recirculation. "NSK K1" can be installed on other types not listed in the dimension table, please consult with NSK.

##### (4) Application examples

Ball screws equipped with NSK K1 are maintenance-free for a long period of time. Its application is expanding in various industries.



◇Reference number for ball screw equipped with NSK K1

**W1401 -\*\* P K1 - C3 Z10**

NSK K1 equipped type ball screw code

#### 3. Precautions for use

Temperature range for use: Maximum temperature for use: 50°C

Momentary maximum temperature in use: 80°C

Chemicals that should not come to contact with K1:

Do not leave K1 Seal in organic solvent, white kerosene such as hexane, thinner which removes oil, and rust preventive oil which contains white kerosene.

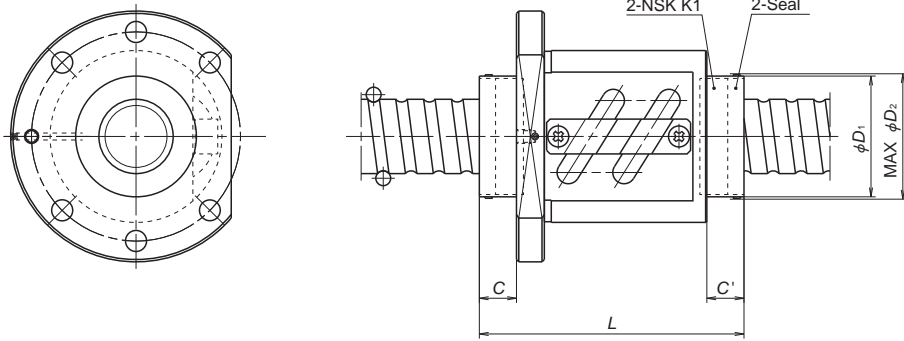
Note: Water-type cutting oil, oil-type cutting oil, grease such as mineral-type AS2 and ester-type PS2 do not damage K1 Seal.

#### 4. Example of reference number

A structure of "Reference number for ball screw" is as follows.

Note: "K1" is added at the end of "nut model code" and "Specifications number".

(1) Tube type



Tube type

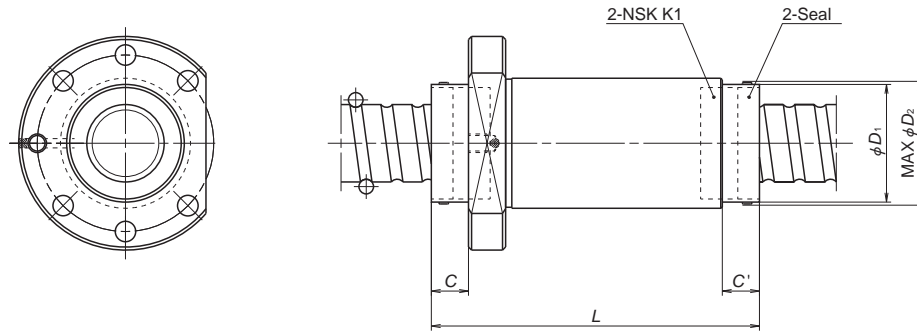
Model No.	Screw shaft dia. <i>d</i>	Lead <i>I</i>	K1 installing dimension		Overall length when equipped K1 <i>L</i>	K1 cap dimension	
			<i>C</i>	<i>C'</i>		Cup dia. $\phi D_1$	Protruding dimension $\phi D_2$
PFT1004-2.5	10	4	14	15	61.5	$\phi 22$	MAX $\phi 24$
PFT1205-2.5	12	5	14	15	66	$\phi 26.5$	MAX $\phi 29$
LPFT1210-2.5	12	10	14	17	79	$\phi 26.5$	MAX $\phi 29$
PFT1405-2.5	14	5	14	15	65	$\phi 30$	MAX $\phi 32$
LPFT1510-2.5	15	10	14	15	76	$\phi 30$	MAX $\phi 32$
PFT1605-2.5	16	5	14	15	67	$\phi 32$	MAX $\phi 34$
PFT2005-5	20	5	14	14	81	$\phi 38$	MAX $\phi 40$
LPFT2010-2.5	20	10	14	14	78	$\phi 38$	MAX $\phi 40$
LPFT2020-1.5	20	20	14	14	84	$\phi 38$	MAX $\phi 40$
ZFT2505-10	25	5	16	17	115	$\phi 44$	MAX $\phi 46$
PFT2506-5	25	6	16	17	93	$\phi 44$	MAX $\phi 46$
PFT2510-2.5	25	10	16	17	89	$\phi 44$	MAX $\phi 46$
ZFT2510-3	25	10	16	17	103	$\phi 44$	MAX $\phi 46$
LPFT2520-2.5	25	20	12	12	109	$\phi 38$	MAX $\phi 40$
LPFT2525-1.5	25	25	12	12	98	$\phi 38$	MAX $\phi 40$
DFT2805-5	28	5	16	17	137	$\phi 48$	MAX $\phi 50$
PFT2810-2.5	28	10	16	17	90	$\phi 48$	MAX $\phi 50$
DFT2810-3	28	10	16	17	174	$\phi 48$	MAX $\phi 50$
PFT3206-5	32	6	16	17	93	$\phi 52$	MAX $\phi 54$
ZFT3206-10	32	6	16	17	129	$\phi 52$	MAX $\phi 54$
PFT3210-5	32	10	16	17	122	$\phi 52$	MAX $\phi 54$
ZFT3210-5	32	10	16	17	122	$\phi 52$	MAX $\phi 54$
DFT3210-5	32	10	16	16	212	$\phi 52$	MAX $\phi 54$
PFT3212-3	32	12	16	17	114	$\phi 52$	MAX $\phi 54$
DFT3212-3	32	12	16	16	198	$\phi 52$	MAX $\phi 54$
LPFT3225-2.5	32	25	12	12	122	$\phi 46$	MAX $\phi 48$
LPFT3232-1.5	32	32	12	12	109	$\phi 46$	MAX $\phi 48$

Remarks 1. "NSK K1" can be installed on other types not listed in the table. Please consult NSK.  
2. C, C' and L are the dimensions when one NSK K1 is equipped to both ends of the nut.

Model No.	Screw shaft dia. <i>d</i>	Lead <i>I</i>	K1 installing dimension		Overall length when equipped k1 <i>L</i>	K1 cap dimension	
			<i>C</i>	<i>C'</i>		Cup dia. $\phi D_1$	Protruding dimension $\phi D_2$
PFT3610-5	36	10	19	20	131	$\phi 56$	MAX $\phi 58$
DFT3610-5	36	10	19	19	221	$\phi 56$	MAX $\phi 58$
HZF3616-5	36	16	19	19	163	$\phi 56$	MAX $\phi 58$
HZF3620-3.5	36	20	19	19	146	$\phi 56$	MAX $\phi 58$
PFT4008-5	40	8	19	20	117	$\phi 62$	MAX $\phi 64$
ZFT4008-10	40	8	19	20	165	$\phi 62$	MAX $\phi 64$
ZFT4010-7	40	10	19	20	152	$\phi 62$	MAX $\phi 64$
DFT4010-5	40	10	19	19	222	$\phi 61$	MAX $\phi 64$
PFT4012-5	40	12	19	20	144	$\phi 62$	MAX $\phi 64$
DFT4012-5	40	12	19	19	252	$\phi 61$	MAX $\phi 64$
HZF4016-5	40	16	19	19	164	$\phi 61$	MAX $\phi 64$
HZF4020-5	40	20	19	19	189	$\phi 61$	MAX $\phi 64$
LPFT4032-2.5	40	32	14	14	151	$\phi 54$	MAX $\phi 56$
LPFT4040-1.5	40	40	14	14	133	$\phi 54$	MAX $\phi 56$
DFT4510-5	45	10	19	19	222	$\phi 72$	MAX $\phi 75$
DFT4512-5	45	12	19	19	254	$\phi 72$	MAX $\phi 75$
HZF4520-5	45	20	19	19	190	$\phi 72$	MAX $\phi 75$
ZFT5010-10	50	10	19	20	194	$\phi 73$	MAX $\phi 76$
DFT5012-5	50	12	19	19	256	$\phi 73$	MAX $\phi 76$
ZFT5016-5	50	16	19	20	172	$\phi 73$	MAX $\phi 76$
DFT5016-5	50	16	19	19	300	$\phi 73$	MAX $\phi 76$
HZF5020-5	50	20	19	19	192	$\phi 73$	MAX $\phi 76$
HZF5025-5	50	25	19	19	221	$\phi 73$	MAX $\phi 76$
DFT5516-5	55	16	22	22	178	$\phi 81$	MAX $\phi 87$
HZF5520-5	55	20	22	22	198	$\phi 81$	MAX $\phi 87$
HZF5525-5	55	25	22	22	227	$\phi 81$	MAX $\phi 87$
DFT6316-5	63	16	22	22	322	$\phi 89$	MAX $\phi 95$
DFT6320-5	63	20	22	22	362	$\phi 89$	MAX $\phi 95$

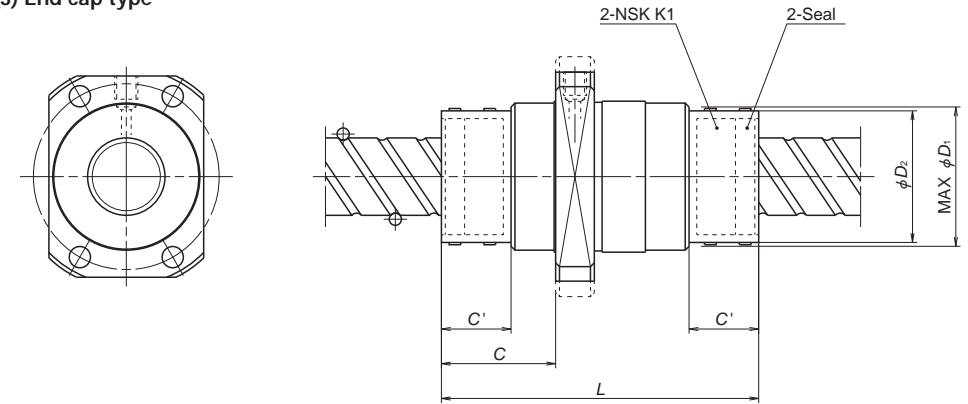


(2) Deflector type



Deflector type

(3) End cap type



End cap type

Model No.	Screw shaft dia. <i>d</i>	Lead <i>l</i>	K1 installing dimension		Overall length when equipped K1 <i>L</i>	K1 cap dimension	
			<i>C</i>	<i>C'</i>		Cup dia. $\phi D_1$	Protruding dimension $\phi D_2$
ZFD2005-6	20	5	9	9	87	$\phi 32$	MAX $\phi 34$
ZFD2506-6	25	6	12	—	102	$\phi 38$	MAX $\phi 40$
ZFD2510-4	25	10	12	12	106	$\phi 38$	MAX $\phi 40$
ZFD3208-8	32	8	12	12	136	$\phi 46$	MAX $\phi 48$
ZFD3210-6	32	10	12	12	138	$\phi 46$	MAX $\phi 48$
ZFD3212-6	32	12	12	12	153	$\phi 46$	MAX $\phi 48$
ZFD4010-8	40	10	14	14	167	$\phi 54$	MAX $\phi 57$
ZFD4012-8	40	12	14	14	189	$\phi 54$	MAX $\phi 57$
ZFD5010-8	50	10	14	14	169	$\phi 64$	MAX $\phi 67$
ZFD5012-6	50	12	14	14	167	$\phi 64$	MAX $\phi 67$

Remarks 1. "NSK K1" can be installed on other types not listed in the table. Please consult NSK.  
2. C, C' and L are the dimensions when one NSK K1 is equipped to both ends of the nut.

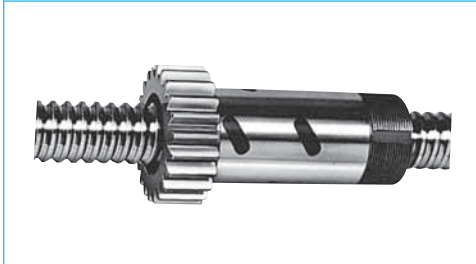
Model No.	Screw shaft dia. <i>d</i>	Lead <i>l</i>	K1 installing dimension		Overall length when equipped K1 <i>L</i>	K1 cap dimension	
			<i>C</i>	<i>C'</i>		Cup dia. $\phi D_1$	Protruding dimension $\phi D_2$
UPFC1520-1.5	15	20	29	18	81	$\phi 30$	MAX $\phi 32$
LPFC1616-3	16	16	28	18	74	$\phi 28$	MAX $\phi 30$
LPFC2020-3	20	20	29.5	18	82	$\phi 34$	MAX $\phi 36$
UPFC2040-1	20	40	29	18	77	$\phi 32$	MAX $\phi 34$
LPFC2525-3	25	25	34	21	97	$\phi 44$	MAX $\phi 46$
UPFC2550-1	25	50	34	21	92	$\phi 44$	MAX $\phi 46$
LPFC3232-3	32	32	37	21	112	$\phi 52$	MAX $\phi 54$
UPFC3264-1	32	64	36.5	21	104	$\phi 52$	MAX $\phi 54$
LPFC4040-3	40	40	43.5	24	133	$\phi 62$	MAX $\phi 65$
LPFC5050-3	50	50	45.5	24	155	$\phi 74$	MAX $\phi 77$

Remarks 1. "NSK K1" can be installed on other types not listed in the table. Please consult NSK.  
2. C, C' and L are the dimensions when one NSK K1 is equipped to both ends of the nut.

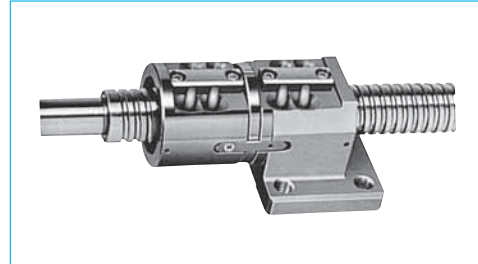
**B-3-1.12 Special Ball Screws.**

In addition to the standard ball screws, NSK manufactures various types of ball screws in special shapes as shown below.

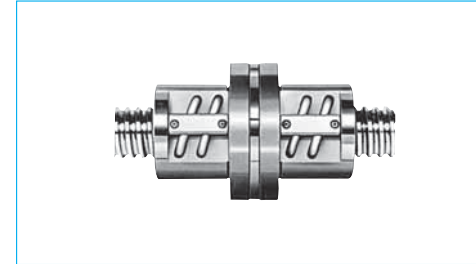
Thoroughly discuss with NSK the specifications before determining specifications and ordering ball screws in special shapes.



Nut with gear



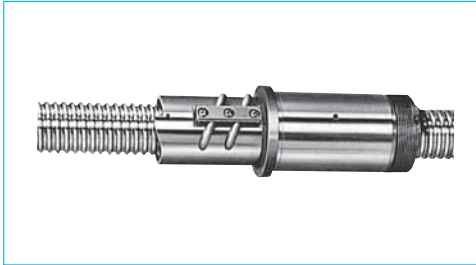
Double nut with flat mounting face



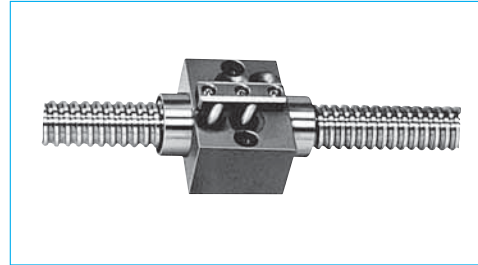
Flanged to flanged ball nut



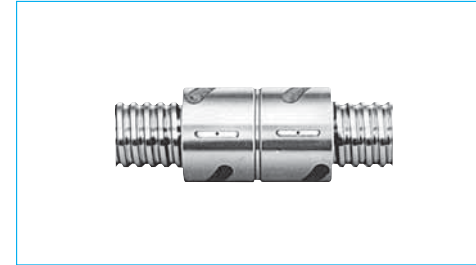
Ball screw for aircraft



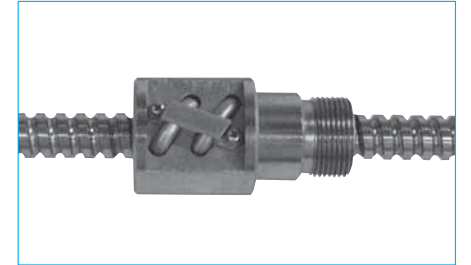
Lightly preloaded single nut with bearing seat



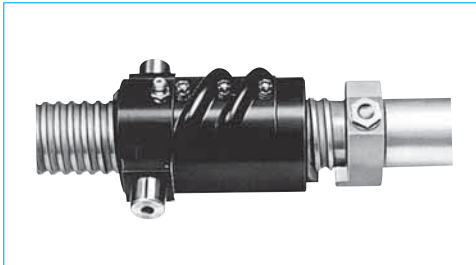
Lightly preloaded single nut with flat mounting face



Cylindrical double nut



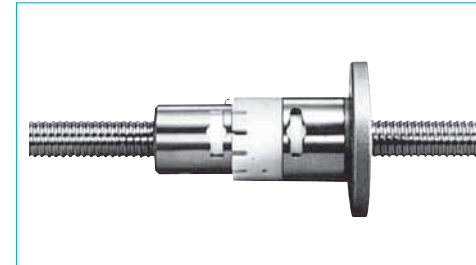
Ball screw for Nuclear power



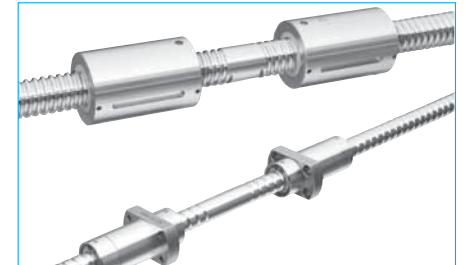
Nut with trunion



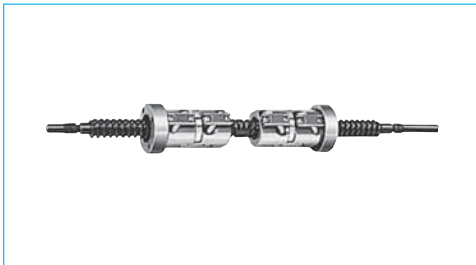
Hollow shaft, lightly preloaded single nut, with large shaft diameter and fine lead



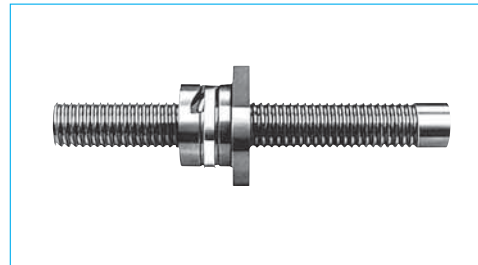
Spring preload ball screw



Right and left hand thread on each side of screw



Double nut with right and left turn thread on each side of screw shaft



Ceramic ball screw

Compact FA PSS Type	B219
Finished Shaft End	B241
MA Type, Miniature, Fine Lead	B243
FA Type for Small Equipment	B265
SA Type for Machine Tools	B301
Finished Shaft End	B357
KA Type Stainless Steel Product	
Blank Shaft End	B383
MS Type, Miniature, Fine Lead	B385
FS Type for Small Equipment	B393
SS Type for Machine Tools	B405
Accessories	B433

## B-3-2 Dimension Table and Reference Number of Standard Ball Screws

B-3- 2.1 Compact FA PSS Type

◆Features

In order to respond quickly to a wide range of needs, NSK keeps end-deflector recirculation system ball screws, which offer high-speed and low-noise operation and compact design, in standard stock as the Compact FA Series.

The exceptionally high performance ball screws are ready for use in a variety of fields such as semiconductor manufacturing equipment, LCD manufacturing equipment, chip mounting equipment, measuring apparatus, and medical equipment.

●Quieter sound

The noise level of ball screws has been reduced by 6 dB, about half of what is sensed by the ear.

●Compact

The outside diameter of the ball nut is as much as 30% smaller than those of NSK conventional products. This contributes to more compact design of all sorts of equipment and devices such as thinner XY tables.

●High speed

Permissible rotational speeds up to 5 000 min<sup>-1</sup>. This capability dramatically expands the range of service conditions.

Please refer to the dimension table for details of permissible rotational speed.

●Grease fitting provided as standard equipment

The new ball screws are standardly equipped with a grease fitting (M5 × 0.8). Lubrication ports are provided in 2 places to facilitate maintenance. The ball screws can be easily connected to an integrated lubrication system. Also, compact, thin plastic seal is available. Nut outside diameter is compact compare with the return tube recirculation system.

●Low-profile design

The low-profile support units especially compatible with the compact FA PSS type are available for uniquely space-saving design.

◆Ball screw sizes are arranged in order of the page number.

Table begins with the smallest shaft diameter ball screw, and proceeds to the larger sizes

◆Dimension tables

Dimension tables show shapes/sizes as well as specification factors of 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 figure is obtained by subtracting the nut length from the effective threaded length (L1).

●Lead accuracy

Lead accuracy is C5 grades

T: Travel compensation;

e<sub>p</sub>: Tolerance on specified travel;

v<sub>u</sub>: Travel variation

See "Technical Description: Lead accuracy" (Page B41) for the details of the codes.

●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 a ball screw shaft. Critical speed depends on the supporting condition of screw shaft.

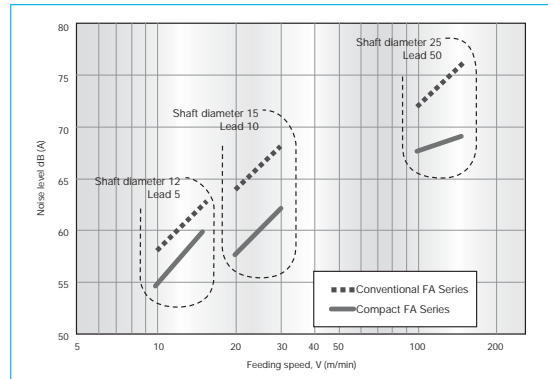
The lower of the two criteria, d·n and Critical Speed, will determine the overall Permissible Rotational Speed of the ball screw. For details, see "Technical description: Permissible rotational speed" (Page B51).

◆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 or in special environments, or if using special lubricant or oil.

For special environments, refer to Pages B74 and D2. For lubricants, refer to Pages B71 and D13.

Note: For details of standard stock products, contact NSK.



(Microphone was positioned at a distance of 400 mm for all noise levels)

Fig. 1 Comparison of noise level

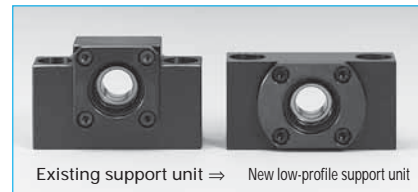


Fig. 2 Comparison of support units

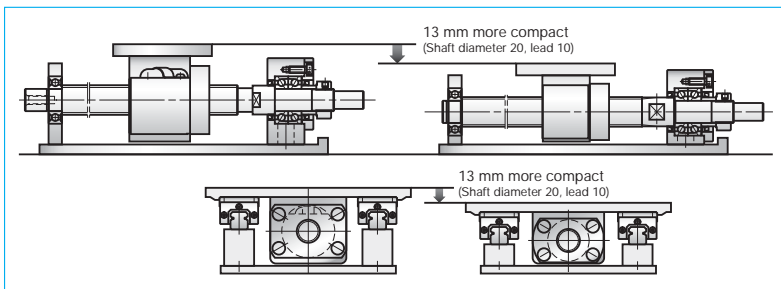
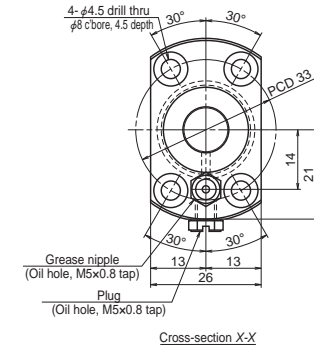
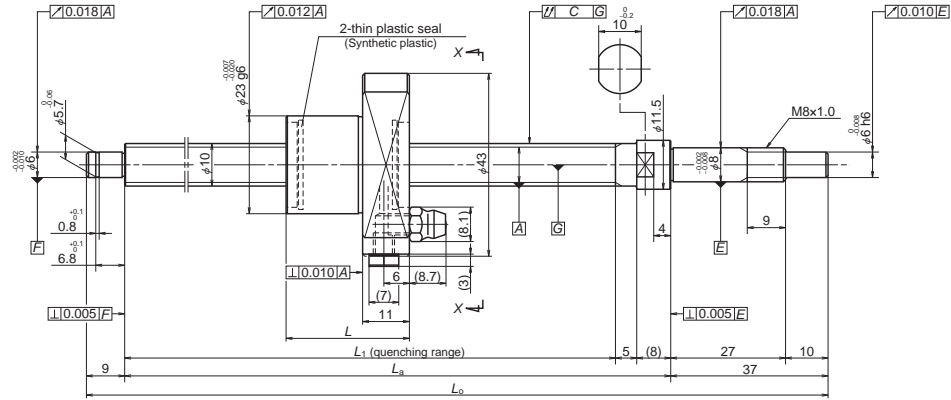


Fig. 3 Comparison of FA Type and Compact FA Series

Table 1 Combinations of screw shaft diameter and lead

Screw shaft diameter \ Lead	5	10	20	25	30	40	50	60
10	B221	B221						
12	B223	B223	B223		B223			
15	B225	B225	B227		B227			
20	B229	B229	B231		B231	B233		B233
25	B235	B235	B237	B237	B239		B239	

# Compact FA PSS Type



Screw shaft ø10

Lead 5, 10

Unit: mm

Ball screw specification	
Preload type	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 pre-packed grease	NSK grease PS2

Recommended support unit	Unit: mm	
	For drive side	For opposite to drive side
WBK08-01B (square)	○	
WBK08S-01B (square)		○
WBK08-11B (round)	○	

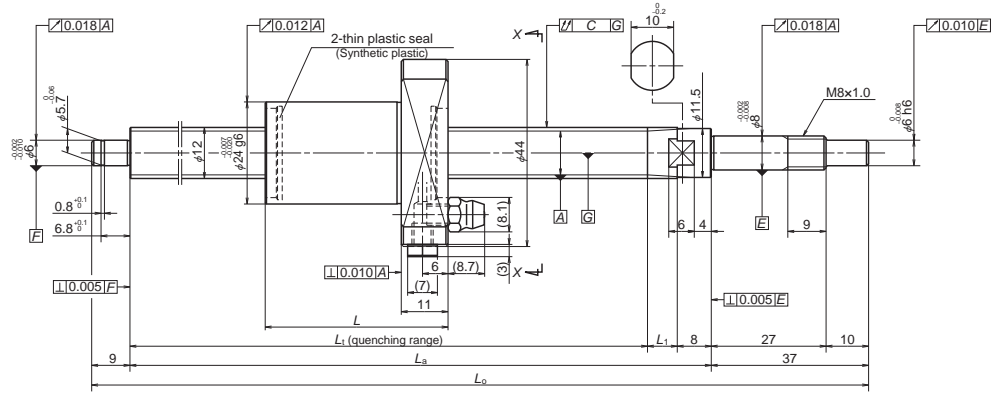
Ball screw No.	Screw shaft diameter <i>d</i>	Lead <i>I</i>	Basic load ratings (N)		Stroke		Nut length <i>L</i>	Screw shaft dimensions		
			Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	Nominal	Max. <i>L<sub>i</sub>-L</i>		<i>L<sub>i</sub></i>	<i>L<sub>a</sub></i>	<i>L<sub>o</sub></i>
PSS1005N1D0171	10	5	2 930	4 790	50	83	29	112	125	171
PSS1005N1D0221					100	133		162	175	221
PSS1005N1D0321					200	233		262	275	321
PSS1005N1D0421					300	333		362	375	421
PSS1005N1D0521					400	433		462	475	521
PSS1010N1D0221		10	1 970	3 010	100	130	32	162	175	221
PSS1010N1D0321					200	230		262	275	321
PSS1010N1D0421					300	330		362	375	421
PSS1010N1D0521					400	430		462	475	521

- Remarks:
1. Indicates ball screw preload control value. About 2.0 N·cm of torque is added due to thin plastic seal.
  2. Contact NSK if permissible rotational speed is to be exceeded.
  3. Service temperature range is 0°C to 80°C.

Lead accuracy			Shaft runout <i>C</i>	Dynamic preload torque (N·cm) *1	Mass (kg)	Permissible rotational speed (min <sup>-1</sup> ) *1	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )	
Target value <i>T</i>	Error <i>e<sub>p</sub></i>	Variation <i>v<sub>i</sub></i>							
0	0.020	0.018	0.030	0.7 - 3.3	0.3	5 000	0.8	0.4	
			0.045	0.7 - 3.3	0.3				
			0.060	0.6 - 4.3	0.3				
			0.070	0.6 - 4.3	0.4				
			0.085	0.4 - 4.9	0.5				
	0.023	0.020	0.018	0.045	0.7 - 3.3	0.3	5 000	0.7	0.4
				0.060	0.6 - 4.3	0.4			
				0.070	0.6 - 4.3	0.4			
				0.085	0.4 - 4.9	0.5			

- Remarks:
4. NSK support unit is recommended. Refer to Page B433 for details.
  5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.

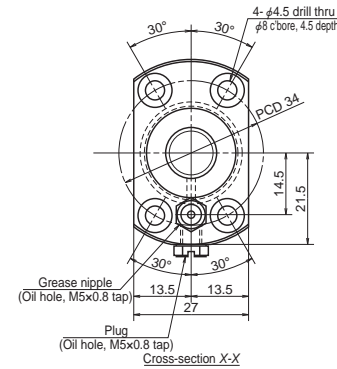
# Compact FA PSS Type



# NSK

## Screw shaft ø12 Lead 5, 10, 20, 30

Unit: mm



### Ball screw specification

Preload type	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 pre-packed grease	NSK grease PS2

Recommended support unit	For drive side	For opposite to drive side
WBK08-01B (square)	○	
WBK08S-01B (square)		○
WBK08-11B (round)	○	

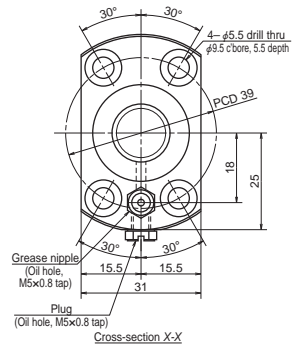
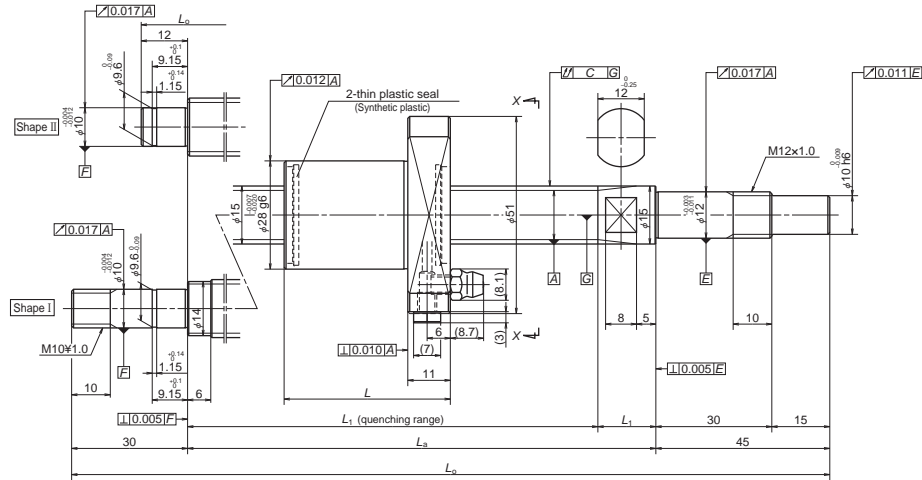
Ball screw No.	Screw shaft diameter <i>d</i>	Lead <i>I</i>	Basic load ratings (N)		Stroke		Nut length <i>L</i>	Screw shaft dimensions			
			Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	Nominal	Max. <i>L<sub>i</sub>-L</i>		<i>L<sub>1</sub></i>	<i>L<sub>a</sub></i>	<i>L<sub>0</sub></i>	<i>L<sub>1</sub></i>
PSS1205N1D0171	12	5	3 200	5 860	50	80	30	110	125	171	7
PSS1205N1D0221					100	130		160	175	221	
PSS1205N1D0321					200	230		260	275	321	
PSS1205N1D0421					300	330		360	375	421	
PSS1205N1D0521					400	430		460	475	521	
PSS1205N1D0621					500	530		560	575	621	
PSS1210N1D0221		10	3 200	5 860	100	117	43	160	175	221	7
PSS1210N1D0321					200	217		260	275	321	
PSS1210N1D0421					300	317		360	375	421	
PSS1210N1D0521					400	417		460	475	521	
PSS1210N1D0621					500	517		560	575	621	
PSS1220N1D0271					20	2 150		3 610	100	158	
PSS1220N1D0371		200	258	308			325		371		
PSS1220N1D0471		300	358	408			425		471		
PSS1220N1D0571	400	458	508	525			571				
PSS1220N1D0671	500	558	608	625			671				
PSS1230N1D0271	30	2 150	3 610	100			133		70	203	225
PSS1230N1D0371				200	233	303	325	371			
PSS1230N1D0471				300	333	403	425	471			
PSS1230N1D0571				400	433	503	525	571			
PSS1230N1D0671				500	533	603	625	671			

Remarks: 1. Indicates ball screw preload control value. About 2.0 N-cm of torque is added due to thin plastic seal.  
2. Contact NSK if permissible rotational speed is to be exceeded.  
3. Service temperature range is 0°C to 80°C.

Unit: mm

Target value <i>T</i>	Lead accuracy		Shaft runout <i>C</i>	Dynamic preload torque (N-cm) <sup>*1</sup>	Mass (kg)	Permissible rotational speed (min <sup>-1</sup> ) <sup>*2</sup>	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )	
	Error <i>e<sub>p</sub></i>	Variation <i>v<sub>i</sub></i>							Fixed-Simple
0	0.020	0.018	0.030	0.7 - 3.3	0.3	5 000	1.0	0.5	
	0.020	0.018	0.045	0.7 - 3.3	0.3				
	0.023	0.018	0.060	0.6 - 4.3	0.4				
	0.025	0.020	0.070	0.6 - 4.3	0.5				
	0.027	0.020	0.085	0.6 - 4.3	0.6				
	0.030	0.023	0.085	0.4 - 4.9	0.7				
	0.020	0.018	0.045	0.7 - 3.3	0.4	5 000	1.0	0.5	
	0.023	0.018	0.060	0.6 - 4.3	0.5				
	0.025	0.020	0.070	0.6 - 4.3	0.5				
	0.027	0.020	0.085	0.6 - 4.3	0.6				
	0.030	0.023	0.085	0.4 - 4.9	0.7				
	0.030	0.023	0.110	0.6 - 5.9	0.8				
	4 200	0.023	0.018	0.045	1.4 - 4.5	0.5	5 000	1.5	0.8
		0.023	0.018	0.060	0.9 - 4.9	0.6			
0.027		0.020	0.070	0.9 - 4.9	0.7				
0.030		0.023	0.085	0.6 - 5.9	0.7				
0.030		0.023	0.110	0.6 - 5.9	0.8				
4 300		0.030	0.023	0.110	0.6 - 5.9	0.8			

Remarks: 4. NSK support unit is recommended. Refer to Page B433 for details.  
5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.



Ball screw specification	
Preload type	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 pre-packed grease	NSK grease LR3

Recommended support unit	Unit: mm	
	For drive side	For opposite to drive side
WBK12-01B (square)	○	
WBK12S-01B (square)		○
WBK12-11 (round)	○	
WBK10-01B (square)		○
WBK10-11 (round)		○

Ball screw No.	Screw shaft diameter <i>d</i>	Lead <i>I</i>	Basic load ratings (N)		Stroke		Nut length <i>L</i>	Screw shaft dimensions			
			Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	Nominal	Max. <i>L<sub>1</sub>-L</i>		<i>L<sub>1</sub></i>	<i>L<sub>a</sub></i>	<i>L<sub>b</sub></i>	<i>L<sub>1</sub></i>
PSS1505N1D0211	15	5	5 460	10 200	50	109	30	139	154	211	15
PSS1505N1D0261					100	159		189	204	261	
PSS1505N1D0361					200	259		289	304	361	
PSS1505N1D0461					300	359		389	404	461	
PSS1505N1D0561					400	459		489	504	561	
PSS1505N1D0661					500	559		589	604	661	
PSS1505N1D0761					600	659		689	704	761	
PSS1510N1D0261					10	5 460		10 200	100	146	
PSS1510N1D0361		200	246	289			304		361		
PSS1510N1D0461		300	346	389			404		461		
PSS1510N1D0561		400	446	489			504		561		
PSS1510N1D0661		500	546	589			604		661		
PSS1510N1D0761		600	646	689			704		761		
PSS1510N1D0879		700	746	789			804		879		
PSS1510N1D0979	800	846	889	904			979				
PSS1510N1D1179	1 000	1 046	1 089	1 104			1 179				

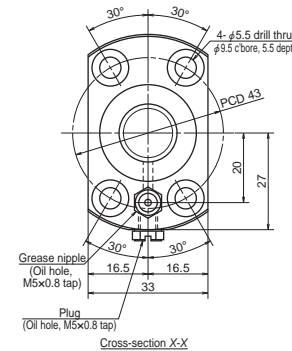
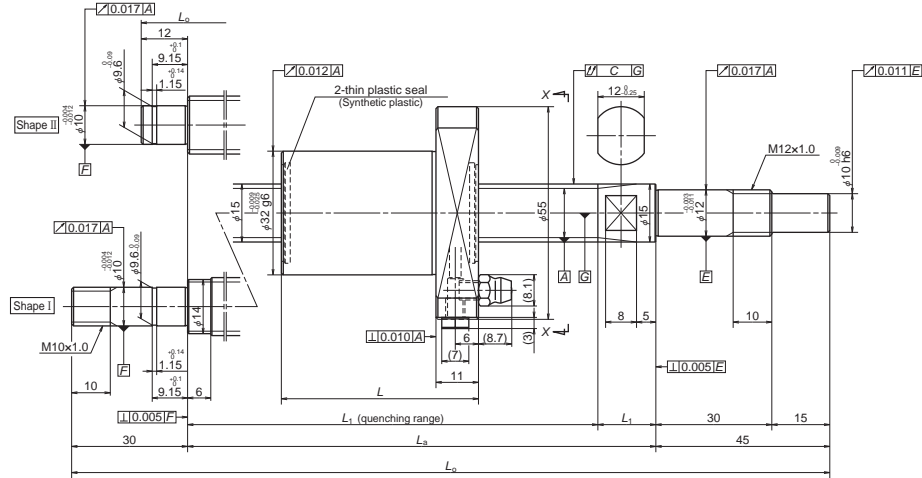
Remarks: 1. Indicates ball screw preload control value. About 2.0 N-cm of torque is added due to thin plastic seal.  
2. Contact NSK if permissible rotational speed is to be exceeded.  
3. Service temperature range is 0°C to 80°C.

Unit: mm

Left shaft end (opposite driven side)	Lead accuracy			Shaft runout <i>C</i>	Dynamic preload torque (N-cm)*1	Mass (kg)	Permissible rotational speed (min) <sup>2</sup>		Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )
	Target value <i>T</i>	Error <i>e<sub>p</sub></i>	Variation <i>v<sub>u</sub></i>				Fixed-Simple	Fixed-Fixed		
II	0	0.020	0.018	0.035	0.2 - 6.9	0.5	5 000	—	2.0	1.0
		0.020	0.018	0.035	0.2 - 6.9	0.5				
		0.023	0.018	0.045	0.2 - 6.9	0.6				
		0.025	0.020	0.050	0.4 - 9.8	0.8				
		0.027	0.020	0.060	0.4 - 9.8	0.9				
		0.030	0.023	0.075	0.4 - 9.8	1.0				
		0.035	0.025	0.075	0.4 - 11.8	1.1				
		3 600								
II	0	0.020	0.018	0.035	0.6 - 7.4	0.6	5 000	—	2.0	1.0
		0.023	0.018	0.045	0.6 - 7.4	0.7				
		0.025	0.020	0.050	0.4 - 9.8	0.8				
		0.027	0.020	0.060	0.4 - 9.8	1.0				
		0.030	0.023	0.075	0.4 - 9.8	1.1				
		0.035	0.025	0.075	0.4 - 11.8	1.2				
3 600										
I	0	0.035	0.025	0.095	0.4 - 11.8	1.4	2 700	3 400	2.0	1.0
		0.040	0.027	0.095	0.4 - 11.8	1.5	2 200	3 400		
		0.046	0.030	0.120	0.4 - 11.8	1.7	1 400	2 300		

Remarks: 4. NSK support unit is recommended. Refer to Page B433 for details.  
5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.

# Compact FA PSS Type



Screw shaft ø15

Lead 20, 30

Unit: mm

Ball screw specification	
Preload type	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 pre-packed grease	NSK grease LR3

Recommended support unit	Unit: mm	
	For drive side	For opposite to drive side
WBK12-01B (square)	○	
WBK12S-01B (square)		○
WBK12-11 (round)	○	
WBK10-01B (square)		○
WBK10-11 (round)		○

Ball screw No.	Screw shaft diameter <i>d</i>	Lead <i>I</i>	Basic load ratings (N)		Stroke		Nut length <i>L</i>	Screw shaft dimensions			
			Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	Nominal	Max. <i>L<sub>1</sub>-L</i>		<i>L<sub>1</sub></i>	<i>L<sub>a</sub></i>	<i>L<sub>b</sub></i>	<i>L<sub>1</sub></i>
PSS1520N1D0261	15	20	5 070	8 730	100	135	51	186	204	261	18
PSS1520N1D0361					200	235		286	304	361	
PSS1520N1D0461					300	335		386	404	461	
PSS1520N1D0561					400	435		486	504	561	
PSS1520N1D0661					500	535		586	604	661	
PSS1520N1D0761					600	635		686	704	761	
PSS1520N1D0879					700	735		786	804	879	
PSS1520N1D0979					800	835		886	904	979	
PSS1520N1D1179					1 000	1 035		1 086	1 104	1 179	
PSS1530N1D0311					30	5 070		8 730	100	159	
PSS1530N1D0411	200	259	330	354			411				
PSS1530N1D0511	300	359	430	454			511				
PSS1530N1D0611	400	459	530	554			611				
PSS1530N1D0711	500	559	630	654			711				
PSS1530N1D0811	600	659	730	754			811				
PSS1530N1D0929	700	759	830	854			929				
PSS1530N1D1029	800	859	930	954			1 029				
PSS1530N1D1229	1 000	1 059	1 130	1 154			1 229				

Remarks: 1. Indicates ball screw preload control value. About 2.0 N-cm of torque is added due to thin plastic seal.  
 2. Contact NSK if permissible rotational speed is to be exceeded.  
 3. Service temperature range is 0°C to 80°C.

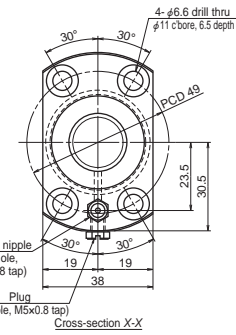
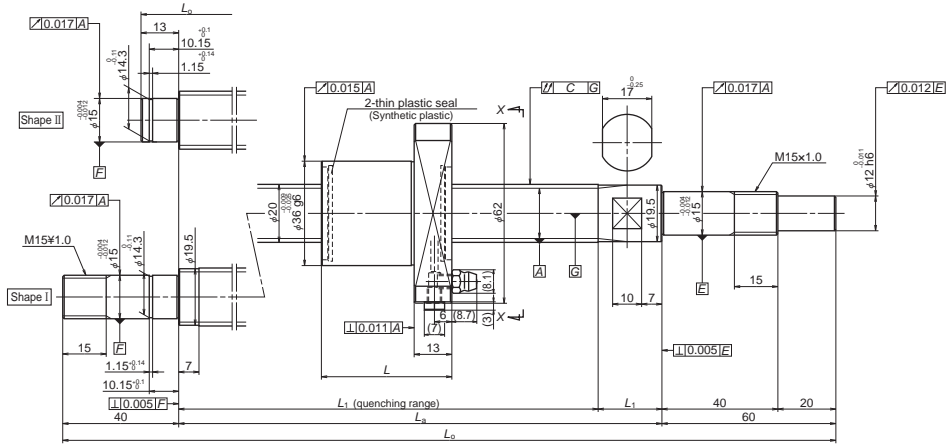
Unit: mm

Left shaft end (opposite driven side)	Lead accuracy			Shaft runout <i>C</i>	Dynamic preload torque (N-cm) *1	Mass (kg)	Permissible rotational speed (min) <sup>*2</sup>		Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )
	Target value <i>T</i>	Error <i>e<sub>p</sub></i>	Variation <i>v<sub>u</sub></i>				Fixed-Simple	Fixed-Fixed		
II	0	0.020	0.018	0.035	0.8 - 8.8	0.7	5 000	—	2.8	1.4
		0.023	0.018	0.045	0.8 - 8.8	0.8				
		0.025	0.020	0.050	0.8 - 10.8	0.9				
		0.027	0.020	0.060	0.8 - 10.8	1.1				
		0.030	0.023	0.075	0.8 - 10.8	1.2				
		0.035	0.025	0.075	0.8 - 13.8	1.3				
I	0	0.035	0.025	0.095	0.8 - 13.8	1.5	2 900	4 200		
		0.040	0.027	0.095	0.8 - 13.8	1.6	2 200	3 300		
II	0	0.046	0.030	0.120	0.8 - 13.8	1.9	1 500	2 200		
		0.023	0.018	0.035	1.2 - 9.3	0.8	5 000	—	3.4	1.7
		0.025	0.020	0.050	0.8 - 10.8	1.0				
		0.027	0.020	0.060	0.8 - 10.8	1.1				
0.030	0.023	0.060	0.8 - 10.8	1.2						
I	0	0.030	0.023	0.075	0.8 - 13.8	1.4	4 500			
		0.035	0.025	0.095	0.8 - 13.8	1.5	3 300			
		0.040	0.027	0.095	0.8 - 13.8	1.6	2 600	3 800		
		0.040	0.027	0.120	0.8 - 13.8	1.8	2 000	3 000		
I	0	0.046	0.030	0.120	0.8 - 13.8	2.0	1 400	2 000		

Remarks: 4. NSK support unit is recommended. Refer to Page B433 for details.  
 5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.



# Compact FA PSS Type



# NSK

## Screw shaft ø20

### Lead 5, 10

Unit: mm

Ball screw specification	
Preload type	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 pre-packed grease	NSK grease LR3

Recommended support unit	Unit: mm	
	For drive side	For opposite to drive side
WBK15-01B (square)	○	○
WBK15S-01B (square)		○
WBK15-11 (round)	○	○

Ball screw No.	Screw shaft diameter <i>d</i>	Lead <i>I</i>	Basic load ratings (N)		Stroke		Nut length <i>L</i>	Screw shaft dimensions								
			Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	Nominal	Max. <i>L<sub>1</sub>-L</i>		<i>L<sub>1</sub></i>	<i>L<sub>a</sub></i>	<i>L<sub>b</sub></i>	<i>L<sub>c</sub></i>					
												<i>C<sub>a</sub></i>	<i>C<sub>0a</sub></i>	Nominal	Max. <i>L<sub>1</sub>-L</i>	<i>L<sub>1</sub></i>
PSS2005N1D0323	20	5	8 790	18 500	150	197	31	228	250	323	22					
PSS2005N1D0373					200	247		278	300	373						
PSS2005N1D0473					300	347		378	400	473						
PSS2005N1D0573					400	447		478	500	573						
PSS2005N1D0673					500	547		578	600	673						
PSS2005N1D0773					600	647		678	700	773						
PSS2005N1D0873					700	747		778	800	873						
PSS2005N1D1000					800	847		878	900	1000						
PSS2010N1D0387					10	8 790		18 500	200	247		45	292	314	387	22
PSS2010N1D0487									300	347			392	414	487	
PSS2010N1D0587	400	447	492	514			587									
PSS2010N1D0687	500	547	592	614			687									
PSS2010N1D0787	600	647	692	714			787									
PSS2010N1D0887	700	747	792	814			887									
PSS2010N1D1014	800	847	892	914			1014									
PSS2010N1D1214	1 000	1047	1092	1 114			1214									
PSS2010N1D1414	1 200	1247	1292	1 314			1414									

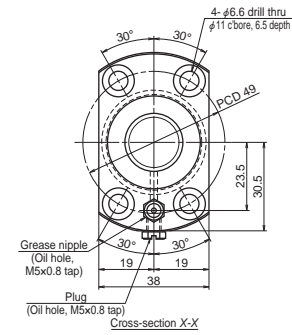
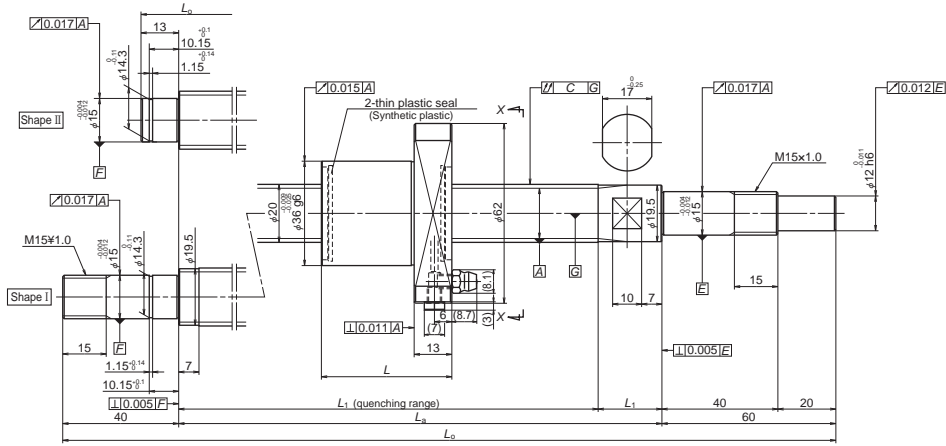
Remarks: 1. Indicates ball screw preload control value. About 2.0 N-cm of torque is added due to thin plastic seal.  
2. Contact NSK if permissible rotational speed is to be exceeded.  
3. Service temperature range is 0°C to 80°C.

Unit: mm

Left shaft end (opposite driven side)	Lead accuracy			Shaft runout <i>C</i>	Dynamic preload torque (N-cm) <sup>*1</sup>	Mass (kg)	Permissible rotational speed (min) <sup>*2</sup>		Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )
	Target value <i>T</i>	Error <i>e<sub>p</sub></i>	Variation <i>v<sub>u</sub></i>				Fixed-Simple	Fixed-Fixed		
II	0	0.023	0.018	0.045	0.6 - 7.4	1.0	5 000	—	3.4	1.7
		0.023	0.018	0.045	0.6 - 7.4	1.1				
		0.025	0.020	0.050	0.6 - 7.4	1.3				
		0.027	0.020	0.060	0.4 - 9.8	1.5				
		0.030	0.023	0.075	0.4 - 9.8	1.7				
		0.035	0.025	0.075	0.4 - 9.8	1.9				
		0.035	0.025	0.095	0.4 - 9.8	2.2				
		0.040	0.027	0.095	0.4 - 11.8	2.4				
		0.040	0.027	0.095	0.4 - 11.8	2.4				
		0.040	0.027	0.095	0.4 - 11.8	2.4				
II	0	0.023	0.018	0.045	1.2 - 9.3	1.2	5 000	—	3.2	1.6
		0.025	0.020	0.050	1.2 - 9.3	1.4				
		0.027	0.020	0.060	0.8 - 10.8	1.7				
		0.030	0.023	0.075	0.8 - 10.8	1.9				
		0.035	0.025	0.075	0.8 - 10.8	2.1				
		0.035	0.025	0.095	0.8 - 10.8	2.4				
I	0	0.040	0.027	0.120	0.8 - 13.8	2.6	4 000	4 600	3.2	1.6
		0.046	0.030	0.120	0.8 - 13.8	3.1				
		0.054	0.035	0.160	0.8 - 13.8	3.6				
		0.054	0.035	0.160	0.8 - 13.8	3.6				

Remarks: 4. NSK support unit is recommended. Refer to Page B433 for details.  
5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.

# Compact FA PSS Type



Screw shaft  $\phi 20$

Lead 20, 30

Unit: mm

### Ball screw specification

Preload type	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 pre-packed grease	NSK grease LR3

### Recommended support unit

Recommended support unit	For drive side	For opposite to drive side
WBK15-01B (square)	○	○
WBK15S-01B (square)		○
WBK15-11 (round)	○	○

Ball screw No.	Screw shaft diameter <i>d</i>	Lead <i>I</i>	Basic load ratings (N)		Stroke		Nut length <i>L</i>	Screw shaft dimensions									
			Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	Nominal	Max. <i>L<sub>1</sub>-L</i>		<i>L<sub>1</sub></i>	<i>L<sub>a</sub></i>	<i>L<sub>b</sub></i>	<i>L<sub>1</sub></i>						
												<i>C<sub>a</sub></i>	<i>C<sub>0a</sub></i>	Nominal	Max. <i>L<sub>1</sub>-L</i>	<i>L<sub>1</sub></i>	<i>L<sub>a</sub></i>
PSS2020N1D0508	20	20	5 900	11 700	300	359	54	413	435	508	22						
PSS2020N1D0608					400	459		513	535	608							
PSS2020N1D0708					500	559		613	635	708							
PSS2020N1D0808					600	659		713	735	808							
PSS2020N1D0908					700	759		813	835	908							
PSS2020N1D1035					800	859		913	935	1 035							
PSS2020N1D1235					1 000	1 059		1 113	1 135	1 235							
PSS2020N1D1435					1 200	1 259		1 313	1 335	1 435							
PSS2020N1D1835					1 600	1 659		1 713	1 735	1 835							
PSS2030N1D0408					30	30		5 900	11 700	200		234	74	308	335	408	27
PSS2030N1D0508										300		334		408	435	508	
PSS2030N1D0608										400		434		508	535	608	
PSS2030N1D0708										500		534		608	635	708	
PSS2030N1D0808										600		634		708	735	808	
PSS2030N1D0908	700	734	808	835			908										
PSS2030N1D1035	800	834	908	935			1 035										
PSS2030N1D1235	1 000	1 034	1 108	1 135			1 235										
PSS2030N1D1435	1 200	1 234	1 308	1 335			1 435										

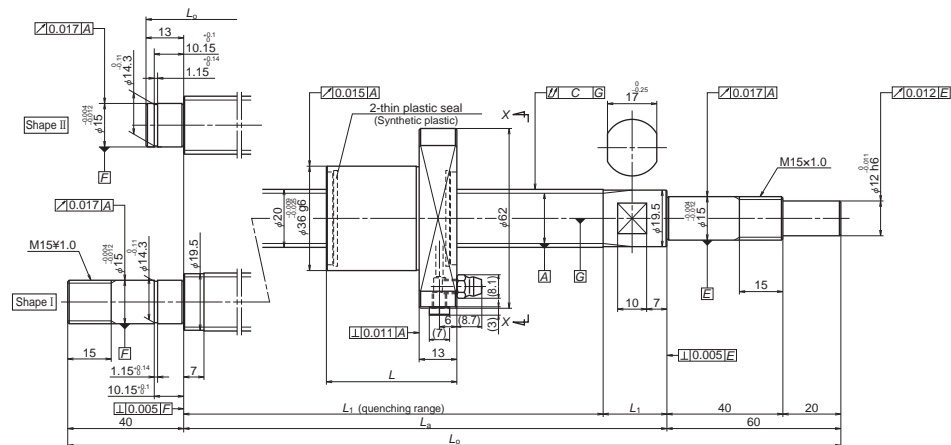
- Remarks: 1. Indicates ball screw preload control value. About 2.0 N-cm of torque is added due to thin plastic seal.  
 2. Contact NSK if permissible rotational speed is to be exceeded.  
 3. Service temperature range is 0°C to 80°C.

Unit: mm

Left shaft end (opposite driven side)	Lead accuracy			Shaft runout <i>C</i>	Dynamic preload torque (N-cm) *1	Mass (kg)	Permissible rotational speed (min) *2		Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )
	Target value <i>T</i>	Error <i>e<sub>p</sub></i>	Variation <i>v<sub>u</sub></i>				Fixed-Simple	Fixed-Fixed		
II	0	0.027	0.020	0.060	1.4 - 11.8	1.6	5 000	—	3.2	1.6
		0.030	0.023	0.060	1.4 - 11.8	1.8				
		0.030	0.023	0.075	1.4 - 11.8	2.0				
		0.035	0.025	0.095	1.4 - 11.8	2.3				
		0.040	0.027	0.095	0.8 - 13.8	2.5				
I	0	0.040	0.027	0.120	0.8 - 13.8	2.8	3 000	4 500	4.6	2.3
		0.046	0.030	0.120	0.8 - 13.8	3.3	2 000	3 000		
		0.054	0.035	0.160	0.8 - 13.8	3.8	1 400	2 100		
		0.065	0.040	0.200	0.8 - 13.8	4.7	800	1 200		
II	0	0.023	0.018	0.050	1.6 - 9.8	1.4	5 000	—	4.6	2.3
		0.027	0.020	0.060	1.4 - 11.8	1.7				
		0.030	0.023	0.060	1.4 - 11.8	1.9				
		0.030	0.023	0.075	1.4 - 11.8	2.1				
		0.035	0.025	0.095	1.4 - 11.8	2.4				
I	0	0.040	0.027	0.120	0.8 - 13.8	2.9	3 100	4 600	4.6	2.3
		0.046	0.030	0.120	0.8 - 13.8	3.4	2 100	3 000		
		0.054	0.035	0.160	0.8 - 13.8	3.9	1 500	2 200		

- Remarks: 4. NSK support unit is recommended. Refer to Page B433 for details.  
 5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.

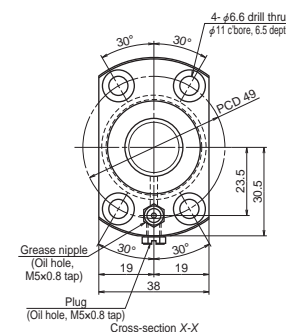
## Compact FA PSS Type



Screw shaft ø20

Lead 40, 60

Unit: mm



### Ball screw specification

Preload type	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 pre-packed grease	NSK grease LR3

Recommended support unit	For drive side	For opposite to drive side
WBK15-01B (square)	○	○
WBK15S-01B (square)		○
WBK15-11 (round)	○	○

Unit: mm

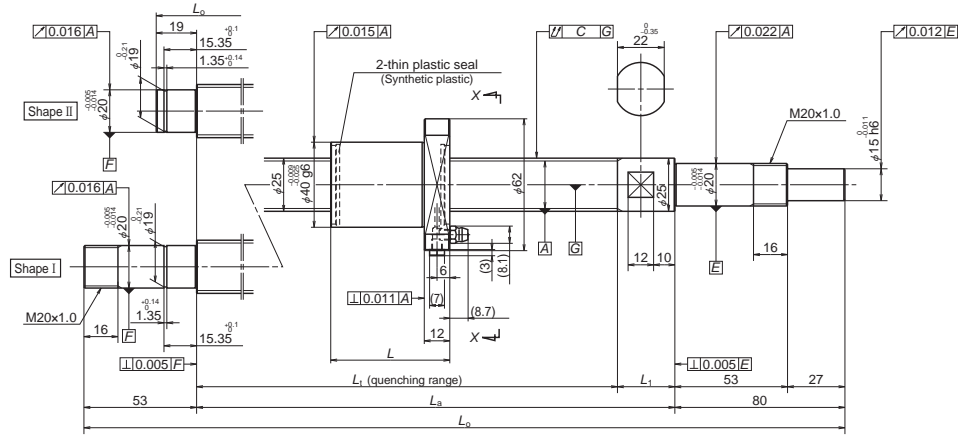
Ball screw No.	Screw shaft diameter <i>d</i>	Lead <i>I</i>	Basic load ratings (N)		Stroke		Nut length <i>L</i>	Screw shaft dimensions								
			Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	Nominal	Max. <i>L<sub>1</sub>-L</i>		<i>L<sub>1</sub></i>	<i>L<sub>a</sub></i>	<i>L<sub>b</sub></i>	<i>L<sub>c</sub></i>					
PSS2040N1D0658	20	40	5 900	11 700	400	461	92	553	585	658	32					
PSS2040N1D0758					500	561		653	685	758						
PSS2040N1D0858					600	661		753	785	858						
PSS2040N1D0958					700	761		853	885	958						
PSS2040N1D1085					800	861		953	985	1 085						
PSS2040N1D1285					1 000	1 061		1 153	1 185	1 285						
PSS2040N1D1485					1 200	1 261		1 353	1 385	1 485						
PSS2040N1D1885					1 600	1 661		1 753	1 785	1 885						
PSS2040N1D2285					2 000	2 061		2 153	2 185	2 285						
PSS2060N1D0708					60	5 900		11 700	400	464		129	593	635	708	42
PSS2060N1D0808									500	564			693	735	808	
PSS2060N1D0908									600	664			793	835	908	
PSS2060N1D1008									700	764			893	935	1 008	
PSS2060N1D1135									800	864			993	1 035	1 135	
PSS2060N1D1335	1 000	1 064	1 193	1 235			1 335									
PSS2060N1D1535	1 200	1 264	1 393	1 435			1 535									
PSS2060N1D1935	1 600	1 664	1 793	1 835			1 935									
PSS2060N1D2335	2 000	2 064	2 193	2 235			2 335									

- Remarks: 1. Indicates ball screw preload control value. About 2.0 N-cm of torque is added due to thin plastic seal.  
2. Contact NSK if permissible rotational speed is to be exceeded.  
3. Service temperature range is 0°C to 80°C.

Left shaft end (opposite driven side)	Lead accuracy			Shaft runout <i>C</i>	Dynamic preload torque (N-cm) <sup>*1</sup>	Mass (kg)	Permissible rotational speed (min) <sup>*2</sup>		Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )			
	Target value <i>T</i>	Error <i>e<sub>p</sub></i>	Variation <i>v<sub>u</sub></i>				Fixed-Simple	Fixed-Fixed					
II	0	0.030	0.023	0.075	2.2 - 12.8	2.1	5 000	—	5.3	2.7			
		0.035	0.025	0.075	2.2 - 12.8	2.4							
		0.035	0.025	0.095	2.2 - 12.8	2.6							
		0.040	0.027	0.095	1.8 - 14.8	2.8							
I		0.040	0.027	0.120	1.8 - 14.8	3.1	2 800	4 200					
		0.046	0.030	0.160	1.8 - 14.8	3.6	1 900	2 800					
		0.054	0.035	0.160	1.8 - 14.8	4.1	1 400	2 000					
		0.065	0.040	0.200	1.8 - 14.8	5.1	800	1 200					
		0.077	0.046	0.240	1.8 - 14.8	6.0	500	800					
		II	0.030	0.023	0.075	2.7 - 13.8	2.4	5 000			—	7.0	3.5
0.035			0.025	0.095	2.7 - 13.8	2.6							
0.035			0.025	0.095	2.7 - 13.8	2.9							
0.040			0.027	0.120	1.8 - 14.8	3.1	3 300						
I			0.040	0.027	0.120	1.8 - 14.8	3.4						
	0.046		0.030	0.160	1.8 - 14.8	3.9	1 800		2 700				
	0.054	0.035	0.160	1.8 - 14.8	4.4	1 300	1 900						
	0.065	0.040	0.200	1.8 - 14.8	5.4	800	1 100						
0.077	0.046	0.240	1.8 - 14.8	6.3	500	700							

- Remarks: 4. NSK support unit is recommended. Refer to Page B433 for details.  
5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.

# Compact FA PSS Type

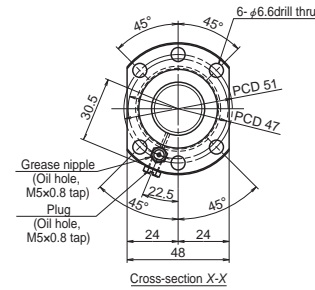


# NSK

## Screw shaft ø25

### Lead 5, 10

Unit: mm



### Ball screw specification

Preload type	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 pre-packed grease	NSK grease LR3

Recommended support unit	For drive side	For opposite to drive side
WBK20-01 (square)	○	○
WBK20S-01 (square)		○
WBK20-11 (round)	○	○

Ball screw No.	Screw shaft diameter <i>d</i>	Lead <i>I</i>	Basic load ratings (N)		Stroke		Nut length <i>L</i>	Screw shaft dimensions			
			Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	Nominal	Max. <i>L<sub>1</sub>-L</i>		<i>L<sub>1</sub></i>	<i>L<sub>a</sub></i>	<i>L<sub>b</sub></i>	<i>L<sub>1</sub></i>
PSS2505N1D0349	25	5	9 760	23 600	150	191	32	223	250	349	27
PSS2505N1D0399					200	241		273	300	399	
PSS2505N1D0499					300	341		373	400	499	
PSS2505N1D0599					400	441		473	500	599	
PSS2505N1D0699					500	541		573	600	699	
PSS2505N1D0899					700	741		773	800	899	
PSS2505N1D0999					800	841		873	900	999	
PSS2505N1D1233					1 000	1 041		1 073	1 100	1 233	
PSS2510N1D0549					300	367		423	450	549	
PSS2510N1D0649		400	467	523	550	649					
PSS2510N1D0749		500	567	623	650	749					
PSS2510N1D0849		600	667	723	750	849					
PSS2510N1D0949		700	767	823	850	949					
PSS2510N1D1049		800	867	923	950	1 049					
PSS2510N1D1283		1 000	1 067	1 123	1 150	1 283					
PSS2510N1D1883		1 600	1 667	1 723	1 750	1 883					

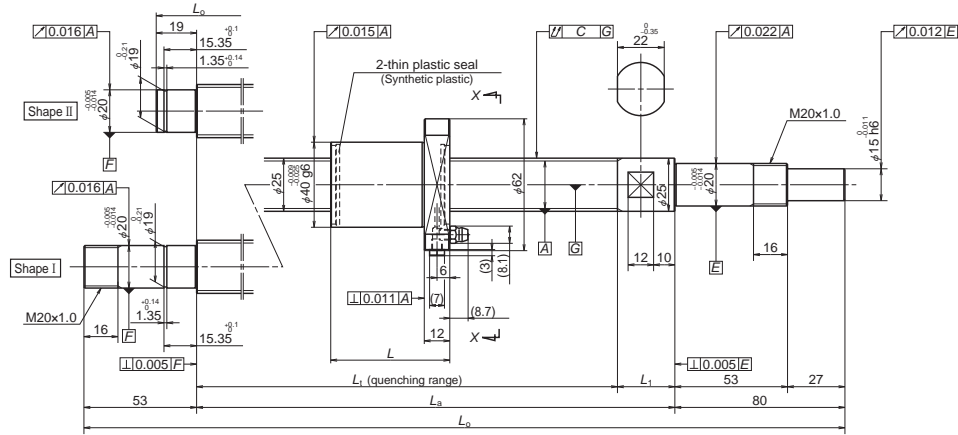
- Remarks: 1. Indicates ball screw preload control value. About 2.0 N-cm of torque is added due to thin plastic seal.  
 2. Contact NSK if permissible rotational speed is to be exceeded.  
 3. Service temperature range is 0°C to 80°C.

Unit: mm

Left shaft end (opposite driven side)	Lead accuracy			Shaft runout <i>C</i>	Dynamic preload torque (N-cm)*1	Mass (kg)	Permissible rotational speed (min) <sup>2)</sup>		Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )
	Target value <i>T</i>	Error <i>e<sub>p</sub></i>	Variation <i>v<sub>u</sub></i>				Fixed-Simple	Fixed-Fixed		
II	0	0.023	0.018	0.035	1.2 - 9.3	1.5	5 000	—	4.4	2.2
		0.023	0.018	0.035	1.2 - 9.3	1.6				
		0.025	0.020	0.040	1.2 - 9.3	2.0				
		0.027	0.020	0.045	1.2 - 9.3	2.3				
		0.030	0.023	0.055	0.8 - 10.8	2.7				
		0.035	0.025	0.065	0.8 - 10.8	3.4				
		0.040	0.027	0.065	0.8 - 10.8	3.7				
		0.040	0.027	0.065	0.8 - 10.8	3.7				
		0.046	0.030	0.080	0.8 - 13.8	4.5				
I	0	0.027	0.020	0.045	3.1 - 11.8	2.4	5 000	—	4.7	2.4
		0.030	0.023	0.055	2.2 - 12.8	2.7				
		0.030	0.023	0.055	2.2 - 12.8	3.1				
II	0	0.035	0.025	0.065	2.2 - 12.8	3.5	5 000	—	4.7	2.4
		0.040	0.027	0.065	2.2 - 12.8	3.8				
		0.040	0.027	0.080	2.2 - 12.8	4.2				
I	0	0.046	0.030	0.100	1.8 - 14.8	5.0	2 500	3 700	4.7	2.4
		0.065	0.040	0.130	1.8 - 14.8	7.2				

- Remarks: 4. NSK support unit is recommended. Refer to Page B433 for details.  
 5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.

# Compact FA PSS Type

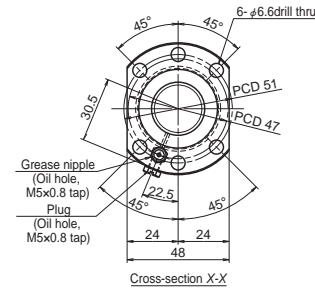


# NSK

## Screw shaft ø25

### Lead 20, 25

Unit: mm



### Ball screw specification

Preload type	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 pre-packed grease	NSK grease LR3

Recommended support unit	For drive side	For opposite to drive side
WBK20-01 (square)	○	○
WBK20S-01 (square)	○	○
WBK20-11 (round)	○	○

Ball screw No.	Screw shaft diameter <i>d</i>	Lead <i>I</i>	Basic load ratings (N)		Stroke		Nut length <i>L</i>	Screw shaft dimensions									
			Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	Nominal	Max. <i>L<sub>1</sub>-L</i>		<i>L<sub>1</sub></i>	<i>L<sub>a</sub></i>	<i>L<sub>b</sub></i>	<i>L<sub>1</sub></i>						
												<i>C<sub>a</sub></i>	<i>C<sub>0a</sub></i>	Nominal	Max. <i>L<sub>1</sub>-L</i>	<i>L<sub>1</sub></i>	<i>L<sub>a</sub></i>
PSS2520N1D0729	25	20	6 560	14 600	500	550	54	604	630	729	26						
PSS2520N1D0829					600	650		704	730	829							
PSS2520N1D0929					700	750		804	830	929							
PSS2520N1D1029					800	850		904	930	1 029							
PSS2520N1D1263					1 000	1 050		1 104	1 130	1 263							
PSS2520N1D1463					1 200	1 250		1 304	1 330	1 463							
PSS2520N1D1863					1 600	1 650		1 704	1 730	1 863							
PSS2520N1D2263					2 000	2 050		2 104	2 130	2 263							
PSS2525N1D0779					25	25		6 560	14 600	500		587	63	650	680	779	30
PSS2525N1D0879										600		687		750	780	879	
PSS2525N1D0979	700	787	850	880			979										
PSS2525N1D1079	800	887	950	980			1 079										
PSS2525N1D1313	1 000	1 087	1 150	1 180			1 313										
PSS2525N1D1513	1 200	1 287	1 350	1 380			1 513										
PSS2525N1D1913	1 600	1 687	1 750	1 780			1 913										
PSS2525N1D2313	2 000	2 087	2 150	2 180			2 313										

- Remarks: 1. Indicates ball screw preload control value. About 2.0 N-cm of torque is added due to thin plastic seal.  
2. Contact NSK if permissible rotational speed is to be exceeded.  
3. Service temperature range is 0°C to 80°C.

Unit: mm

Left shaft end (opposite driven side)	Lead accuracy			Shaft runout <i>C</i>	Dynamic preload torque (N-cm) *1	Mass (kg)	Permissible rotational speed (min) <sup>*)</sup>		Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )
	Target value <i>T</i>	Error <i>e<sub>p</sub></i>	Variation <i>v<sub>u</sub></i>				Fixed-Simple	Fixed-Fixed		
II	0	0.030	0.023	0.055	2.2 - 12.8	3.1	5 000	—	3.9	2.0
		0.035	0.025	0.065	2.2 - 12.8	3.4				
		0.040	0.027	0.065	2.2 - 12.8	3.8				
		0.040	0.027	0.080	2.2 - 12.8	4.2				
		0.046	0.030	0.100	1.8 - 14.8	5.0				
I	0	0.054	0.035	0.100	1.8 - 14.8	5.8	1 800	2 700	4.3	2.2
		0.065	0.040	0.130	1.8 - 14.8	7.3	1 100	1 600		
		0.077	0.046	0.170	1.8 - 14.8	8.8	700	1 000		
II	0	0.035	0.025	0.055	2.7 - 13.8	3.3	5 000	—	4.3	2.2
		0.035	0.025	0.065	2.7 - 13.8	3.7				
		0.040	0.027	0.065	2.7 - 13.8	4.1				
		0.040	0.027	0.080	2.7 - 13.8	4.4				
		0.046	0.030	0.100	1.8 - 14.8	5.3				
I	0	0.054	0.035	0.100	1.8 - 14.8	6.0	1 700	2 600	4.3	2.2
		0.065	0.040	0.130	1.8 - 14.8	7.5	1 000	1 500		
		0.077	0.046	0.170	1.8 - 14.8	9.1	700	1 000		

- Remarks: 4. NSK support unit is recommended. Refer to Page B433 for details.  
5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.



B-3-2.2 Finished Shaft End MA type, FA type, SA type

◇Ball screw sizes are arranged in order of the page number.

The Table begins with the smallest shaft diameter of each MA, FA, and SA type ball screws, and proceeds to the larger sizes. If ball screws have the same shaft diameter, those with smaller leads appear first. Page numbers of shaft diameter and lead combinations are shown in Table 1.

◇Dimension tables

Dimension tables show shapes/sizes as well as specification factors of 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 figure is obtained by subtracting the nut length from the effective threaded length ( $L_i$ ).

●Lead accuracy

Lead accuracy is C3 and C5 grades  
 $T$  : Travel compensation;  
 $e_p$  : Tolerance on specified travel;  
 $v_u$  : Travel variation  
 See "Technical Description: Lead accuracy"

Table 1 Combinations of screw shaft diameter and lead

Lead (mm) \ Screw shaft diameter (mm)	1	1.5	2	2.5	4	5	6
4	B243						
6	B245						
8	B247	B249	B251				
10			B253	B255	B265		
12			B257	B259		B267	
14						B271	
15							
16			B261	B263		B279	
20					B301	B303	
25					B305	B307	B309
28						B313 B315	B317 B319
32						B321 B323	B325 B327
36							
40						B339	
45							
50							

(Page B41) for the details of the codes.

●Permissible rotational speed

$d \cdot n$ : Limited by the relative peripheral speed between the screw shaft and the nut.

Critical speed: Limited by the natural frequency of a ball screw shaft. Critical speed depends on the supporting condition of 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 B51).

◇Other

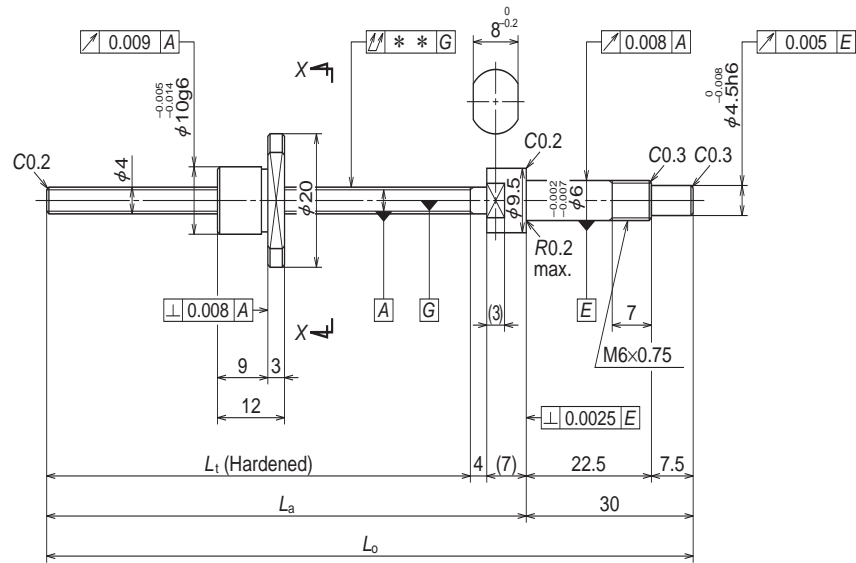
The seal of the ball screw, ball recirculating deflector, and end cap are made of synthetic resin. Consult NSK when using our ball screws under extreme environments or in special environments, or if using special lubricant or oil. For special environments, refer to Pages B74 and D2. For lubricants, refer to Pages B71 and D13.

Note: For details of standard stock products, contact NSK.

	8	10	12	16	20	25	32	40	50
		B269							
B273		B275			B277				
				B281			B283		
		B285			B287			B289	
		B311			B291	B293			B295
B329	B331					B297	B299		
	B333								
	B335								
	B337								
B341	B343	B347							
	B345	B349							
	B351								
	B353								
	B355								

## Finished shaft end MA Type

(Fine lead) Dia. 4, Lead 1

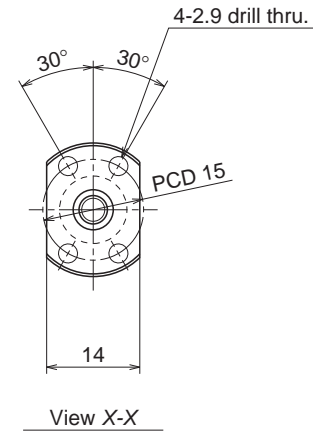


## Nut models: MPFD, MSFD

**NSK**

ø4×1

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	
Ball dia. / Ball circle dia.		0.800/4.2	
Screw shaft root diameter		3.2	
Effective turns of balls		1×2	
Accuracy grade / Preload / Axial play		C3/Z	C3/T
Basic load rating (N)	Dynamic $C_a$	315	
	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

WBK06-01A	(square)
WBK06-11	(round)

Unit: mm

Ball screw No.		Stroke	
		Nominal	Maximum ( $L_t$ —Nut length)
Preloaded (MPFD)	Precise clearance (MSFD)		
<b>W0400MA-1PY-C3Z1</b>	<b>W0400MA-2Y-C3T1</b>	20	32
<b>W0400MA-3PY-C3Z1</b>	<b>W0400MA-4Y-C3T1</b>	40	52
<b>W0401MA-1PY-C3Z1</b>	<b>W0401MA-2Y-C3T1</b>	70	82

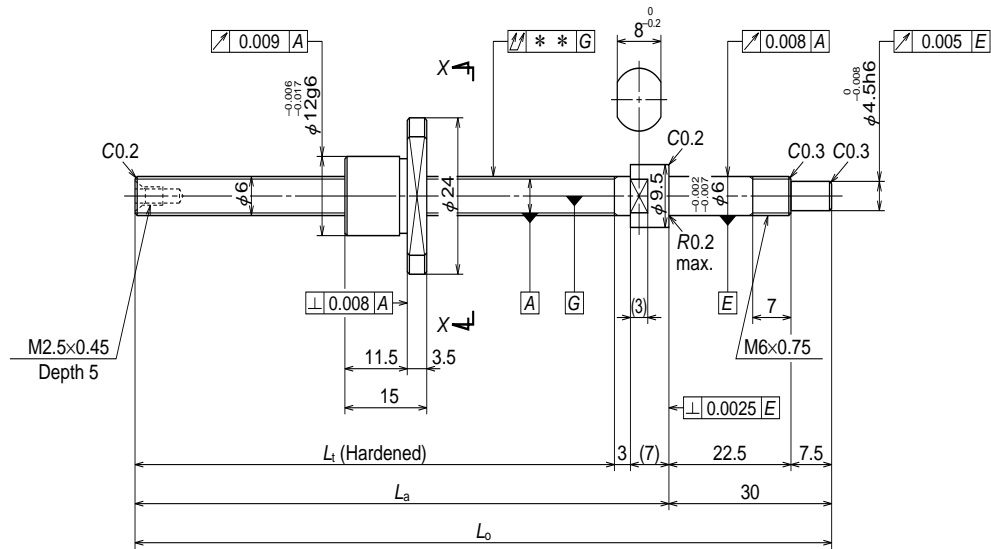
- Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. NSK grease PS2 is recommended. Apply to the screw shaft surface when replenishing. Refer to Page D16 for details.
  3. Nut does not have a seal.
  4. Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
$L_t$	$L_a$	$L_o$	$T$	$e_p$	$v_u$			Supporting condition
44	55	85	0	0.008	0.008	0.015	0.024	3000
64	75	105	0	0.008	0.008	0.020	0.026	3000
94	105	135	0	0.008	0.008	0.025	0.028	3000



# Finished shaft end MA Type

(Fine lead) Dia. 6, Lead 1

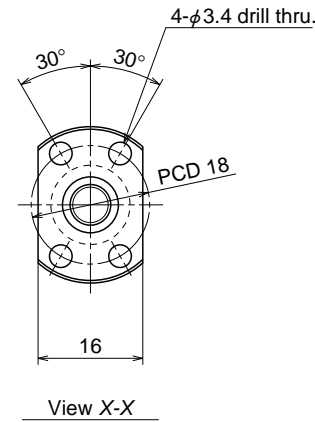


# Nut models: MPFD, MSFD

**NSK**

ø6×1

Unit: mm



## Ball screw specifications

Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	6x1/Right	
Preload / Ball recirculation	P preload / Deflector	
Ball dia. / Ball circle dia.	0.800/6.2	
Screw shaft root diameter	5.2	
Effective turns of balls	1x3	
Accuracy grade / Preload / Axial play	C3/Z	C3/T
Basic load rating (N)	Dynamic C <sub>a</sub>	575
	Static C <sub>0a</sub>	925
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

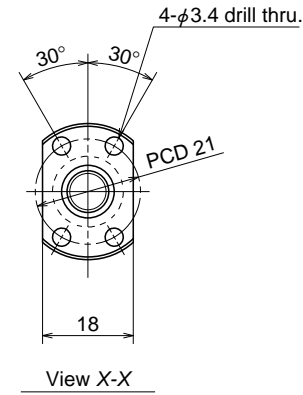
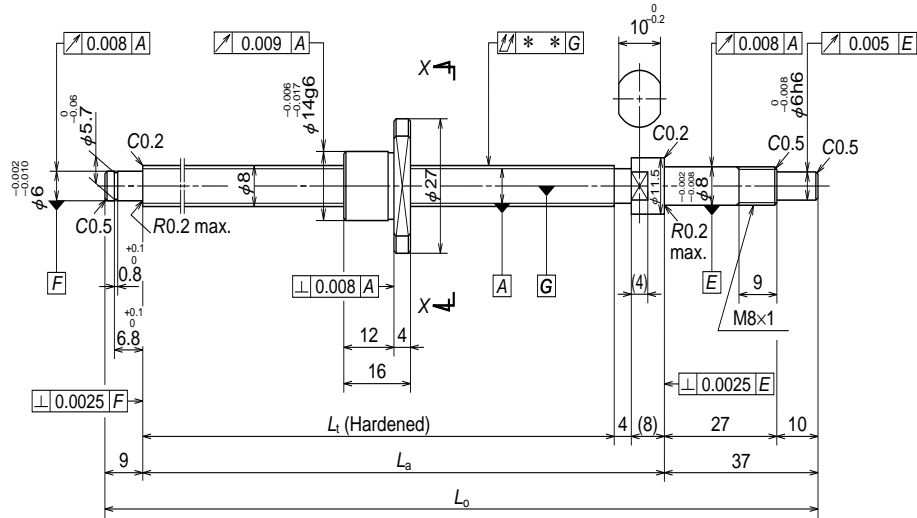
WBK06-01A	(square)
WBK06-11	(round)

Unit: mm

Ball screw No.		Stroke	
		Nominal	Maximum (L <sub>i</sub> —Nut length)
Preloaded (MPFD)	Precise clearance (MSFD)		
<b>W0600MA-1PY-C3Z1</b>	<b>W0600MA-2Y-C3T1</b>	40	50
<b>W0601MA-1PY-C3Z1</b>	<b>W0601MA-2Y-C3T1</b>	70	80
<b>W0601MA-3PY-C3Z1</b>	<b>W0601MA-4Y-C3T1</b>	100	110

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
L <sub>i</sub>	L <sub>a</sub>	L <sub>o</sub>	T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition
								Fixed - Free
65	75	105	0	0.008	0.008	0.015	0.039	3000
95	105	135	0	0.008	0.008	0.020	0.045	3000
125	135	165	0	0.010	0.008	0.025	0.051	3000

- Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. NSK grease PS2 is recommended. Apply to the screw shaft surface when replenishing. Refer to Page D16 for details.
  3. Nut does not have a seal.
  4. Contact NSK if permissible rotational speed is to be exceeded.



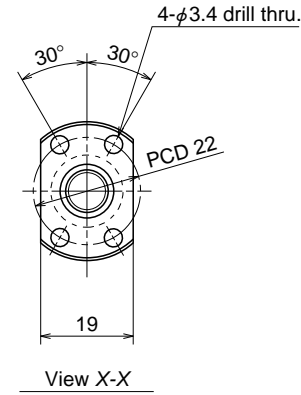
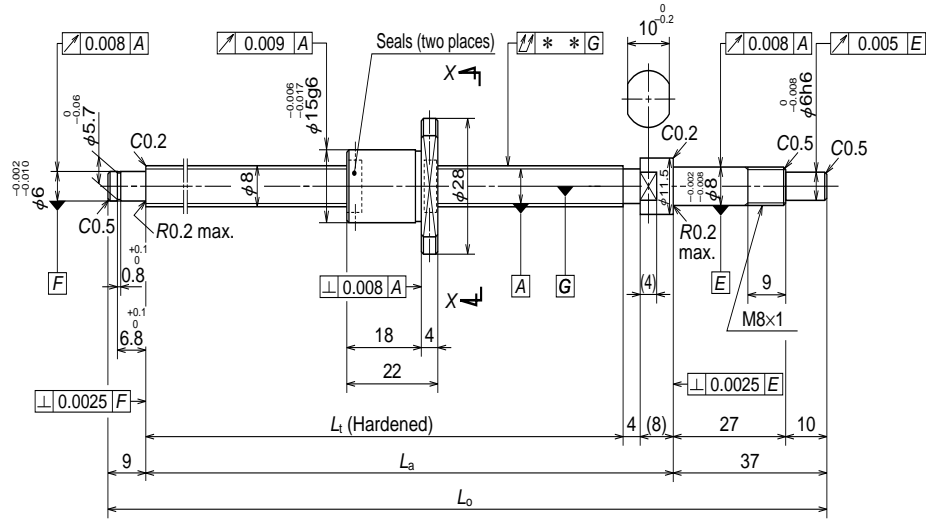
Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	8×1/Right	
Preload / Ball recirculation	P preload / Deflector	
Ball dia. / Ball circle dia.	0.800/8.2	
Screw shaft root diameter	7.2	
Effective turns of balls	1×3	
Accuracy grade / Preload / Axial play	C3/Z	C3/T
Basic load rating (N)	Dynamic $C_a$	670
	Static $C_{0a}$	1290
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	For opposite to drive side
WBK08S-01 (square)		○
WBK08-11 (round)	○	

Ball screw No.		Stroke	
		Nominal	Maximum ( $L_1$ —Nut length)
Preloaded (MPFD)	Precise clearance (MSFD)		
<b>W0800MA-1PY-C3Z1</b>	<b>W0800MA-2Y-C3T1</b>	40	64
<b>W0801MA-1PY-C3Z1</b>	<b>W0801MA-2Y-C3T1</b>	70	94
<b>W0801MA-3PY-C3Z1</b>	<b>W0801MA-4Y-C3T1</b>	100	124
<b>W0802MA-1PY-C3Z1</b>	<b>W0802MA-2Y-C3T1</b>	150	174

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
$L_1$	$L_a$	$L_o$	T	$e_p$	$v_u$			
80	92	138	0	0.008	0.008	0.025	0.073	3000
110	122	168	0	0.010	0.008	0.030	0.084	3000
140	152	198	0	0.010	0.008	0.030	0.095	3000
190	202	248	0	0.010	0.008	0.035	0.11	3000

- Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. NSK grease PS2 is recommended. Apply to the screw shaft surface when replenishing. Refer to Page D16 for details.
  3. Nut does not have a seal.
  4. Contact NSK if permissible rotational speed is to be exceeded.



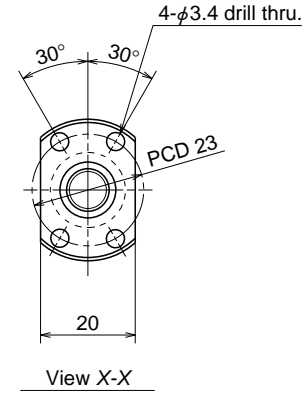
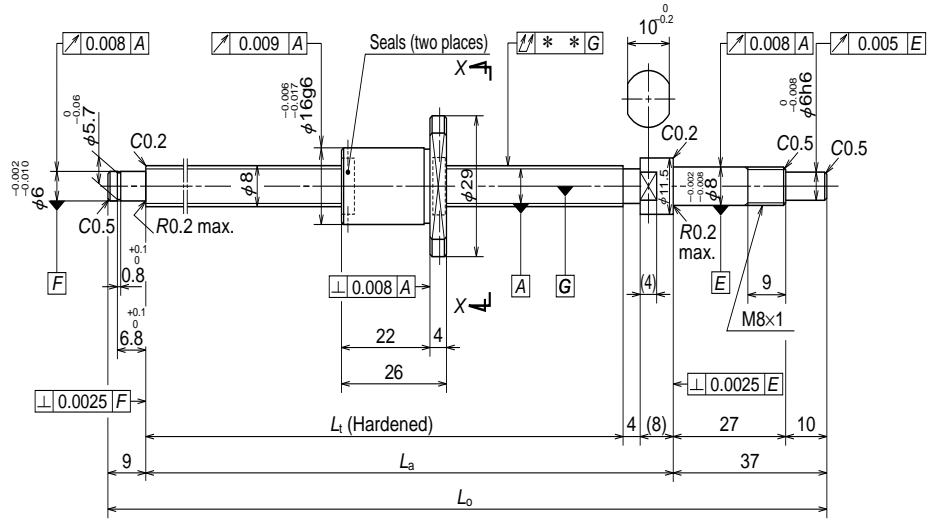
Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	8×1.5/Right	
Preload / Ball recirculation	P preload / Deflector	
Ball dia. / Ball circle dia.	1.000/8.3	
Screw shaft root diameter	7.0	
Effective turns of balls	1×3	
Accuracy grade / Preload / Axial play	C3/Z	C3/T
Basic load rating (N)	Dynamic $C_a$	1080
	Static $C_{0a}$	1980
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	Unit: mm	
	For drive side	For opposite to drive side
WBK08-01A (square)	○	
WBK08S-01 (square)		○
WBK08-11 (round)	○	

Ball screw No.		Stroke	
		Nominal	Maximum ( $L_t$ —Nut length)
Preloaded (MPFD)	Precise clearance (MSFD)		
<b>W0800MA-3PY-C3Z1.5</b>	<b>W0800MA-4Y-C3T1.5</b>	40	58
<b>W0801MA-5PY-C3Z1.5</b>	<b>W0801MA-6Y-C3T1.5</b>	70	88
<b>W0801MA-7PY-C3Z1.5</b>	<b>W0801MA-8Y-C3T1.5</b>	100	118
<b>W0802MA-3PY-C3Z1.5</b>	<b>W0802MA-4Y-C3T1.5</b>	150	168

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
$L_t$	$L_a$	$L_o$	T	$e_p$	$v_u$			
80	92	138	0	0.008	0.008	0.025	0.082	3000
110	122	168	0	0.010	0.008	0.030	0.093	3000
140	152	198	0	0.010	0.008	0.030	0.10	3000
190	202	248	0	0.010	0.008	0.035	0.12	3000

- Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. NSK grease PS2 is recommended. Apply to the screw shaft surface when replenishing. Refer to Page D16 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.



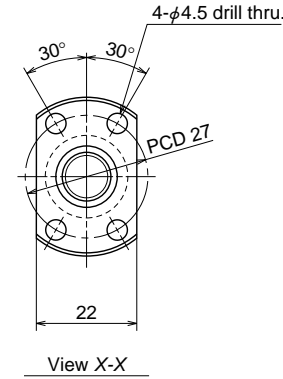
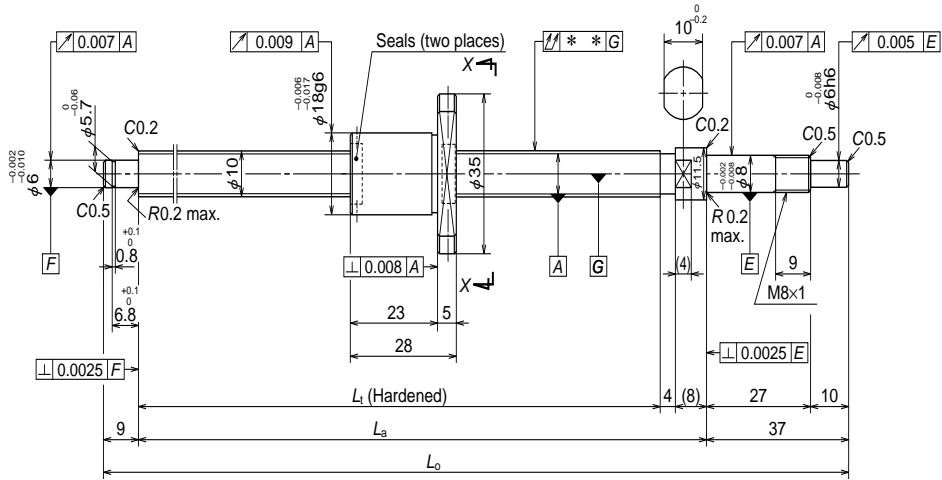
Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	8×2/Right	
Preload / Ball recirculation	P preload / Deflector	
Ball dia. / Ball circle dia.	1.200/8.3	
Screw shaft root diameter	6.9	
Effective turns of balls	1×3	
Accuracy grade / Preload / Axial play	C3/Z	C3/T
Basic load rating (N)	Dynamic $C_a$	1320
	Static $C_{0a}$	2210
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	Unit: mm	
	For drive side	For opposite to drive side
WBK08-01A (square)	○	
WBK08S-01 (square)		○
WBK08-11 (round)	○	

Ball screw No.		Stroke	
		Nominal	Maximum ( $L_t$ —Nut length)
Preloaded (MPFD)	Precise clearance (MSFD)		
<b>W0800MA-5PY-C3Z2</b>	<b>W0800MA-6Y-C3T2</b>	40	54
<b>W0801MA-9PY-C3Z2</b>	<b>W0801MA-10Y-C3T2</b>	70	84
<b>W0801MA-11PY-C3Z2</b>	<b>W0801MA-12Y-C3T2</b>	100	114
<b>W0802MA-5PY-C3Z2</b>	<b>W0802MA-6Y-C3T2</b>	150	164

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
$L_t$	$L_a$	$L_o$	T	$e_p$	$v_u$			Supporting condition
80	92	138	0	0.008	0.008	0.025	0.09	3000
110	122	168	0	0.010	0.008	0.030	0.10	3000
140	152	198	0	0.010	0.008	0.030	0.11	3000
190	202	248	0	0.010	0.008	0.035	0.13	3000

- Remarks:
- We recommend NSK support unit. Refer to Page B433 for details.
  - NSK grease PS2 is recommended. Apply to the screw shaft surface when replenishing. Refer to Page D16 for details.
  - Contact NSK if permissible rotational speed is to be exceeded.



Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	10×2/Right	
Preload / Ball recirculation	P preload / Deflector	
Ball dia. / Ball circle dia.	1.200/10.3	
Screw shaft root diameter	8.9	
Effective turns of balls	1×3	
Accuracy grade / Preload / Axial play	C3/Z	C3/T
Basic load rating (N)	Dynamic $C_a$	1490
	Static $C_{0a}$	2850
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	

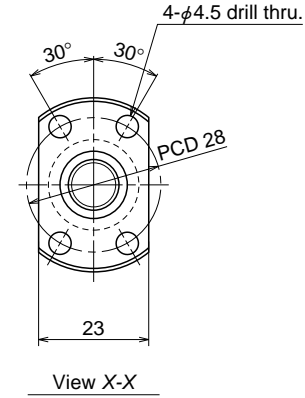
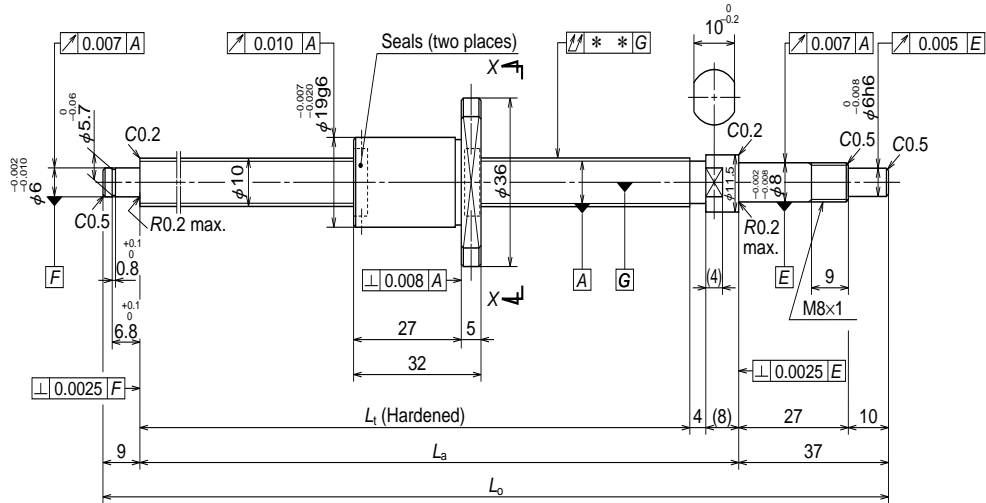
Recommended support unit	For drive side	For opposite to drive side
	WBK08-01A (square)	○
WBK08S-01 (square)		○
WBK08-11 (round)	○	

Unit: mm

Ball screw No.		Stroke	
		Nominal	Maximum ( $L_1$ —Nut length)
Preloaded (MPFD)	Precise clearance (MSFD)		
<b>W1001MA-1PY-C3Z2</b>	<b>W1001MA-2Y-C3T2</b>	50	72
<b>W1001MA-3PY-C3Z2</b>	<b>W1001MA-4Y-C3T2</b>	100	122
<b>W1002MA-1PY-C3Z2</b>	<b>W1002MA-2Y-C3T2</b>	150	172
<b>W1002MA-3PY-C3Z2</b>	<b>W1002MA-4Y-C3T2</b>	200	222

- Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.  
 2. NSK grease PS2 is recommended. Apply to the screw shaft surface when replenishing. Refer to Page D16 for details.  
 3. Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
$L_1$	$L_a$	$L_o$	$T$	$e_p$	$v_u$			Supporting condition
								Fixed - Simple support
100	112	158	0	0.008	0.008	0.020	0.13	3000
150	162	208	0	0.010	0.008	0.030	0.16	3000
200	212	258	0	0.010	0.008	0.030	0.19	3000
250	262	308	0	0.012	0.008	0.030	0.22	3000



Ball screw specifications

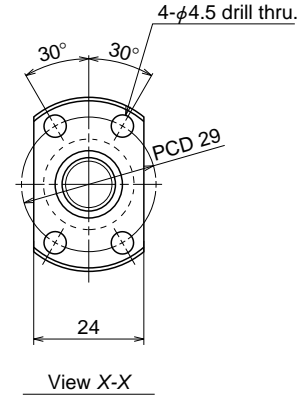
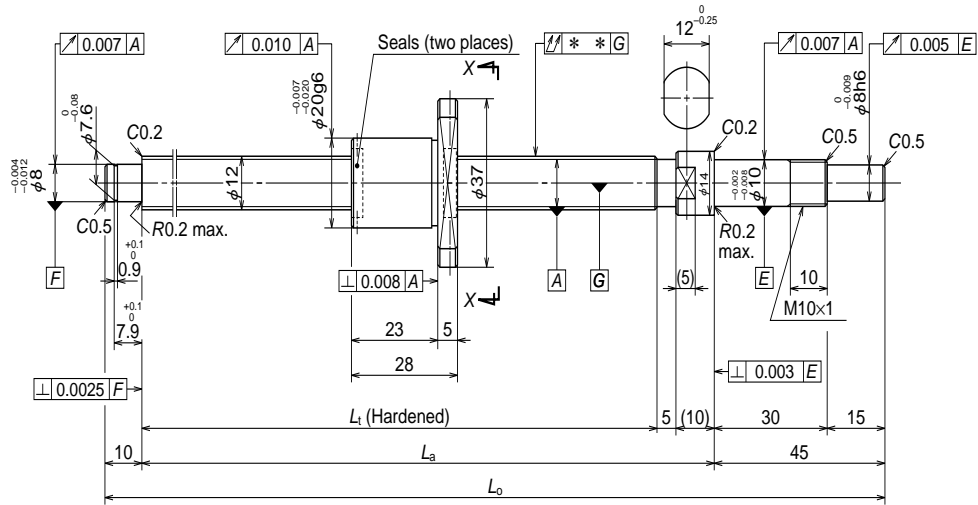
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	10x2.5/Right	
Preload / Ball recirculation	P preload / Deflector	
Ball dia. / Ball circle dia.	1.588/10.4	
Screw shaft root diameter	8.6	
Effective turns of balls	1x3	
Accuracy grade / Preload / Axial play	C3/Z	C3/T
Basic load rating (N)	Dynamic $C_a$	2130
	Static $C_{0a}$	3640
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	Unit: mm	
	For drive side	For opposite to drive side
WBK08-01A (square)	○	
WBK08S-01 (square)		○
WBK08-11 (round)	○	

Ball screw No.		Stroke	
		Nominal	Maximum ( $L_1$ —Nut length)
Preloaded (MPFD)	Precise clearance (MSFD)		
<b>W1001MA-5PY-C3Z2.5</b>	<b>W1001MA-6Y-C3T2.5</b>	50	68
<b>W1001MA-7PY-C3Z2.5</b>	<b>W1001MA-8Y-C3T2.5</b>	100	118
<b>W1002MA-5PY-C3Z2.5</b>	<b>W1002MA-6Y-C3T2.5</b>	150	168
<b>W1002MA-7PY-C3Z2.5</b>	<b>W1002MA-8Y-C3T2.5</b>	200	218

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
$L_1$	$L_a$	$L_0$	T	$e_p$	$v_u$			
100	112	158	0	0.008	0.008	0.020	0.14	3000
150	162	208	0	0.010	0.008	0.030	0.17	3000
200	212	258	0	0.010	0.008	0.030	0.20	3000
250	262	308	0	0.012	0.008	0.030	0.23	3000

- Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. NSK grease PS2 is recommended. Apply to the screw shaft surface when replenishing. Refer to Page D16 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.



Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	12×2/Right	
Preload / Ball recirculation	P preload / Deflector	
Ball dia. / Ball circle dia.	1.200/12.3	
Screw shaft root diameter	10.9	
Effective turns of balls	1×3	
Accuracy grade / Preload / Axial play	C3/Z	C3/T
Basic load rating (N)	Dynamic C <sub>a</sub>	1660
	Static C <sub>0a</sub>	3620
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	

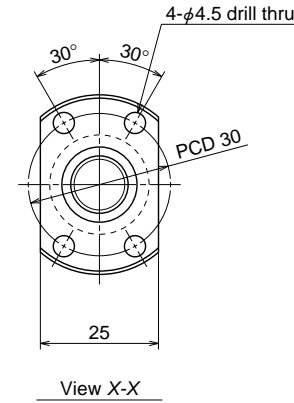
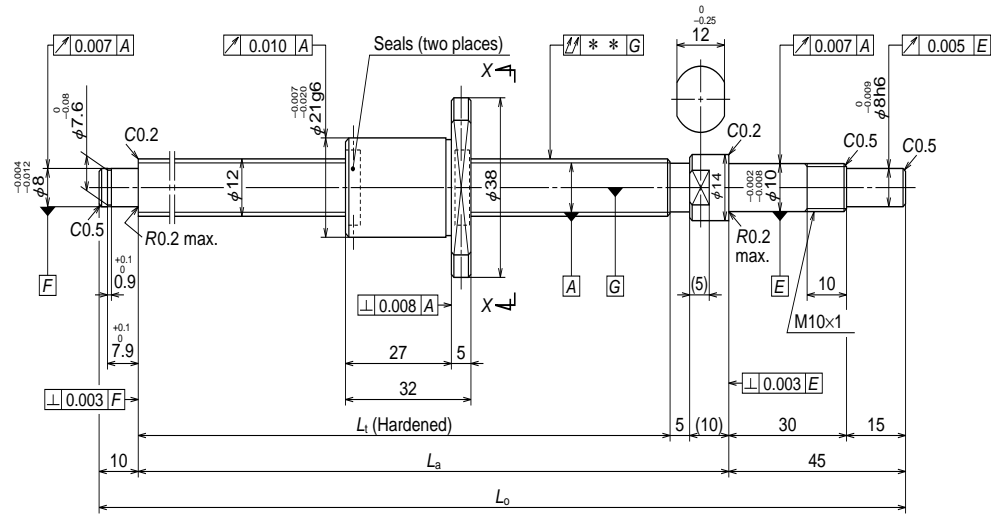
Recommended support unit		For drive side	For opposite to drive side
		WBK10-01A (square)	○
WBK10S-01 (square)			○
WBK10-11 (round)		○	

Unit: mm

Ball screw No.		Stroke	
		Nominal	Maximum (L <sub>t</sub> —Nut length)
Preloaded (MPFD)	Precise clearance (MSFD)		
<b>W1201MA-1PY-C3Z2</b>	<b>W1201MA-2Y-C3T2</b>	50	82
<b>W1201MA-3PY-C3Z2</b>	<b>W1201MA-4Y-C3T2</b>	100	132
<b>W1202MA-1PY-C3Z2</b>	<b>W1202MA-2Y-C3T2</b>	150	182
<b>W1202MA-3PY-C3Z2</b>	<b>W1202MA-4Y-C3T2</b>	200	232
<b>W1203MA-1PY-C3Z2</b>	<b>W1203MA-2Y-C3T2</b>	250	282

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
L <sub>t</sub>	L <sub>a</sub>	L <sub>o</sub>	T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition
110	125	180	0	0.010	0.008	0.020	0.20	3000
160	175	230	0	0.010	0.008	0.030	0.24	3000
210	225	280	0	0.012	0.008	0.030	0.28	3000
260	275	330	0	0.012	0.008	0.040	0.32	3000
310	325	380	0	0.012	0.008	0.040	0.36	3000

- Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.  
 2. NSK grease PS2 is recommended. Apply to the screw shaft surface when replenishing. Refer to Page D16 for details.  
 3. Contact NSK if permissible rotational speed is to be exceeded.



Ball screw specifications

Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	12x2.5/Right	
Preload / Ball recirculation	P preload / Deflector	
Ball dia. / Ball circle dia.	1.588/12.4	
Screw shaft root diameter	10.6	
Effective turns of balls	1x3	
Accuracy grade / Preload / Axial play	C3/Z	C3/T
Basic load rating (N)	Dynamic $C_a$	2360
	Static $C_{0a}$	4540
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	

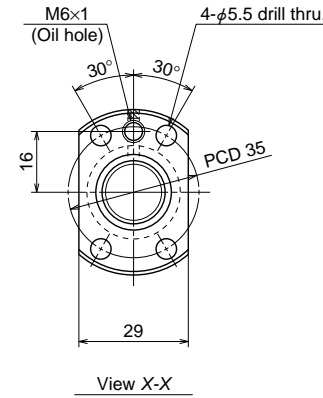
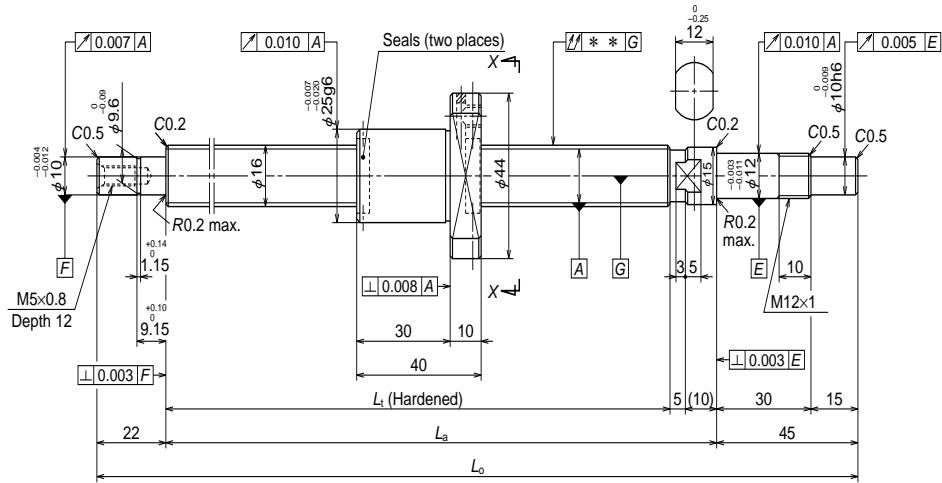
Recommended support unit	Unit: mm	
	For drive side	For opposite to drive side
WBK10-01A (square)	○	
WBK10S-01 (square)		○
WBK10-11 (round)	○	

Ball screw No.		Stroke	
		Nominal	Maximum ( $L_1$ —Nut length)
Preloaded (MPFD)	Precise clearance (MSFD)		
<b>W1201MA-5PY-C3Z2.5</b>	<b>W1201MA-6Y-C3T2.5</b>	50	78
<b>W1201MA-7PY-C3Z2.5</b>	<b>W1201MA-8Y-C3T2.5</b>	100	128
<b>W1202MA-5PY-C3Z2.5</b>	<b>W1202MA-6Y-C3T2.5</b>	150	178
<b>W1202MA-7PY-C3Z2.5</b>	<b>W1202MA-8Y-C3T2.5</b>	200	228
<b>W1203MA-3PY-C3Z2.5</b>	<b>W1203MA-4Y-C3T2.5</b>	250	278

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
$L_1$	$L_a$	$L_o$	T	$e_p$	$v_u$			
110	125	180	0	0.010	0.008	0.020	0.21	3000
160	175	230	0	0.010	0.008	0.030	0.25	3000
210	225	280	0	0.012	0.008	0.030	0.29	3000
260	275	330	0	0.012	0.008	0.040	0.33	3000
310	325	380	0	0.012	0.008	0.040	0.37	3000

- Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. NSK grease PS2 is recommended. Apply to the screw shaft surface when replenishing. Refer to Page D16 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.





Ball screw specifications

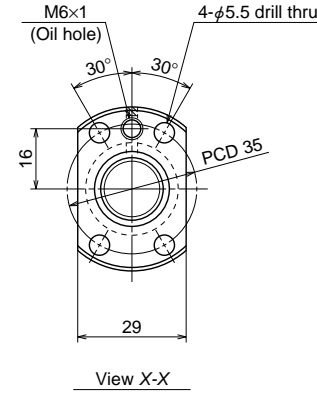
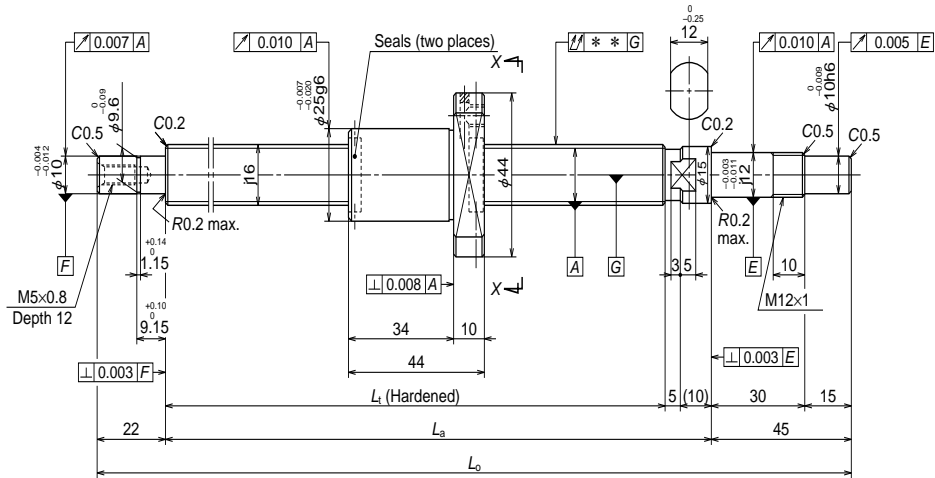
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	16x2/Right	
Preload / Ball recirculation	P preload / Deflector	
Ball dia. / Ball circle dia.	1.588/16.4	
Screw shaft root diameter	14.6	
Effective turns of balls	1x4	
Accuracy grade / Preload / Axial play	C3/Z	C3/T
Basic load rating (N)	Dynamic $C_a$	3510
	Static $C_{0a}$	8450
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	
Internal spatial volume of nut (cm <sup>3</sup> )	1.6	
Standard volume of grease replenishing (cm <sup>3</sup> )	0.8	

Recommended support unit	For drive side	For opposite to drive side
WBK12-01A (square)	○	
WBK12S-01 (square)		○
WBK12-11 (round)	○	

Ball screw No.		Stroke	
		Nominal	Maximum ( $L_1$ —Nut length)
Preloaded (MPFD)	Precise clearance (MSFD)		
<b>W1601MA-1PY-C3Z2</b>	<b>W1601MA-2Y-C3T2</b>	50	99
<b>W1601MA-3PY-C3Z2</b>	<b>W1601MA-4Y-C3T2</b>	100	149
<b>W1602MA-1PY-C3Z2</b>	<b>W1602MA-2Y-C3T2</b>	150	199
<b>W1602MA-3PY-C3Z2</b>	<b>W1602MA-4Y-C3T2</b>	200	249
<b>W1603MA-1PY-C3Z2</b>	<b>W1603MA-2Y-C3T2</b>	300	349

- Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.  
 2. NSK grease PS2 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.  
 3. Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
$L_1$	$L_a$	$L_o$	$T$	$e_p$	$v_u$			Supporting condition	
								Fixed - Simple support	Fixed - Fixed
139	154	221	0	0.010	0.008	0.020	0.41	3000	3000
189	204	271	0	0.010	0.008	0.020	0.48	3000	3000
239	254	321	0	0.012	0.008	0.030	0.55	3000	3000
289	304	371	0	0.012	0.008	0.030	0.62	3000	3000
389	404	471	0	0.013	0.010	0.035	0.77	3000	3000



Ball screw specifications

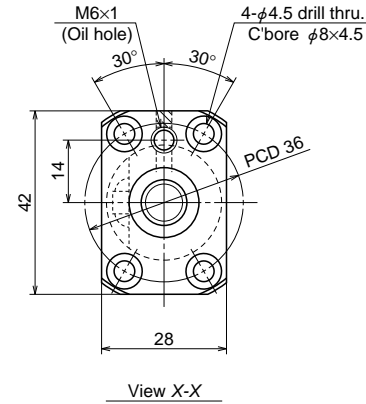
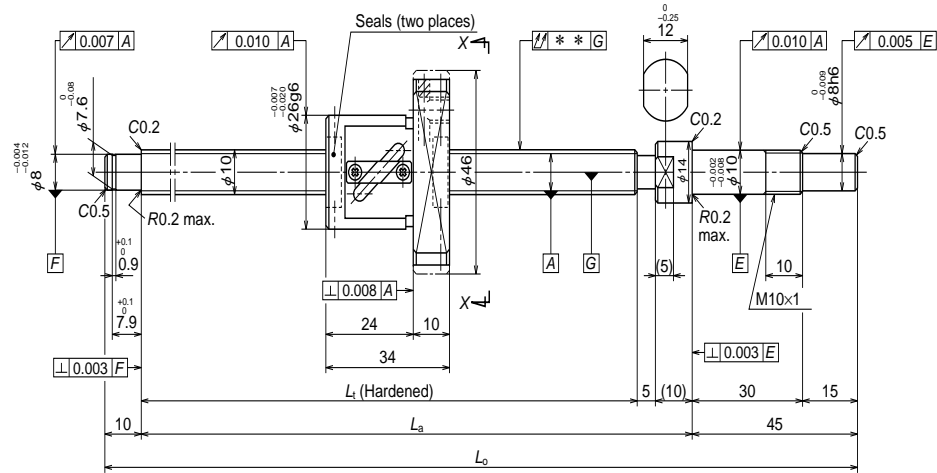
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		16x2.5/Right	
Preload / Ball recirculation		P preload / Deflector	
Ball dia. / Ball circle dia.		1.588/16.4	
Screw shaft root diameter		14.6	
Effective turns of balls		1x4	
Accuracy grade / Preload / Axial play		C3/Z	C3/T
Basic load rating (N)	Dynamic $C_a$	3510	
	Static $C_{0a}$	8450	
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	
Internal spatial volume of nut (cm <sup>3</sup> )		1.6	
Standard volume of grease replenishing (cm <sup>3</sup> )		0.8	

Recommended support unit	For drive side	For opposite to drive side
	WBK12-01A (square)	○
WBK12S-01 (square)	○	○
WBK12-11 (round)	○	○

Ball screw No.		Stroke	
		Nominal	Maximum ( $L_1$ —Nut length)
Preloaded (MPFD)	Precise clearance (MSFD)		
<b>W1601MA-5PY-C3Z2.5</b>	<b>W1601MA-6Y-C3T2.5</b>	50	95
<b>W1601MA-7PY-C3Z2.5</b>	<b>W1601MA-8Y-C3T2.5</b>	100	145
<b>W1602MA-5PY-C3Z2.5</b>	<b>W1602MA-6Y-C3T2.5</b>	150	195
<b>W1602MA-7PY-C3Z2.5</b>	<b>W1602MA-8Y-C3T2.5</b>	200	245
<b>W1603MA-3PY-C3Z2.5</b>	<b>W1603MA-4Y-C3T2.5</b>	300	345

- Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.  
 2. NSK grease PS2 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.  
 3. Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
$L_1$	$L_a$	$L_o$	T	$e_p$	$v_u$			Supporting condition	
								Fixed - Simple support	Fixed - Fixed
139	154	221	0	0.010	0.008	0.020	0.42	3000	3000
189	204	271	0	0.010	0.008	0.020	0.49	3000	3000
239	254	321	0	0.012	0.008	0.030	0.57	3000	3000
289	304	371	0	0.012	0.008	0.030	0.64	3000	3000
389	404	471	0	0.013	0.010	0.035	0.79	3000	3000



Ball screw specifications			
Product classification	Preloaded	Precise clearance	
Shaft dia. x Lead / Direction of turn	10x4/Right		
Preload / Ball recirculation	P preload / Return tube		
Ball dia. / Ball circle dia.	2.000/10.3		
Screw shaft root diameter	8.2		
Effective turns of balls	2.5x1		
Accuracy grade / Preload / Axial play	C3/Z	C3/T	
Basic load rating (N)	Dynamic C <sub>a</sub>	1730	2740
	Static C <sub>0a</sub>	2230	4450
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		
Internal spatial volume of nut (cm <sup>3</sup> )	0.8		
Standard volume of grease replenishing (cm <sup>3</sup> )	0.4		

Recommended support unit	For drive side	For opposite to drive side
	WBK10-01A (square)	○
WBK10S-01 (square)		○
WBK10-11 (round)	○	

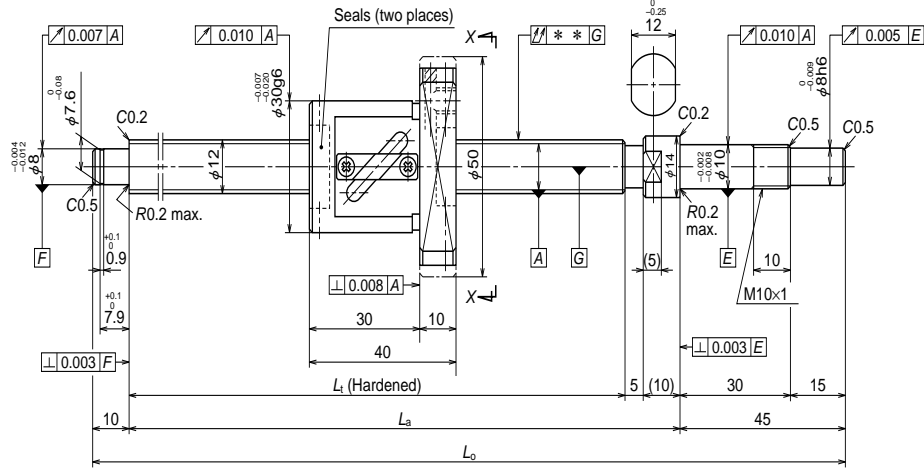
Ball screw No.		Stroke	
		Nominal	Maximum (L <sub>i</sub> —Nut length)
Preloaded (PFT)	Precise clearance (SFT)		
<b>W1001FA-1P-C3Z4</b>	<b>W1001FA-2-C3T4</b>	50	76
<b>W1001FA-3P-C3Z4</b>	<b>W1001FA-4-C3T4</b>	100	126
<b>W1002FA-1P-C3Z4</b>	<b>W1002FA-2-C3T4</b>	150	176
<b>W1002FA-3P-C3Z4</b>	<b>W1002FA-4-C3T4</b>	200	226
<b>W1003FA-1P-C3Z4</b>	<b>W1003FA-2-C3T4</b>	250	276
<b>W1003FA-3P-C3Z4</b>	<b>W1003FA-4-C3T4</b>	300	326

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> ) Supporting condition Fixed - Simple support
L <sub>i</sub>	L <sub>a</sub>	L <sub>o</sub>	T	e <sub>p</sub>	v <sub>u</sub>			
110	125	180	0	0.010	0.008	0.020	0.26	3000
160	175	230	0	0.010	0.008	0.030	0.28	3000
210	225	280	0	0.012	0.008	0.030	0.31	3000
260	275	330	0	0.012	0.008	0.040	0.34	3000
310	325	380	0	0.012	0.008	0.040	0.37	3000
360	375	430	0	0.013	0.010	0.050	0.39	3000

- Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.  
 2. NSK grease PS2 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.  
 3. Contact NSK if permissible rotational speed is to be exceeded.

# Finished shaft end FA Type

(Fine lead) Dia. 12, Lead 5

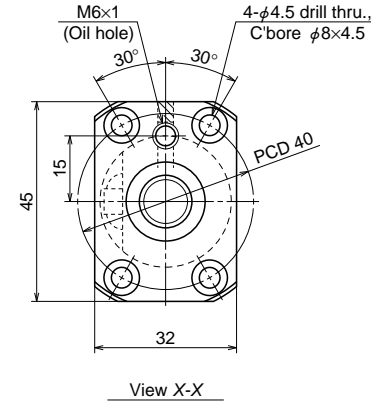


# Nut models: PFT, SFT

**NSK**

ø12×5

Unit: mm



## Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		12×5/Right	
Preload / Ball recirculation		P preload / Return tube	
Ball dia. / Ball circle dia.		2.381/12.3	
Screw shaft root diameter		9.8	
Effective turns of balls		2.5×1	
Accuracy grade / Preload / Axial play		C3/Z	C3/T
Basic load rating (N)	Dynamic C <sub>a</sub>	2370	3760
	Static C <sub>0a</sub>	3160	6310
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	
Internal spatial volume of nut (cm <sup>3</sup> )		1.2	
Standard volume of grease replenishing (cm <sup>3</sup> )		0.6	

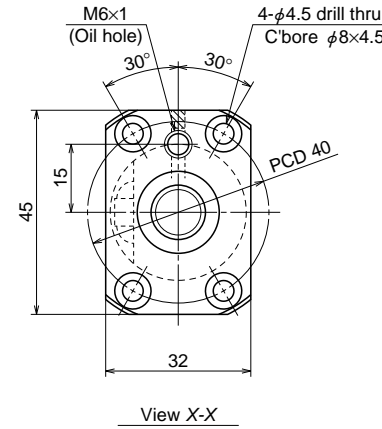
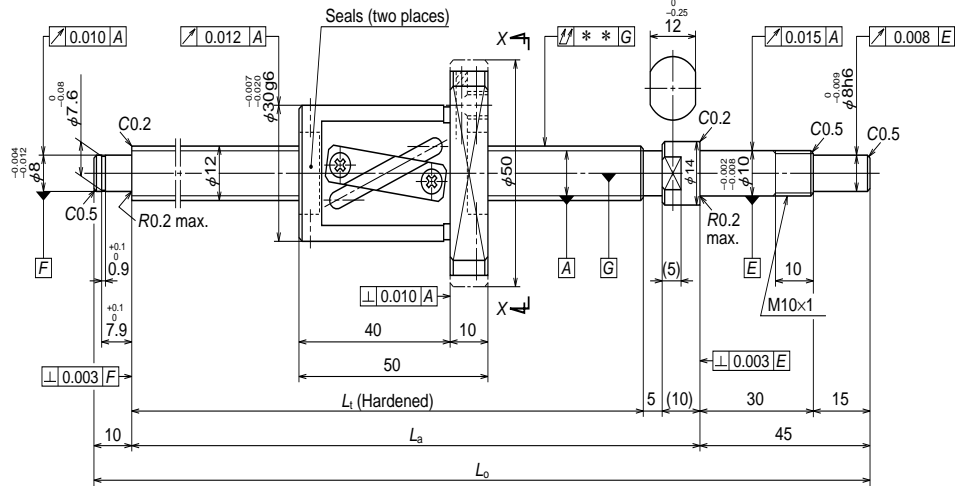
Recommended support unit		For drive side	For opposite to drive side
WBK10-01A	(square)	○	
WBK10S-01	(square)		○
WBK10-11	(round)	○	

Unit: mm

Ball screw No.		Stroke	
		Nominal	Maximum (L <sub>1</sub> —Nut length)
Preloaded (PFT)	Precise clearance (SFT)		
<b>W1201FA-1P-C3Z5</b>	<b>W1201FA-2-C3T5</b>	50	70
<b>W1201FA-3P-C3Z5</b>	<b>W1201FA-4-C3T5</b>	100	120
<b>W1202FA-1P-C3Z5</b>	<b>W1202FA-2-C3T5</b>	150	170
<b>W1202FA-3P-C3Z5</b>	<b>W1202FA-4-C3T5</b>	200	220
<b>W1203FA-1P-C3Z5</b>	<b>W1203FA-2-C3T5</b>	250	270
<b>W1204FA-1P-C3Z5</b>	<b>W1204FA-2-C3T5</b>	350	370
<b>W1205FA-1P-C3Z5</b>	<b>W1205FA-2-C3T5</b>	450	470

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> ) Supporting condition Fixed · Simple support
L <sub>1</sub>	L <sub>a</sub>	L <sub>o</sub>	T	e <sub>p</sub>	v <sub>u</sub>			
110	125	180	0	0.010	0.008	0.020	0.35	3000
160	175	230	0	0.010	0.008	0.030	0.38	3000
210	225	280	0	0.012	0.008	0.030	0.42	3000
260	275	330	0	0.012	0.008	0.040	0.46	3000
310	325	380	0	0.012	0.008	0.040	0.50	3000
410	425	480	0	0.015	0.010	0.050	0.58	3000
510	525	580	0	0.016	0.012	0.065	0.66	3000

- Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. NSK grease PS2 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.



Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	12×10/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	2.381/12.5	
Screw shaft root diameter	10.0	
Effective turns of balls	2.5×1	
Accuracy grade / Preload / Axial play	C5/Z	C5/T
Basic load rating (N)	Dynamic C <sub>a</sub>	2360
	Static C <sub>0a</sub>	3240
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	
Internal spatial volume of nut (cm <sup>3</sup> )	1.4	
Standard volume of grease replenishing (cm <sup>3</sup> )	0.7	

Recommended support unit	For drive side	For opposite to drive side
	WBK10-01A (square)	○
WBK10S-01 (square)		○
WBK10-11 (round)	○	

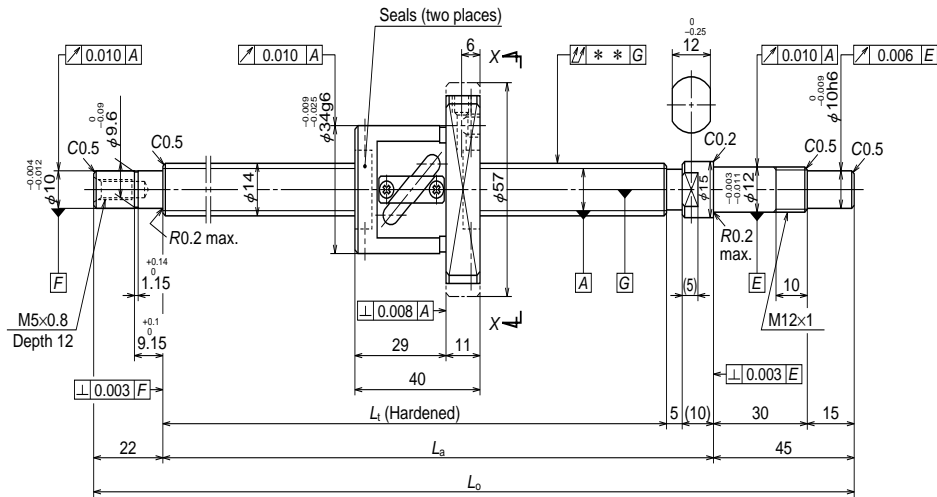
Ball screw No.		Stroke	
		Nominal	Maximum (L <sub>t</sub> —Nut length)
Preloaded (LPFT)	Precise clearance (LSFT)		
<b>W1201FA-5P-C5Z10</b>	<b>W1201FA-6-C5T10</b>	100	110
<b>W1202FA-5P-C5Z10</b>	<b>W1202FA-6-C5T10</b>	150	160
<b>W1203FA-3P-C5Z10</b>	<b>W1203FA-4-C5T10</b>	250	260
<b>W1204FA-3P-C5Z10</b>	<b>W1204FA-4-C5T10</b>	350	360
<b>W1205FA-3P-C5Z10</b>	<b>W1205FA-4-C5T10</b>	450	460

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
L <sub>t</sub>	L <sub>a</sub>	L <sub>o</sub>	T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition
160	175	230	0	0.020	0.018	0.035	0.43	3000
210	225	280	0	0.023	0.018	0.035	0.47	3000
310	325	380	0	0.023	0.018	0.050	0.56	3000
410	425	480	0	0.027	0.020	0.060	0.64	3000
510	525	580	0	0.030	0.023	0.075	0.72	3000

Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.  
 2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.  
 3. Contact NSK if permissible rotational speed is to be exceeded.

# Finished shaft end FA Type

(Fine lead) Dia. 14, Lead 5

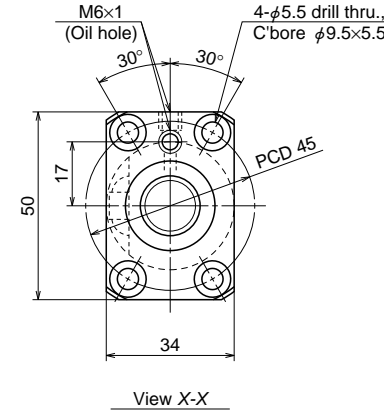


# Nut models: PFT, SFT

**NSK**

ø14×5

Unit: mm



## Ball screw specifications

Product classification	Preloaded	Precise clearance	
Shaft dia. x Lead / Direction of turn	14x5/Right		
Preload / Ball recirculation	P preload / Return tube		
Ball dia. / Ball circle dia.	3.175/14.5		
Screw shaft root diameter	11.2		
Effective turns of balls	2.5x1		
Accuracy grade / Preload / Axial play	C3/Z	C3/T	
Basic load rating (N)	Dynamic C <sub>a</sub>	4280	6790
	Static C <sub>0a</sub>	5840	11700
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		
Internal spatial volume of nut (cm <sup>3</sup> )	2.2		
Standard volume of grease replenishing (cm <sup>3</sup> )	1.1		

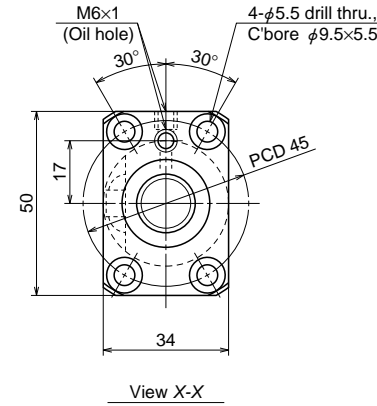
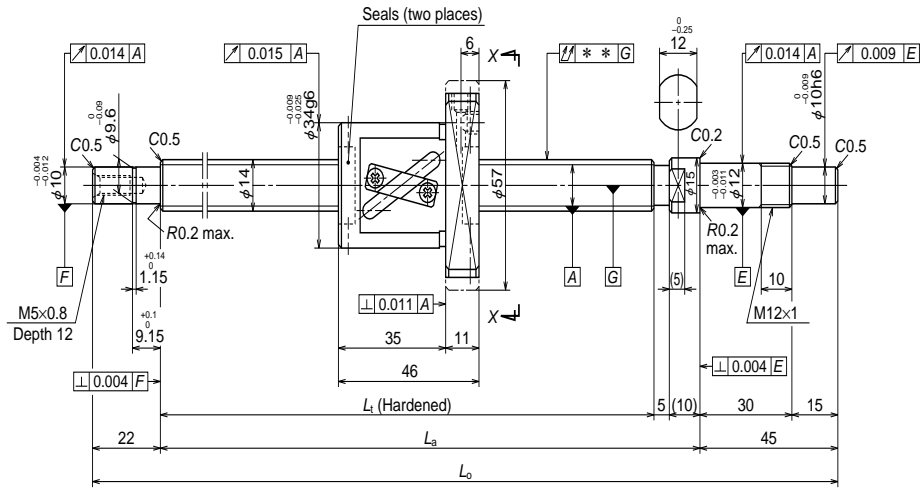
Recommended support unit	For drive side	For opposite to drive side
WBK12-01A (square)	○	
WBK12S-01 (square)		○
WBK12-11 (round)	○	

Unit: mm

Ball screw No.		Stroke	
Preloaded (PFT)	Precise clearance (SFT)	Nominal	Maximum (L <sub>1</sub> —Nut length)
<b>W1401FA-1P-C3Z5</b>	<b>W1401FA-2-C3T5</b>	100	149
<b>W1402FA-1P-C3Z5</b>	<b>W1402FA-2-C3T5</b>	150	199
<b>W1403FA-1P-C3Z5</b>	<b>W1403FA-2-C3T5</b>	250	299
<b>W1404FA-1P-C3Z5</b>	<b>W1404FA-2-C3T5</b>	350	399
<b>W1405FA-1P-C3Z5</b>	<b>W1405FA-2-C3T5</b>	450	499
<b>W1406FA-1P-C3Z5</b>	<b>W1406FA-2-C3T5</b>	600	649

- Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.  
 2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.  
 3. Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
L <sub>1</sub>	L <sub>a</sub>	L <sub>0</sub>	T	e <sub>p</sub>	v <sub>a</sub>			Supporting condition	
								Fixed - Simple support	Fixed - Fixed
189	204	271	0	0.010	0.008	0.020	0.52	3000	3000
239	254	321	0	0.012	0.008	0.030	0.57	3000	3000
339	354	421	0	0.013	0.010	0.035	0.67	3000	3000
439	454	521	0	0.015	0.010	0.045	0.77	3000	3000
539	554	621	0	0.016	0.012	0.045	0.87	3000	3000
689	704	771	0	0.018	0.013	0.055	1.0	3000	3000



Recommended support unit	For drive side	For opposite to drive side
WBK12-01A (square)	○	
WBK12S-01 (square)		○
WBK12-11 (round)	○	

Ball screw specifications

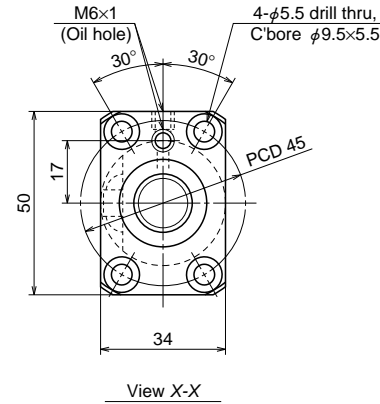
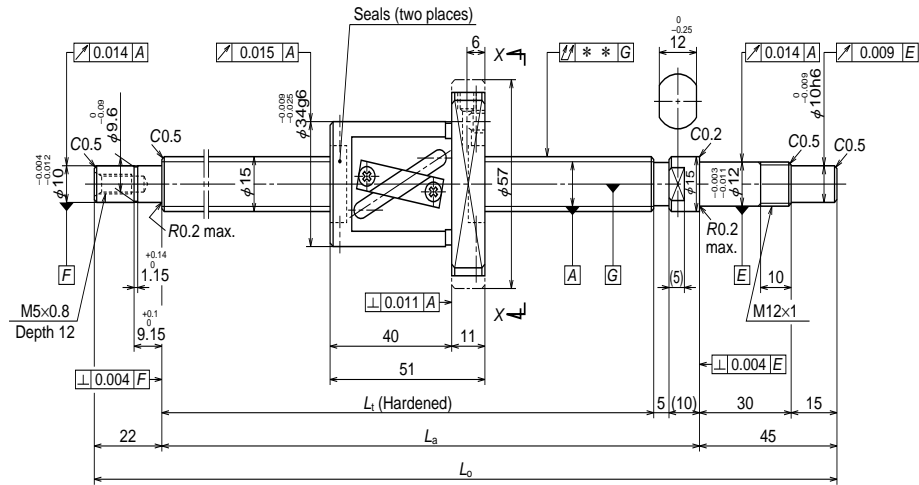
Product classification	Preloaded	Precise clearance	
Shaft dia. x Lead / Direction of turn	14x8/Right		
Preload / Ball recirculation	P preload / Return tube		
Ball dia. / Ball circle dia.	3.175/14.5		
Screw shaft root diameter	11.2		
Effective turns of balls	2.5x1		
Accuracy grade / Preload / Axial play	C5/Z	C5/T	
Basic load rating (N)	Dynamic C <sub>a</sub>	4280	6790
	Static C <sub>0a</sub>	5840	11700
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		
Internal spatial volume of nut (cm <sup>3</sup> )	2.1		
Standard volume of grease replenishing (cm <sup>3</sup> )	1.1		

Unit: mm

Ball screw No.		Stroke	
		Nominal	Maximum (L <sub>1</sub> —Nut length)
Preloaded (LPFT)	Precise clearance (LSFT)		
<b>W1401FA-3P-C5Z8</b>	<b>W1401FA-4-C5T8</b>	100	143
<b>W1402FA-3P-C5Z8</b>	<b>W1402FA-4-C5T8</b>	150	193
<b>W1402FA-5P-C5Z8</b>	<b>W1402FA-6-C5T8</b>	200	243
<b>W1403FA-3P-C5Z8</b>	<b>W1403FA-4-C5T8</b>	250	293
<b>W1403FA-5P-C5Z8</b>	<b>W1403FA-6-C5T8</b>	300	343
<b>W1404FA-3P-C5Z8</b>	<b>W1404FA-4-C5T8</b>	350	393
<b>W1404FA-5P-C5Z8</b>	<b>W1404FA-6-C5T8</b>	400	443
<b>W1405FA-3P-C5Z8</b>	<b>W1405FA-4-C5T8</b>	450	493
<b>W1405FA-5P-C5Z8</b>	<b>W1405FA-6-C5T8</b>	500	543
<b>W1406FA-3P-C5Z8</b>	<b>W1406FA-4-C5T8</b>	550	593
<b>W1406FA-5P-C5Z8</b>	<b>W1406FA-6-C5T8</b>	600	643
<b>W1407FA-1P-C5Z8</b>	<b>W1407FA-2-C5T8</b>	700	743

- Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
								Supporting condition	
L <sub>1</sub>	L <sub>a</sub>	L <sub>0</sub>	T	e <sub>p</sub>	v <sub>a</sub>		Fixed - Simple support	Fixed - Fixed	
189	204	271	0	0.020	0.018	0.025	0.56	3000	3000
239	254	321	0	0.023	0.018	0.035	0.61	3000	3000
289	304	371	0	0.023	0.018	0.035	0.67	3000	3000
339	354	421	0	0.025	0.020	0.040	0.72	3000	3000
389	404	471	0	0.025	0.020	0.040	0.78	3000	3000
439	454	521	0	0.027	0.020	0.050	0.83	3000	3000
489	504	571	0	0.027	0.020	0.050	0.88	3000	3000
539	554	621	0	0.030	0.023	0.050	0.94	3000	3000
589	604	671	0	0.030	0.023	0.065	0.99	3000	3000
639	654	721	0	0.035	0.025	0.065	1.0	3000	3000
689	704	771	0	0.035	0.025	0.065	1.1	3000	3000
789	804	871	0	0.035	0.025	0.085	1.2	2800	3000



Recommended support unit	For drive side	For opposite to drive side
WBK12-01A (square)	○	
WBK12S-01 (square)		○
WBK12-11 (round)	○	

Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	15×10/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	3.175/15.5	
Screw shaft root diameter	12.2	
Effective turns of balls	2.5×1	
Accuracy grade / Preload / Axial play	C5/Z	C5/T
Basic load rating (N)	Dynamic C <sub>a</sub>	4450
	Static C <sub>0a</sub>	6380
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	
Internal spatial volume of nut (cm <sup>3</sup> )	2.3	
Standard volume of grease replenishing (cm <sup>3</sup> )	1.2	

Unit: mm

Ball screw No.		Stroke	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L <sub>1</sub> —Nut length)
W1501FA-1P-C5Z10	W1501FA-2-C5T10	100	138
W1502FA-1P-C5Z10	W1502FA-2-C5T10	150	188
W1502FA-3P-C5Z10	W1502FA-4-C5T10	200	238
W1503FA-1P-C5Z10	W1503FA-2-C5T10	250	288
W1503FA-3P-C5Z10	W1503FA-4-C5T10	300	338
W1504FA-1P-C5Z10	W1504FA-2-C5T10	350	388
W1504FA-3P-C5Z10	W1504FA-4-C5T10	400	438
W1505FA-1P-C5Z10	W1505FA-2-C5T10	450	488
W1505FA-3P-C5Z10	W1505FA-4-C5T10	500	538
W1506FA-1P-C5Z10	W1506FA-2-C5T10	550	588
W1506FA-3P-C5Z10	W1506FA-4-C5T10	600	638
W1507FA-1P-C5Z10	W1507FA-2-C5T10	700	738
W1508FA-1P-C5Z10	W1508FA-2-C5T10	800	838
W1510FA-1P-C5Z10	W1510FA-2-C5T10	1000	1038

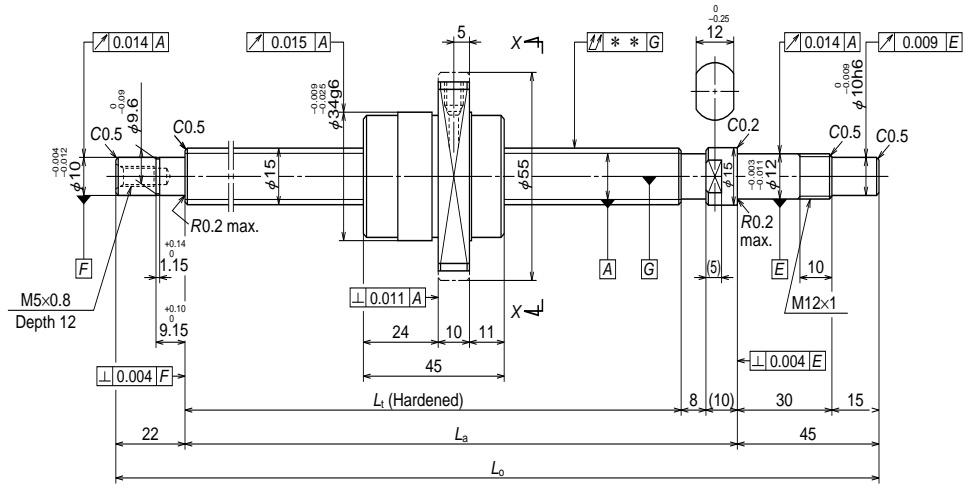
Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
L <sub>1</sub>	L <sub>a</sub>	L <sub>o</sub>	T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition	
								Fixed - Simple support	Fixed - Fixed
189	204	271	0	0.020	0.018	0.025	0.61	3000	3000
239	254	321	0	0.023	0.018	0.035	0.67	3000	3000
289	304	371	0	0.023	0.018	0.035	0.74	3000	3000
339	354	421	0	0.025	0.020	0.040	0.80	3000	3000
389	404	471	0	0.025	0.020	0.040	0.86	3000	3000
439	454	521	0	0.027	0.020	0.050	0.93	3000	3000
489	504	571	0	0.027	0.020	0.050	1.0	3000	3000
539	554	621	0	0.030	0.023	0.050	1.1	3000	3000
589	604	671	0	0.030	0.023	0.065	1.1	3000	3000
639	654	721	0	0.035	0.025	0.065	1.2	3000	3000
689	704	771	0	0.035	0.025	0.065	1.2	3000	3000
789	804	871	0	0.035	0.025	0.085	1.4	3000	3000
889	904	971	0	0.040	0.027	0.085	1.5	2400	3000
1089	1104	1171	0	0.046	0.030	0.110	1.8	1590	2250

- Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.  
 2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.  
 3. Contact NSK if permissible rotational speed is to be exceeded.



# Finished shaft end FA Type

(High helix lead) Dia. 15, Lead 20

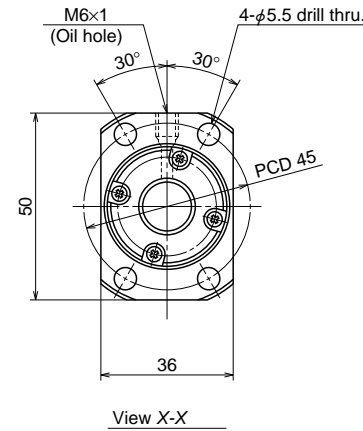


# Nut models: UPFC, USFC

**NSK**

ø15×20

Unit: mm



Recommended support unit	For drive side	For opposite to drive side
WBK12-01A (square)	○	
WBK12S-01 (square)		○
WBK12-11 (round)	○	

## Ball screw specifications

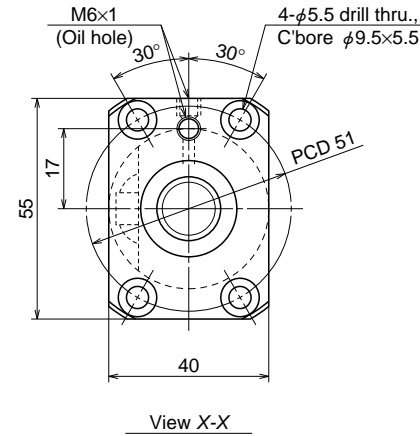
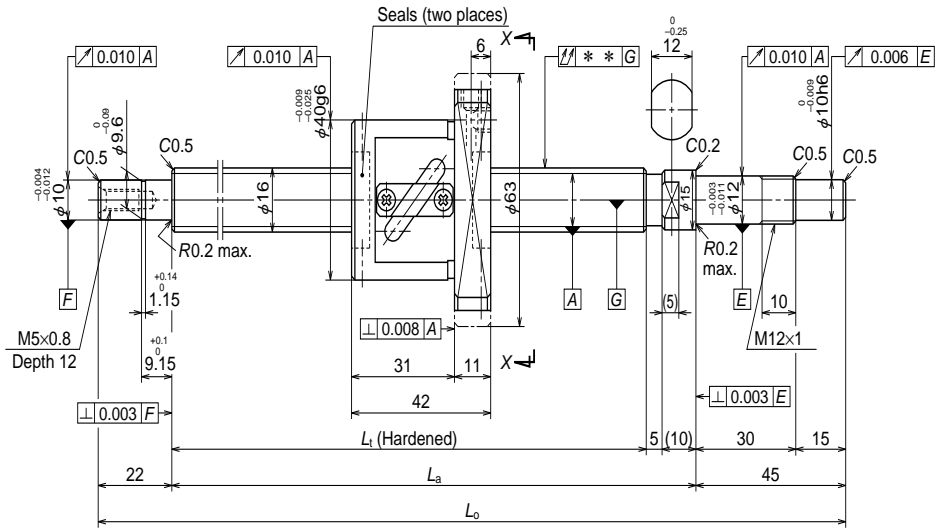
Product classification	Preloaded	Precise clearance	
Shaft dia. x Lead / Direction of turn	15x20/Right		
Preload / Ball recirculation	P preload / End cap		
Ball dia. / Ball circle dia.	3.175/15.5		
Screw shaft root diameter	12.2		
Effective turns of balls	1.7x1		
Accuracy grade / Preload / Axial play	C5/Z	C5/T	
Basic load rating (N)	Dynamic C <sub>a</sub>	3870	5070
	Static C <sub>0a</sub>	5820	8730
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		
Internal spatial volume of nut (cm <sup>3</sup> )	1.9		
Standard volume of grease replenishing (cm <sup>3</sup> )	1.0		

Unit: mm

Ball screw No.		Stroke	
Preloaded (UPFC)	Precise clearance (USFC)	Nominal	Maximum (L <sub>1</sub> —Nut length)
<b>W1501FA-3PG-C5Z20</b>	<b>W1501FA-4G-C5T20</b>	100	141
<b>W1502FA-5PG-C5Z20</b>	<b>W1502FA-6G-C5T20</b>	150	191
<b>W1502FA-7PG-C5Z20</b>	<b>W1502FA-8G-C5T20</b>	200	241
<b>W1503FA-5PG-C5Z20</b>	<b>W1503FA-6G-C5T20</b>	250	291
<b>W1503FA-7PG-C5Z20</b>	<b>W1503FA-8G-C5T20</b>	300	341
<b>W1504FA-5PG-C5Z20</b>	<b>W1504FA-6G-C5T20</b>	350	391
<b>W1504FA-7PG-C5Z20</b>	<b>W1504FA-8G-C5T20</b>	400	441
<b>W1505FA-5PG-C5Z20</b>	<b>W1505FA-6G-C5T20</b>	450	491
<b>W1505FA-7PG-C5Z20</b>	<b>W1505FA-8G-C5T20</b>	500	541
<b>W1506FA-5PG-C5Z20</b>	<b>W1506FA-6G-C5T20</b>	550	591
<b>W1506FA-7PG-C5Z20</b>	<b>W1506FA-8G-C5T20</b>	600	641
<b>W1507FA-3PG-C5Z20</b>	<b>W1507FA-4G-C5T20</b>	700	741
<b>W1508FA-3PG-C5Z20</b>	<b>W1508FA-4G-C5T20</b>	800	841
<b>W1510FA-3PG-C5Z20</b>	<b>W1510FA-4G-C5T20</b>	1000	1041

- Remarks:
- We recommend NSK support unit. Refer to Page B433 for details.
  - NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
  - Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
L <sub>1</sub>	L <sub>a</sub>	L <sub>o</sub>	T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition	
								Fixed - Simple support	Fixed - Fixed
186	204	271	0	0.020	0.018	0.025	0.61	3000	3000
236	254	321	0	0.023	0.018	0.035	0.68	3000	3000
286	304	371	0	0.023	0.018	0.035	0.75	3000	3000
336	354	421	0	0.025	0.020	0.040	0.81	3000	3000
386	404	471	0	0.025	0.020	0.040	0.88	3000	3000
436	454	521	0	0.027	0.020	0.050	0.95	3000	3000
486	504	571	0	0.027	0.020	0.050	1.0	3000	3000
536	554	621	0	0.030	0.023	0.050	1.1	3000	3000
586	604	671	0	0.030	0.023	0.065	1.1	3000	3000
636	654	721	0	0.035	0.025	0.065	1.2	3000	3000
686	704	771	0	0.035	0.025	0.065	1.3	3000	3000
786	804	871	0	0.035	0.025	0.085	1.4	3000	3000
886	904	971	0	0.040	0.027	0.085	1.5	2400	3000
1086	1104	1171	0	0.046	0.030	0.110	1.8	1590	2240



Ball screw specifications

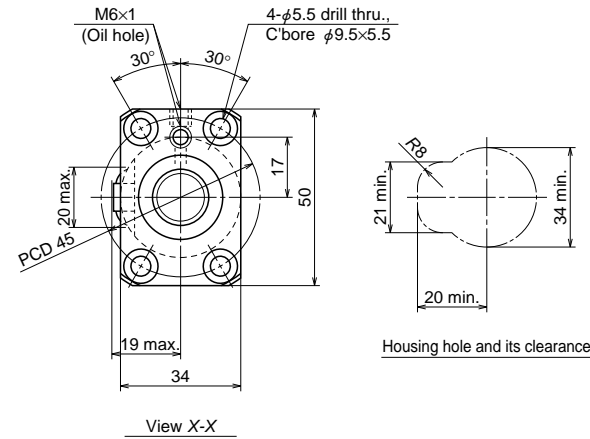
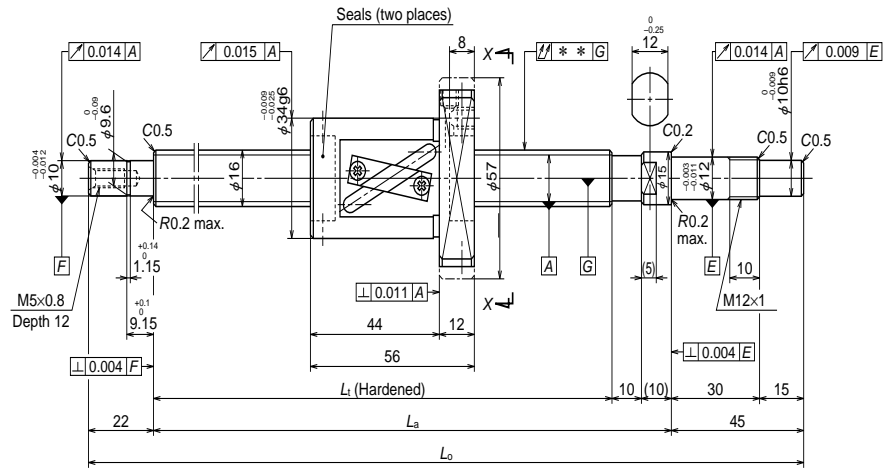
Product classification	Preloaded	Precise clearance	
Shaft dia. x Lead / Direction of turn	16x5/Right		
Preload / Ball recirculation	P preload / Return tube		
Ball dia. / Ball circle dia.	3.175/16.5		
Screw shaft root diameter	13.2		
Effective turns of balls	2.5x1		
Accuracy grade / Preload / Axial play	C3/Z	C3/T	
Basic load rating (N)	Dynamic C <sub>a</sub>	4620	7330
	Static C <sub>0a</sub>	6750	13500
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		
Internal spatial volume of nut (cm <sup>3</sup> )	2.6		
Standard volume of grease replenishing (cm <sup>3</sup> )	1.3		

Recommended support unit	For drive side	For opposite to drive side
WBK12-01A (square)	○	
WBK12S-01 (square)		○
WBK12-11 (round)	○	

Ball screw No.		Stroke	
		Nominal	Maximum (L <sub>1</sub> —Nut length)
Preloaded (PFT)	Precise clearance (SFT)		
<b>W1601FA-1P-C3Z5</b>	<b>W1601FA-2-C3T5</b>	100	147
<b>W1602FA-1P-C3Z5</b>	<b>W1602FA-2-C3T5</b>	200	247
<b>W1603FA-1P-C3Z5</b>	<b>W1603FA-2-C3T5</b>	300	347
<b>W1604FA-1P-C3Z5</b>	<b>W1604FA-2-C3T5</b>	400	447
<b>W1606FA-1P-C3Z5</b>	<b>W1606FA-2-C3T5</b>	600	647
<b>W1608FA-1P-C3Z5</b>	<b>W1608FA-2-C3T5</b>	800	847

- Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.  
 2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.  
 3. Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
L <sub>1</sub>	L <sub>a</sub>	L <sub>o</sub>	T	e <sub>p</sub>	v <sub>a</sub>			Supporting condition	
								Fixed - Simple support	Fixed - Fixed
189	204	271	0	0.010	0.008	0.020	0.70	3000	3000
289	304	371	0	0.012	0.008	0.030	0.83	3000	3000
389	404	471	0	0.013	0.010	0.035	0.97	3000	3000
489	504	571	0	0.015	0.010	0.045	1.1	3000	3000
689	704	771	0	0.018	0.013	0.055	1.4	3000	3000
889	904	971	0	0.021	0.015	0.075	1.6	2570	3000



Recommended support unit	For drive side	For opposite to drive side
WBK12-01A (square)	○	
WBK12S-01 (square)		○
WBK12-11 (round)	○	

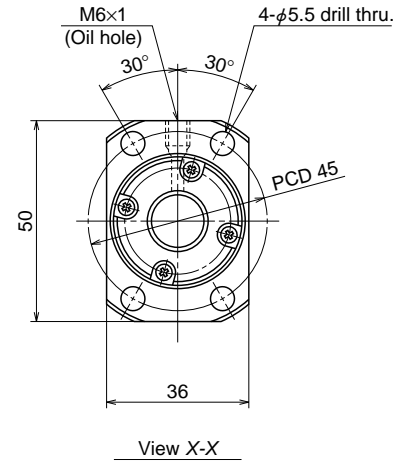
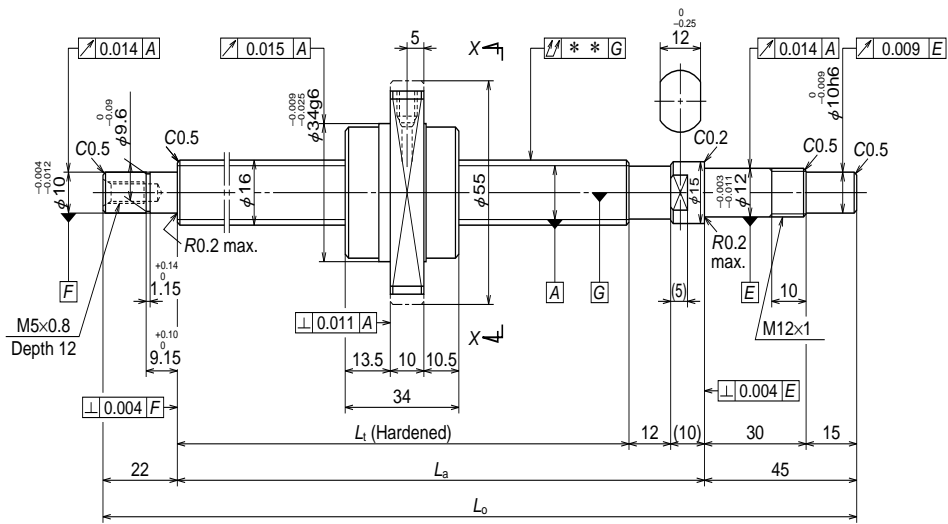
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Ball screw specifications			
Product classification	Preloaded	Precise clearance	
Shaft dia. x Lead / Direction of turn	16x16/Right		
Preload / Ball recirculation	P preload / Return tube		
Ball dia. / Ball circle dia.	3.175/16.75		
Screw shaft root diameter	13.4		
Effective turns of balls	1.5x1		
Accuracy grade / Preload / Axial play	C5/Z	C5/T	
Basic load rating (N)	Dynamic C <sub>a</sub>	3600	4710
	Static C <sub>0a</sub>	5410	8110
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		
Internal spatial volume of nut (cm <sup>3</sup> )	2.1		
Standard volume of grease replenishing (cm <sup>3</sup> )	1.1		

Ball screw No.		Stroke	
		Nominal	Maximum (L <sub>t</sub> —Nut length)
Preloaded (LPFT)	Precise clearance (LSFT)		
<b>W1601FA-3P-C5Z16</b>	<b>W1601FA-4-C5T16</b>	100	128
<b>W1602FA-3P-C5Z16</b>	<b>W1602FA-4-C5T16</b>	150	178
<b>W1602FA-5P-C5Z16</b>	<b>W1602FA-6-C5T16</b>	200	228
<b>W1603FA-3P-C5Z16</b>	<b>W1603FA-4-C5T16</b>	250	278
<b>W1603FA-5P-C5Z16</b>	<b>W1603FA-6-C5T16</b>	300	328
<b>W1604FA-3P-C5Z16</b>	<b>W1604FA-4-C5T16</b>	350	378
<b>W1604FA-5P-C5Z16</b>	<b>W1604FA-6-C5T16</b>	400	428
<b>W1605FA-1P-C5Z16</b>	<b>W1605FA-2-C5T16</b>	450	478
<b>W1605FA-3P-C5Z16</b>	<b>W1605FA-4-C5T16</b>	500	528
<b>W1606FA-3P-C5Z16</b>	<b>W1606FA-4-C5T16</b>	550	578
<b>W1606FA-5P-C5Z16</b>	<b>W1606FA-6-C5T16</b>	600	628
<b>W1607FA-1P-C5Z16</b>	<b>W1607FA-2-C5T16</b>	700	728
<b>W1608FA-3P-C5Z16</b>	<b>W1608FA-4-C5T16</b>	800	828
<b>W1610FA-1P-C5Z16</b>	<b>W1610FA-2-C5T16</b>	1000	1028

- 1. We recommend NSK support unit. Refer to Page B433 for details.
- 2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
- 3. Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
								Supporting condition	
L <sub>t</sub>	L <sub>a</sub>	L <sub>o</sub>	T	e <sub>p</sub>	v <sub>a</sub>		Fixed - Simple support	Fixed - Fixed	
184	204	271	0	0.020	0.018	0.025	0.69	3000	3000
234	254	321	0	0.023	0.018	0.035	0.77	3000	3000
284	304	371	0	0.023	0.018	0.035	0.84	3000	3000
334	354	421	0	0.025	0.020	0.040	0.92	3000	3000
384	404	471	0	0.025	0.020	0.040	0.99	3000	3000
434	454	521	0	0.027	0.020	0.050	1.1	3000	3000
484	504	571	0	0.027	0.020	0.050	1.1	3000	3000
534	554	621	0	0.030	0.023	0.050	1.2	3000	3000
584	604	671	0	0.030	0.023	0.065	1.3	3000	3000
634	654	721	0	0.035	0.025	0.065	1.4	3000	3000
684	704	771	0	0.035	0.025	0.065	1.4	3000	3000
784	804	871	0	0.035	0.025	0.085	1.6	3000	3000
884	904	971	0	0.040	0.027	0.085	1.7	2690	3000
1084	1104	1171	0	0.046	0.030	0.110	2.0	1770	2480



Ball screw specifications

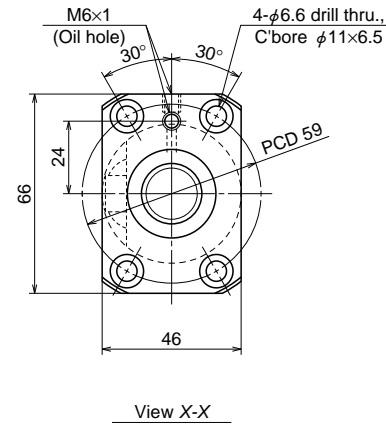
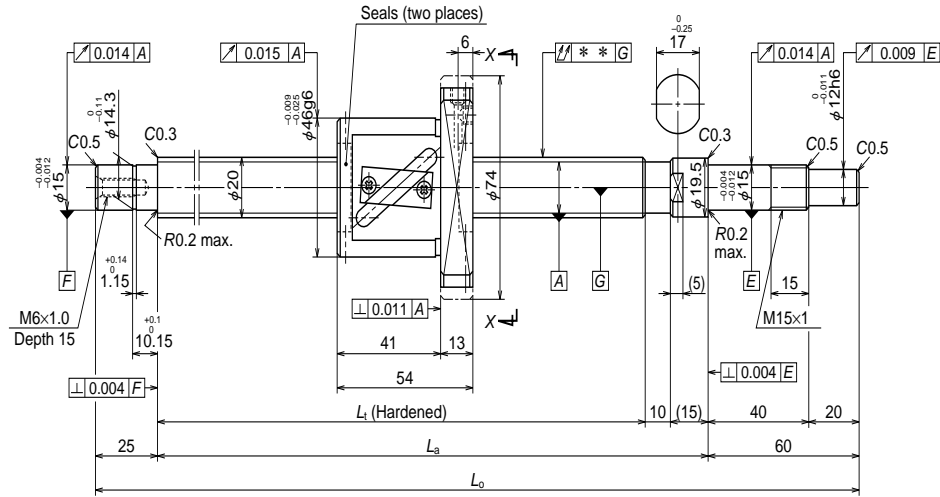
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		16×32/Right	
Preload / Ball recirculation		P preload / End cap	
Ball dia. / Ball circle dia.		3.175/16.75	
Screw shaft root diameter		13.4	
Effective turns of balls		0.7×2	
Accuracy grade / Preload / Axial play		C5/Z	C5/T
Basic load rating (N)	Dynamic C <sub>a</sub>	4000	
	Static C <sub>0a</sub>	6690	
Axial play		0	0.005 or less
Preload (N)		118	—
Dynamic friction torque, (N·cm)		1.5 - 9.8	2.4 or less
Spacer ball		None	
Factory packed grease		NSK grease LR3	
Internal spatial volume of nut (cm <sup>3</sup> )		2.0	
Standard volume of grease replenishing (cm <sup>3</sup> )		1.0	

Recommended support unit	For drive side	For opposite to drive side
WBK12-01A (square)	○	
WBK12S-01 (square)		○
WBK12-11 (round)	○	

Ball screw No.		Stroke	
		Nominal	Maximum (L <sub>1</sub> —Nut length)
Preloaded (UPFC)	Precise clearance (USFC)		
<b>W1603FA-7PGX-C5Z32</b>	<b>W1603FA-8GX-C5T32</b>	300	348
<b>W1605FA-5PGX-C5Z32</b>	<b>W1605FA-6GX-C5T32</b>	500	548
<b>W1608FA-5PGX-C5Z32</b>	<b>W1608FA-6GX-C5T32</b>	800	848
<b>W1612FA-1PGX-C5Z32</b>	<b>W1612FA-2GX-C5T32</b>	1200	1248

- Remarks:
- We recommend NSK support unit. Refer to Page B433 for details.
  - NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
  - Nut does not have a seal.
  - Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
L <sub>1</sub>	L <sub>a</sub>	L <sub>o</sub>	T	e <sub>p</sub>	v <sub>a</sub>			Supporting condition	
								Fixed - Simple support	Fixed - Fixed
382	404	471	0	0.025	0.020	0.040	0.90	3000	3000
582	604	671	0	0.030	0.023	0.065	1.2	3000	3000
882	904	971	0	0.040	0.027	0.085	1.7	2630	3000
1282	1304	1371	0	0.054	0.035	0.150	2.3	1240	1740



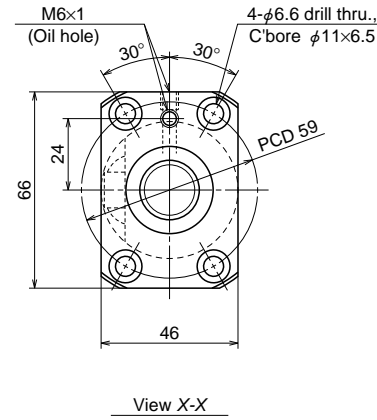
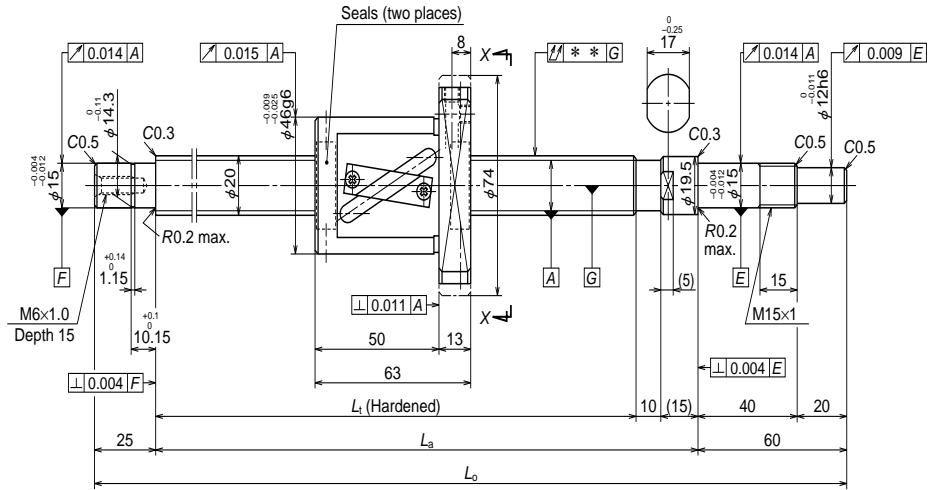
Recommended support unit	For drive side	For opposite to drive side
WBK15-01A (square)	○	
WBK15S-01 (square)		○
WBK15-11 (round)	○	

Ball screw specifications			
Product classification	Preloaded	Precise clearance	
Shaft dia. x Lead / Direction of turn	20×10/Right		
Preload / Ball recirculation	P preload / Return tube		
Ball dia. / Ball circle dia.	3.969/21		
Screw shaft root diameter	16.9		
Effective turns of balls	2.5×1		
Accuracy grade / Preload / Axial play	C5/Z	C5/T	
Basic load rating (N)	Dynamic $C_a$	6880	10900
	Static $C_{0a}$	10800	21700
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		
Internal spatial volume of nut (cm <sup>3</sup> )	4.7		
Standard volume of grease replenishing (cm <sup>3</sup> )	2.4		

Ball screw No.		Stroke	
		Nominal	Maximum (L <sub>1</sub> —Nut length)
Preloaded (LPFT)	Precise clearance (LSFT)		
<b>W2002FA-1P-C5Z10</b>	<b>W2002FA-2-C5T10</b>	200	235
<b>W2003FA-1P-C5Z10</b>	<b>W2003FA-2-C5T10</b>	300	335
<b>W2004FA-1P-C5Z10</b>	<b>W2004FA-2-C5T10</b>	400	435
<b>W2005FA-1P-C5Z10</b>	<b>W2005FA-2-C5T10</b>	500	535
<b>W2006FA-1P-C5Z10</b>	<b>W2006FA-2-C5T10</b>	600	635
<b>W2007FA-1P-C5Z10</b>	<b>W2007FA-2-C5T10</b>	700	735
<b>W2008FA-1P-C5Z10</b>	<b>W2008FA-2-C5T10</b>	800	835
<b>W2009FA-1P-C5Z10</b>	<b>W2009FA-2-C5T10</b>	900	935
<b>W2010FA-1P-C5Z10</b>	<b>W2010FA-2-C5T10</b>	1000	1035
<b>W2011FA-1P-C5Z10</b>	<b>W2011FA-2-C5T10</b>	1100	1135
<b>W2012FA-1P-C5Z10</b>	<b>W2012FA-2-C5T10</b>	1200	1235

- Remarks:
- We recommend NSK support unit. Refer to Page B433 for details.
  - NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
  - Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
L <sub>1</sub>	L <sub>a</sub>	L <sub>0</sub>	T	e <sub>p</sub>	v <sub>a</sub>			Supporting condition	
								Fixed - Simple support	Fixed - Fixed
289	314	399	0	0.023	0.018	0.035	1.4	3000	3000
389	414	499	0	0.025	0.020	0.040	1.6	3000	3000
489	514	599	0	0.027	0.020	0.050	1.9	3000	3000
589	614	699	0	0.030	0.023	0.065	2.1	3000	3000
689	714	799	0	0.035	0.025	0.065	2.3	3000	3000
789	814	899	0	0.035	0.025	0.085	2.5	3000	3000
889	914	999	0	0.040	0.027	0.085	2.8	3000	3000
989	1014	1099	0	0.040	0.027	0.110	3.0	2680	3000
1089	1114	1199	0	0.046	0.030	0.110	3.2	2210	3000
1189	1214	1299	0	0.046	0.030	0.150	3.4	1840	2570
1289	1314	1399	0	0.054	0.035	0.150	3.7	1570	2190



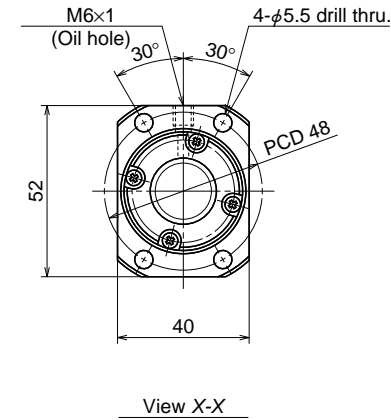
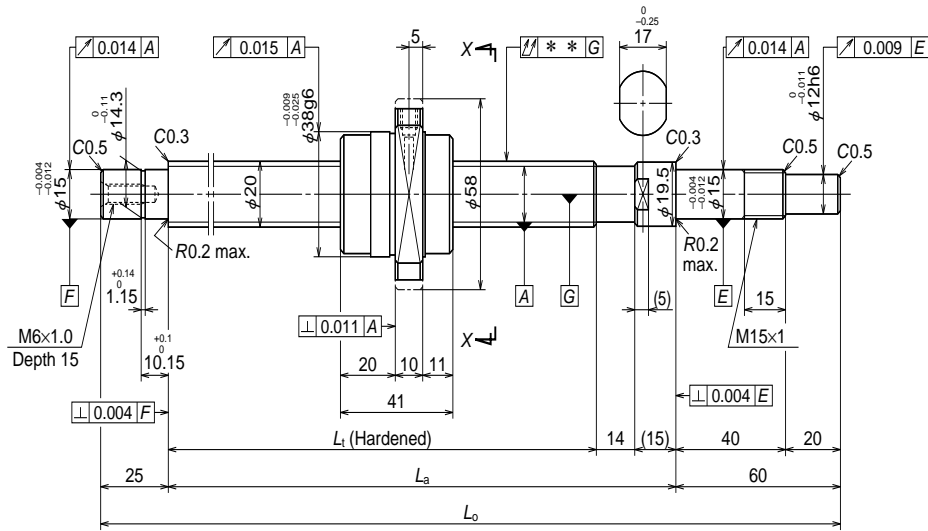
Recommended support unit	For drive side	For opposite to drive side
WBK15-01A (square)	○	
WBK15S-01 (square)		○
WBK15-11 (round)	○	

Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	20×20/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	3.969/21	
Screw shaft root diameter	16.9	
Effective turns of balls	1.5×1	
Accuracy grade / Preload / Axial play	C5/Z	C53/T
Basic load rating (N)	Dynamic $C_a$	5370
	Static $C_{0a}$	8450
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	
Internal spatial volume of nut (cm <sup>3</sup> )	4.2	
Standard volume of grease replenishing (cm <sup>3</sup> )	2.1	

Ball screw No.		Stroke	
		Nominal	Maximum ( $L_t$ —Nut length)
Preloaded (LPFT)	Precise clearance (LSFT)		
<b>W2003FA-3P-C5Z20</b>	<b>W2003FA-4-C5T20</b>	200	247
<b>W2004FA-3P-C5Z20</b>	<b>W2004FA-4-C5T20</b>	300	347
<b>W2005FA-3P-C5Z20</b>	<b>W2005FA-4-C5T20</b>	400	447
<b>W2006FA-3P-C5Z20</b>	<b>W2006FA-4-C5T20</b>	500	547
<b>W2007FA-3P-C5Z20</b>	<b>W2007FA-4-C5T20</b>	600	647
<b>W2008FA-3P-C5Z20</b>	<b>W2008FA-4-C5T20</b>	700	747
<b>W2009FA-3P-C5Z20</b>	<b>W2009FA-4-C5T20</b>	800	847
<b>W2010FA-3P-C5Z20</b>	<b>W2010FA-4-C5T20</b>	900	947
<b>W2011FA-3P-C5Z20</b>	<b>W2011FA-4-C5T20</b>	1000	1047
<b>W2012FA-3P-C5Z20</b>	<b>W2012FA-4-C5T20</b>	1100	1147
<b>W2015FA-1P-C5Z20</b>	<b>W2015FA-2-C5T20</b>	1400	1447

- Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.  
 2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.  
 3. Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
								Supporting condition	
$L_t$	$L_a$	$L_o$	$T$	$e_p$	$v_u$		Fixed - Simple support	Fixed - Fixed	
310	335	420	0	0.023	0.018	0.040	1.6	3000	3000
410	435	520	0	0.027	0.020	0.050	1.8	3000	3000
510	535	620	0	0.030	0.023	0.050	2.0	3000	3000
610	635	720	0	0.030	0.023	0.065	2.3	3000	3000
710	735	820	0	0.035	0.025	0.085	2.5	3000	3000
810	835	920	0	0.040	0.027	0.085	2.7	3000	3000
910	935	1020	0	0.040	0.027	0.110	3.0	3000	3000
1010	1035	1120	0	0.046	0.030	0.110	3.2	2590	3000
1110	1135	1220	0	0.046	0.030	0.110	3.4	2140	2970
1210	1235	1320	0	0.046	0.030	0.150	3.7	1790	2500
1510	1535	1620	0	0.054	0.035	0.180	4.4	1140	1610



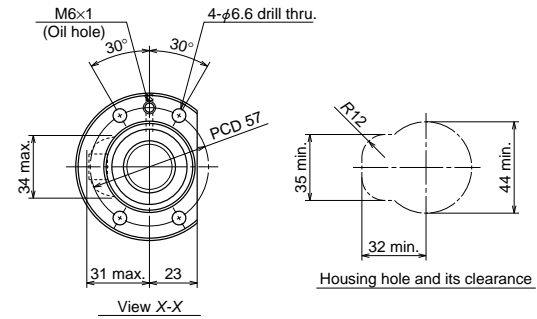
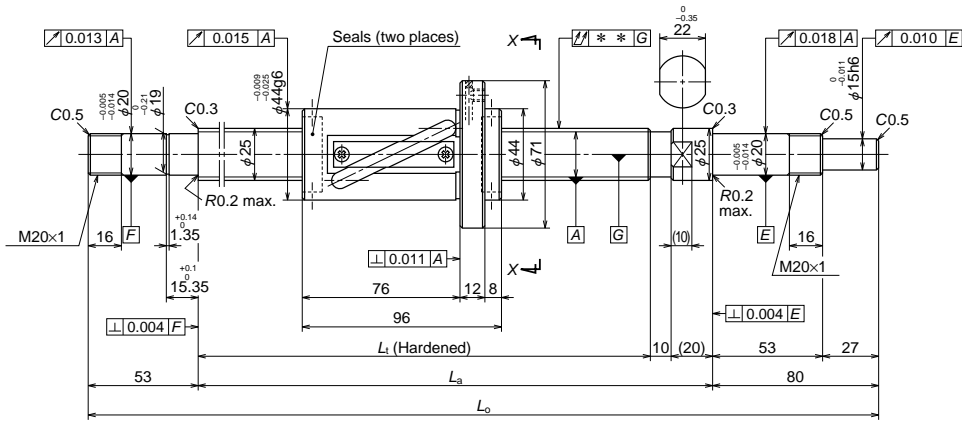
Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	20x40/Right	
Preload / Ball recirculation	P preload / End cap	
Ball dia. / Ball circle dia.	3.175/20.75	
Screw shaft root diameter	17.4	
Effective turns of balls	0.7x2	
Accuracy grade / Preload / Axial play	C5/Z	C5/T
Basic load rating (N)	Dynamic C <sub>a</sub>	4490
	Static C <sub>0a</sub>	8640
Axial play	0	0.005 or less
Preload (N)	148	—
Dynamic friction torque, (N·cm)	2.0 - 11.8	2.9 or less
Spacer ball	None	
Factory packed grease	NSK grease LR3	
Internal spatial volume of nut (cm <sup>3</sup> )	2.8	
Standard volume of grease replenishing (cm <sup>3</sup> )	1.4	

Recommended support unit	For opposite to drive side	
	For drive side	For opposite to drive side
WBK15-01A (square)	○	
WBK15S-01 (square)		○
WBK15-11 (round)	○	

Ball screw No.		Stroke	
		Nominal	Maximum (L <sub>t</sub> —Nut length)
Preloaded (UPFC)	Precise clearance (USFC)		
<b>W2005FA-5PGX-C5Z40</b>	<b>W2005FA-6GX-C5T40</b>	400	465
<b>W2007FA-5PGX-C5Z40</b>	<b>W2007FA-6GX-C5T40</b>	600	665
<b>W2009FA-5PGX-C5Z40</b>	<b>W2009FA-6GX-C5T40</b>	800	865
<b>W2011FA-5PGX-C5Z40</b>	<b>W2011FA-6GX-C5T40</b>	1000	1065
<b>W2013FA-1PGX-C5Z40</b>	<b>W2013FA-2GX-C5T40</b>	1200	1265
<b>W2017FA-1PGX-C5Z40</b>	<b>W2017FA-2GX-C5T40</b>	1600	1665

- Remarks:
- We recommend NSK support unit. Refer to Page B433 for details.
  - NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
  - Nut does not have a seal.
  - Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
								Supporting condition	
L <sub>t</sub>	L <sub>a</sub>	L <sub>o</sub>	T	e <sub>p</sub>	v <sub>a</sub>		Fixed - Simple support	Fixed - Fixed	
506	535	620	0	0.030	0.023	0.050	1.7	3000	3000
706	735	820	0	0.035	0.025	0.085	2.2	3000	3000
906	935	1020	0	0.040	0.027	0.110	2.7	3000	3000
1106	1135	1220	0	0.046	0.030	0.110	3.1	2170	3000
1306	1335	1420	0	0.054	0.035	0.150	3.6	1550	2160
1706	1735	1820	0	0.065	0.040	0.230	4.6	910	1270



Recommended support unit	For drive side	For opposite to drive side
WBK20-01 (square)	○	○
WBK20S-01 (square)		○
WBK20-11 (round)	○	○

Ball screw specifications

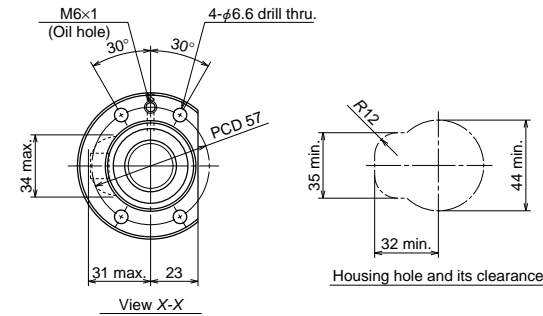
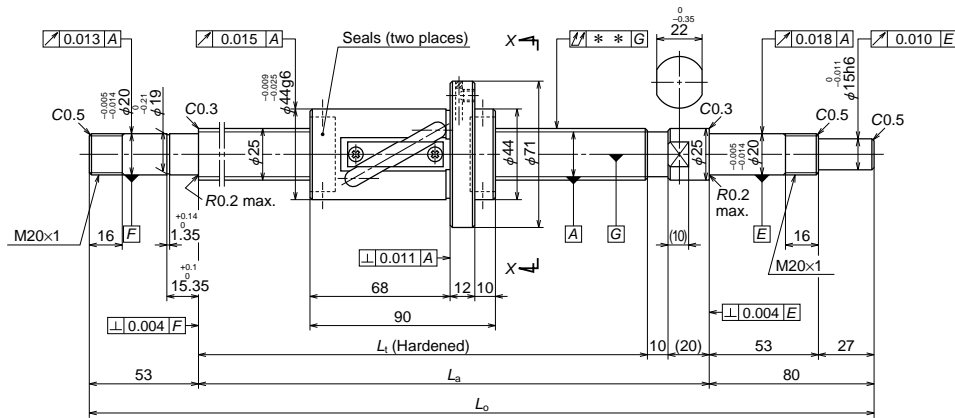
Product classification	Preloaded	Precise clearance	
Shaft dia. x Lead / Direction of turn	25x20/Right		
Preload / Ball recirculation	P preload / Return tube		
Ball dia. / Ball circle dia.	4.762/26.25		
Screw shaft root diameter	21.3		
Effective turns of balls	2.5x1		
Accuracy grade / Preload / Axial play	C5/Z	C5/T	
Basic load rating (N)	Dynamic C <sub>a</sub>	9900	15700
	Static C <sub>0a</sub>	16400	32800
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		
Internal spatial volume of nut (cm <sup>3</sup> )	12		
Standard volume of grease replenishing (cm <sup>3</sup> )	6		

Ball screw No.		Stroke	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L <sub>r</sub> —Nut length)
W2507FA-1P-C5Z20	W2507FA-2-C5T20	600	654
W2509FA-1P-C5Z20	W2509FA-2-C5T20	800	854
W2511FA-1P-C5Z20	W2511FA-2-C5T20	1000	1054
W2513FA-1P-C5Z20	W2513FA-2-C5T20	1200	1254
W2515FA-1P-C5Z20	W2515FA-2-C5T20	1400	1454
W2517FA-1P-C5Z20	W2517FA-2-C5T20	1600	1654
W2521FA-1P-C5Z20	W2521FA-2-C5T20	2000	2054

- Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.  
 2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.  
 3. Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
L <sub>t</sub>	L <sub>a</sub>	L <sub>o</sub>	T	e <sub>p</sub>	v <sub>a</sub>			Supporting condition	
								Fixed - Simple support	Fixed - Fixed
750	780	913	0	0.035	0.025	0.055	4.0	2800	2800
950	980	1113	0	0.040	0.027	0.070	4.7	2800	2800
1150	1180	1313	0	0.046	0.030	0.090	5.4	2560	2800
1350	1380	1513	0	0.054	0.035	0.090	6.2	1840	2550
1550	1580	1713	0	0.054	0.035	0.120	6.9	1390	1940
1750	1780	1913	0	0.065	0.040	0.120	7.6	1080	1520
2150	2180	2313	0	0.077	0.046	0.160	9.1	710	1000





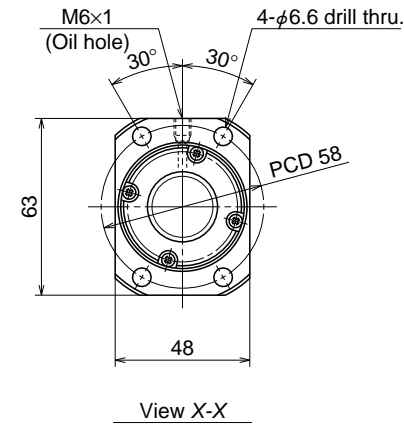
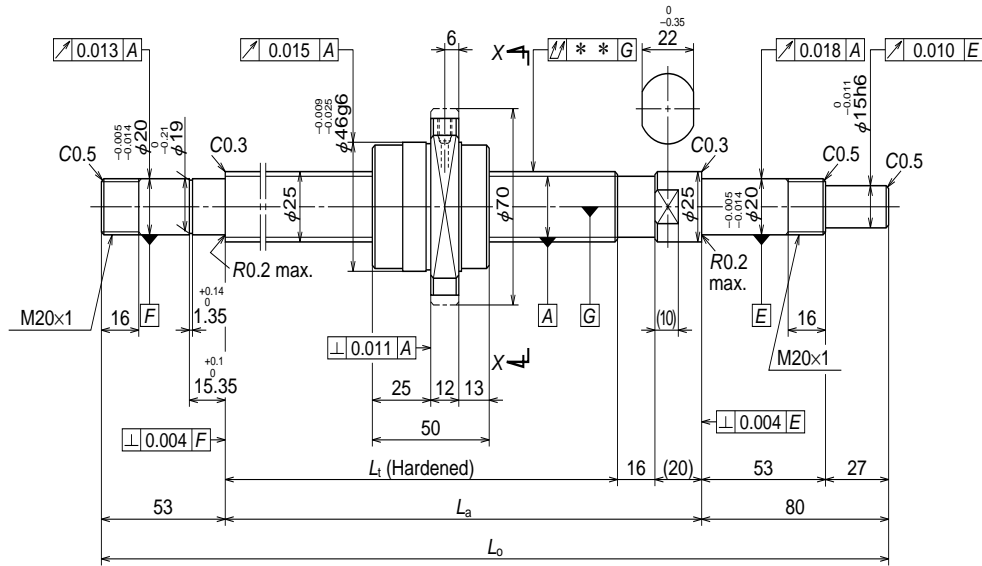
Ball screw specifications			
Product classification	Preloaded	Precise clearance	
Shaft dia. x Lead / Direction of turn	25×25/Right		
Preload / Ball recirculation	P preload / Return tube		
Ball dia. / Ball circle dia.	4.762/26.25		
Screw shaft root diameter	21.3		
Effective turns of balls	1.5×1		
Accuracy grade / Preload / Axial play	C5/Z	C5/T	
Basic load rating (N)	Dynamic $C_a$	7730	10100
	Static $C_{0a}$	12700	19100
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		
Internal spatial volume of nut (cm <sup>3</sup> )	7.5		
Standard volume of grease replenishing (cm <sup>3</sup> )	3.8		

Recommended support unit	For drive side		For opposite to drive side	
	For drive side	For opposite to drive side	For drive side	For opposite to drive side
WBK20-01 (square)	○	○	○	○
WBK20S-01 (square)			○	○
WBK20-11 (round)	○	○	○	○

Ball screw No.		Stroke	
		Nominal	Maximum ( $L_t$ —Nut length)
Preloaded (LPFT)	Precise clearance (LSFT)		
<b>W2507FA-3P-C5Z25</b>	<b>W2507FA-4-C5T25</b>	600	660
<b>W2509FA-3P-C5Z25</b>	<b>W2509FA-4-C5T25</b>	800	860
<b>W2511FA-3P-C5Z25</b>	<b>W2511FA-4-C5T25</b>	1000	1060
<b>W2513FA-3P-C5Z25</b>	<b>W2513FA-4-C5T25</b>	1200	1260
<b>W2515FA-3P-C5Z25</b>	<b>W2515FA-4-C5T25</b>	1400	1460
<b>W2517FA-3P-C5Z25</b>	<b>W2517FA-4-C5T25</b>	1600	1660
<b>W2521FA-3P-C5Z25</b>	<b>W2521FA-4-C5T25</b>	2000	2060

- Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.  
 2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.  
 3. Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
								Supporting condition	
$L_t$	$L_a$	$L_o$	$T$	$e_p$	$v_a$		Fixed - Simple support	Fixed - Fixed	
750	780	913	0	0.035	0.025	0.055	4.0	2800	2800
950	980	1113	0	0.040	0.027	0.070	4.7	2800	2800
1150	1180	1313	0	0.046	0.030	0.090	5.4	2540	2800
1350	1380	1513	0	0.054	0.035	0.090	6.2	1830	2540
1550	1580	1713	0	0.054	0.035	0.120	7.0	1380	1930
1750	1780	1913	0	0.065	0.040	0.120	7.7	1080	1510
2150	2180	2313	0	0.077	0.046	0.160	9.1	710	1000



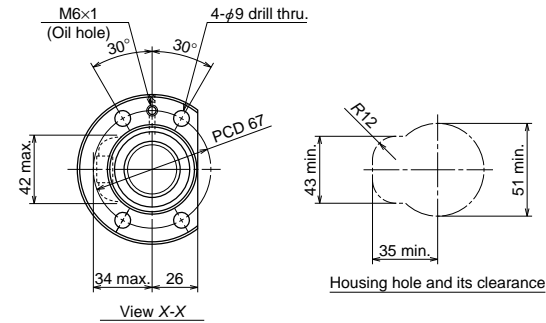
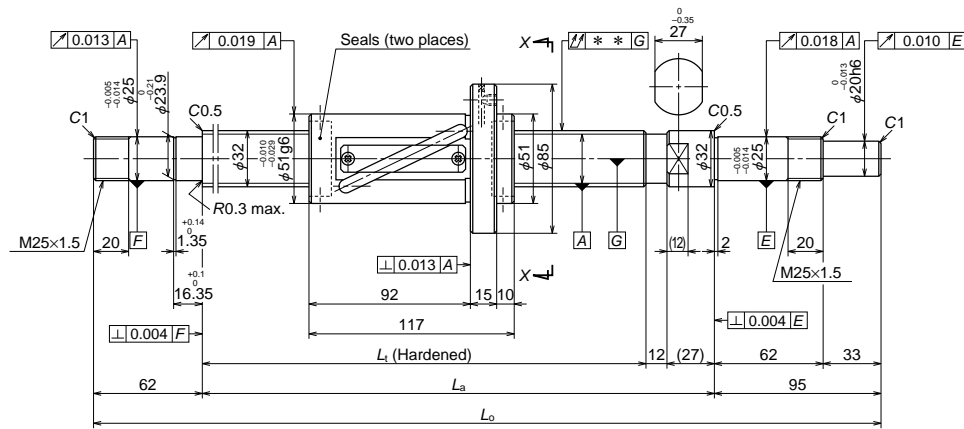
Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	25×50/Right	
Preload / Ball recirculation	P preload / End cap	
Ball dia. / Ball circle dia.	3.969/26	
Screw shaft root diameter	21.9	
Effective turns of balls	0.7×2	
Accuracy grade / Preload / Axial play	C5/Z	C5/T
Basic load rating (N)	Dynamic $C_a$	6690
	Static $C_{0a}$	13500
Axial play	0	0.005 or less
Preload (N)	196	—
Dynamic friction torque, (N·cm)	2.9 - 21.5	4.9 or less
Spacer ball	None	
Factory packed grease	NSK grease LR3	
Internal spatial volume of nut (cm <sup>3</sup> )	4.2	
Standard volume of grease replenishing (cm <sup>3</sup> )	2.1	

Recommended support unit	For drive side	For opposite to drive side
WBK20-01 (square)	○	○
WBK20S-01 (square)		○
WBK20-11 (round)	○	○

Ball screw No.		Stroke	
		Nominal	Maximum ( $L_t$ —Nut length)
Preloaded (UPFC)	Precise clearance (USFC)		
<b>W2508FA-1PGX-C5Z50</b>	<b>W2508FA-2GX-C5T50</b>	700	794
<b>W2511FA-5PGX-C5Z50</b>	<b>W2511FA-6GX-C5T50</b>	1000	1094
<b>W2516FA-1PGX-C5Z50</b>	<b>W2516FA-2GX-C5T50</b>	1500	1594
<b>W2521FA-5PGX-C5Z50</b>	<b>W2521FA-6GX-C5T50</b>	2000	2094

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
$L_t$	$L_a$	$L_o$	$T$	$e_p$	$v_a$			Supporting condition	
								Fixed - Simple support	Fixed - Fixed
844	880	1013	0	0.040	0.027	0.070	4.1	2800	2800
1144	1180	1313	0	0.046	0.030	0.090	5.3	2550	2800
1644	1680	1813	0	0.065	0.040	0.120	7.2	1230	1710
2144	2180	2313	0	0.077	0.046	0.160	9.1	720	1010

- Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
  3. Nut does not have a seal.
  4. Contact NSK if permissible rotational speed is to be exceeded.



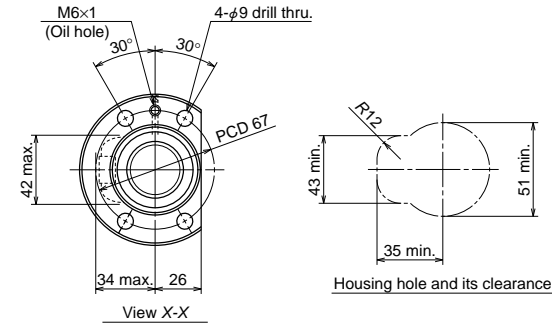
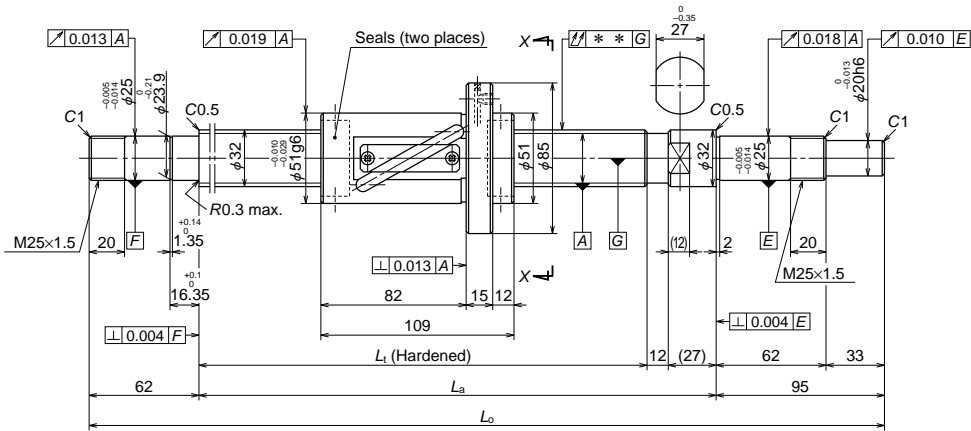
Ball screw specifications			
Product classification	Preloaded	Precise clearance	
Shaft dia. x Lead / Direction of turn	32×25/Right		
Preload / Ball recirculation	P preload / Return tube		
Ball dia. / Ball circle dia.	4.762/33.25		
Screw shaft root diameter	28.3		
Effective turns of balls	2.5×1		
Accuracy grade / Preload / Axial play	C5/Z	C5/T	
Basic load rating (N)	Dynamic $C_a$	11300	17900
	Static $C_{0a}$	20900	41800
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		
Internal spatial volume of nut (cm <sup>3</sup> )	17.5		
Standard volume of grease replenishing (cm <sup>3</sup> )	8.8		

Recommended support unit	For drive side	For opposite to drive side
	WBK25-01 (square)	○
WBK25S-01 (square)		○
WBK25-11 (round)	○	○

Ball screw No.		Stroke	
		Nominal	Maximum ( $L_t$ —Nut length)
Preloaded (LPFT)	Precise clearance (LSFT)		
<b>W3211FA-1P-C5Z25</b>	<b>W3211FA-2-C5T25</b>	1000	1063
<b>W3216FA-1P-C5Z25</b>	<b>W3216FA-2-C5T25</b>	1500	1563
<b>W3221FA-1P-C5Z25</b>	<b>W3221FA-2-C5T25</b>	2000	2063
<b>W3227FA-1P-C5Z25</b>	<b>W3227FA-2-C5T25</b>	2600	2663

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
								Supporting condition	
$L_t$	$L_a$	$L_o$	$T$	$e_p$	$v_a$		Fixed - Simple support	Fixed - Fixed	
1180	1219	1376	0	0.046	0.030	0.090	9.3	2180	2180
1680	1719	1876	0	0.065	0.040	0.120	12.3	1580	2180
2180	2219	2376	0	0.077	0.046	0.160	15.4	930	1300
2780	2819	2976	0	0.093	0.054	0.200	19.1	560	800



Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	32×32/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	4.762/33.25	
Screw shaft root diameter	28.3	
Effective turns of balls	1.5×1	
Accuracy grade / Preload / Axial play	C5/Z	C5/T
Basic load rating (N)	Dynamic $C_a$	8800
	Static $C_{0a}$	16600
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	
Internal spatial volume of nut (cm <sup>3</sup> )	14	
Standard volume of grease replenishing (cm <sup>3</sup> )	7	

Recommended support unit	For drive side	For opposite to drive side
	WBK25-01 (square)	○
WBK25S-01 (square)		○
WBK25-11 (round)	○	○

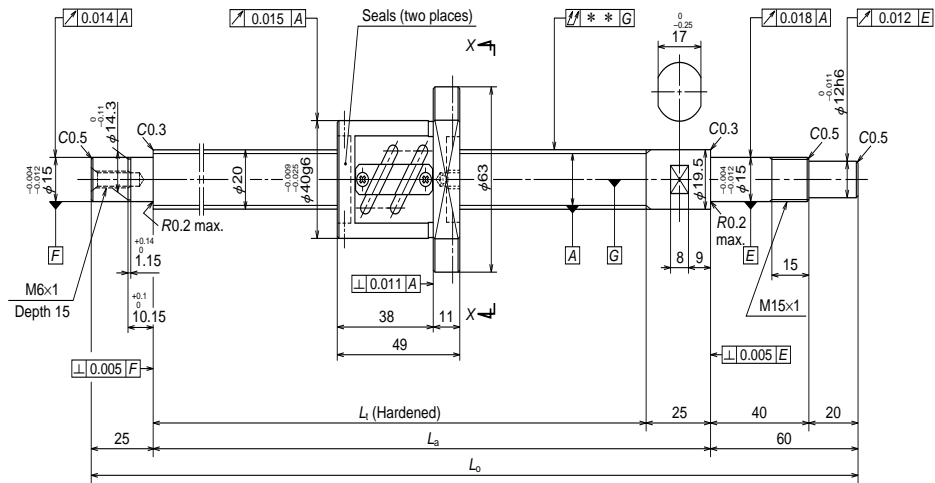
Ball screw No.		Stroke	
		Nominal	Maximum ( $L_t$ —Nut length)
Preloaded (LPFT)	Precise clearance (LSFT)		
<b>W3211FA-3P-C5Z32</b>	<b>W3211FA-4-C5T32</b>	1000	1071
<b>W3216FA-3P-C5Z32</b>	<b>W3216FA-4-C5T32</b>	1500	1571
<b>W3221FA-3P-C5Z32</b>	<b>W3221FA-4-C5T32</b>	2000	2071
<b>W3227FA-3P-C5Z32</b>	<b>W3227FA-4-C5T32</b>	2600	2671

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
								Supporting condition	
$L_t$	$L_a$	$L_o$	$T$	$e_p$	$v_a$		Fixed - Simple support	Fixed - Fixed	
1180	1219	1376	0	0.046	0.030	0.090	9.3	2180	2180
1680	1719	1876	0	0.065	0.040	0.120	12.3	1570	2180
2180	2219	2376	0	0.077	0.046	0.160	15.4	920	1290
2780	2819	2976	0	0.093	0.054	0.200	19.1	560	790

# Finished shaft end SA Type

(Fine lead) Dia. 20, Lead 4

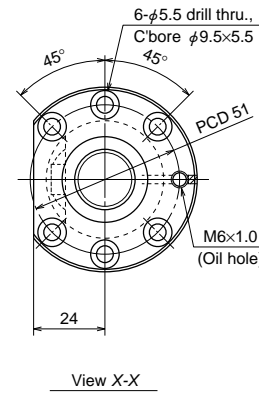


# Nut models: PFT

**NSK**

ø20×4

Unit: mm



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	20x4/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	2.381/20.3	
Effective turns of balls	2.5x2	
Screw shaft root diameter	17.8	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	5420
	Static $C_{0a}$	10700
Preload (N)	294	
Dynamic friction torque, median, (N·cm)	3.9	
Spacer ball	Yes	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	2.7	
Standard volume of grease replenishing (cm <sup>3</sup> )	1.4	

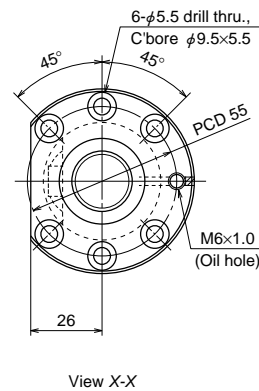
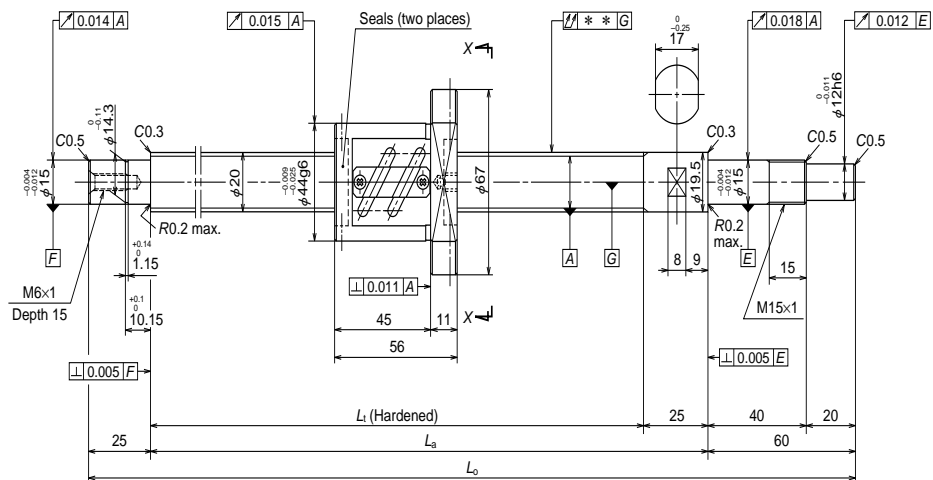
Recommended support unit	For drive side	For opposite to drive side
	WBK15-01A (square)	○
WBK15S-01 (square)		○
WBK15-11 (round)	○	

Unit: mm

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L <sub>1</sub> —Nut length)	L <sub>1</sub>	L <sub>a</sub>	L <sub>0</sub>
			W2002SA-1P-C5Z4	150	176
W2002SA-2P-C5Z4	200	226	275	300	385
W2003SA-1P-C5Z4	300	326	375	400	485
W2004SA-1P-C5Z4	400	426	475	500	585
W2005SA-1P-C5Z4	500	526	575	600	685
W2006SA-1P-C5Z4	600	626	675	700	785

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition	
					Fixed - Simple support	Fixed - Fixed
-0.005	0.023	0.018	0.045	1.1	3000	3000
-0.007	0.023	0.018	0.045	1.2	3000	3000
-0.009	0.025	0.020	0.055	1.5	3000	3000
-0.011	0.027	0.020	0.070	1.7	3000	3000
-0.014	0.030	0.023	0.085	1.9	3000	3000
-0.016	0.035	0.025	0.085	2.1	3000	3000

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.



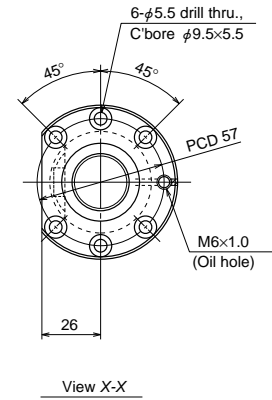
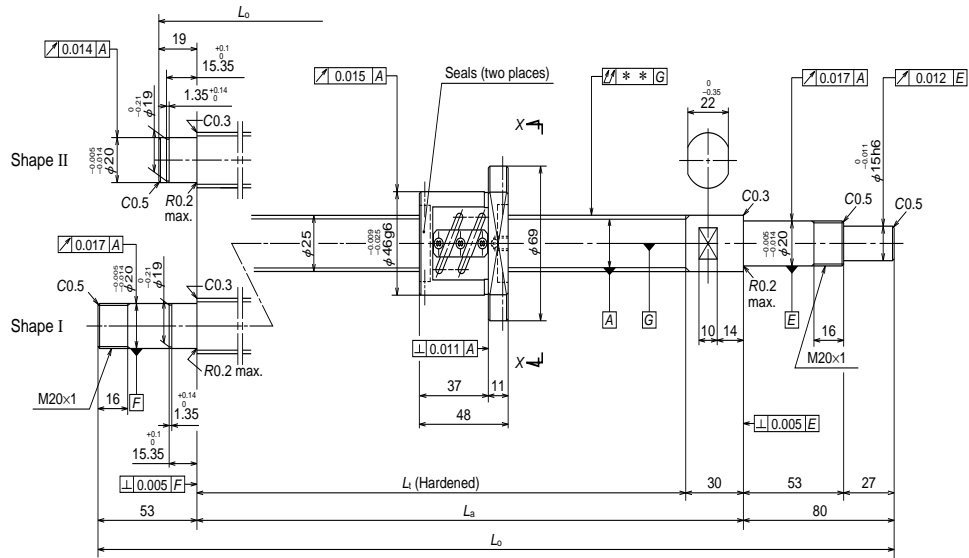
Ball screw specifications		
Shaft dia. x Lead / Direction of turn	20x5/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	3.175/20.5	
Screw shaft root diameter	17.2	
Effective turns of balls	2.5x2	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic C <sub>a</sub>	9410
	Static C <sub>0a</sub>	17100
Preload (N)	490	
Dynamic friction torque, median, (N·cm)	7.8	
Spacer ball	Yes	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	4.3	
Standard volume of grease replenishing (cm <sup>3</sup> )	2.2	

Recommended support unit	For drive side		For opposite to drive side	
	For drive side	For opposite to drive side	For drive side	For opposite to drive side
WBK15-01A (square)	○			
WBK15S-01 (square)			○	
WBK15-11 (round)	○			

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L <sub>t</sub> —Nut length)	L <sub>t</sub>	L <sub>a</sub>	L <sub>o</sub>
W2002SA-3P-C5Z5	150	169	225	250	335
W2002SA-4P-C5Z5	200	219	275	300	385
W2003SA-2P-C5Z5	300	319	375	400	485
W2004SA-2P-C5Z5	400	419	475	500	585
W2005SA-2P-C5Z5	500	519	575	600	685
W2007SA-1P-C5Z5	700	719	775	800	885

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition	
					Fixed - Simple support	Fixed - Fixed
-0.005	0.023	0.018	0.045	1.3	3000	3000
-0.007	0.023	0.018	0.045	1.4	3000	3000
-0.009	0.025	0.020	0.055	1.6	3000	3000
-0.011	0.027	0.020	0.070	1.8	3000	3000
-0.014	0.030	0.023	0.085	2.0	3000	3000
-0.019	0.035	0.025	0.110	2.5	3000	3000



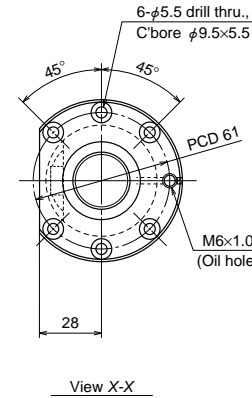
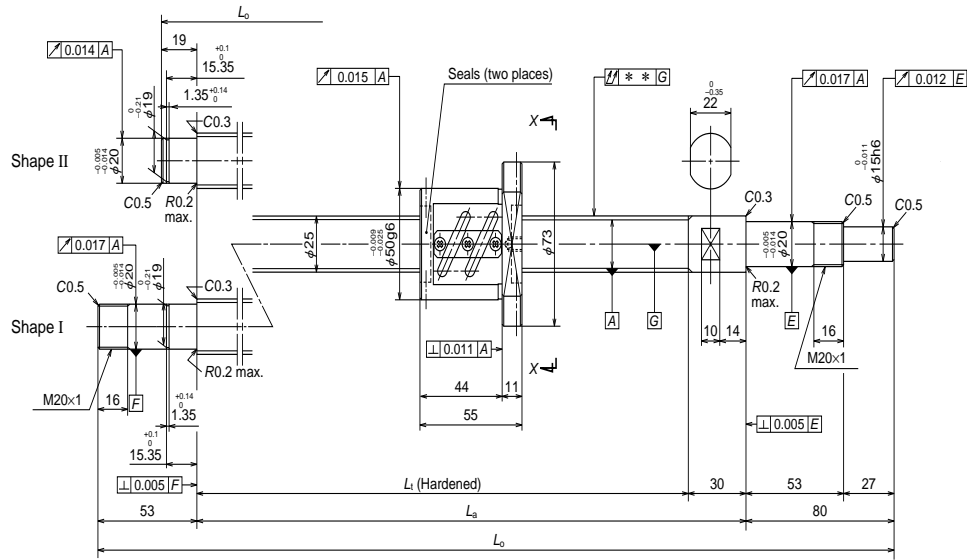
Ball screw specifications		
Shaft dia. x Lead / Direction of turn	25×4/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	2.381/25.3	
Screw shaft root diameter	22.8	
Effective turns of balls	2.5×2	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	6020
	Static $C_{0a}$	13600
Preload (N)	290	
Dynamic friction torque, median, (N·cm)	4.9	
Spacer ball	Yes	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	3.2	
Standard volume of grease replenishing (cm <sup>3</sup> )	1.6	

Recommended support unit	For drive side		For opposite to drive side	
	For drive side	For opposite to drive side	For drive side	For opposite to drive side
WBK20-01 (square)	○	○	○	○
WBK20S-01 (square)	○	○	○	○
WBK20-11 (round)	○	○	○	○

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L <sub>t</sub> —Nut length)	L <sub>t</sub>	L <sub>a</sub>	L <sub>0</sub>
W2502SA-1P-C5Z4	150	172	220	250	349
W2502SA-2P-C5Z4	200	222	270	300	399
W2503SA-1P-C5Z4	300	322	370	400	499
W2504SA-1P-C5Z4	400	422	470	500	599
W2505SA-1P-C5Z4	500	522	570	600	733
W2507SA-1P-C5Z4	700	722	770	800	933

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition	
	Fixed - Simple support		Fixed - Fixed				
II	-0.005	0.023	0.018	0.035	1.6	2800	—
II	-0.006	0.023	0.018	0.035	1.8	2800	—
II	-0.009	0.025	0.020	0.040	2.2	2800	—
II	-0.011	0.027	0.020	0.050	2.5	2800	—
I	-0.014	0.030	0.023	0.060	3.0	2800	2800
I	-0.018	0.035	0.025	0.075	3.7	2800	2800



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	25x5/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	3.175/25.5	
Screw shaft root diameter	22.2	
Effective turns of balls	2.5x2	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	10400
	Static $C_{0a}$	21900
Preload (N)	540	
Dynamic friction torque, median, (N·cm)	8.8	
Spacer ball	Yes	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	5.0	
Standard volume of grease replenishing (cm <sup>3</sup> )	2.5	

Recommended support unit	For drive side		For opposite to drive side	
	For drive side	For opposite to drive side	For drive side	For opposite to drive side
WBK20-01 (square)	○	○	○	○
WBK20S-01 (square)	○	○	○	○
WBK20-11 (round)	○	○	○	○

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum ( $L_t$ —Nut length)	$L_t$	$L_a$	$L_o$
W2502SA-3P-C5Z5	150	165	220	250	349
W2502SA-4P-C5Z5	200	215	270	300	399
W2503SA-2P-C5Z5	300	315	370	400	499
W2504SA-2P-C5Z5	400	415	470	500	599
W2505SA-2P-C5Z5	500	515	570	600	733
W2506SA-1P-C5Z5	600	615	670	700	833
W2507SA-2P-C5Z5	700	715	770	800	933
W2509SA-1P-C5Z5	900	915	970	1000	1133
W2511SA-1P-C5Z5	1000	1115	1170	1200	1333

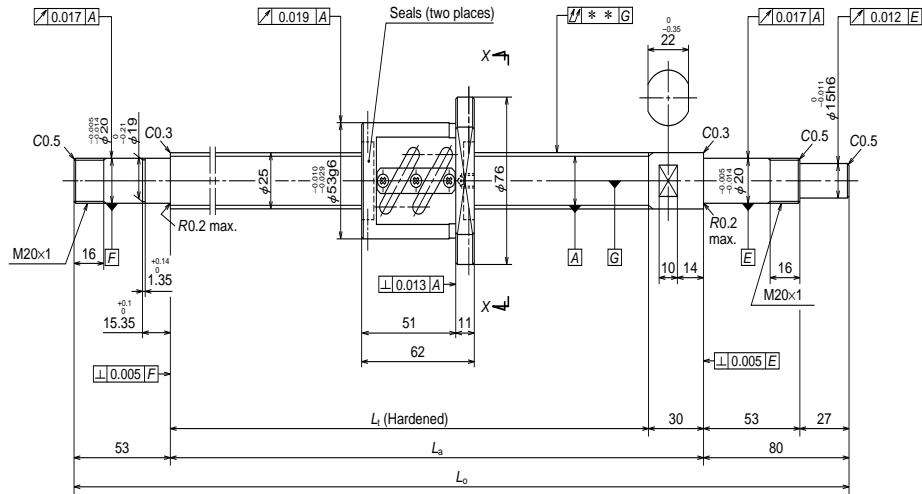
Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	$T$	$e_p$	$v_u$			Supporting condition	
						Fixed - Simple support	Fixed - Fixed
II	-0.005	0.023	0.018	0.035	1.8	2800	—
II	-0.006	0.023	0.018	0.035	2.0	2800	—
II	-0.009	0.025	0.020	0.040	2.3	2800	—
II	-0.011	0.027	0.020	0.050	2.7	2800	—
I	-0.014	0.030	0.023	0.060	3.1	2800	2800
I	-0.016	0.035	0.025	0.075	3.4	2800	2800
I	-0.018	0.035	0.025	0.075	3.8	2800	2800
I	-0.023	0.040	0.027	0.090	4.5	2800	2800
I	-0.028	0.046	0.030	0.120	5.2	2480	2800

Remarks 1. We recommend NSK support unit. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Contact NSK if permissible rotational speed is to be exceeded.



### Finished shaft end SA Type

(Fine lead) Dia. 25, Lead 6

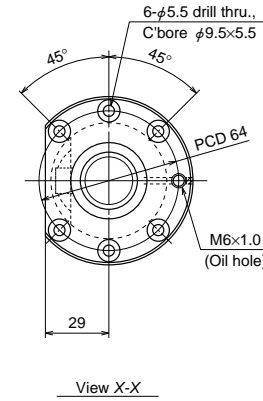


### Nut models: PFT

NSK

ø25×6

Unit: mm



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	25x6/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	3.969/25.5	
Screw shaft root diameter	21.4	
Effective turns of balls	2.5x2	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	14100
	Static $C_{0a}$	26800
Preload (N)	685	
Dynamic friction torque, median, (N·cm)	13.8	
Spacer ball	Yes	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	7.0	
Standard volume of grease replenishing (cm <sup>3</sup> )	3.5	

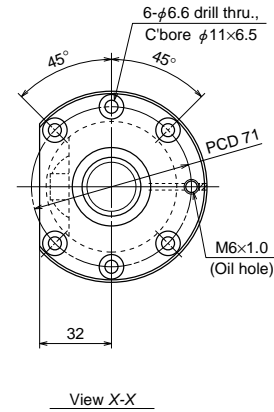
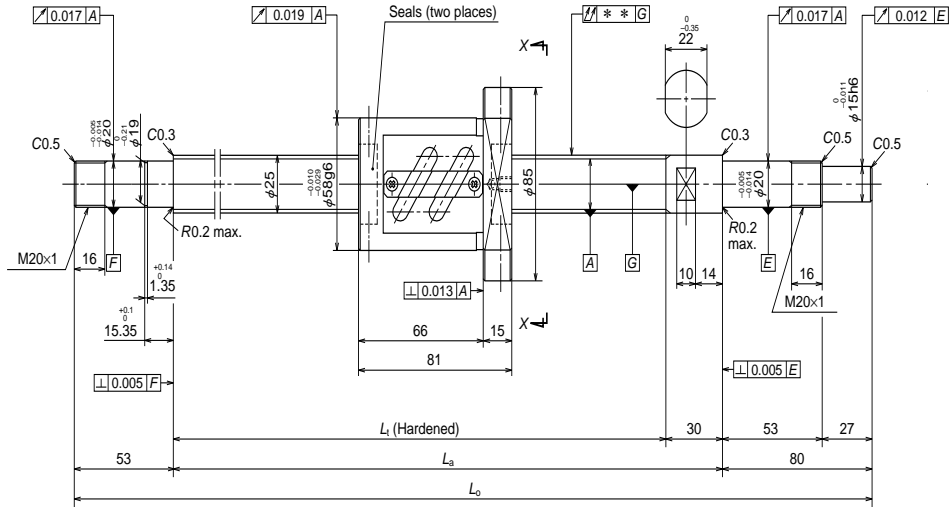
Recommended support unit	For drive side		For opposite to drive side	
	For drive side	For opposite to drive side	For drive side	For opposite to drive side
WBK20-01 (square)	○	○	○	○
WBK20S-01 (square)	○	○	○	○
WBK20-11 (round)	○	○	○	○

Unit: mm

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum ( $L_t$ —Nut length)	$L_t$	$L_a$	$L_o$
W2503SA-3P-C5Z6	250	308	370	400	533
W2505SA-3P-C5Z6	450	508	570	600	733
W2507SA-3P-C5Z6	650	708	770	800	933
W2511SA-2P-C5Z6	1050	1108	1170	1200	1333

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
$T$	$e_p$	$v_u$			Supporting condition	
					Fixed - Simple support	Fixed - Fixed
-0.009	0.025	0.020	0.050	2.5	2800	2800
-0.014	0.030	0.023	0.060	3.2	2800	2800
-0.018	0.035	0.025	0.075	3.9	2800	2800
-0.028	0.046	0.030	0.120	5.2	2410	2800

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.



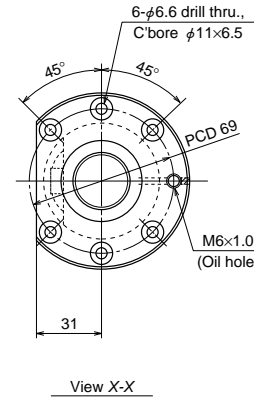
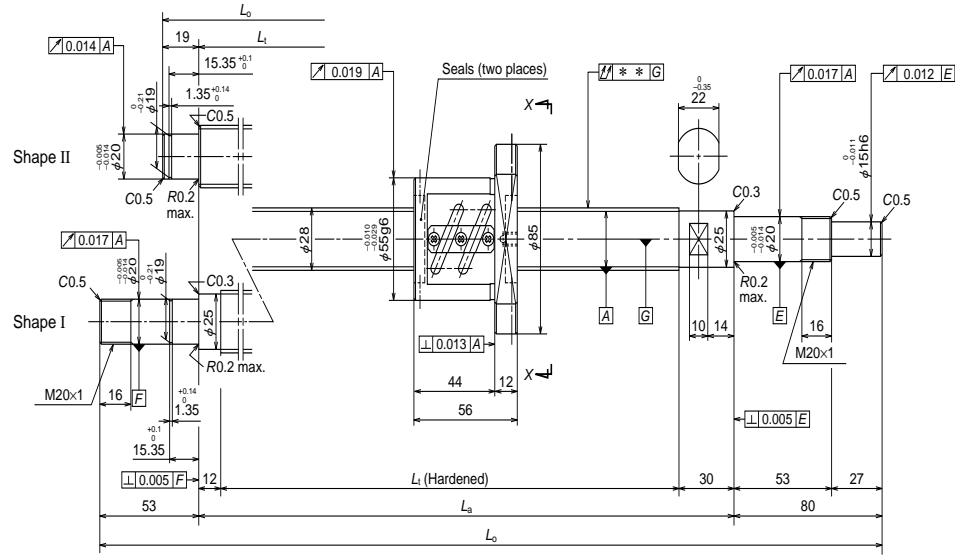
Ball screw specifications		
Shaft dia. x Lead / Direction of turn	25×10/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	4.762/25.5	
Screw shaft root diameter	20.5	
Effective turns of balls	1.5×2	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic C <sub>a</sub>	11600
	Static C <sub>0a</sub>	19000
Preload (N)	585	
Dynamic friction torque, median, (N·cm)	13.8	
Spacer ball	Yes	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	9.5	
Standard volume of grease replenishing (cm <sup>3</sup> )	4.8	

Recommended support unit	For drive side		For opposite to drive side	
	For drive side	For opposite to drive side	For drive side	For opposite to drive side
WBK20-01 (square)	○	○	○	○
WBK20S-01 (square)	○	○	○	○
WBK20-11 (round)	○	○	○	○

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L <sub>1</sub> —Nut length)	L <sub>1</sub>	L <sub>a</sub>	L <sub>0</sub>
W2503SA-4P-C5Z10	250	289	370	400	533
W2505SA-4P-C5Z10	450	489	570	600	733
W2507SA-4P-C5Z10	650	689	770	800	933
W2509SA-2P-C5Z10	850	889	970	1000	1133
W2511SA-3P-C5Z10	1050	1089	1170	1200	1333
W2514SA-1P-C5Z10	1350	1389	1470	1500	1633

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition	
					Fixed - Simple support	Fixed - Fixed
-0.009	0.025	0.020	0.050	3.2	2800	2800
-0.014	0.030	0.023	0.060	3.8	2800	2800
-0.018	0.035	0.025	0.075	4.5	2800	2800
-0.023	0.040	0.027	0.090	5.2	2800	2800
-0.028	0.046	0.030	0.120	5.9	2340	2800
-0.035	0.054	0.035	0.150	6.9	1470	2050

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	28x5/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	3.175/28.5	
Screw shaft root diameter	25.2	
Effective turns of balls	2.5x2	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	11000
	Static $C_{0a}$	24400
Preload (N)	540	
Dynamic friction torque, median, (N·cm)	9.8	
Spacer ball	Yes	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	6.0	
Standard volume of grease replenishing (cm <sup>3</sup> )	3.0	

Recommended support unit	For drive side		For opposite to drive side	
	For drive side	For opposite to drive side	For drive side	For opposite to drive side
WBK20-01 (square)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
WBK20S-01 (square)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
WBK20-11 (round)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

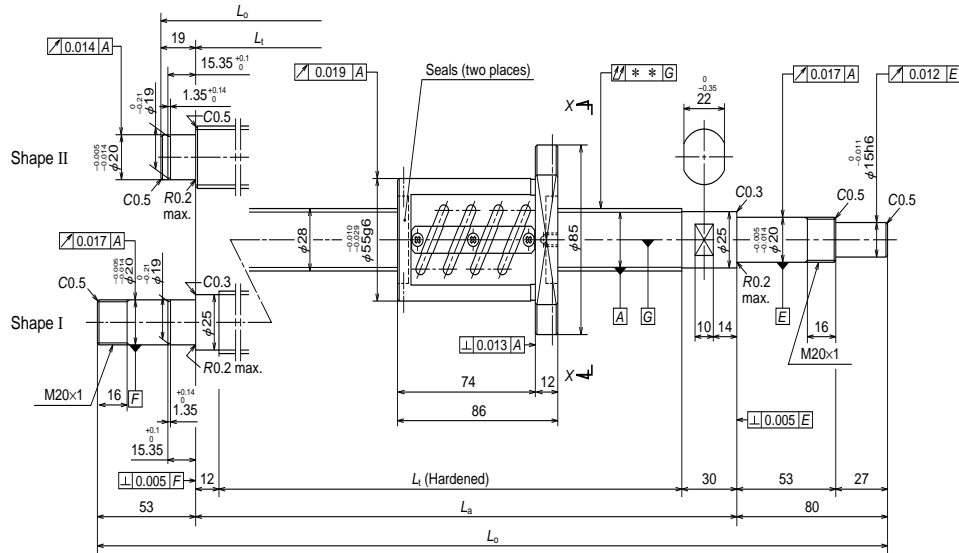
Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L <sub>1</sub> —Nut length)	L <sub>1</sub>	L <sub>a</sub>	L <sub>0</sub>
W2802SA-1P-C5Z5	200	214	270	300	399
W2803SA-1P-C5Z5	300	314	370	400	499
W2804SA-1P-C5Z5	400	414	470	500	599
W2805SA-1P-C5Z5	450	502	558	600	733
W2807SA-1P-C5Z5	650	702	758	800	933
W2809SA-1P-C5Z5	850	902	958	1000	1133
W2811SA-1P-C5Z5	1050	1102	1158	1200	1333

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition	
						Fixed - Simple support	Fixed - Fixed
II	-0.006	0.023	0.018	0.035	2.5	2500	—
II	-0.009	0.025	0.020	0.040	2.9	2500	—
II	-0.011	0.027	0.020	0.050	3.3	2500	—
I	-0.014	0.030	0.023	0.060	3.8	2500	2500
I	-0.018	0.035	0.025	0.075	4.7	2500	2500
I	-0.024	0.040	0.027	0.090	5.6	2500	2500
I	-0.028	0.046	0.030	0.120	6.5	2500	2500

# Finished shaft end SA Type

(Fine lead) Dia. 28, Lead 5

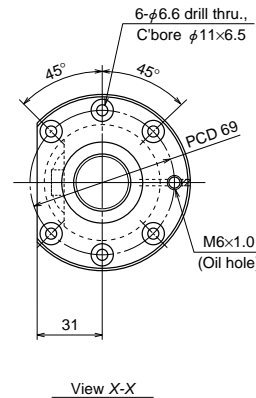


# Nut models: ZFT



ø28×5

Unit: mm



Ball screw specifications		
Shaft dia. x Lead / Direction of turn		28x5/Right
Preload / Ball recirculation		Z preload / Return tube
Ball dia. / Ball circle dia.		3.175/28.5
Screw shaft root diameter		25.2
Effective turns of balls		2.5x2
Accuracy grade / Preload		C5/Z
Basic load rating (N)	Dynamic C <sub>s</sub>	17400
	Static C <sub>0a</sub>	48800
Preload (N)		1220
Dynamic friction torque, median, (N·cm)		21.5
Spacer ball		None
Factory packed grease		Refer to Remarks 2.
Internal spatial volume of nut (cm <sup>3</sup> )		9.0
Standard volume of grease replenishing (cm <sup>3</sup> )		4.5

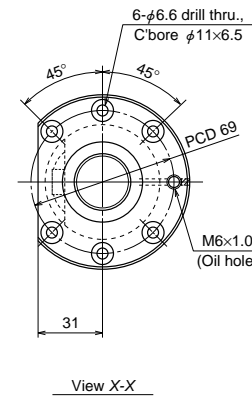
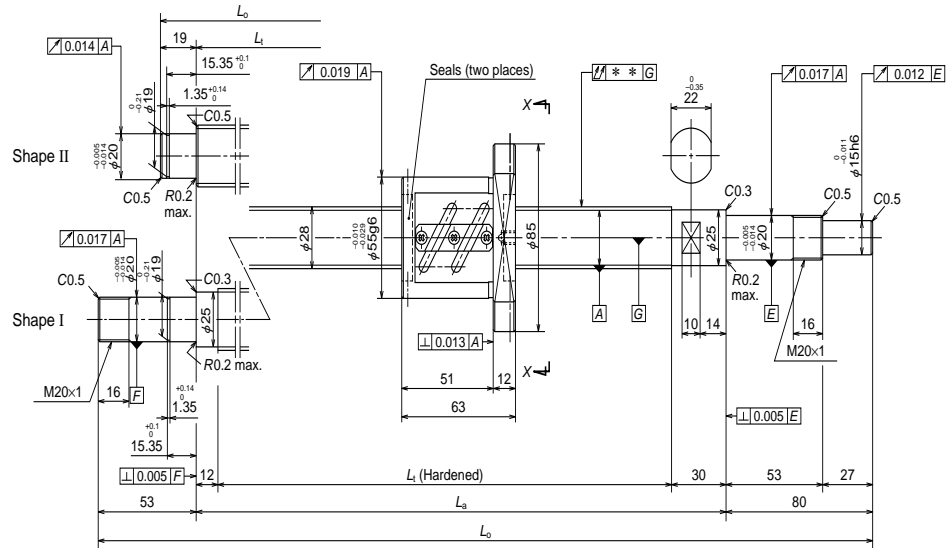
Recommended support unit	For drive side		For opposite to drive side	
	For drive side	For opposite to drive side	For drive side	For opposite to drive side
WBK20-01 (square)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
WBK20S-01 (square)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
WBK20-11 (round)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Unit: mm

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L <sub>t</sub> —Nut length)	L <sub>t</sub>	L <sub>a</sub>	L <sub>o</sub>
W2802SA-2Z-C5Z5	150	184	270	300	399
W2803SA-2Z-C5Z5	250	284	370	400	499
W2804SA-2Z-C5Z5	350	384	470	500	599
W2805SA-2Z-C5Z5	450	472	558	600	733
W2807SA-2Z-C5Z5	650	672	758	800	933
W2809SA-2Z-C5Z5	850	872	958	1000	1133
W2811SA-2Z-C5Z5	1050	1072	1158	1200	1333

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition	
	Fixed - Simple support		Fixed - Fixed				
II	-0.006	0.023	0.018	0.035	2.8	2500	—
II	-0.009	0.025	0.020	0.040	3.2	2500	—
II	-0.011	0.027	0.020	0.050	3.7	2500	—
I	-0.013	0.030	0.023	0.060	4.2	2500	2500
I	-0.018	0.035	0.025	0.075	5.1	2500	2500
I	-0.023	0.040	0.027	0.090	5.9	2500	2500
I	-0.028	0.046	0.030	0.120	6.8	2500	2500



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	28x6/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	3.175/28.5	
Screw shaft root diameter	25.2	
Effective turns of balls	2.5x2	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	11000
	Static $C_{0a}$	24400
Preload (N)	540	
Dynamic friction torque, median, (N·cm)	11.8	
Spacer ball	Yes	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	6.0	
Standard volume of grease replenishing (cm <sup>3</sup> )	3.0	

Recommended support unit	For drive side		For opposite to drive side	
	For drive side	For opposite to drive side	For drive side	For opposite to drive side
WBK20-01 (square)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
WBK20S-01 (square)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
WBK20-11 (round)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

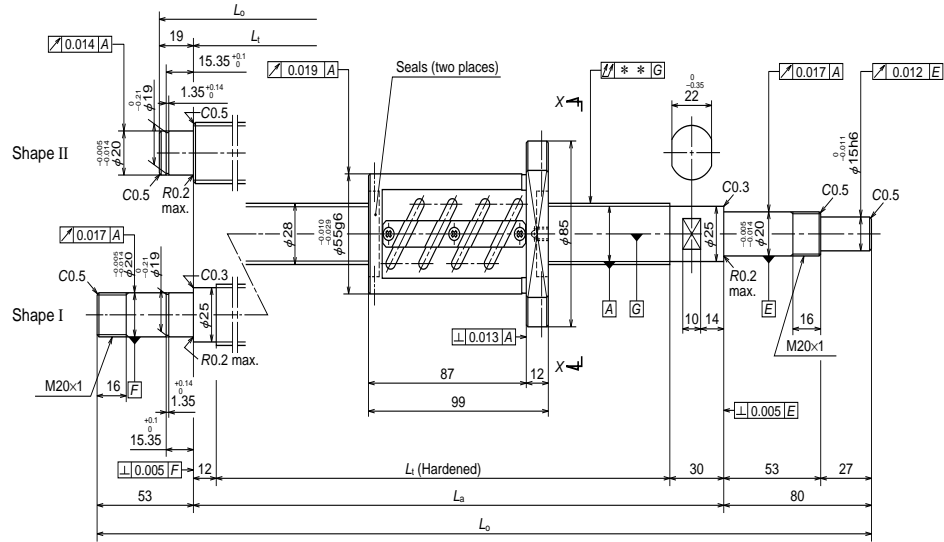
Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum ( $L_1$ —Nut length)	$L_1$	$L_2$	$L_3$
W2803SA-3P-C5Z6	250	307	370	400	499
W2805SA-3P-C5Z6	450	507	570	600	699
W2807SA-3P-C5Z6	650	695	758	800	933
W2809SA-3P-C5Z6	850	895	958	1000	1133
W2811SA-3P-C5Z6	1050	1095	1158	1200	1333

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	$T$	$e_p$	$v_u$			Supporting condition	
						Fixed - Simple support	Fixed - Fixed
II	-0.009	0.025	0.020	0.040	3.0	2500	—
II	-0.014	0.030	0.023	0.060	3.9	2500	—
I	-0.018	0.035	0.025	0.075	4.9	2500	2500
I	-0.023	0.040	0.027	0.090	5.8	2500	2500
I	-0.028	0.046	0.030	0.120	6.6	2500	2500

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.

# Finished shaft end SA Type

(Fine lead) Dia. 28, Lead 6

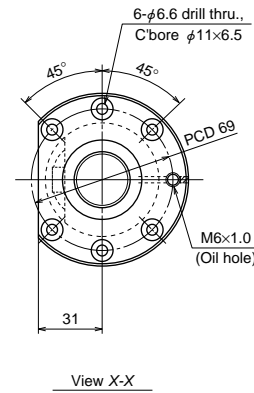


# Nut models: ZFT

NSK

ø28×6

Unit: mm



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	28×6/Right	
Preload / Ball recirculation	Z preload / Return tube	
Ball dia. / Ball circle dia.	3.175/28.5	
Screw shaft root diameter	25.2	
Effective turns of balls	2.5×2	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	17400
	Static $C_{0a}$	48800
Preload (N)	1220	
Dynamic friction torque, median, (N·cm)	23.5	
Spacer ball	None	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	9.5	
Standard volume of grease replenishing (cm <sup>3</sup> )	4.8	

Recommended support unit	For drive side		For opposite to drive side
	For drive side	For opposite to drive side	
WBK20-01 (square)	○	○	
WBK20S-01 (square)		○	
WBK20-11 (round)	○	○	

Unit: mm

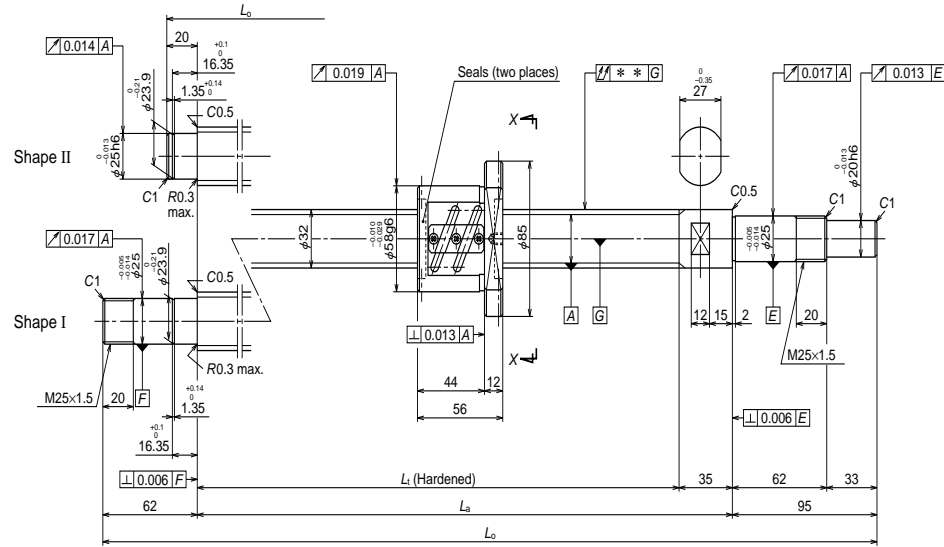
Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum ( $L_t$ —Nut length)	$L_t$	$L_a$	$L_o$
W2803SA-4Z-C5Z6	250	271	370	400	499
W2805SA-4Z-C5Z6	450	471	570	600	699
W2807SA-4Z-C5Z6	650	659	758	800	933
W2809SA-4Z-C5Z6	850	859	958	1000	1133
W2811SA-4Z-C5Z6	1050	1059	1158	1200	1333

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	$T$	$e_p$	$v_u$			Supporting condition	
						Fixed - Simple support	Fixed - Fixed
II	-0.009	0.025	0.020	0.040	3.4	2500	—
II	-0.014	0.030	0.023	0.060	4.3	2500	—
I	-0.018	0.035	0.025	0.075	5.3	2500	2500
I	-0.023	0.040	0.027	0.090	6.2	2500	2500
I	-0.028	0.046	0.030	0.120	7.1	2500	2500

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.

# Finished shaft end SA Type

(Fine lead) Dia. 32, Lead 5

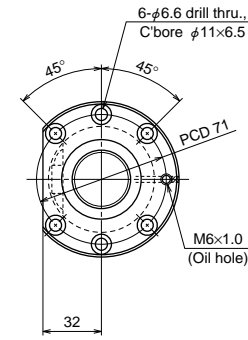


# Nut models: PFT

**NSK**

ø32×5

Unit: mm



View X-X

## Ball screw specifications

Shaft dia. x Lead / Direction of turn	32x5/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	3.175/32.5	
Screw shaft root diameter	29.2	
Effective turns of balls	2.5x2	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	11600
	Static $C_{0a}$	28000
Preload (N)	590	
Dynamic friction torque, median, (N·cm)	11.8	
Spacer ball	Yes	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	7.0	
Standard volume of grease replenishing (cm <sup>3</sup> )	3.5	

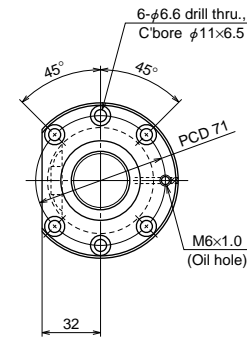
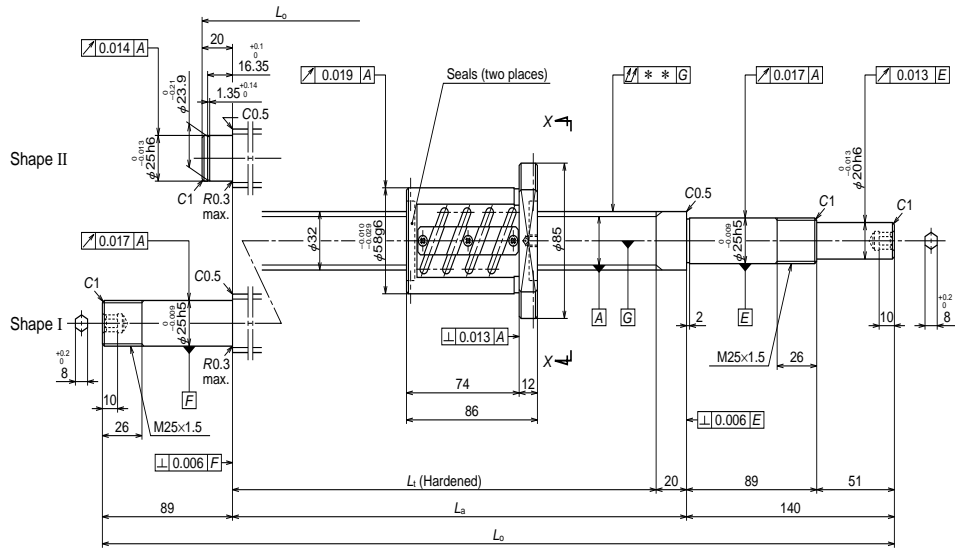
Recommended support unit	For drive side		For opposite to drive side	
	For drive side	For opposite to drive side	For drive side	For opposite to drive side
WBK25-01 (square)	○	○	○	○
WBK25S-01 (square)	○	○	○	○
WBK25-11 (round)	○	○	○	○

Unit: mm

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum ( $L_t$ —Nut length)	$L_t$	$L_a$	$L_o$
<b>W3202SA-1P-C5Z5</b>	150	209	265	300	415
<b>W3203SA-1P-C5Z5</b>	250	309	365	400	515
<b>W3204SA-1P-C5Z5</b>	350	409	465	500	615
<b>W3205SA-1P-C5Z5</b>	450	509	565	600	715
<b>W3206SA-1P-C5Z5</b>	550	609	665	700	857
<b>W3207SA-1P-C5Z5</b>	650	709	765	800	957
<b>W3209SA-1P-C5Z5</b>	850	909	965	1000	1157
<b>W3211SA-1P-C5Z5</b>	1050	1109	1165	1200	1357
<b>W3214SA-1P-C5Z5</b>	1350	1409	1465	1500	1657

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	$T$	$e_p$	$v_u$			Supporting condition	
	Fixed - Simple support		Fixed - Fixed				
II	-0.006	0.023	0.018	0.040	3.1	2180	—
II	-0.009	0.025	0.020	0.050	3.7	2180	—
II	-0.011	0.027	0.020	0.050	4.2	2180	—
II	-0.014	0.030	0.023	0.060	4.8	2180	—
I	-0.016	0.035	0.025	0.075	5.6	2180	2180
I	-0.018	0.035	0.025	0.075	6.1	2180	2180
I	-0.023	0.040	0.027	0.090	7.3	2180	2180
I	-0.028	0.046	0.030	0.120	8.5	2180	2180
I	-0.035	0.054	0.035	0.150	10.2	2070	2180



View X-X

**Ball screw specifications**

Shaft dia. x Lead / Direction of turn	32x5/Right	
Preload / Ball recirculation	Z preload / Return tube	
Ball dia. / Ball circle dia.	3.175/32.5	
Screw shaft root diameter	29.2	
Effective turns of balls	2.5x2	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	18500
	Static $C_{0a}$	56100
Preload (N)	1270	
Dynamic friction torque, median, (N·cm)	23.5	
Spacer ball	None	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	10	
Standard volume of grease replenishing (cm <sup>3</sup> )	5	

**Recommended support unit**

WBK25DF-31	(round)
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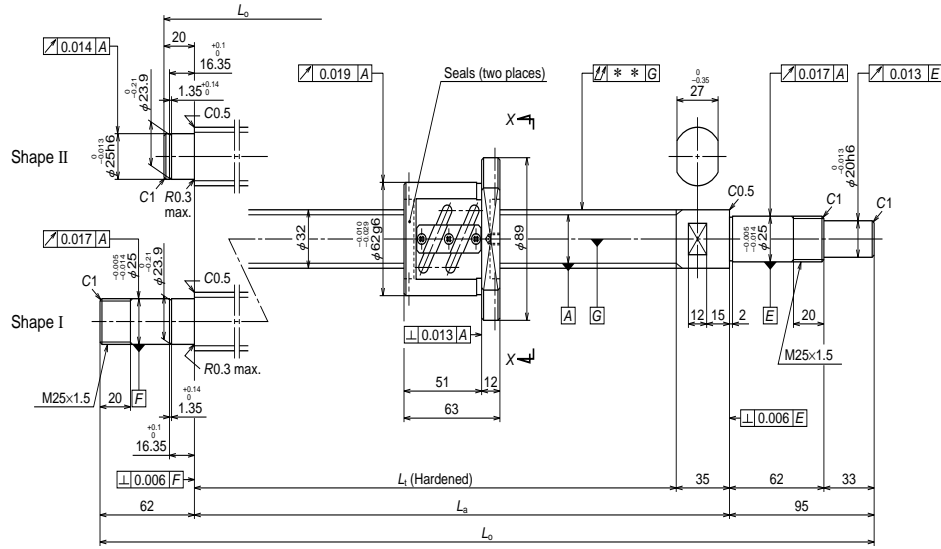
Unit: mm

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum ( $L_i$ —Nut length)	$L_1$	$L_a$	$L_o$
<b>W3202SA-2Z-C5Z5</b>	150	194	280	300	460
<b>W3203SA-2Z-C5Z5</b>	250	294	380	400	560
<b>W3204SA-2Z-C5Z5</b>	350	394	480	500	660
<b>W3205SA-2Z-C5Z5</b>	450	494	580	600	760
<b>W3206SA-2Z-C5Z5</b>	550	594	680	700	929
<b>W3207SA-2Z-C5Z5</b>	650	694	780	800	1029
<b>W3209SA-2Z-C5Z5</b>	850	894	980	1000	1229
<b>W3211SA-2Z-C5Z5</b>	1050	1094	1180	1200	1429
<b>W3214SA-2Z-C5Z5</b>	1350	1394	1480	1500	1729

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	$T$	$e_p$	$v_u$			Supporting condition	
	Fixed - Simple support		Fixed - Fixed				
II	-0.007	0.023	0.018	0.040	3.5	2180	—
II	-0.009	0.025	0.020	0.050	4.1	2180	—
II	-0.012	0.027	0.020	0.060	4.7	2180	—
II	-0.014	0.030	0.023	0.060	5.3	2180	—
I	-0.016	0.035	0.025	0.075	6.1	2180	2180
I	-0.019	0.035	0.025	0.090	6.7	2180	2180
I	-0.024	0.040	0.027	0.090	7.9	2180	2180
I	-0.028	0.046	0.030	0.120	9.0	2180	2180
I	-0.036	0.054	0.035	0.150	10.8	2040	2180

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.





Ball screw specifications		
Shaft dia. x Lead / Direction of turn	32×6/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	3.969/32.5	
Screw shaft root diameter	28.4	
Effective turns of balls	2.5×2	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	15500
	Static $C_{0a}$	34700
Preload (N)	780	
Dynamic friction torque, median, (N·cm)	15.7	
Spacer ball	Yes	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	9.5	
Standard volume of grease replenishing (cm <sup>3</sup> )	4.8	

Recommended support unit	For drive side		For opposite to drive side
	For drive side	For opposite to drive side	
WBK25-01 (square)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
WBK25S-01 (square)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
WBK25-11 (round)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

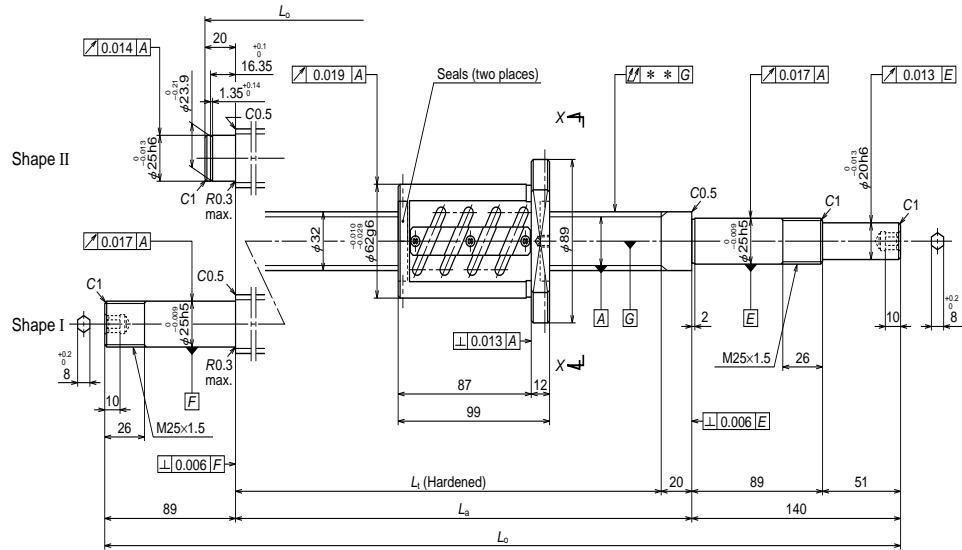
Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum ( $L_1$ —Nut length)	$L_1$	$L_a$	$L_o$
<b>W3203SA-3P-C5Z6</b>	250	302	365	400	515
<b>W3205SA-3P-C5Z6</b>	450	502	565	600	715
<b>W3207SA-3P-C5Z6</b>	650	702	765	800	957
<b>W3209SA-3P-C5Z6</b>	850	902	965	1000	1157
<b>W3211SA-3P-C5Z6</b>	1050	1102	1165	1200	1357
<b>W3214SA-3P-C5Z6</b>	1350	1402	1465	1500	1657

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	$T$	$e_p$	$v_u$			Supporting condition	
						Fixed - Simple support	Fixed - Fixed
II	-0.009	0.025	0.020	0.050	3.8	2180	—
II	-0.014	0.030	0.023	0.060	5.0	2180	—
I	-0.018	0.035	0.025	0.075	6.3	2180	2180
I	-0.023	0.040	0.027	0.090	7.4	2180	2180
I	-0.028	0.046	0.030	0.120	8.5	2180	2180
I	-0.035	0.054	0.035	0.150	10.2	2020	2180

- Remarks
- We recommend NSK support unit. Refer to Page B433 for details.
  - Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  - Contact NSK if permissible rotational speed is to be exceeded.

# Finished shaft end SA Type

(Fine lead) Dia. 32, Lead 6

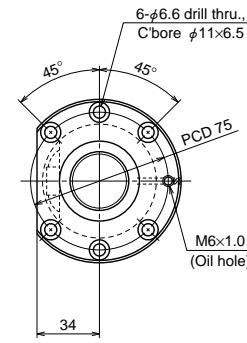


# Nut models: ZFT

NSK

ø32×6

Unit: mm



View X-X

### Ball screw specifications

Shaft dia. x Lead / Direction of turn		32x6/Right
Preload / Ball recirculation		Z preload / Return tube
Ball dia. / Ball circle dia.		3.969/32.5
Screw shaft root diameter		28.4
Effective turns of balls		2.5x2
Accuracy grade / Preload		C5/Z
Basic load rating (N)	Dynamic $C_a$	24700
	Static $C_{0a}$	69400
Preload (N)		1710
Dynamic friction torque, median, (N·cm)		35.0
Spacer ball		None
Factory packed grease		Refer to Remarks 2.
Internal spatial volume of nut (cm <sup>3</sup> )		14
Standard volume of grease replenishing (cm <sup>3</sup> )		7

### Recommended support unit

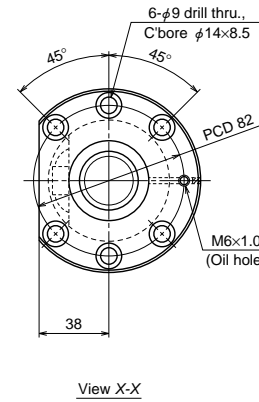
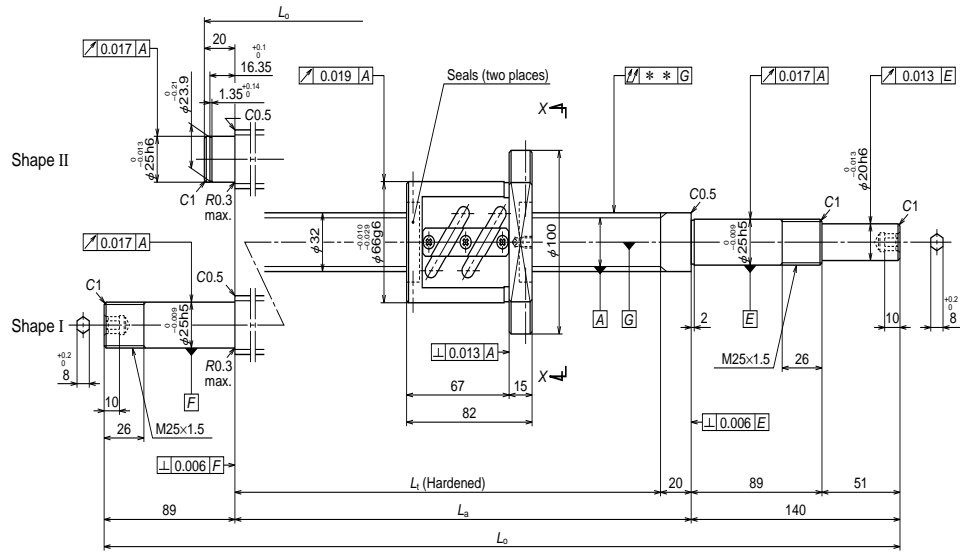
WBK25DF-31	(round)
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Unit: mm

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum ( $L_1$ —Nut length)	$L_1$	$L_a$	$L_b$
<b>W3203SA-4Z-C5Z6</b>	250	281	380	400	560
<b>W3205SA-4Z-C5Z6</b>	450	481	580	600	760
<b>W3207SA-4Z-C5Z6</b>	650	681	780	800	1029
<b>W3209SA-4Z-C5Z6</b>	850	881	980	1000	1229
<b>W3211SA-4Z-C5Z6</b>	1050	1081	1180	1200	1429
<b>W3214SA-4Z-C5Z6</b>	1350	1381	1480	1500	1729

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	$T$	$e_p$	$v_u$			Supporting condition	
	Fixed - Simple support		Fixed - Fixed				
II	-0.009	0.025	0.020	0.050	4.5	2180	—
II	-0.014	0.030	0.023	0.060	5.6	2180	—
I	-0.019	0.035	0.025	0.090	7.0	2180	2180
I	-0.024	0.040	0.027	0.090	8.1	2180	2180
I	-0.028	0.046	0.030	0.120	9.3	2180	2180
I	-0.036	0.054	0.035	0.150	11.0	2000	2180

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.



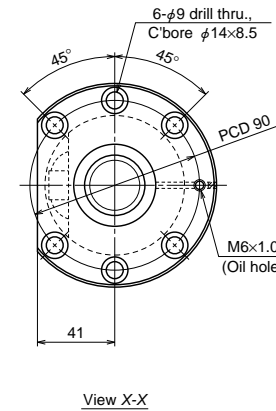
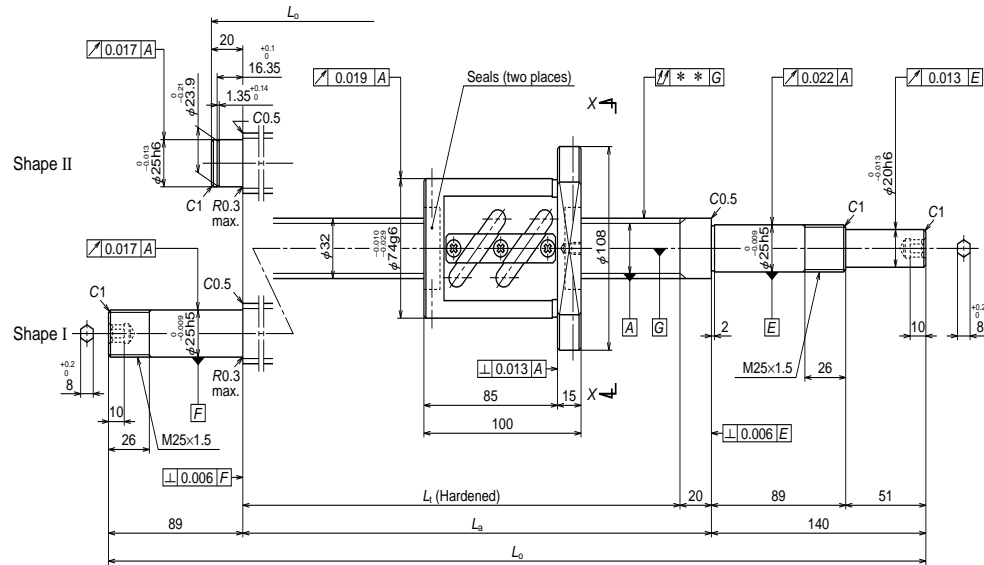
Ball screw specifications		
Shaft dia. x Lead / Direction of turn	32x8/Right	
Preload / Ball recirculation	Z preload / Return tube	
Ball dia. / Ball circle dia.	4.762/32.5	
Screw shaft root diameter	27.5	
Effective turns of balls	2.5x1	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	17500
	Static $C_{0a}$	41000
Preload (N)	1320	
Dynamic friction torque, median, (N·cm)	31.0	
Spacer ball	None	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	13	
Standard volume of grease replenishing (cm <sup>3</sup> )	6.5	

Recommended support unit	
WBK25DF-31	(round)

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum ( $L_1$ —Nut length)	$L_1$	$L_b$	$L_o$
W3203SA-5Z-C5Z8	250	298	380	400	560
W3205SA-5Z-C5Z8	450	498	580	600	760
W3207SA-5Z-C5Z8	650	698	780	800	1029
W3209SA-5Z-C5Z8	850	898	980	1000	1229
W3214SA-5Z-C5Z8	1350	1398	1480	1500	1729

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	$T$	$e_p$	$v_u$			Supporting condition	
	Fixed - Simple support		Fixed - Fixed				
II	-0.009	0.025	0.020	0.050	4.7	2180	—
II	-0.014	0.030	0.023	0.060	5.8	2180	—
I	-0.019	0.035	0.025	0.090	7.2	2180	2180
I	-0.024	0.040	0.027	0.090	8.3	2180	2180
I	-0.036	0.054	0.035	0.150	11.1	1920	2180

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	32x10/Right	
Preload / Ball recirculation	Z preload / Return tube	
Ball dia. / Ball circle dia.	6.35/33	
Screw shaft root diameter	26.4	
Effective turns of balls	2.5x1	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic C <sub>s</sub>	25500
	Static C <sub>0s</sub>	54000
Preload (N)	1960	
Dynamic friction torque, median, (N·cm)	54.0	
Spacer ball	None	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	22	
Standard volume of grease replenishing (cm <sup>3</sup> )	11	

Recommended support unit	
WBK25DF-31	(round)

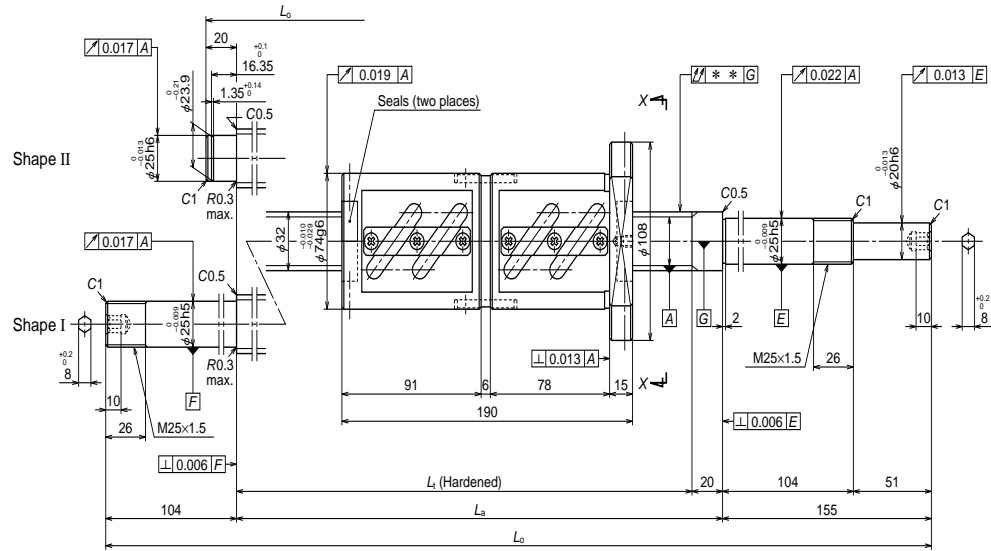
Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L <sub>1</sub> —Nut length)	L <sub>1</sub>	L <sub>a</sub>	L <sub>0</sub>
W3203SA-6Z-C5Z10	250	280	380	400	560
W3204SA-3Z-C5Z10	350	380	480	500	660
W3205SA-6Z-C5Z10	450	480	580	600	760
W3206SA-3Z-C5Z10	550	580	680	700	929
W3207SA-6Z-C5Z10	650	680	780	800	1029
W3209SA-6Z-C5Z10	850	880	980	1000	1229
W3211SA-5Z-C5Z10	1050	1080	1180	1200	1429
W3214SA-6Z-C5Z10	1350	1380	1480	1500	1729
W3217SA-1Z-C5Z10	1650	1680	1780	1800	2029

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition	
						Fixed - Simple support	Fixed - Fixed
II	-0.009	0.025	0.020	0.050	5.5	2180	—
II	-0.012	0.027	0.020	0.060	6.0	2180	—
II	-0.014	0.030	0.023	0.060	6.6	2180	—
I	-0.016	0.035	0.025	0.075	7.4	2180	2180
I	-0.019	0.035	0.025	0.090	7.9	2180	2180
I	-0.024	0.040	0.027	0.090	9.0	2180	2180
I	-0.028	0.046	0.030	0.120	10.1	2180	2180
I	-0.036	0.054	0.035	0.150	11.7	1860	2180
I	-0.043	0.065	0.040	0.200	13.3	1280	1820

Remarks 1. We recommend NSK support unit. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Contact NSK if permissible rotational speed is to be exceeded.

# Finished shaft end SA Type

(Fine lead) Dia. 32, Lead 10

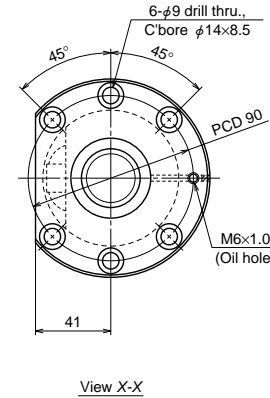


Nut models: DFT

**NSK**

ø32×10

Unit: mm



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	32×10/Right	
Preload / Ball recirculation	D preload / Return tube	
Ball dia. / Ball circle dia.	6.35/33	
Screw shaft root diameter	26.4	
Effective turns of balls	2.5×2	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic C <sub>s</sub>	46300
	Static C <sub>0s</sub>	108000
Preload (N)	3230	
Dynamic friction torque, median, (N·cm)	83.0	
Spacer ball	None	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	44	
Standard volume of grease replenishing (cm <sup>3</sup> )	22	

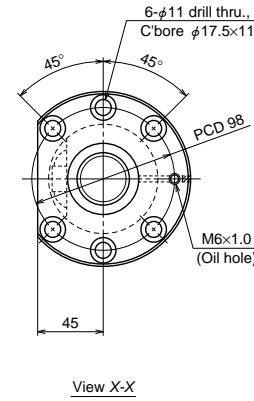
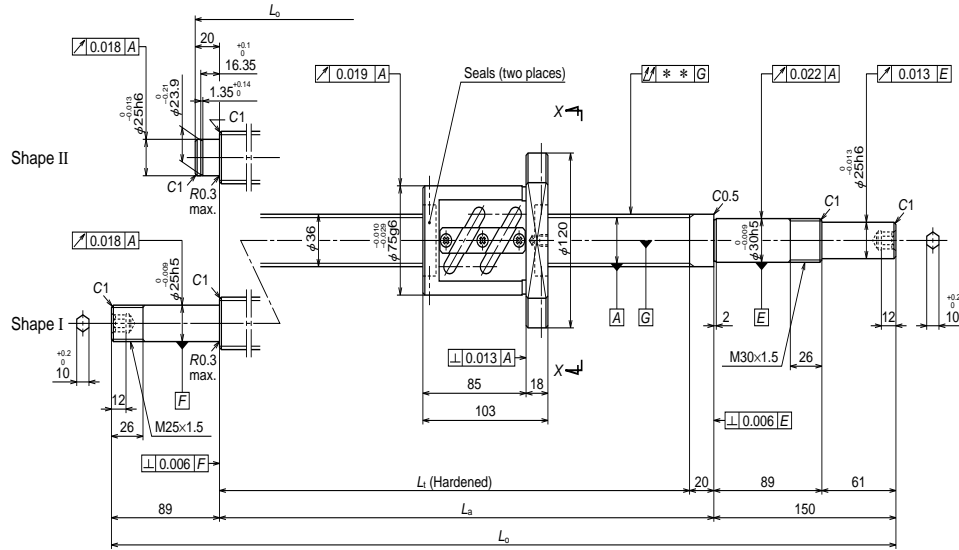
Recommended support unit	
WBK25DFD-31	(round)

Unit: mm

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L <sub>t</sub> —Nut length)	L <sub>1</sub>	L <sub>a</sub>	L <sub>o</sub>
W3203SA-7D-C5Z10	150	190	380	400	575
W3204SA-4D-C5Z10	250	290	480	500	675
W3205SA-7D-C5Z10	350	390	580	600	775
W3206SA-4D-C5Z10	450	490	680	700	959
W3207SA-7D-C5Z10	550	590	780	800	1059
W3209SA-7D-C5Z10	750	790	980	1000	1259
W3211SA-6D-C5Z10	950	990	1180	1200	1459
W3214SA-7D-C5Z10	1250	1290	1480	1500	1759
W3217SA-2D-C5Z10	1550	1590	1780	1800	2059

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition	
	Fixed - Simple support		Fixed - Fixed				
II	-0.009	0.025	0.020	0.050	7.5	2180	—
II	-0.012	0.027	0.020	0.060	8.1	2180	—
II	-0.014	0.030	0.023	0.060	8.6	2180	—
I	-0.016	0.035	0.025	0.075	9.5	2180	2180
I	-0.019	0.035	0.025	0.090	10.0	2180	2180
I	-0.024	0.040	0.027	0.120	11.1	2180	2180
I	-0.028	0.046	0.030	0.120	12.2	2180	2180
I	-0.036	0.054	0.035	0.150	13.8	1980	2180
I	-0.043	0.065	0.040	0.200	15.4	1350	1910

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.



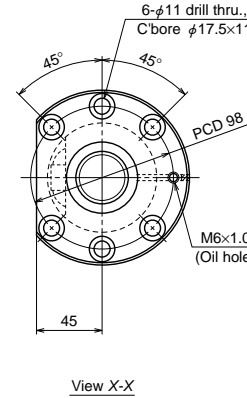
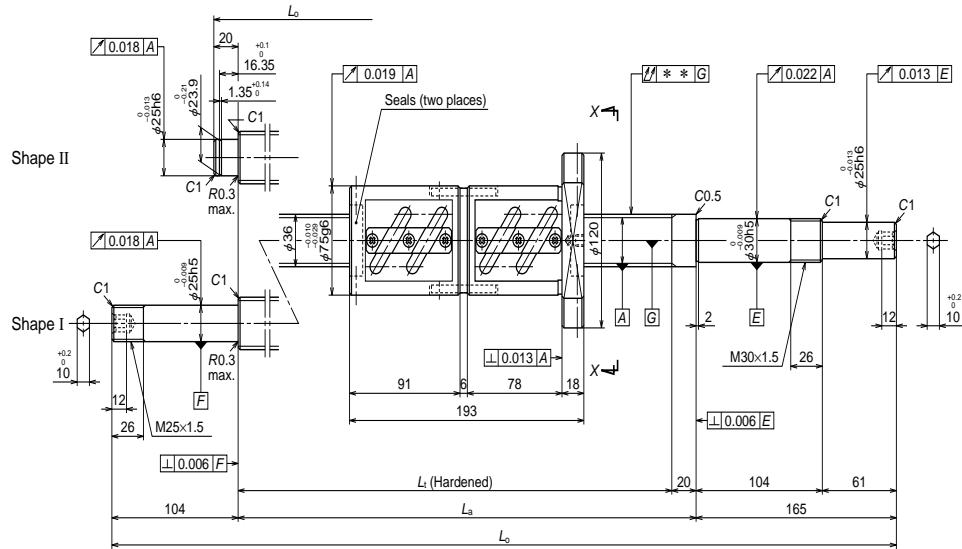
Ball screw specifications		
Shaft dia. x Lead / Direction of turn	36×10/Right	
Preload / Ball recirculation	Z preload / Return tube	
Ball dia. / Ball circle dia.	6.35/37	
Screw shaft root diameter	30.4	
Effective turns of balls	2.5×1	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic C <sub>a</sub>	27200
	Static C <sub>0a</sub>	61300
Preload (N)	2060	
Dynamic friction torque, median, (N·cm)	59.0	
Spacer ball	None	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	32	
Standard volume of grease replenishing (cm <sup>3</sup> )	16	

Recommended support unit	For drive side		For opposite to drive side
	WBK30DF-31 (round)	<input type="radio"/>	<input type="radio"/>
WBK25DF-31 (round)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L <sub>1</sub> —Nut length)	L <sub>1</sub>	L <sub>a</sub>	L <sub>o</sub>
W3604SA-1Z-C5Z10	350	377	480	500	670
W3606SA-1Z-C5Z10	550	577	680	700	870
W3609SA-1Z-C5Z10	850	877	980	1000	1239
W3613SA-1Z-C5Z10	1250	1277	1380	1400	1639
W3617SA-1Z-C5Z10	1650	1677	1780	1800	2039

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition	
	Fixed - Simple support		Fixed - Fixed				
II	-0.012	0.027	0.020	0.040	7.4	1940	—
II	-0.016	0.035	0.025	0.050	8.8	1940	—
I	-0.024	0.040	0.027	0.065	11.1	1940	1940
I	-0.033	0.054	0.035	0.100	13.9	1940	1940
I	-0.043	0.065	0.040	0.130	16.6	1480	1940



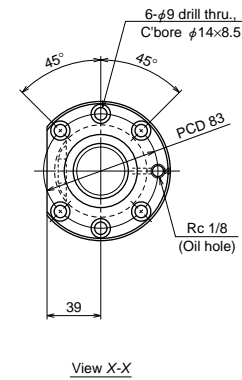
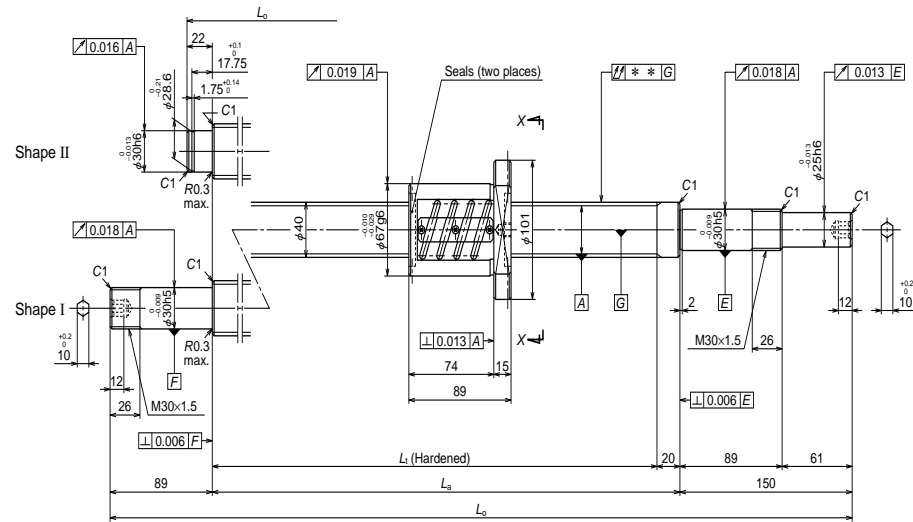
Ball screw specifications		
Shaft dia. x Lead / Direction of turn	36x10/Right	
Preload / Ball recirculation	D preload / Return tube	
Ball dia. / Ball circle dia.	6.35/37	
Screw shaft root diameter	30.4	
Effective turns of balls	2.5x2	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic C <sub>a</sub>	49300
	Static C <sub>0a</sub>	123000
Preload (N)	3430	
Dynamic friction torque, median, (N·cm)	93.0	
Spacer ball	None	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	64	
Standard volume of grease replenishing (cm <sup>3</sup> )	27	

Recommended support unit	For drive side	For opposite to drive side
	WBK30DFD-31 (round)	○
WBK25DFD-31 (round)	○	○

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L <sub>t</sub> —Nut length)	L <sub>t</sub>	L <sub>a</sub>	L <sub>o</sub>
			W3604SA-2D-C5Z10	250	287
W3606SA-2D-C5Z10	450	487	680	700	885
W3609SA-2D-C5Z10	750	787	980	1000	1269
W3613SA-2D-C5Z10	1150	1187	1380	1400	1669
W3617SA-2D-C5Z10	1550	1587	1780	1800	2069

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition	
						Fixed - Simple support	Fixed - Fixed
II	-0.012	0.027	0.020	0.040	9.3	1940	—
II	-0.016	0.035	0.025	0.050	10.7	1940	—
I	-0.024	0.040	0.027	0.080	13.1	1940	1940
I	-0.033	0.054	0.035	0.100	15.9	1940	1940
I	-0.043	0.065	0.040	0.130	18.6	1540	1940

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	40x5/Right	
Preload / Ball recirculation	Z preload / Return tube	
Ball dia. / Ball circle dia.	3.175/40.5	
Screw shaft root diameter	37.2	
Effective turns of balls	2.5x2	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	20200
	Static $C_{0a}$	70600
Preload (N)	1420	
Dynamic friction torque, median, (N·cm)	29.5	
Spacer ball	None	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	14	
Standard volume of grease replenishing (cm <sup>3</sup> )	7	

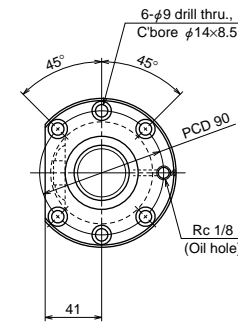
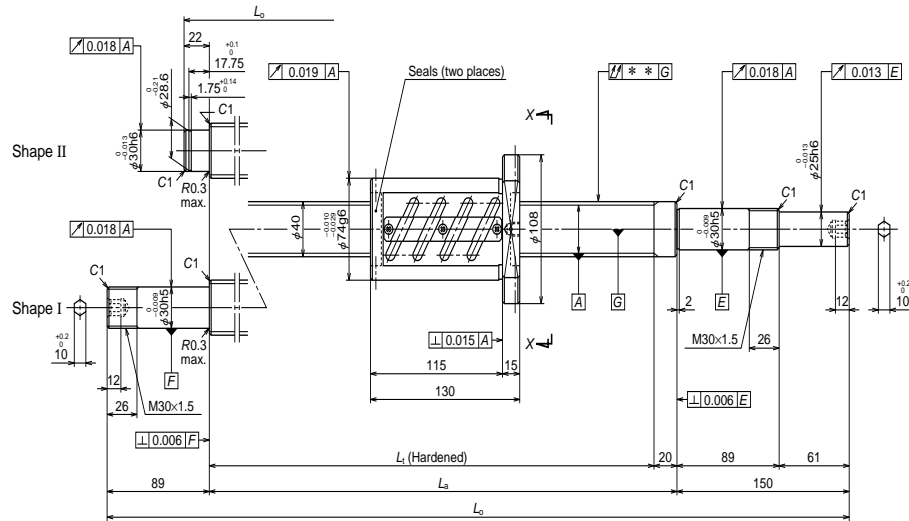
Recommended support unit	
WBK30DF-31	(round)

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum ( $L_1$ —Nut length)	$L_1$	$L_2$	$L_3$
W4003SA-1Z-C5Z5	250	291	380	400	572
W4005SA-1Z-C5Z5	450	491	580	600	772
W4007SA-1Z-C5Z5	650	691	780	800	1039
W4009SA-1Z-C5Z5	850	891	980	1000	1239
W4011SA-1Z-C5Z5	1050	1091	1180	1200	1439
W4015SA-1Z-C5Z5	1450	1491	1580	1600	1839

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	$T$	$e_p$	$v_u$			Supporting condition	
	Fixed - Simple support		Fixed - Fixed				
II	-0.009	0.025	0.020	0.035	6.3	1750	—
II	-0.014	0.030	0.023	0.040	8.1	1750	—
I	-0.019	0.035	0.025	0.065	10.3	1750	1750
I	-0.024	0.040	0.027	0.065	12.2	1750	1750
I	-0.028	0.046	0.030	0.080	14.0	1750	1750
I	-0.038	0.054	0.035	0.100	17.7	1750	1750





Ball screw specifications

Shaft dia. x Lead / Direction of turn	40x8/Right	
Preload / Ball recirculation	Z preload / Return tube	
Ball dia. / Ball circle dia.	4.762/40.5	
Screw shaft root diameter	35.5	
Effective turns of balls	2.5x2	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic C <sub>a</sub>	34900
	Static C <sub>0a</sub>	103000
Preload (N)	2450	
Dynamic friction torque, median, (N·cm)	64.0	
Spacer ball	None	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	27	
Standard volume of grease replenishing (cm <sup>3</sup> )	14	

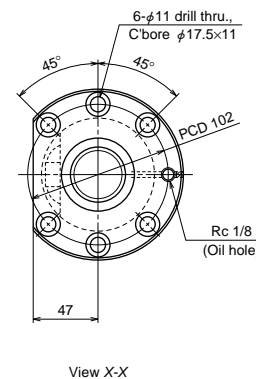
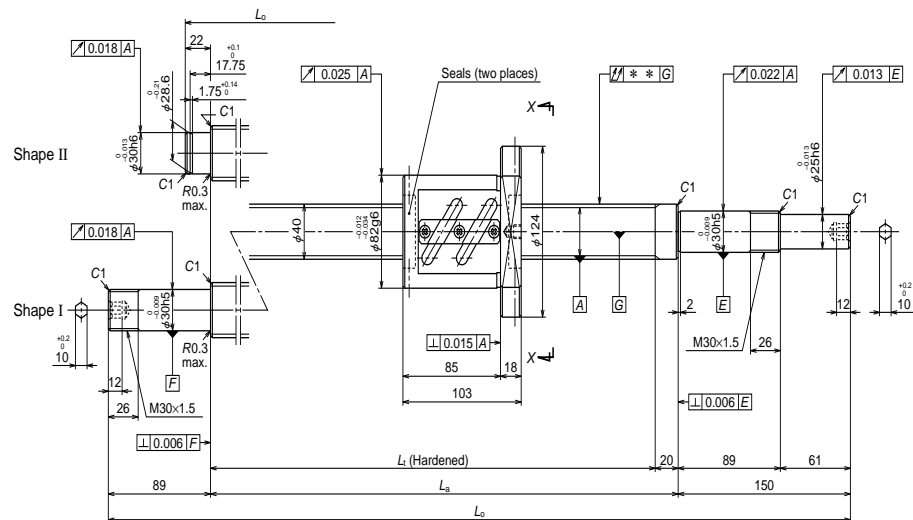
Recommended support unit

WBK30DF-31	(round)
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Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L <sub>1</sub> —Nut length)	L <sub>1</sub>	L <sub>a</sub>	L <sub>o</sub>
W4003SA-2Z-C5Z8	200	250	380	400	572
W4005SA-2Z-C5Z8	400	450	580	600	772
W4007SA-2Z-C5Z8	600	650	780	800	1039
W4009SA-2Z-C5Z8	800	850	980	1000	1239
W4011SA-2Z-C5Z8	1000	1050	1180	1200	1439
W4015SA-2Z-C5Z8	1400	1450	1580	1600	1839

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition	
						Fixed - Simple support	Fixed - Fixed
II	-0.009	0.025	0.020	0.035	7.4	1750	—
II	-0.014	0.030	0.023	0.040	9.2	1750	—
I	-0.019	0.035	0.025	0.065	11.3	1750	1750
I	-0.024	0.040	0.027	0.065	13.1	1750	1750
I	-0.028	0.046	0.030	0.080	14.9	1750	1750
I	-0.038	0.054	0.035	0.100	18.5	1750	1750

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.



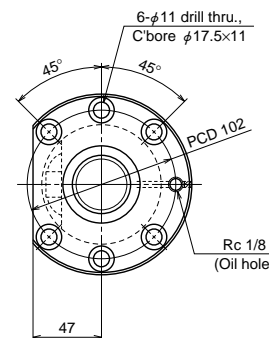
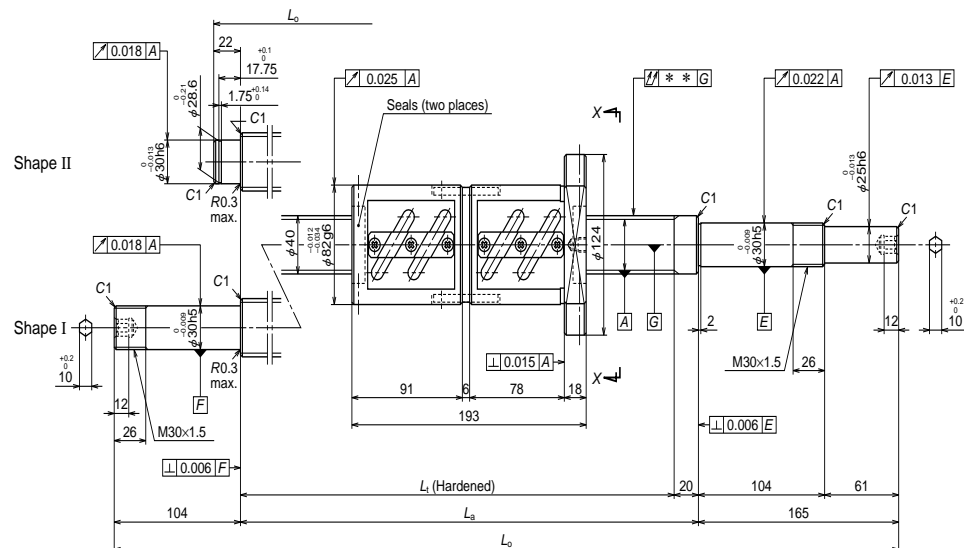
Ball screw specifications		
Shaft dia. x Lead / Direction of turn	40x10/Right	
Preload / Ball recirculation	Z preload / Return tube	
Ball dia. / Ball circle dia.	6.35/41	
Screw shaft root diameter	34.4	
Effective turns of balls	2.5x1	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	28600
	Static $C_{0a}$	68600
Preload (N)	2160	
Dynamic friction torque, median, (N·cm)	64.0	
Spacer ball	None	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	30	
Standard volume of grease replenishing (cm <sup>3</sup> )	15	

Recommended support unit	
WBK30DF-31	(round)

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum ( $L_1$ —Nut length)	$L_1$	$L_2$	$L_0$
W4004SA-1Z-C5Z10	350	377	480	500	672
W4005SA-3Z-C5Z10	450	477	580	600	772
W4006SA-1Z-C5Z10	550	577	680	700	872
W4007SA-3Z-C5Z10	650	677	780	800	1039
W4009SA-3Z-C5Z10	850	877	980	1000	1239
W4011SA-3Z-C5Z10	1050	1077	1180	1200	1439
W4013SA-1Z-C5Z10	1250	1277	1380	1400	1639
W4015SA-3Z-C5Z10	1450	1477	1580	1600	1839
W4017SA-1Z-C5Z10	1650	1677	1780	1800	2039
W4023SA-1Z-C5Z10	2250	2277	2380	2400	2639

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	$T$	$e_p$	$v_u$			Supporting condition	
						Fixed - Simple support	Fixed - Fixed
II	-0.012	0.027	0.020	0.040	8.7	1750	—
II	-0.014	0.030	0.023	0.040	9.6	1750	—
II	-0.016	0.035	0.025	0.050	10.4	1750	—
I	-0.019	0.035	0.025	0.065	11.7	1750	1750
I	-0.024	0.040	0.027	0.065	13.4	1750	1750
I	-0.028	0.046	0.030	0.080	15.1	1750	1750
I	-0.033	0.054	0.035	0.100	16.9	1750	1750
I	-0.038	0.054	0.035	0.100	18.6	1750	1750
I	-0.043	0.065	0.040	0.130	20.3	1670	1750
I	-0.057	0.077	0.046	0.170	25.5	930	1320

Remarks 1. We recommend NSK support unit. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Contact NSK if permissible rotational speed is to be exceeded.



View X-X

Ball screw specifications

Shaft dia. x Lead / Direction of turn	40×10/Right	
Preload / Ball recirculation	D preload / Return tube	
Ball dia. / Ball circle dia.	6.35/41	
Screw shaft root diameter	34.4	
Effective turns of balls	2.5×2	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic C <sub>a</sub>	52000
	Static C <sub>0a</sub>	137000
Preload (N)	3630	
Dynamic friction torque, median, (N·cm)	108	
Spacer ball	None	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	59	
Standard volume of grease replenishing (cm <sup>3</sup> )	30	

Recommended support unit

WBK30DFD-31	(round)
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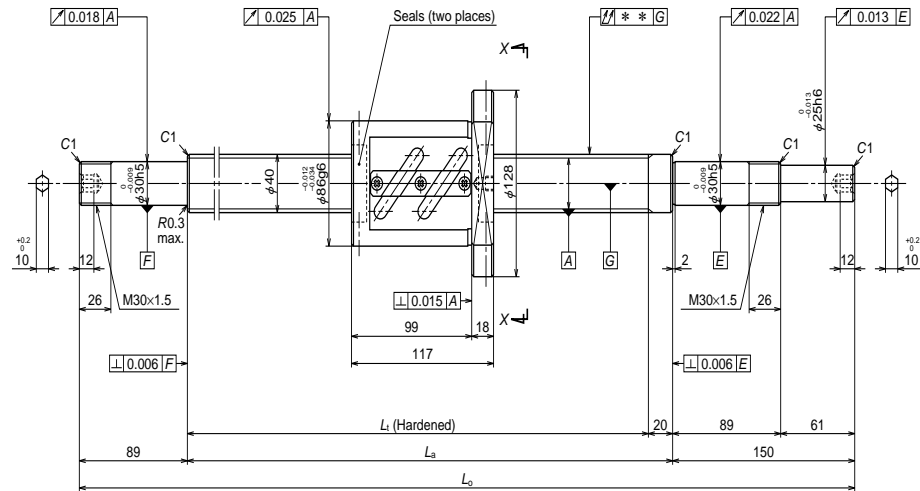
Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L <sub>1</sub> —Nut length)	L <sub>1</sub>	L <sub>2</sub>	L <sub>0</sub>
W4004SA-2D-C5Z10	250	287	480	500	687
W4005SA-4D-C5Z10	350	387	580	600	787
W4006SA-2D-C5Z10	450	487	680	700	887
W4007SA-4D-C5Z10	550	587	780	800	1069
W4009SA-4D-C5Z10	750	787	980	1000	1269
W4011SA-4D-C5Z10	950	987	1180	1200	1469
W4013SA-2D-C5Z10	1150	1187	1380	1400	1669
W4015SA-4D-C5Z10	1350	1387	1580	1600	1869
W4017SA-2D-C5Z10	1550	1587	1780	1800	2069
W4023SA-2D-C5Z10	2150	2187	2380	2400	2669

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
	T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition	
						Fixed - Simple support	Fixed - Fixed
II	-0.012	0.027	0.020	0.040	11.0	1750	—
II	-0.014	0.030	0.023	0.040	11.9	1750	—
II	-0.016	0.035	0.025	0.050	12.7	1750	—
I	-0.019	0.035	0.025	0.065	14.1	1750	1750
I	-0.024	0.040	0.027	0.080	15.8	1750	1750
I	-0.028	0.046	0.030	0.080	17.5	1750	1750
I	-0.033	0.054	0.035	0.100	19.3	1750	1750
I	-0.038	0.054	0.035	0.100	21.0	1750	1750
I	-0.043	0.065	0.040	0.130	22.7	1750	1750
I	-0.057	0.077	0.046	0.170	27.9	960	1370

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.

## Finished shaft end SA Type

(Fine lead) Dia. 40, Lead 12

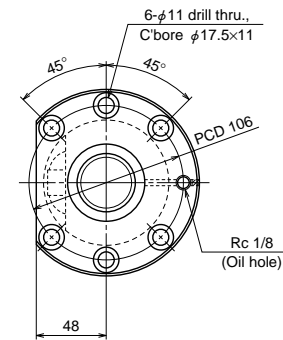


## Nut models: ZFT

**NSK**

ø40×12

Unit: mm



View X-X

### Ball screw specifications

Shaft dia. x Lead / Direction of turn	40×12/Right	
Preload / Ball recirculation	Z preload / Return tube	
Ball dia. / Ball circle dia.	7.144/41.5	
Screw shaft root diameter	34.1	
Effective turns of balls	2.5×1	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	33600
	Static $C_{0a}$	77500
Preload (N)	2550	
Dynamic friction torque, median, (N·cm)	83.0	
Spacer ball	None	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	33	
Standard volume of grease replenishing (cm <sup>3</sup> )	17	

### Recommended support unit

WBK30DF-31	(round)
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Unit: mm

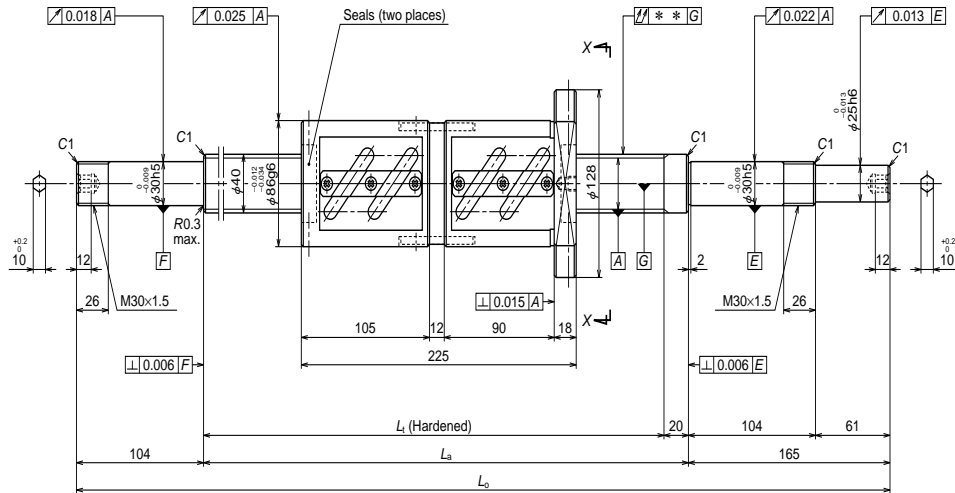
Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum ( $L_i$ —Nut length)	$L_1$	$L_a$	$L_0$
<b>W4006SA-3Z-C5Z12</b>	500	563	680	700	939
<b>W4009SA-5Z-C5Z12</b>	800	863	980	1000	1239
<b>W4013SA-3Z-C5Z12</b>	1200	1263	1380	1400	1639
<b>W4017SA-3Z-C5Z12</b>	1600	1663	1780	1800	2039
<b>W4024SA-1Z-C5Z12</b>	2300	2363	2480	2500	2739

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
$T$	$e_p$	$v_u$			Supporting condition	
					Fixed - Simple support	Fixed - Fixed
-0.016	0.035	0.025	0.050	11.6	1750	1750
-0.024	0.040	0.027	0.065	14.2	1750	1750
-0.033	0.054	0.035	0.100	17.7	1750	1750
-0.043	0.065	0.040	0.130	21.2	1670	1750
-0.060	0.077	0.046	0.170	27.2	850	1220

# Finished shaft end SA Type

(Fine lead) Dia. 40, Lead 12

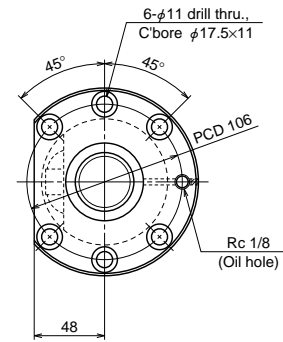


Nut models: DFT

**NSK**

ø40×12

Unit: mm



View X-X

## Ball screw specifications

Shaft dia. x Lead / Direction of turn	40×12/Right	
Preload / Ball recirculation	D preload / Return tube	
Ball dia. / Ball circle dia.	7.144/41.5	
Screw shaft root diameter	34.1	
Effective turns of balls	2.5×2	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	61000
	Static $C_{0a}$	155000
Preload (N)	4310	
Dynamic friction torque, median, (N·cm)	137	
Spacer ball	None	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	76	
Standard volume of grease replenishing (cm <sup>3</sup> )	38	

## Recommended support unit

WBK30DFD-31	(round)
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Unit: mm

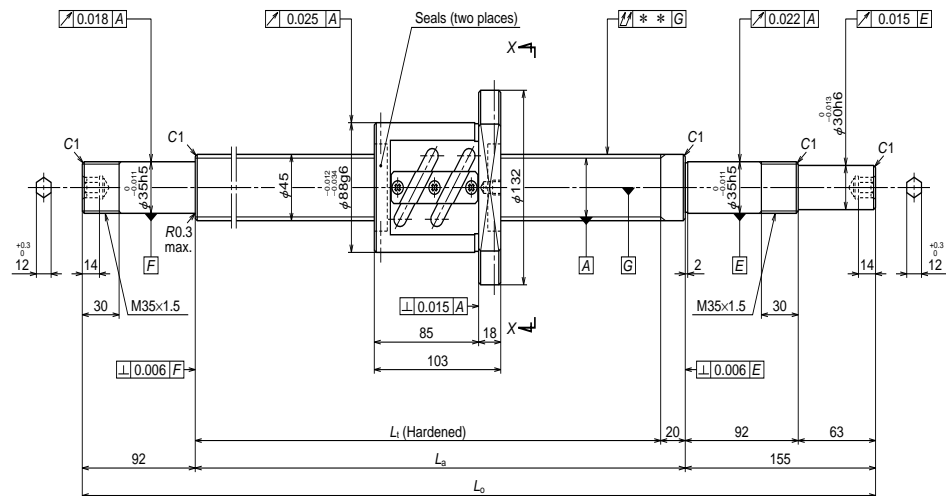
Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum ( $L_1$ —Nut length)	$L_1$	$L_a$	$L_0$
<b>W4006SA-4D-C5Z12</b>	400	455	680	700	969
<b>W4009SA-6D-C5Z12</b>	700	755	980	1000	1269
<b>W4013SA-4D-C5Z12</b>	1100	1155	1380	1400	1669
<b>W4017SA-4D-C5Z12</b>	1500	1555	1780	1800	2069
<b>W4024SA-2D-C5Z12</b>	2200	2255	2480	2500	2769

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
$T$	$e_p$	$v_u$			Supporting condition	
					Fixed - Simple support	Fixed - Fixed
-0.016	0.035	0.025	0.050	14.8	1750	1750
-0.024	0.040	0.027	0.080	17.4	1750	1750
-0.033	0.054	0.035	0.100	20.9	1750	1750
-0.043	0.065	0.040	0.130	24.3	1750	1750
-0.060	0.077	0.046	0.170	30.4	880	1260

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.

# Finished shaft end SA Type

(Fine lead) Dia. 45, Lead 10

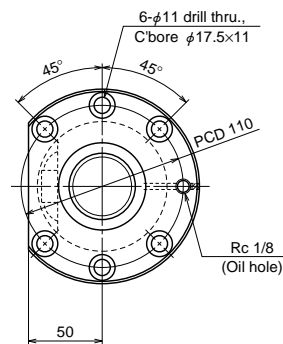


# Nut models: ZFT

**NSK**

ø45×10

Unit: mm



View X-X

## Ball screw specifications

Shaft dia. x Lead / Direction of turn	45×10/Right	
Preload / Ball recirculation	Z preload / Return tube	
Ball dia. / Ball circle dia.	6.35/46	
Screw shaft root diameter	39.4	
Effective turns of balls	2.5×1	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic C <sub>a</sub>	29900
	Static C <sub>0a</sub>	77300
Preload (N)	2260	
Dynamic friction torque, median, (N·cm)	69.0	
Spacer ball	None	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	33	
Standard volume of grease replenishing (cm <sup>3</sup> )	17	

## Recommended support unit

WBK35DF-31	(round)
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Unit: mm

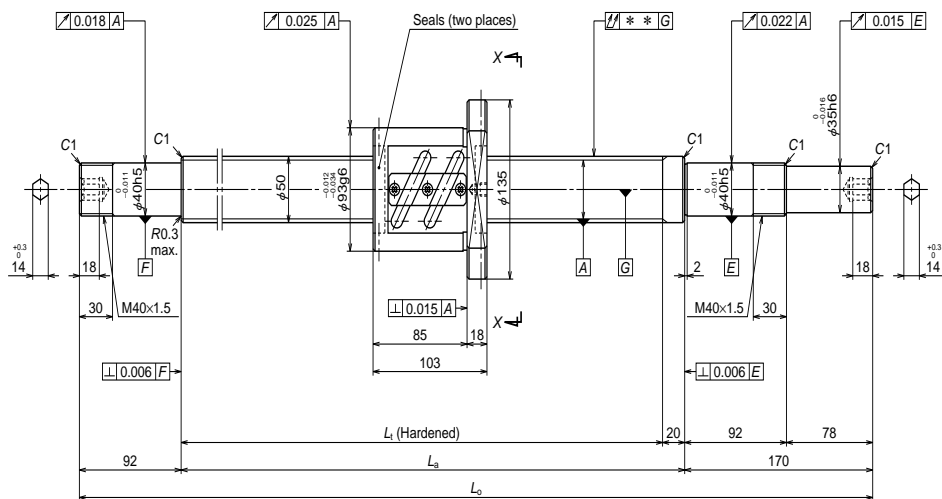
Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L <sub>1</sub> —Nut length)	L <sub>1</sub>	L <sub>2</sub>	L <sub>0</sub>
<b>W4506SA-1Z-C5Z10</b>	550	577	680	700	947
<b>W4509SA-1Z-C5Z10</b>	850	877	980	1000	1247
<b>W4513SA-1Z-C5Z10</b>	1250	1277	1380	1400	1647
<b>W4517SA-1Z-C5Z10</b>	1650	1677	1780	1800	2047
<b>W4524SA-1Z-C5Z10</b>	2350	2377	2480	2500	2747

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition	
					Fixed - Simple support	Fixed - Fixed
-0.016	0.035	0.025	0.050	13.4	1550	1550
-0.024	0.040	0.027	0.065	16.7	1550	1550
-0.033	0.054	0.035	0.100	21.2	1550	1550
-0.043	0.065	0.040	0.130	25.6	1550	1550
-0.060	0.077	0.046	0.170	33.4	980	1400

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.

# Finished shaft end SA Type

(Fine lead) Dia. 50, Lead 10

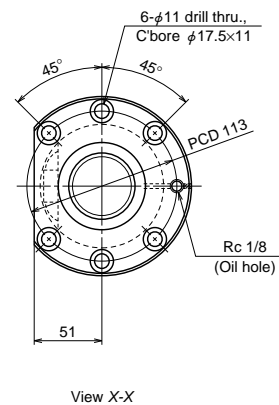


# Nut models: ZFT



ø50×10

Unit: mm



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	50×10/Right	
Preload / Ball recirculation	Z preload / Return tube	
Ball dia. / Ball circle dia.	6.35/51	
Screw shaft root diameter	44.4	
Effective turns of balls	2.5×1	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	31800
	Static $C_{0a}$	87400
Preload (N)	2450	
Dynamic friction torque, median, (N·cm)	79.0	
Spacer ball	None	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	37	
Standard volume of grease replenishing (cm <sup>3</sup> )	19	

Recommended support unit	
WBK40DF-31	(round)

Unit: mm

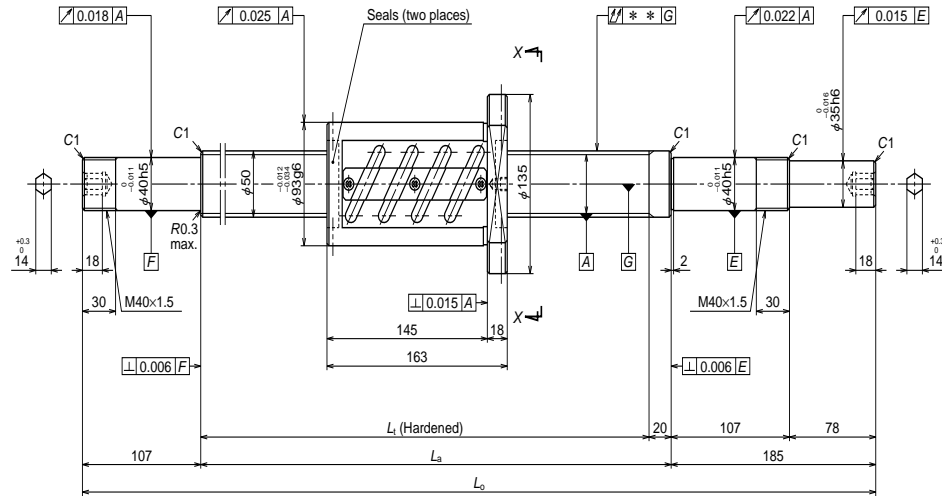
Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum ( $L_1$ —Nut length)	$L_1$	$L_a$	$L_0$
<b>W5005SA-1Z-C5Z10</b>	450	477	580	600	862
<b>W5007SA-1Z-C5Z10</b>	650	677	780	800	1062
<b>W5009SA-1Z-C5Z10</b>	850	877	980	1000	1262
<b>W5011SA-1Z-C5Z10</b>	1050	1077	1180	1200	1462
<b>W5014SA-1Z-C5Z10</b>	1350	1377	1480	1500	1762
<b>W5019SA-1Z-C5Z10</b>	1850	1877	1980	2000	2262
<b>W5025SA-1Z-C5Z10</b>	2450	2477	2580	2600	2862

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
$T$	$e_p$	$v_u$			Supporting condition	
					Fixed - Simple support	Fixed - Fixed
-0.014	0.030	0.023	0.050	14.8	1400	1400
-0.019	0.035	0.025	0.065	17.6	1400	1400
-0.024	0.040	0.027	0.080	20.3	1400	1400
-0.028	0.046	0.030	0.080	23.1	1400	1400
-0.036	0.054	0.035	0.100	27.3	1400	1400
-0.048	0.065	0.040	0.130	34.2	1400	1400
-0.062	0.093	0.054	0.170	42.5	1020	1400

# Finished shaft end SA Type

(Fine lead) Dia. 50, Lead 10

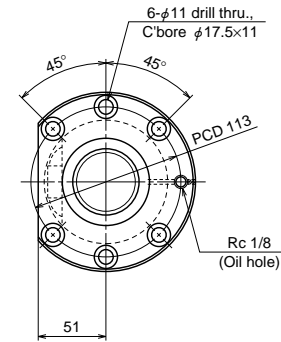


# Nut models: ZFT

**NSK**

ø50×10

Unit: mm



View X-X

## Ball screw specifications

Shaft dia. x Lead / Direction of turn	50x10/Right	
Preload / Ball recirculation	Z preload / Return tube	
Ball dia. / Ball circle dia.	6.35/51	
Screw shaft root diameter	44.4	
Effective turns of balls	2.5x2	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	57700
	Static $C_{0a}$	175000
Preload (N)	4020	
Dynamic friction torque, median, (N·cm)	137	
Spacer ball	None	
Factory packed grease	Refer to Remarks 2.	
Internal spatial volume of nut (cm <sup>3</sup> )	59	
Standard volume of grease replenishing (cm <sup>3</sup> )	30	

## Recommended support unit

WBK40DFD-31	(round)
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Unit: mm

Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum ( $L_1$ —Nut length)	$L_1$	$L_a$	$L_o$
<b>W5005SA-2Z-C5Z10</b>	350	417	580	600	892
<b>W5007SA-2Z-C5Z10</b>	550	617	780	800	1092
<b>W5009SA-2Z-C5Z10</b>	750	817	980	1000	1292
<b>W5011SA-2Z-C5Z10</b>	950	1017	1180	1200	1492
<b>W5014SA-2Z-C5Z10</b>	1250	1317	1480	1500	1792
<b>W5019SA-2Z-C5Z10</b>	1750	1817	1980	2000	2292
<b>W5025SA-2Z-C5Z10</b>	2350	2417	2580	2600	2892

Lead accuracy			Shaft run-out ** $\mu$	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
$T$	$e_p$	$v_u$			Supporting condition	
				Fixed - Simple support	Fixed - Fixed	
-0.014	0.030	0.023	0.050	1400	1400	
-0.019	0.035	0.025	0.065	1400	1400	
-0.024	0.040	0.027	0.080	1400	1400	
-0.028	0.046	0.030	0.080	1400	1400	
-0.036	0.054	0.035	0.100	1400	1400	
-0.048	0.065	0.040	0.130	1400	1400	
-0.062	0.093	0.054	0.170	1040	1400	

- Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Contact NSK if permissible rotational speed is to be exceeded.



**B-3-2.3 Finished Shaft End Ball Screws Made of Stainless Steel KA Type**

◇ **Ball screw sizes are arranged in the order of the page number.**

The table begins with the smallest shaft diameter ball screw, and proceeds to larger sizes. If ball screws have the same shaft diameter, those with smaller leads appear first. Page numbers of shaft diameter and lead combinations are shown in Table 1.

◇ **Dimension tables**

The dimension tables show shapes/sizes as well as specification factors of each shaft diameter/lead combination. Tables also contain data as follows:

● **Stroke**

Nominal stroke : A reference for your use.

Maximum stroke: The stroke limit that the nut can move. The figure is obtained by subtracting the nut length (plus some allowance) from the screw threaded length (*L*).

● **Lead accuracy**

Lead accuracy is C3 and C5 grades.

*T* : Travel compensation;

*e<sub>p</sub>* : Tolerance on specified travel;

*v<sub>l</sub>* : Travel variation

See "Technical Description: Lead error" (Page B41) for details of the codes.

● **Permissible rotational speed**

*d* • *n* : Limited by the relative peripheral speed between screw shaft and nut.

Critical speed: Limited by the natural frequency of a ball screw shaft. Critical speed depends on the supporting condition 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 B51).

◇ **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.

◇ **Other**

Seal of the ball screw, ball recirculating deflector, and end cap are made of synthetic resin. Consult NSK when using the ball screws under extreme environments or special environments, or using special lubricant or oil.

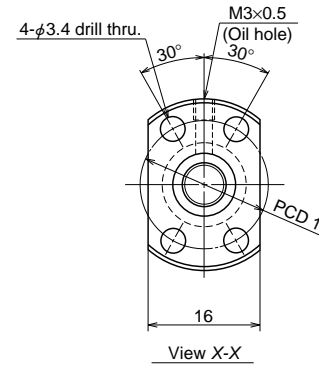
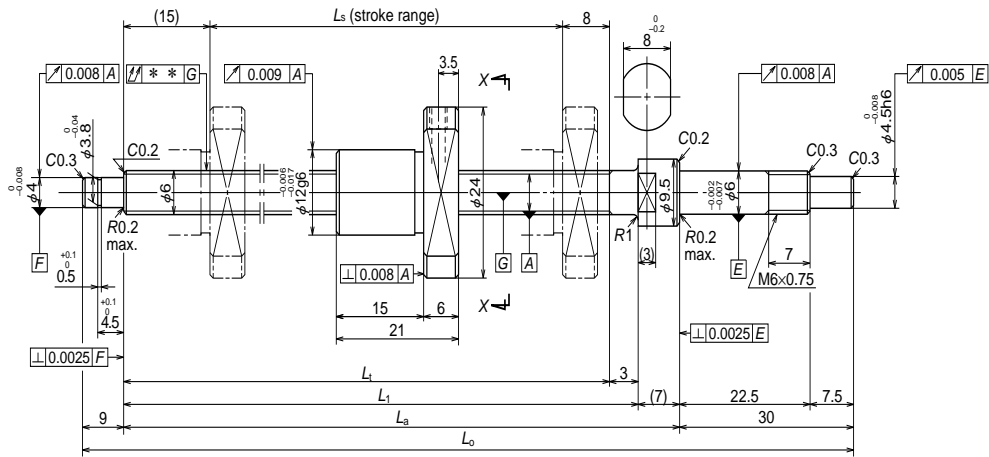
For special environments, refer to Pages B74 and D2. Refer to Pages B71 and D13 for lubricants.

Note: For details of standard stock products, contact NSK.

**Table 1 Combinations of screw shaft diameter and lead**

Lead (mm) \ Screw shaft diameter (mm)	1	2
6	B359	
8	B361	B363
10		B365
12		B369
15		
16		B379
20		

4	5	10	20
B367			
	B371	B373	
		B375	B377
			B381



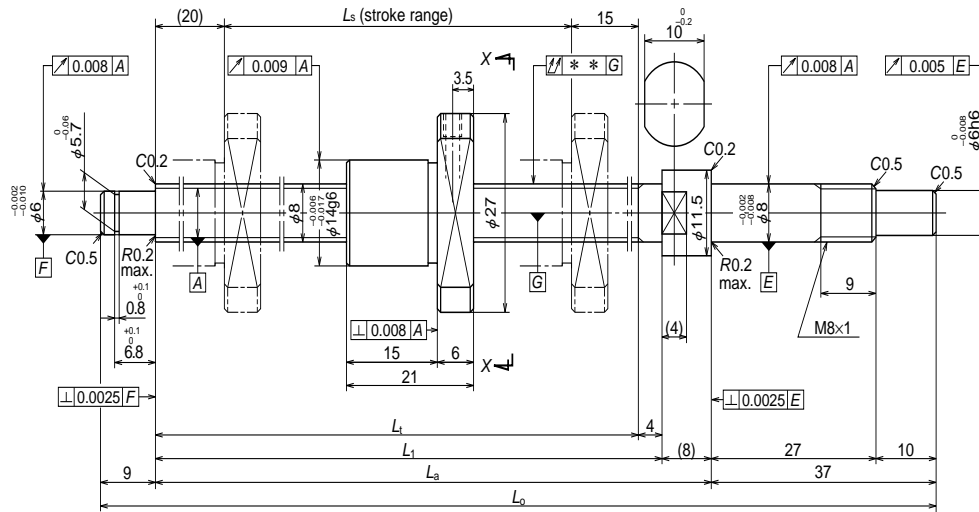
Ball screw specifications

Shaft dia. x Lead / Direction of turn	6×1/Right	
Preload / Ball recirculation	P preload / Deflector	
Ball dia. / Ball circle dia.	0.800/6.2	
Screw shaft root diameter	5.2	
Effective turns of balls	1×3	
Accuracy grade / Preload	C3/Z	
Basic load rating (N)	Dynamic C <sub>a</sub>	470
	Static C <sub>0a</sub>	680
Axial play	0	
Preload (N)	147	
Dynamic friction torque, (N·cm)	1.3 or less	
Spacer ball	None	
Factory packed grease	Refer to the remarks 1. below.	

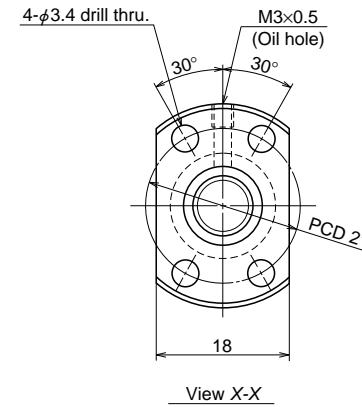
Ball screw No.	Stroke		Thread length			
	Nominal	Maximum	L <sub>1</sub>	L <sub>1</sub>	L <sub>a</sub>	L <sub>o</sub>
<b>W0601KA-3PY-C3Z1</b>	100	102	125	128	135	174

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
T	e <sub>p</sub>	v <sub>u</sub>			Supporting condition
0	0.010	0.008	0.025	0.06	Fixed - Simple support 3000

- Remarks
1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details. NSK Clean Grease LG2 is recommended.
  2. Nut does not have a seal.
  3. Contact NSK if permissible rotational speed is to be exceeded.



Unit: mm



## Ball screw specifications

Shaft dia. x Lead / Direction of turn		8x1/Right
Preload / Ball recirculation		P preload / Deflector
Ball dia. / Ball circle dia.		0.800/8.2
Screw shaft root diameter		7.2
Effective turns of balls		1x3
Accuracy grade / Preload		C3/Z
Basic load rating (N)	Dynamic $C_a$	545
	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 the remarks 1. below.

Clean support unit	For drive side		For opposite of drive side
	WBK08-01C (square)	○	
WBK08-11C (round)	○		
WBK08S-01C (square)			○

Unit: mm

Ball screw No.	Stroke		Thread length			
	Nominal	Maximum	$L_t$	$L_1$	$L_a$	$L_o$
<b>W0802KA-1PY-C3Z1</b>	150	155	190	194	202	248

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
$T$	$e_p$	$v_u$			Supporting condition
0	0.010	0.008	0.035	0.12	Fixed - Simple support 3000

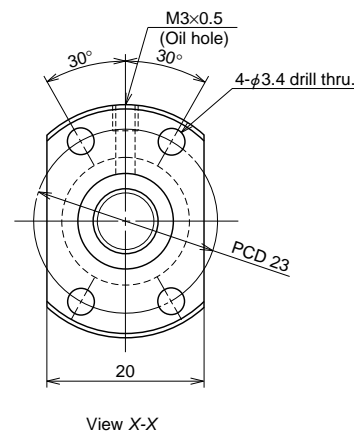
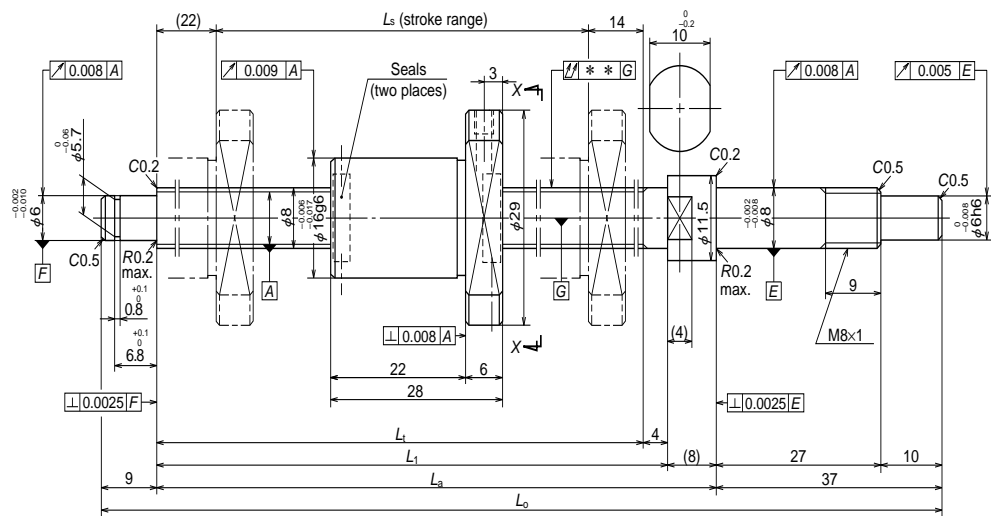
 Remarks **1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**

Refer to Page D13 for details.

NSK Clean Grease LG2 is recommended.

2. Nut does not have a seal.

3. Contact NSK if permissible rotational speed is to be exceeded.



Ball screw specifications

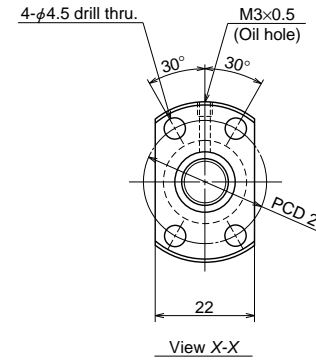
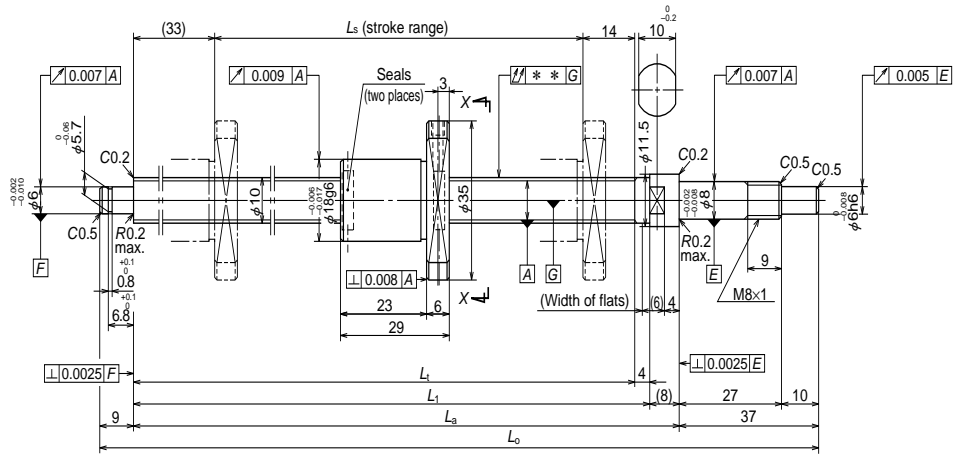
Shaft dia. x Lead / Direction of turn	8×2/Right	
Preload / Ball recirculation	P preload / Deflector	
Ball dia. / Ball circle dia.	1.200/8.3	
Screw shaft root diameter	6.9	
Effective turns of balls	1×3	
Accuracy grade / Preload	C3/Z	
Basic load rating (N)	Dynamic $C_a$	1080
	Static $C_{0a}$	1630
Axial play	0	
Preload (N)	49.0	
Dynamic friction torque, (N·cm)	2.0 or less	
Spacer ball	None	
Factory packed grease	Refer to the remarks 1. below.	
Internal spatial volume of nut (cm <sup>3</sup> )	0.34	
Standard volume of grease replenishing (cm <sup>3</sup> )	0.17	

Clean support unit	For drive side	For opposite of drive side
WBK08-01C (square)	○	
WBK08-11C (round)	○	
WBK08S-01C (square)		○

Ball screw No.	Stroke		Thread length			
	Nominal	Maximum	$L_t$	$L_1$	$L_a$	$L_0$
<b>W0802KA-5PY-C3Z2</b>	150	154	190	194	202	248

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
$T$	$e_p$	$v_u$			Supporting condition
0	0.010	0.008	0.035	0.13	3000

- Remarks
1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details. NSK Clean Grease LG2 is recommended.
  2. Contact NSK if permissible rotational speed is to be exceeded.



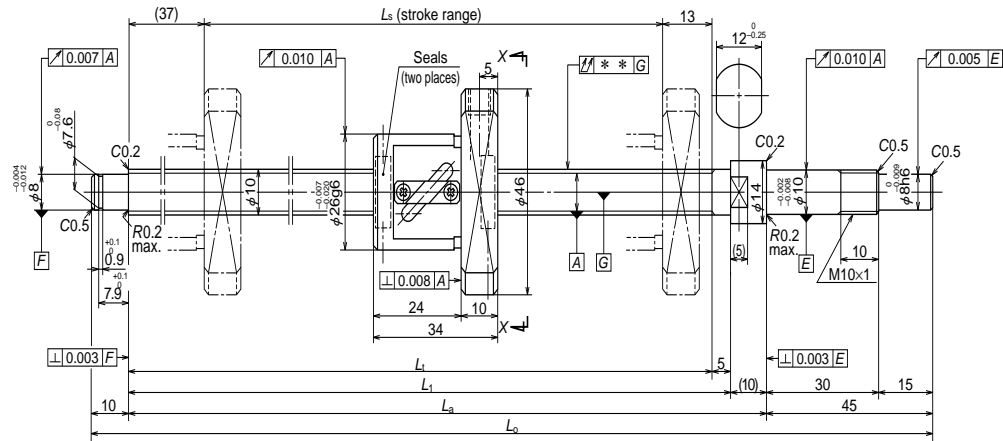
Ball screw specifications		
Shaft dia. x Lead / Direction of turn	10×2/Right	
Preload / Ball recirculation	P preload / Deflector	
Ball dia. / Ball circle dia.	1.200/10.3	
Screw shaft root diameter	8.9	
Effective turns of balls	1×3	
Accuracy grade / Preload	C3/Z	
Basic load rating (N)	Dynamic $C_a$	1210
	Static $C_{0a}$	2110
Axial play		0
Preload (N)		58.8
Dynamic friction torque, (N·cm)		0.10 – 2.5
Spacer ball		None
Factory packed grease		Refer to the remarks 1. below.
Internal spatial volume of nut (cm <sup>3</sup> )		0.44
Standard volume of grease replenishing (cm <sup>3</sup> )		0.22

Clean support unit	For drive side	For opposite of drive side
WBK08-01C (square)	○	
WBK08-11C (round)	○	
WBK08S-01C (square)		○

Ball screw No.	Stroke		Thread length			
	Nominal	Maximum	$L_1$	$L_1$	$L_a$	$L_o$
	<b>W1002KA-3PY-C3Z2</b>	200	203	250	254	262

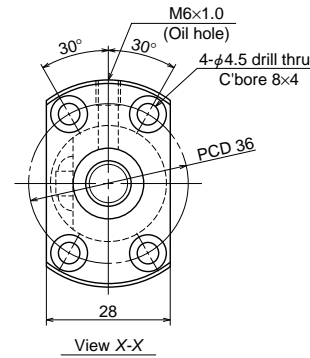
Lead accuracy			Shaft run-out ** ↑↓	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
$T$	$e_p$	$v_u$			Supporting condition
0	0.012	0.008			0.030

- Remarks
1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details. NSK Clean Grease LG2 is recommended.
  2. Contact NSK if permissible rotational speed is to be exceeded.



Ball screw No.	Stroke		Thread length			
	Nominal	Maximum				
			$L_1$	$L_1$	$L_a$	$L_o$
<b>W1001KA-3P-C3Z4</b>	100	110	160	165	175	230
<b>W1003KA-3P-C3Z4</b>	300	310	360	365	375	430

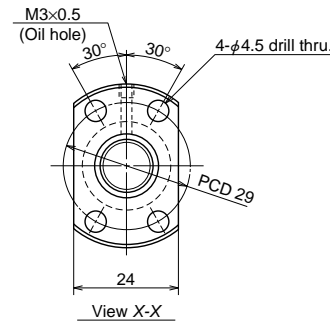
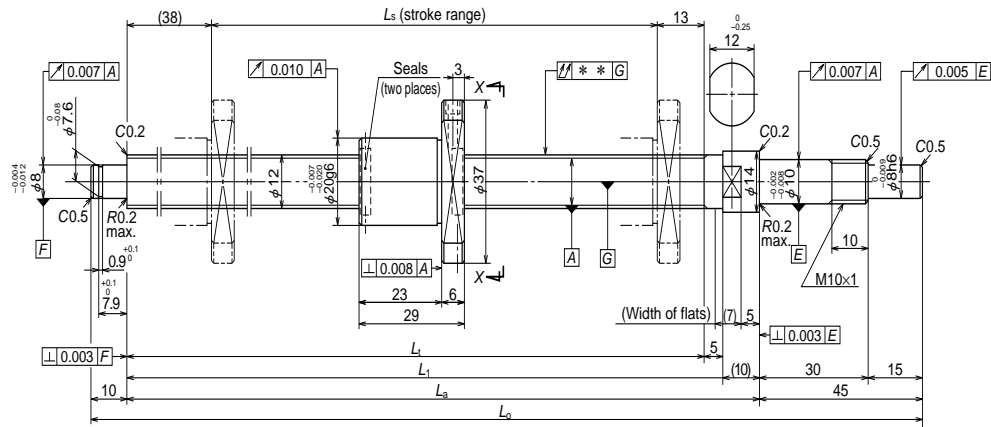
Remarks **1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**  
 Refer to Page D13 for details.  
 NSK Clean Grease LG2 is recommended.  
**2. Contact NSK if permissible rotational speed is to be exceeded.**



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	10x4/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	2.000/10.3	
Screw shaft root diameter	8.2	
Effective turns of balls	2.5x1	
Accuracy grade / Preload	C3/Z	
Basic load rating (N)	Dynamic $C_a$	2250
	Static $C_{0a}$	3290
Axial play	0	
Preload (N)	98.1	
Dynamic friction torque, (N·cm)	0.5 – 3.9	
Spacer ball	None	
Factory packed grease	Refer to the remarks 1. below.	
Internal spatial volume of nut (cm <sup>3</sup> )	0.8	
Standard volume of grease replenishing (cm <sup>3</sup> )	0.4	

Clean support unit	For drive side	For opposite of drive side
WBK10-01C (square)	○	
WBK10-11C (round)	○	
WBK10S-01C (square)		○

Lead accuracy			Shaft run-out ** $\uparrow$	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
$T$	$e_p$	$v_u$			Supporting condition
					Fixed - Simple support
0	0.010	0.008	0.030	0.29	3000
0	0.013	0.008	0.050	0.39	3000



Ball screw specifications

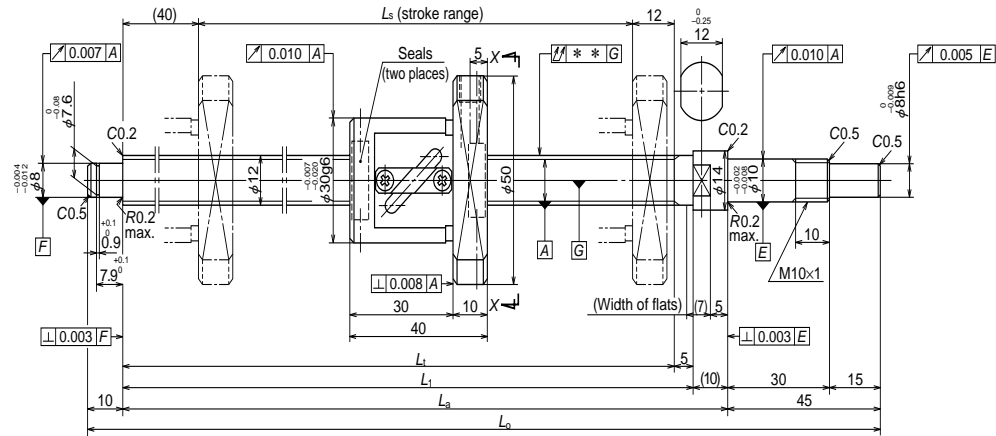
Shaft dia. x Lead / Direction of turn	12×2/Right	
Preload / Ball recirculation	P preload / Deflector	
Ball dia. / Ball circle dia.	1.200/12.3	
Screw shaft root diameter	10.9	
Effective turns of balls	1×3	
Accuracy grade / Preload	C3/Z	
Basic load rating (N)	Dynamic $C_a$	1360
	Static $C_{0a}$	2680
Axial play	0	
Preload (N)	98.1	
Dynamic friction torque, (N·cm)	0.4 – 3.4	
Spacer ball	None	
Factory packed grease	Refer to the remarks 1. below.	
Internal spatial volume of nut (cm <sup>3</sup> )	0.53	
Standard volume of grease replenishing (cm <sup>3</sup> )	0.27	

Clean support unit	For drive side	For opposite of drive side
WBK10-01C (square)	○	
WBK10-11C (round)	○	
WBK10S-01C (square)		○

Ball screw No.	Stroke		Thread length			
	Nominal	Maximum	$L_1$	$L_1$	$L_a$	$L_a$
W1201KA-3PY-C3Z2	100	109	160	165	175	230
W1203KA-1PY-C3Z2	250	259	310	315	325	380

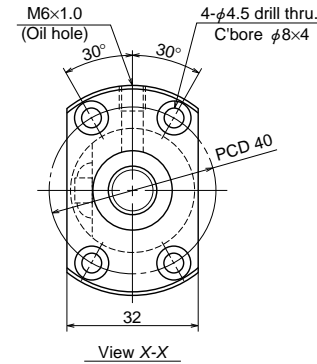
Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
$T$	$e_p$	$v_u$			Supporting condition
0	0.010	0.008	0.030	0.24	3000
0	0.012	0.008	0.040	0.36	3000

- Remarks 1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
NSK Clean Grease LG2 is recommended.  
2. Contact NSK if permissible rotational speed is to be exceeded.



Ball screw No.	Stroke		Thread length			
	Nominal	Maximum	$L_1$	$L_1$	$L_a$	$L_b$
<b>W1202KA-3P-C3Z5</b>	200	208	260	265	275	330
<b>W1205KA-1P-C3Z5</b>	450	458	510	515	525	580

- Remarks **1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**  
 Refer to Page D13 for details.  
 NSK Clean Grease LG2 is recommended.  
**2. Contact NSK if permissible rotational speed is to be exceeded.**

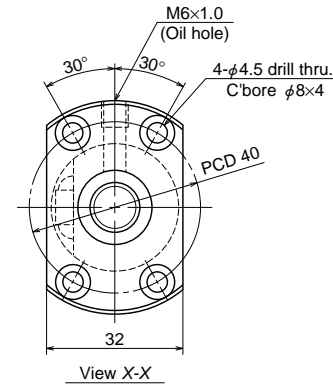
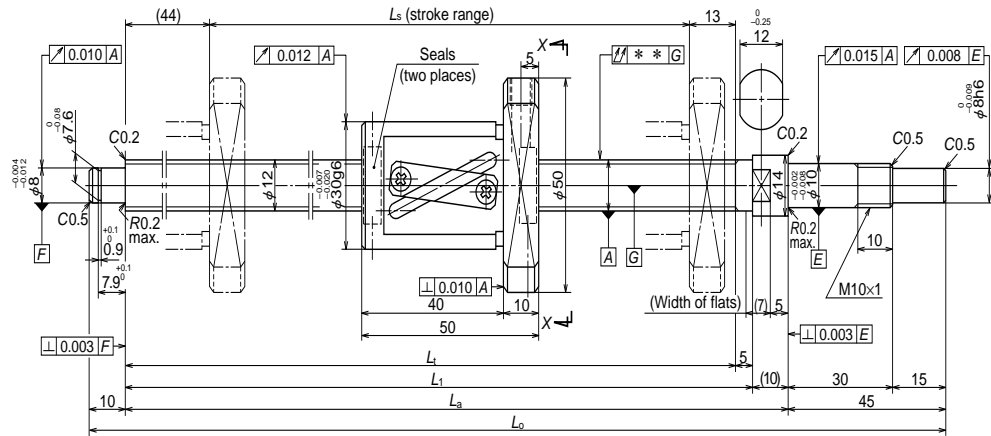


Ball screw specifications		
Shaft dia. x Lead / Direction of turn	12x5/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	2.381/12.3	
Screw shaft root diameter	9.8	
Effective turns of balls	2.5x1	
Accuracy grade / Preload	C3/Z	
Basic load rating (N)	Dynamic $C_a$	3070
	Static $C_{0a}$	4670
Axial play	0	
Preload (N)	98.1	
Dynamic friction torque, (N·cm)	1.0 – 4.4	
Spacer ball	None	
Factory packed grease	Refer to the remarks 1. below.	
Internal spatial volume of nut (cm <sup>3</sup> )	1.2	
Standard volume of grease replenishing (cm <sup>3</sup> )	0.6	

Clean support unit	For drive side	For opposite of drive side
WBK10-01C (square)	○	
WBK10-11C (round)	○	
WBK10S-01C (square)		○

Lead accuracy			Shaft run-out ** $\uparrow$	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
$T$	$e_p$	$v_u$			Supporting condition
					Fixed - Simple support
0	0.012	0.008	0.040	0.47	3000
0	0.016	0.012	0.065	0.66	3000





Ball screw specifications

Shaft dia. x Lead / Direction of turn	12×10/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	2.381/12.5	
Screw shaft root diameter	10.0	
Effective turns of balls	2.5×1	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_d$	3070
	Static $C_{0a}$	4790
Axial play	0	
Preload (N)	98.1	
Dynamic friction torque, (N·cm)	1.0 – 4.9	
Spacer ball	None	
Factory packed grease	Refer to the remarks 1. below.	
Internal spatial volume of nut (cm <sup>3</sup> )	1.4	
Standard volume of grease replenishing (cm <sup>3</sup> )	0.7	

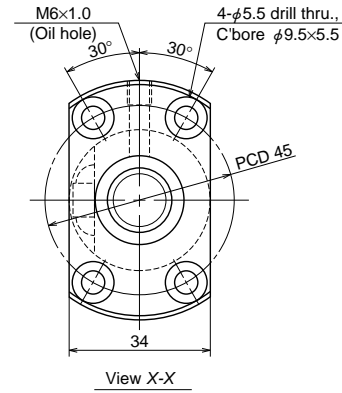
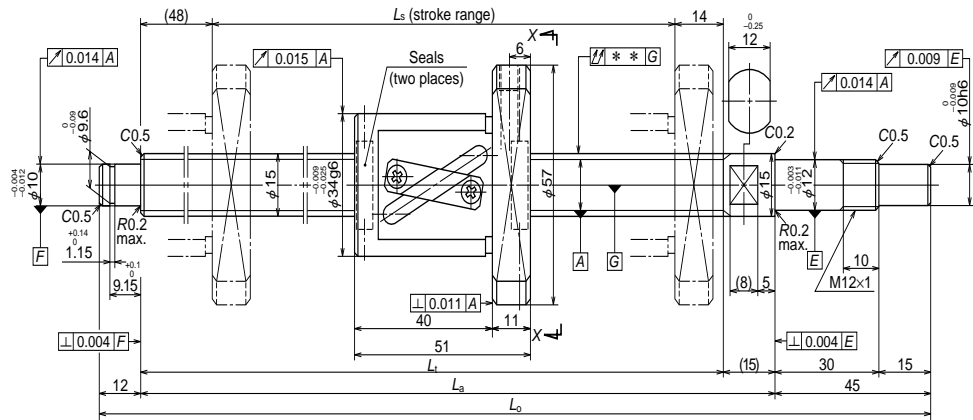
Clean support unit	For drive side	For opposite of drive side
WBK10-01C (square)	○	
WBK10-11C (round)	○	
WBK10S-01C (square)		○

Unit: mm

Ball screw No.	Stroke		Thread length			
	Nominal	Maximum	$L_1$	$L_1$	$L_a$	$L_o$
W1203KA-3P-C5Z10	250	253	310	315	325	380
W1205KA-3P-C5Z10	450	453	510	515	525	580

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
$T$	$e_p$	$v_u$			Supporting condition
0	0.023	0.018	0.050	0.56	3000
0	0.030	0.023	0.075	0.72	3000

- Remarks
1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details. NSK Clean Grease LG2 is recommended.
  2. Contact NSK if permissible rotational speed is to be exceeded.



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	15×10/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	3.175/15.5	
Screw shaft root diameter	12.2	
Effective turns of balls	2.5×1	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	5780
	Static $C_{0a}$	9430
Axial play	0	
Preload (N)	147	
Dynamic friction torque, (N·cm)	1.5 – 7.9	
Spacer ball	None	
Factory packed grease	Refer to the remarks 1. below.	
Internal spatial volume of nut (cm <sup>3</sup> )	2.3	
Standard volume of grease replenishing (cm <sup>3</sup> )	1.4	

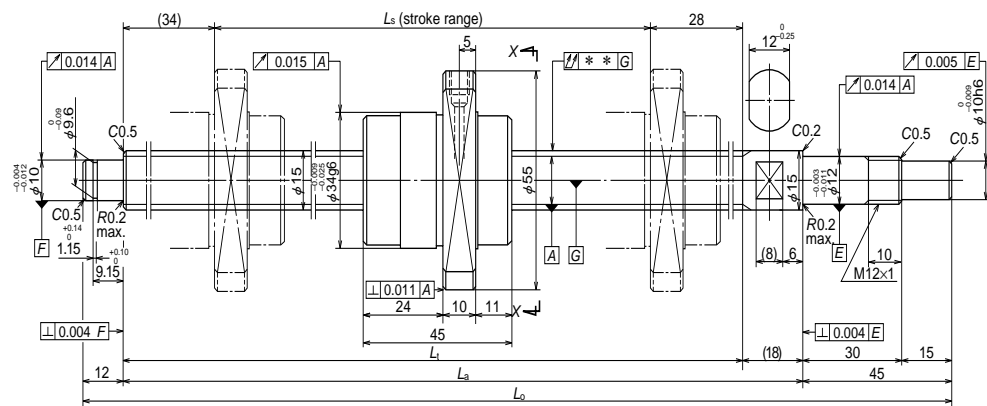
Clean support unit	For drive side	For opposite of drive side
WBK12-01C (square)	○	
WBK12-11C (round)	○	
WBK12S-01C (square)		○

Ball screw No.	Stroke		Thread length		
	Nominal	Maximum	$L_1$	$L_a$	$L_o$
<b>W1504KA-3P-C5Z10</b>	400	427	489	504	561
<b>W1506KA-3P-C5Z10</b>	600	627	689	704	761
<b>W1510KA-1P-C5Z10</b>	1000	1027	1089	1104	1161

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
$T$	$e_p$	$v_u$			Supporting condition
					Fixed - Simple support
0	0.027	0.020	0.050	0.99	3000
0	0.035	0.025	0.065	1.2	3000
0	0.046	0.030	0.110	1.7	1610

- Remarks
1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details. NSK Clean Grease LG2 is recommended.
  2. Contact NSK if permissible rotational speed is to be exceeded.

Finished shaft end Stainless steel product KA Type (Ultra high helix lead) Dia. 15, Lead 20

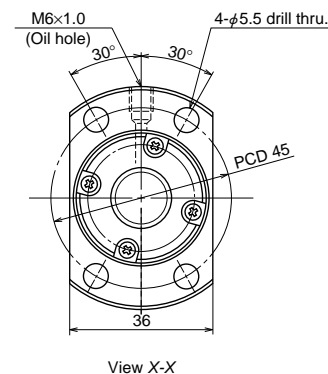


Nut models: UPFC



Stainless ø15×20

Unit: mm



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	15×20/Right	
Preload / Ball recirculation	P preload / End cap	
Ball dia. / Ball circle dia.	3.175/15.5	
Screw shaft root diameter	12.2	
Effective turns of balls	1.7×1	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	4150
	Static $C_{0a}$	6450
Axial play	0	
Preload (N)	147	
Dynamic friction torque, (N·cm)	1.5 – 7.9	
Spacer ball	None	
Factory packed grease	Refer to the remarks 1. below.	
Internal spatial volume of nut (cm <sup>3</sup> )	1.9	
Standard volume of grease replenishing (cm <sup>3</sup> )	1.0	

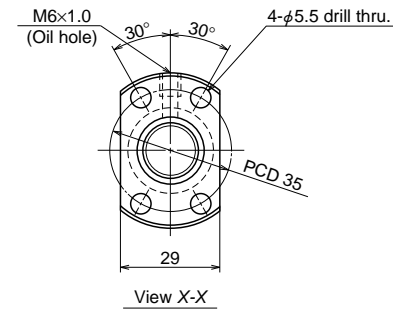
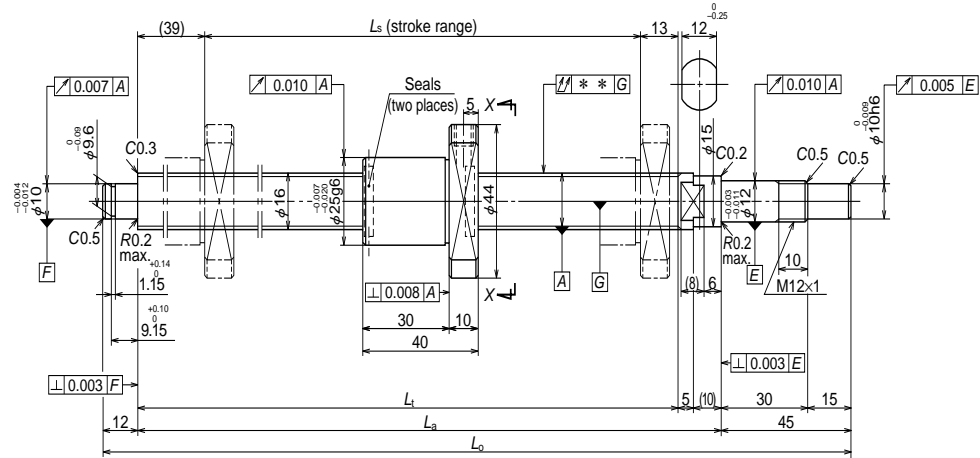
Clean support unit	For drive side	For opposite of drive side
WBK12-01C (square)	○	
WBK12-11C (round)	○	
WBK12S-01C (square)		○

Unit: mm

Ball screw No.	Stroke		Thread length		
	Nominal	Maximum	$L_t$	$L_a$	$L_o$
W1504KA-7PG-C5Z20	400	424	486	504	561
W1506KA-7PG-C5Z20	600	624	686	704	761
W1510KA-3PG-C5Z20	1000	1024	1086	1104	1161

Lead accuracy			Shaft run-out ** $\uparrow$	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
$T$	$e_p$	$v_u$			Supporting condition
					Fixed - Simple support
0	0.027	0.020	0.050	1.0	3000
0	0.035	0.025	0.065	1.3	3000
0	0.046	0.030	0.110	1.8	1610

- Remarks
1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details. NSK Clean Grease LG2 is recommended.
  2. Contact NSK if permissible rotational speed is to be exceeded.



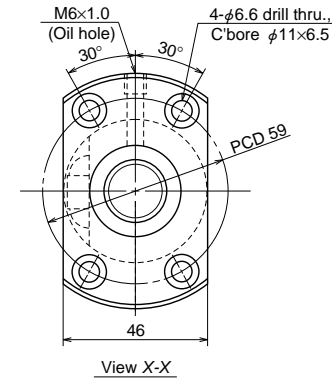
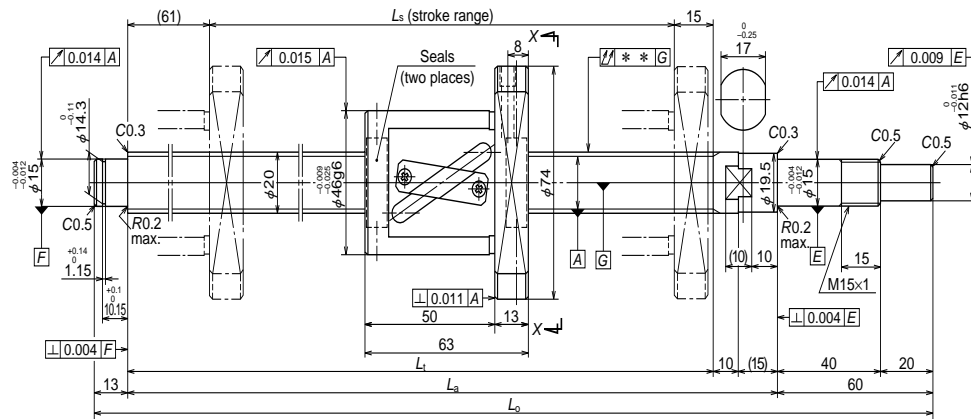
Ball screw specifications		
Shaft dia. x Lead / Direction of turn	16x2/Right	
Preload / Ball recirculation	P preload / Deflector	
Ball dia. / Ball circle dia.	1.588/16.4	
Screw shaft root diameter	14.6	
Effective turns of balls	1x4	
Accuracy grade / Preload	C3/Z	
Basic load rating (N)	Dynamic $C_a$	2870
	Static $C_{0a}$	6250
Axial play	0	
Preload (N)	147	
Dynamic friction torque, (N·cm)	0.5 – 4.9	
Spacer ball	None	
Factory packed grease	Refer to the remarks 1. below.	
Internal spatial volume of nut (cm <sup>3</sup> )	1.6	
Standard volume of grease replenishing (cm <sup>3</sup> )	0.8	

Clean support unit	For drive side	For opposite of drive side
WBK12-01C (square)	○	
WBK12-11C (round)	○	
WBK12S-01C (square)		○

Ball screw No.	Stroke		Thread length		
	Nominal	Maximum	$L_1$	$L_a$	$L_0$
<b>W1601KA-3PY-C3Z2</b>	100	137	189	204	261
<b>W1603KA-1PY-C3Z2</b>	300	337	389	404	461

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	
$T$	$e_p$	$v_u$			Supporting condition	
					Fixed - Simple support	
0	0.010	0.008	0.020	0.46	3000	
0	0.013	0.010	0.035	0.75	3000	

- Remarks
1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details. NSK Clean Grease LG2 is recommended.
  2. Contact NSK if permissible rotational speed is to be exceeded.



Ball screw specifications		
Shaft dia. x Lead / Direction of turn	20×20/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	3.969/21	
Screw shaft root diameter	16.9	
Effective turns of balls	1.5×1	
Accuracy grade / Preload	C5/Z	
Basic load rating (N)	Dynamic $C_a$	5760
	Static $C_{0a}$	9370
Axial play	0	
Preload (N)	196	
Dynamic friction torque, (N·cm)	2.0 - 11.8	
Spacer ball	None	
Factory packed grease	Refer to the remarks 1. below.	
Internal spatial volume of nut (cm <sup>3</sup> )	4.2	
Standard volume of grease replenishing (cm <sup>3</sup> )	2.1	

Clean support unit	For drive side	For opposite of drive side
WBK15-01C (square)	○	
WBK15-11C (round)	○	
WBK15S-01C (square)		○

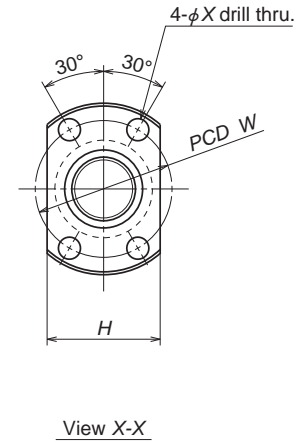
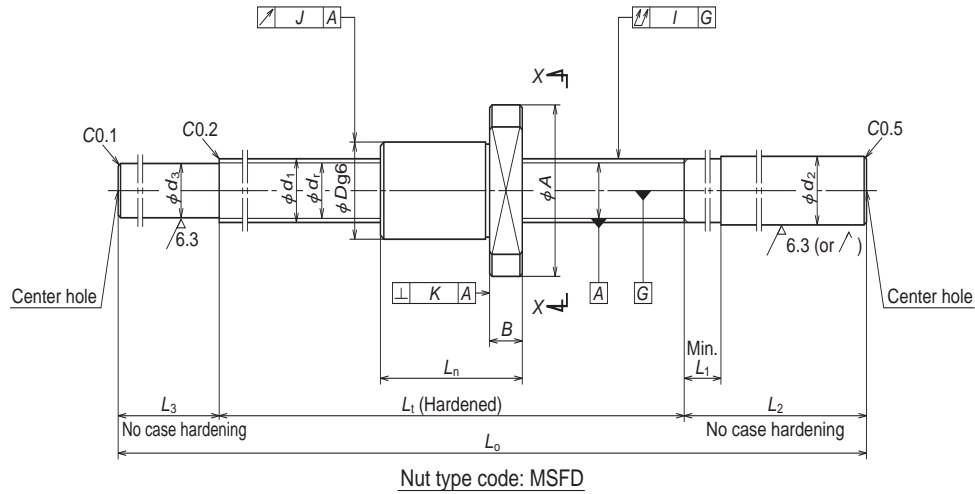
Unit: mm

Ball screw No.	Stroke		Thread length		
	Nominal	Maximum	$L_1$	$L_a$	$L_o$
<b>W2005KA-3P-C5Z20</b>	400	434	510	535	608
<b>W2007KA-3P-C5Z20</b>	600	634	710	735	808
<b>W2011KA-3P-C5Z20</b>	1000	1034	1110	1135	1208

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )
$T$	$e_p$	$v_u$			Supporting condition
					Fixed - Simple support
0	0.030	0.023	0.050	2.0	3000
0	0.035	0.025	0.085	2.5	3000
0	0.046	0.030	0.110	3.4	2160

- Remarks
1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details. NSK Clean Grease LG2 is recommended.
  2. Contact NSK if permissible rotational speed is to be exceeded.





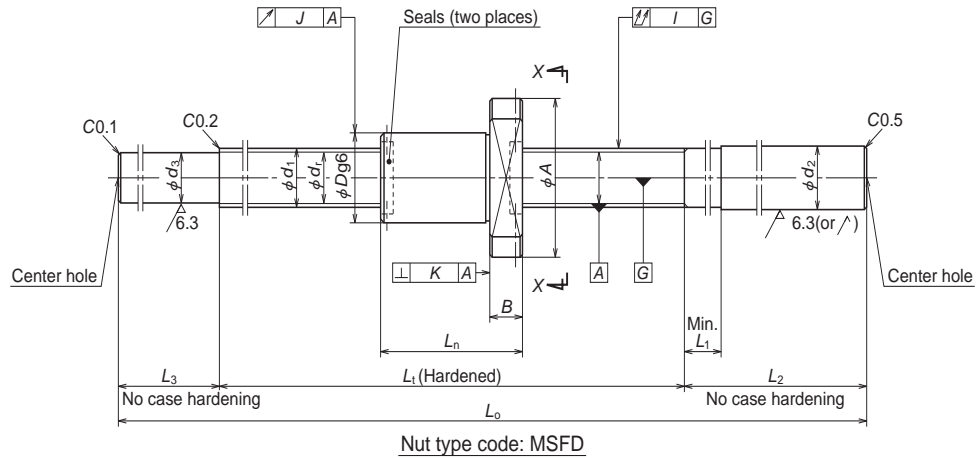
Ball screw No.	Stroke Max. $L_1-L_n$	Screw shaft dia. $d_1$	Lead $I$	Ball dia. $D_w$	Ball circle dia. $d_m$	Root dia. $d_r$	Effective ball turns	Basic load rating (N)		Axial play Max.	Nut			
								Dynamic $C_a$	Static $C_{0a}$		Flange			
											Outside dia. $D$	$A$	$H$	$B$
W0400MS-1Y-C3T1	68	4	1	0.8	4.2	3.2	2	315	370	0.005	10	20	14	3
W0601MS-1Y-C3T1	110	6	1	0.8	6.2	5.2	3	575	925	0.005	12	24	16	3.5
W0801MS-1Y-C3T1	94	8	1	0.8	8.2	7.2	3	670	1290	0.005	14	27	18	4
W0802MS-1Y-C3T1	174													

- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Nut does not have a seal.  
 4. Permissible rotational speed is determined by a d-n value and a critical speed. See page B383 and B51.

Unit: mm

dimensions			Screw shaft dimensions						Lead accuracy			Run out			Mass (kg)	Permissible rotational speed N(min <sup>-1</sup> )	
Overall length $L_n$	Bolt hole		Threaded length $L_1$	Shaft end, right		Shaft end, left		Overall length $L_o$	Deviation $e_p$	Variation $v_u$	Shaft straightness $I$	Nut O.D. eccentricity $J$	Flange perpendicularity $K$				
	$W$	$X$		$d_2$	$L_1$	$L_2$	$d_3$							$L_3$			
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	3000
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	3000
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	3000
			190						0.14								

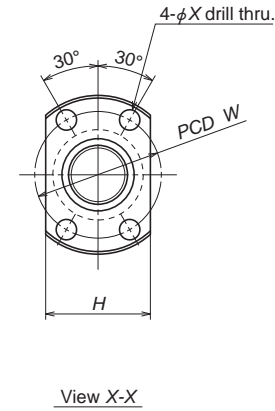
## Blank shaft end MS Type



## Nut models: MSFD

**NSK**

ø8×1.5, ø8×2, ø10×2



Ball screw No.	Stroke Max. $L_1-L_n$	Screw shaft dia. $d_1$	Lead $I$	Ball dia. $D_w$	Ball circle dia. $d_m$	Root dia. $d_t$	Effective ball turns	Basic load rating (N)		Axial play Max.	Nut			
								Dynamic $C_{0a}$	Static $C_{0a}$		Flange			
											Outside dia. $D$	$A$	$H$	$B$
W0801MS-2Y-C3T1.5	88	8	1.5	1.0	8.3	7.0	3	1080	1980	0.005	15	28	19	4
W0802MS-2Y-C3T1.5	168													
W0801MS-3Y-C3T2	84	8	2	1.2	8.3	6.9	3	1320	2210	0.005	16	29	20	4
W0802MS-3Y-C3T2	164													
W1001MS-1Y-C3T2	122	10	2	1.2	10.3	8.9	3	1490	2850	0.005	18	35	22	5
W1002MS-1Y-C3T2	222													

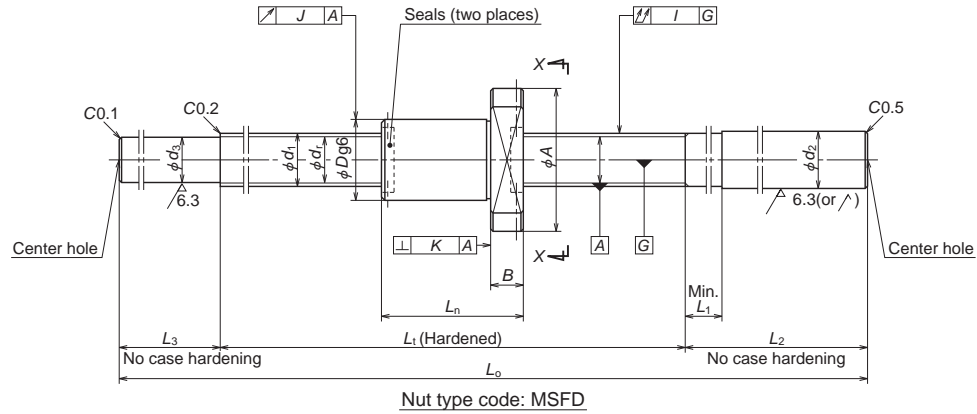
- Remarks:
1. NSK support unit is recommended. Refer to Page B433 for details.
  2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
  3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B383 and B51.

Unit: mm

dimensions			Screw shaft dimensions						Lead accuracy			Run out			Mass (kg)	Permissible rotational speed (min <sup>-1</sup> )	
Overall length $L_n$	Bolt hole $W$ $X$		Threaded length $L_1$	Shaft end, right $d_2$ $L_1$ $L_2$		Shaft end, left $d_3$ $L_3$		Overall length $L_0$	$T$	Deviation $e_p$	Variation $v_u$	Shaft straightness $I$	Nut O.D. eccentricity $J$	Flange perpendicularity $K$			
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	3000
			190						275				0.050			0.15	
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	3000
			190						275				0.050			0.15	
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	3000
			250						350		0.012		0.17				



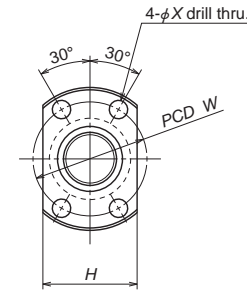
## Blank shaft end MS Type



## Nut models: MSFD

**NSK**

ø10×2.5, ø12×2, ø12×2.5



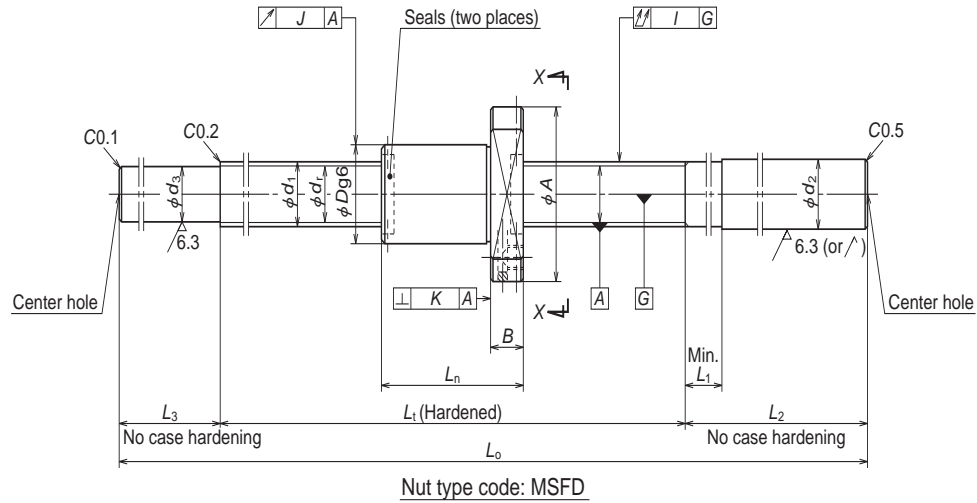
View X-X

Ball screw No.	Stroke Max. $L_1-L_n$	Screw shaft dia. $d_1$	Lead $I$	Ball dia. $D_w$	Ball circle dia. $d_m$	Root dia. $d_r$	Effective ball turns	Basic load rating (N)		Axial play Max.	Nut			
								Dynamic $C_a$	Static $C_{0a}$		Flange			
											Outside dia. $D$	$A$	$H$	$B$
W1001MS-2Y-C3T2.5	118	10	2.5	1.588	10.4	8.6	3	2130	3640	0.005	19	36	23	5
W1002MS-2Y-C3T2.5	218													
W1202MS-1Y-C3T2	182	12	2	1.200	12.3	10.9	3	1660	3620	0.005	20	37	24	5
W1203MS-1Y-C3T2	282													
W1202MS-2Y-C3T2.5	178	12	2.5	1.588	12.4	10.6	3	2360	4540	0.005	21	38	25	5
W1203MS-2Y-C3T2.5	278													

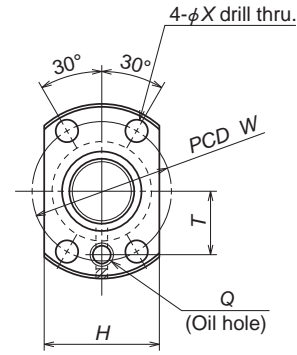
- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B383 and B51.

Unit: mm

dimensions			Screw shaft dimensions						Lead accuracy			Run out			Mass (kg)	Permissible rotational speed (N/min <sup>-1</sup> )
Overall length $L_n$	Bolt hole		Threaded length $L_1$	Shaft end, right		Shaft end, left		Overall length $L_0$	$T$	Deviation $e_p$	Variation $v_u$	Shaft straightness $I$	Nut O.D. eccentricity $J$	Flange perpendicularity $K$		
	$W$	$X$		$d_2$	$L_1$	$L_2$	$d_3$									
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
			250						350							0.050
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
			310						425							0.060
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
			310						425							0.060



Nut type code: MSFD



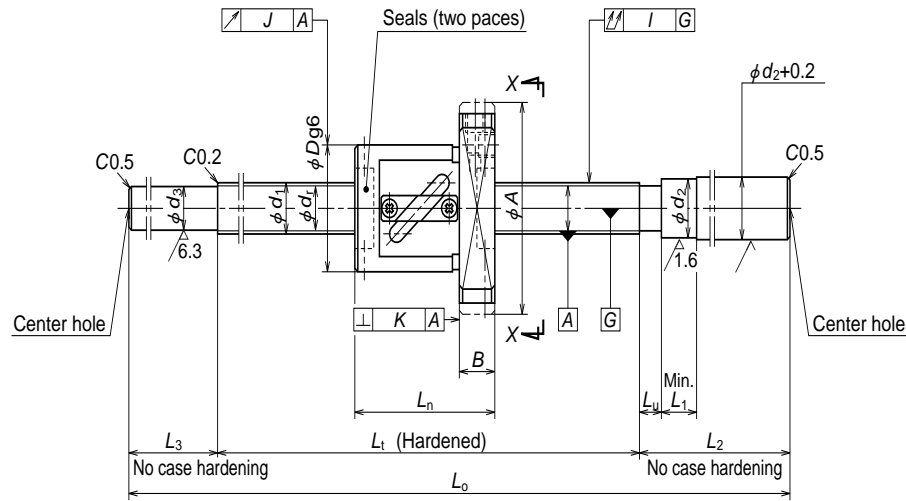
View X-X

Ball screw No.	Stroke Max. L <sub>1</sub> -L <sub>n</sub>	Screw shaft dia. d <sub>1</sub>	Lead I	Ball dia. D <sub>w</sub>	Ball circle dia. d <sub>m</sub>	Root dia. d <sub>r</sub>	Effective ball turns	Basic load rating (N)		Axial play Max.	Nut						
								Dynamic C <sub>a</sub>	Static C <sub>0a</sub>		Outside dia. D	Flange			Overall length L <sub>n</sub>	Bolt hole W	X
												A	H	B			
W1602MS-1Y-C3T2	210	16	2	1.588	16.4	14.6	4	3510	8450	0.005	25	44	29	10	40	35	5.5
W1604MS-1Y-C3T2	360										44	29	10	40	35	5.5	
W1602MS-2Y-C3T2.5	206	16	2.5	1.588	16.4	14.6	4	3510	8450	0.005	25	44	29	10	44	35	5.5
W1604MS-2Y-C3T2.5	356										44	29	10	44	35	5.5	

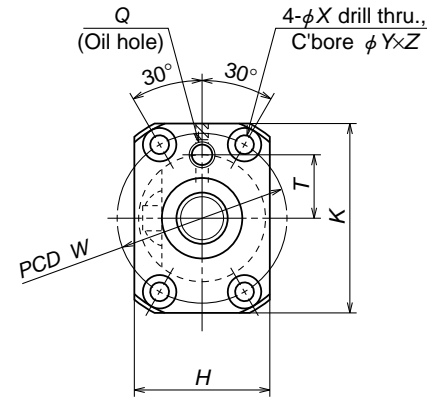
- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B383 and B51.

Unit: mm

dimensions	Screw shaft dimensions						Lead accuracy		Run out			Mass (kg)	Permissible rotational speed N(min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )			
	Oil hole	Threaded length	Shaft end, right	Shaft end, left	Overall length	T	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity							
Q	T	L <sub>1</sub>	d <sub>2</sub>	L <sub>1</sub>	L <sub>2</sub>	d <sub>3</sub>	L <sub>3</sub>	L <sub>0</sub>	T	e <sub>p</sub>	v <sub>u</sub>	I	J	K				
M6x1	16	250	16.2	30	100	14.7	40	390	0	0.012	0.008	0.035	0.010	0.008	0.71	3000	1.5	0.8
		400						540										
M6x1	16	250	16.2	30	100	14.7	40	390	0	0.012	0.008	0.035	0.010	0.008	0.73	3000	1.5	0.8
		400						540										



Nut type code: SFT, LSFT



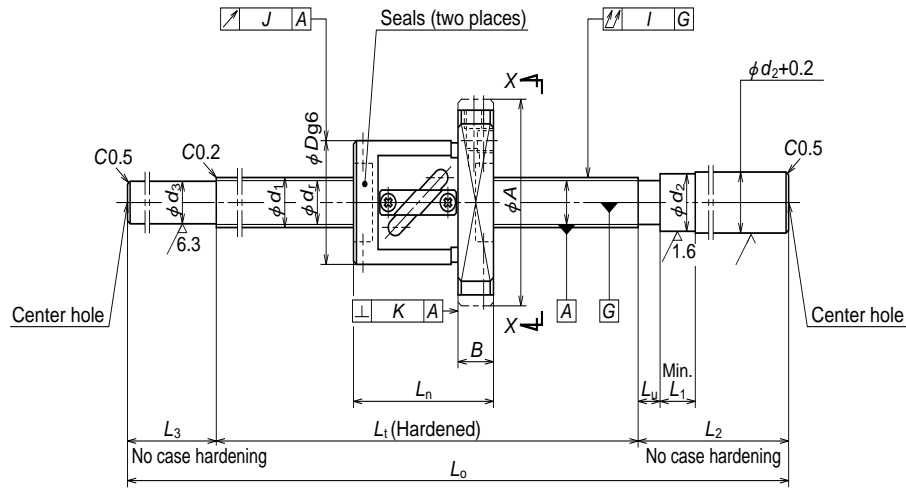
View X-X

Ball screw No.	Stroke Max. $L_1-L_n$	Screw shaft dia. $d_1$	Lead $I$	Ball dia. $D_w$	Ball circle dia. $d_m$	Root dia. $d_r$	Effective ball turns Turns × Circuits	Basic load rating (N)		Axial play Max.	Nut									
								Dynamic $C_a$	Static $C_{0a}$		Outside dia. $D$	Flange				Overall length $L_n$	Bolt hole			
												$D$	$A$	$H$	$K$		$B$	$L_n$	$W$	$X$
<b>W1001FS-1-C3T4</b>	126	10	4	2.000	10.3	8.2	2.5×1	2740	4450	0.005	26	46	28	42	10	34	36	4.5	8	4.5
<b>W1002FS-1-C3T4</b>	226																			
<b>W1003FS-1-C3T4</b>	326																			
<b>W1201FS-1-C3T5</b>	110	12	5	2.381	12.3	9.8	2.5×1	3760	6310	0.005	30	50	32	45	10	40	40	4.5	8	4.5
<b>W1202FS-1-C3T5</b>	210																			
<b>W1204FS-1-C3T5</b>	410																			
<b>W1202FS-2-C5T10</b>	200	12	10	2.381	12.5	10.0	2.5×1	3750	6480	0.005	30	50	32	45	10	50	40	4.5	8	4.5
<b>W1204FS-2-C5T10</b>	400																			

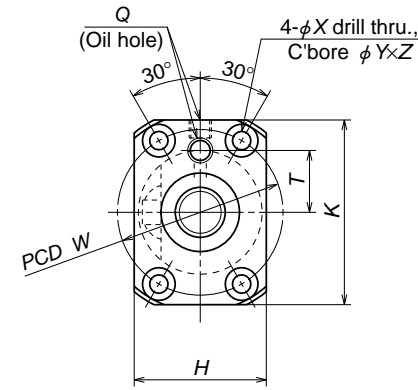
- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B383 and B51.

Unit: mm

dimensions	Screw shaft dimensions						Lead accuracy		Run out			Mass (kg)	Permissible rotational speed N(min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )				
	Oil hole $Q$	Threaded length $T$	Shaft end, right $L_1$	Shaft end, left $L_2$	Overall length $L_0$	Overall length $L_3$	Deviation $e_p$	Variation $v_u$	Shaft straightness $I$	Nut O.D. eccentricity $J$	Flange perpendicularity $K$								
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	3000	0.86	0.43
		260							365		0.012	0.008	0.040			0.39			
		360							465		0.013	0.010	0.050			0.45			
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	3000	1.2	0.6
		250							355		0.012	0.008	0.040			0.52			
M6×1	15	450	14	8	40	70	10.0	35	555	0	0.015	0.010	0.065	0.012	0.010	0.67	3000	1.4	0.7
		250							355		0.023	0.018	0.050			0.57			
		450							555		0.027	0.020	0.075			0.74			



Nut type code: SFT, LSFT



View X-X

Ball screw No.	Stroke Max. $L_1-L_n$	Screw shaft dia. $d_1$	Lead $l$	Ball dia. $D_w$	Ball circle dia. $d_m$	Root dia. $d_f$	Effective ball turns Turns × Circuits	Basic load rating (N)		Axial play Max.	Nut									
								Dynamic $C_a$	Static $C_{0a}$		Outside dia. $D$	Flange				Overall length $L_n$	Bolt hole			
												$A$	$H$	$K$	$B$		$W$	$X$	$Y$	$Z$
W1403FS-1-C3T5	310	14	5	3.175	14.5	11.2	2.5×1	6790	11700	0.005	34	57	34	50	11	40	45	5.5	9.5	5.5
W1406FS-1-C3T5	560																			
W1405FS-1-C5T8	454	14	8	3.175	14.5	11.2	2.5×1	6790	11700	0.005	34	57	34	50	11	46	45	5.5	9.5	5.5
W1408FS-1-C5T8	754																			
W1504FS-1-C5T10	349	15	10	3.175	15.5	12.2	2.5×1	7070	12800	0.005	34	57	34	50	11	51	45	5.5	9.5	5.5
W1506FS-1-C5T10	549																			
W1509FS-1-C5T10	849																			
W1511FS-1-C5T10	1049																			

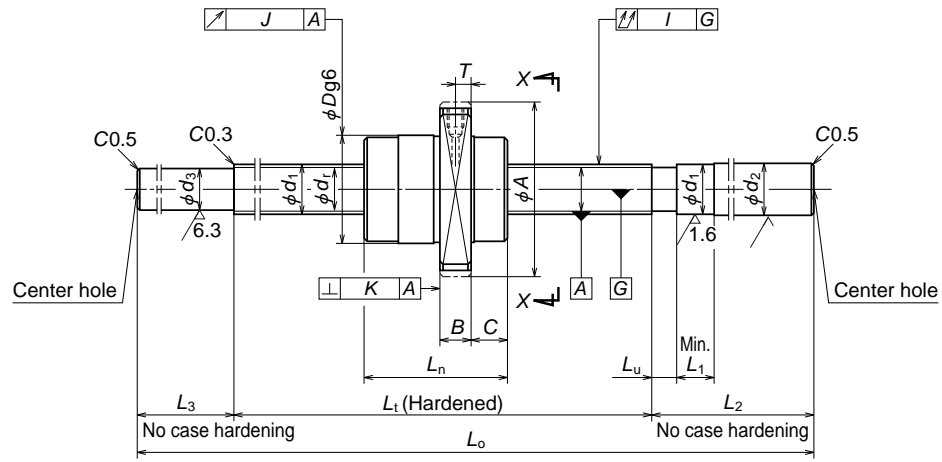
- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B383 and B51.

Unit: mm

dimensions	Screw shaft dimensions							Lead accuracy			Run out			Mass (kg)	Permissible rotational speed N(min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )				
	Oil hole		Threaded length	Shaft end, right		Shaft end, left		Overall length	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity								
	$Q$	$T$		$L_1$	$d_2$	$L_u$	$L_1$											$L_2$	$d_s$	$L_3$	$L_o$
M6×1	17	350	15	5	40	100	11.2	40	0	0.013	0.010	0.035	0.012	0.008	0.78	3000	2.0	1.0			
		600																	0.016	0.012	0.055
M6×1	17	500	15	8	40	100	11.2	40	0	0.027	0.020	0.065	0.015	0.011	1.0	3000	2.0	1.0			
		800																	0.035	0.025	0.085
M6×1	17	400	15	8	40	120	12.2	50	0	0.025	0.020	0.050	0.015	0.011	1.0	3000	2.3	1.2			
		600																	0.030	0.023	0.065
		900																	0.040	0.027	0.110
		1100																	0.046	0.030	0.150

**Blank shaft end FS Type**

(Ultra high helix lead: End cap type)

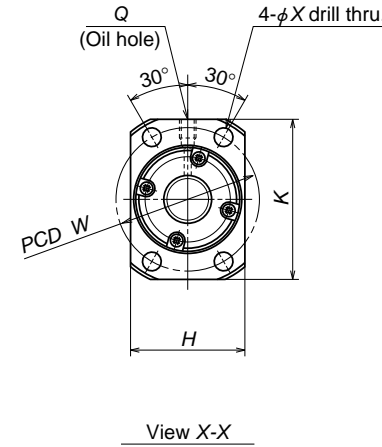


**Nut type code: USFC**

**Nut models: USFC**



ø15×20, ø16×32, ø20×40



Ball screw No.	Stroke Max. $L_t$ - $L_n$	Screw shaft dia. $d_1$	Lead $I$	Ball dia. $D_w$	Ball circle dia. $d_m$	Root dia. $d_f$	Effective ball turns $\times$ Circuits	Basic load rating (N)		Axial play Max.	Nut								
								Dynamic $C_a$	Static $C_{0a}$		Flange					Overall length $L_p$	Bolt hole $W$	X	
											Outside dia. $D$	A	H	K	B				C
W1504FS-2G-C5T20	355	15	20	3.175	15.5	12.2	1.7×1	5070	8730	0.005	34	55	36	50	10	11	45	45	5.5
W1506FS-2G-C5T20	555																		
W1509FS-2G-C5T20	855																		
W1511FS-2G-C5T20	1055																		
W1609FS-2GX-C5T32	866	16	32	3.175	16.75	13.4	0.7×2	4000	6690	0.005	34	55	36	50	10	10.5	34	45	5.5
W1613FS-1GX-C5T32	1266																		
W2011FS-1GX-C5T40	1059	20	40	3.175	20.75	17.4	0.7×2	4490	8640	0.005	38	58	40	52	10	11	41	48	5.5
W2017FS-1GX-C5T40	1659																		

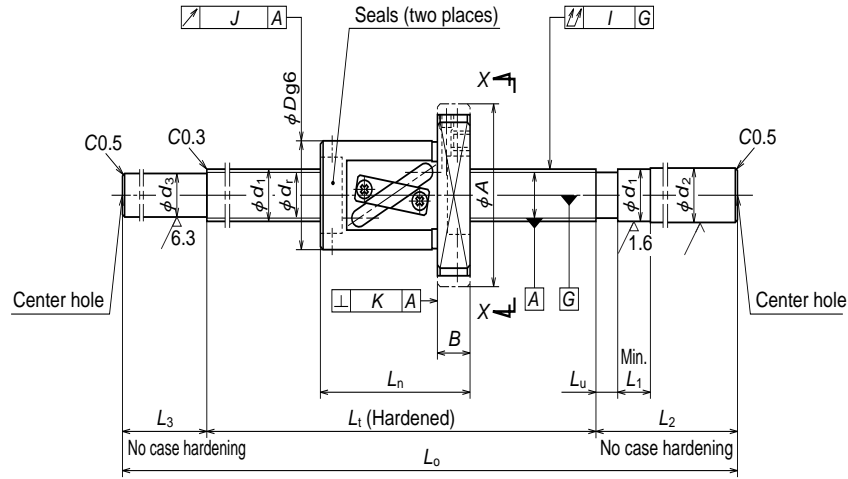
- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B383 and B51.

dimensions	Screw shaft dimensions								Lead accuracy			Run out			Mass (kg)	Permissible rotational speed N(min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )
	Oil hole		Threaded length $L_1$	Shaft end, right		Shaft end, left		Overall length $L_p$	Lead generation $T$	Deviation $e_p$	Variation $v_u$	Shaft straightness $I$	Nut O.D. eccentricity $J$	Flange perpendicularity $K$				
	$Q$	$T$		$d_2$	$L_u$	$L_1$	$L_2$											
M6×1	5	400	15.2	13	40	120	12.2	50	570	0	0.025	0.020	0.050	0.015	0.011	3000	1.9	1.0
		600							770		0.030	0.023	0.065					
		900							1070		0.040	0.027	0.110					
		1100							1270		0.046	0.030	0.150					
M6×1	5	900	16.2	19	40	150	13.4	60	1110	0	0.040	0.027	0.110	0.015	0.011	3000	2.0	1.0
		1300							1510		0.054	0.035	0.150					
M6×1	5	1100	20.2	22	60	150	17.4	80	1330	0	0.046	0.030	0.150	0.015	0.011	3000	2.7	1.4
		1700							1930		0.065	0.040	0.200					

Unit: mm

Blank shaft end FS Type

(Fine, medium, high helix lead: Tube type)

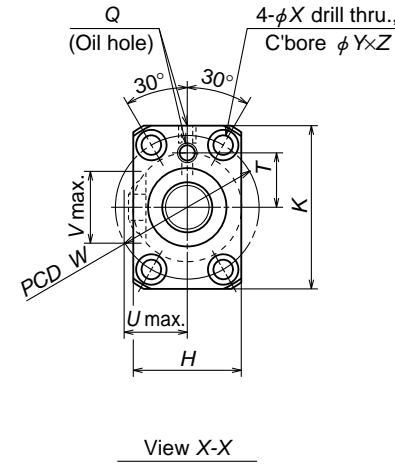


Nut type code: SFT, LSFT

Nut models: SFT, LSFT



ø16×5, ø16×16, ø20×10, ø20×20



Housing hole and its clearance  
(Only applicable to shaft dia. φ16×lead 16)

Ball screw No.	Stroke Max. L <sub>r</sub> -L <sub>n</sub>	Screw shaft dia. d <sub>1</sub>	Lead I	Ball dia. D <sub>w</sub>	Ball circle dia. d <sub>m</sub>	Root dia. d <sub>r</sub>	Effective ball turns Turns × Circuits	Basic load rating (N)		Axial play Max.	Nut											
								Dynamic C <sub>a</sub>	Static C <sub>0a</sub>		Outside dia. D	Flange					Overall length L <sub>n</sub>	Bolt hole				
												A	H	K	B	L <sub>n</sub>		W	X	Y	Z	
W1605FS-1-C3T5	458	16	5	3.175	16.5	13.2	2.5×1	7330	13500	0.005	40	63	40	55	11	42	51	5.9	5.5	5.5		
W1609FS-1-C3T5	858										40	63	40	55	11	42	51	5.9	5.5	5.5		
W1606FS-1-C5T16	544	16	16	3.175	16.75	13.4	1.5×1	4710	8110	0.005	34	57	34	50	12	56	45	5.9	5.5	5.5		
W1611FS-1-C5T16	1044										34	57	34	50	12	56	45	5.9	5.5	5.5		
W2009FS-1-C5T10	846	20	10	3.969	21	16.9	2.5×1	10900	21700	0.005	46	74	46	66	13	54	59	6.6	11	6.5		
W2013FS-1-C5T10	1246										46	74	46	66	13	54	59	6.6	11	6.5		
W2010FS-1-C5T20	937	20	20	3.969	21	16.9	1.5×1	7040	12700	0.005	46	74	46	66	13	63	59	6.6	11	6.5		
W2015FS-1-C5T20	1437										46	74	46	66	13	63	59	6.6	11	6.5		

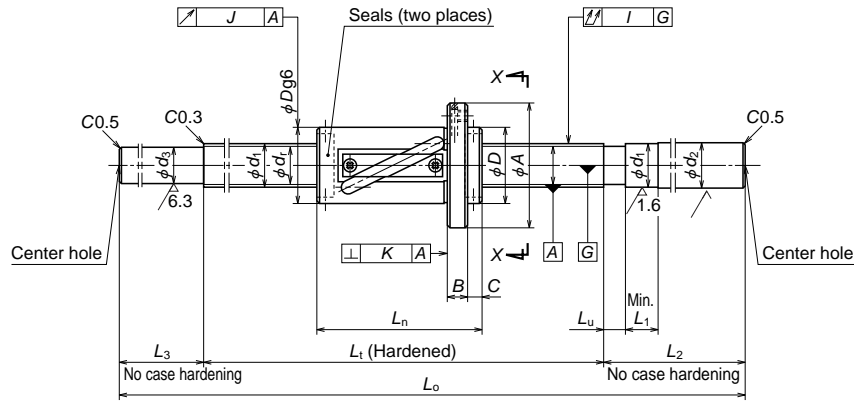
- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B383 and B51.

dimensions		Screw shaft dimensions					Lead accuracy			Run out			Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )						
Projecting tube	Oil hole	Threaded length	Shaft end, right	Shaft end, left	Overall length	T	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity											
U	V	R	Q	T	L <sub>1</sub>	d <sub>2</sub>	L <sub>1</sub>	L <sub>2</sub>	d <sub>3</sub>	L <sub>3</sub>	L <sub>0</sub>	e <sub>p</sub>	v <sub>v</sub>	I	J	K						
—	—	—	M6×1	17	500	16.2	5	40	150	13.2	60	710	0	0.015	0.010	0.055	0.012	0.008	1.4	3000	2.6	1.3
—	—	—	M6×1	17	900	16.2	5	40	150	13.2	60	1110	0	0.021	0.015	0.095	0.015	0.011	1.9			
19	20	8	M6×1	17	600	16.2	10	40	150	13.4	60	810	0	0.030	0.023	0.085	0.015	0.011	1.5	3000	2.1	1.1
—	—	—	M6×1	17	1100	16.2	10	40	150	13.4	60	1310	0	0.046	0.030	0.150	0.015	0.011	2.3			
—	—	—	M6×1	24	900	20.2	10	60	150	16.9	80	1130	0	0.040	0.027	0.110	0.015	0.011	3.2	3000	4.7	2.4
—	—	—	M6×1	24	1300	20.2	10	60	150	16.9	80	1530	0	0.054	0.035	0.150	0.015	0.011	4.1			
—	—	—	M6×1	24	1000	20.2	13	60	150	16.9	80	1230	0	0.040	0.027	0.110	0.015	0.011	3.6	3000	4.2	2.1
—	—	—	M6×1	24	1500	20.2	13	60	150	16.9	80	1730	0	0.054	0.035	0.200	0.015	0.011	4.8			

Unit: mm

**Blank shaft end FS Type**

(Medium • high helix • ultra high helix lead: End cap type)

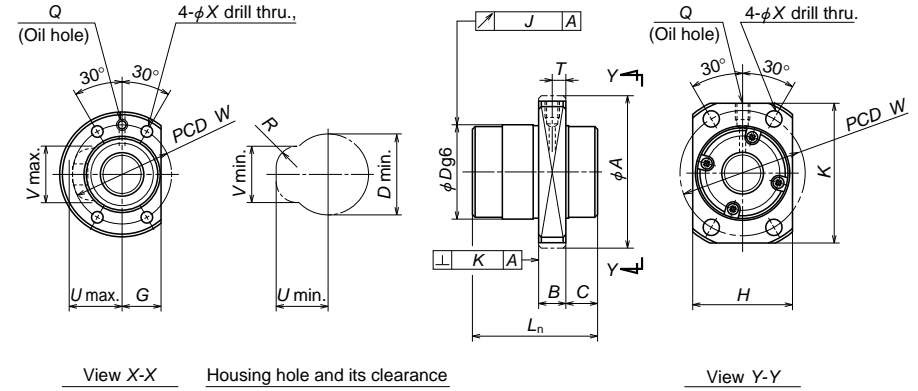


Nut type code: LSFT

**Nut models: LSFT, USFC**



ø25×20, ø25×25, ø25×50



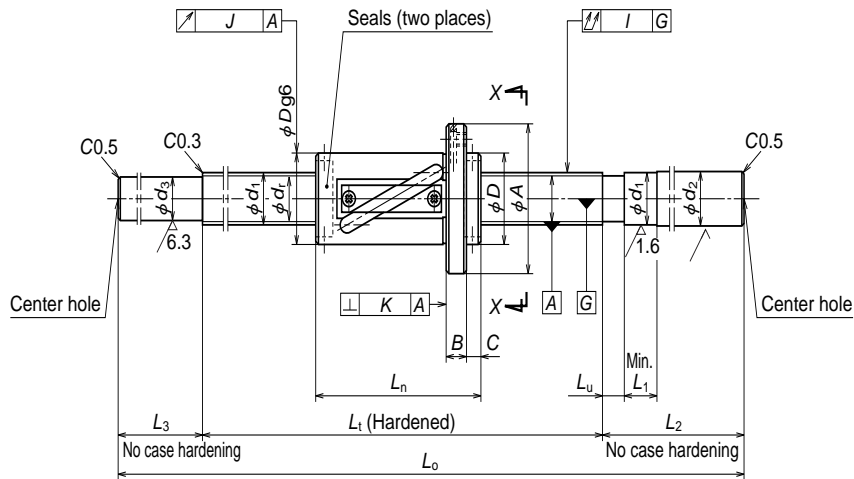
Nut type code: USFC

Ball screw No.	Stroke Max. L <sub>t</sub> -L <sub>n</sub>	Screw shaft dia. d <sub>t</sub>	Lead I	Ball dia. D <sub>w</sub>	Ball circle dia. d <sub>m</sub>	Root dia. d <sub>r</sub>	Effective ball turns x Circuits	Basic load rating (N)		Axial play Max.	Nut										
								Dynamic C <sub>a</sub>	Static C <sub>0a</sub>		Flange								Overall length L <sub>n</sub>	Bolt hole W X	
											D	A	G	H	K	B	C	L <sub>u</sub>			
W2513FS-1-C5T20	1254	25	20	4.762	26.25	21.3	2.5x1	15700	32800	0.005	LSFT	44	71	23	—	—	12	8	96	57	6.8
W2521FS-1-C5T20	2054											48	71	23	—	—	12	8	96	57	6.8
W2513FS-2-C5T25	1260	25	25	4.762	26.25	21.3	1.5x1	10100	19100	0.005	LSFT	44	71	23	—	—	12	10	90	57	6.6
W2521FS-2-C5T25	2060											48	71	23	—	—	12	10	90	57	6.6
W2515FS-1GX-C5T50	1450	25	50	3.969	26	21.9	0.7x2	6700	13500	0.005	USFC	46	70	—	48	63	12	13	50	58	6.6
W2521FS-3GX-C5T50	2100											48	70	—	48	63	12	13	50	58	6.6

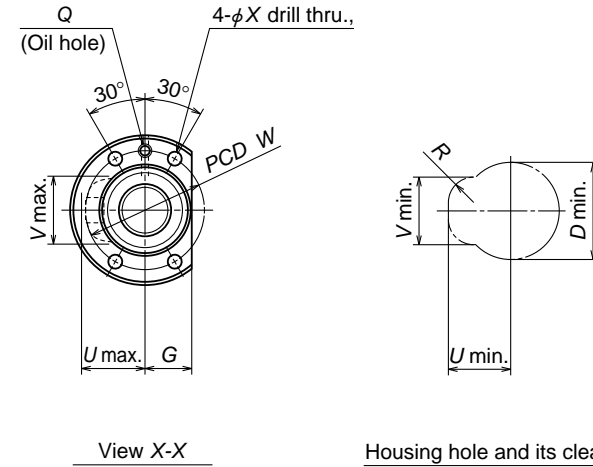
- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B383 and B51.

Unit: mm

dimensions			Screw shaft dimensions					Lead accuracy		Run out			Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )				
Projecting tube	Oil hole		Threaded length	Shaft end, right	Shaft end, left	Overall length	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity									
U	V	R	Q	T	L <sub>1</sub>	d <sub>2</sub>	L <sub>u</sub>	L <sub>1</sub>	L <sub>2</sub>	d <sub>3</sub>	L <sub>3</sub>	L <sub>o</sub>	T	e <sub>p</sub>	v <sub>u</sub>	I	J	K		
31	35	12	M6x1	—	1350	25.2	13	70	200	21.3	100	1650	0	0.054	0.035	0.120	0.015	0.011	6.8	
					2150							2450		0.077	0.046	0.160			9.8	2800
32	34	12	M6x1	—	1350	25.2	15	70	200	21.3	100	1650	0	0.054	0.035	0.120	0.015	0.011	6.8	
					2150							2450		0.077	0.046	0.160			9.8	2800
—	—	—	M6x1	6	1500	25.2	26	70	200	21.9	100	1800	0	0.054	0.035	0.120	0.015	0.011	7.3	
					2150							2450		0.077	0.046	0.160			9.8	2800



Nut type code: LSFT



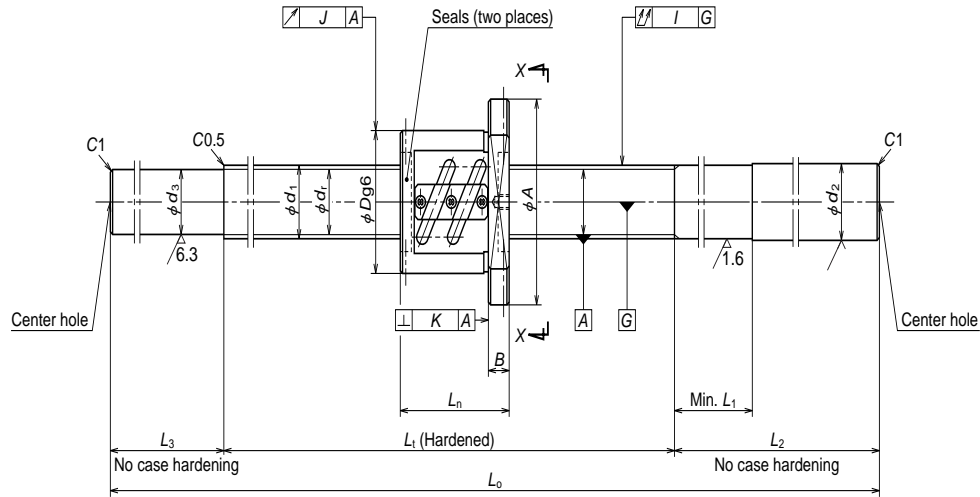
Ball screw No.	Stroke Max. L <sub>t</sub> -L <sub>n</sub>	Screw shaft dia. d <sub>1</sub>	Lead I	Ball dia. D <sub>w</sub>	Ball circle dia. d <sub>m</sub>	Root dia. d <sub>r</sub>	Effective ball turns Turns x Circuits	Basic load rating (N)		Axial play Max.	Nut							
								Dynamic C <sub>a</sub>	Static C <sub>0a</sub>		Outside dia. D	Flange				Overall length L <sub>n</sub>	Bolt hole	
												A	G	B	C		W	X
W3217FS-1-C5T25	1583	32	25	4.762	33.25	28.3	2.5x1	17900	41800	0.005	51	85	26	15	10	117	67	9
W3227FS-1-C5T25	2583																	
W3217FS-2-C5T32	1591	32	32	4.762	33.25	28.3	1.5x1	11500	24800	0.005	51	85	26	15	12	109	67	9
W3227FS-2-C5T32	2591																	

- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B383 and B51.

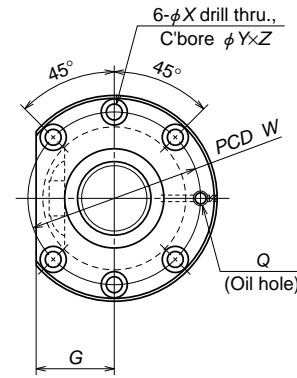
Unit: mm

dimensions			Screw shaft dimensions							Lead accuracy			Run out			Mass (kg)	Permissible rotational speed (N/min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )		
Projecting tube		Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compression	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity						
U	V	R		Q	L <sub>t</sub>	d <sub>2</sub>	L <sub>u</sub>	L <sub>1</sub>												L <sub>2</sub>	d <sub>3</sub>
34	42	12	M6x1	1700	32.3	15	70	250	28.3	120	2070	0	0.065	0.040	0.160	0.019	0.013	13.8	2180	17	8.5
				2700							3070							20.0			
34	42	12	M6x1	1700	32.3	19	70	250	28.3	120	2070	0	0.065	0.040	0.160	0.019	0.013	13.9	2180	15	7.5
				2700							3070							20.0			





Nut type code: PFT



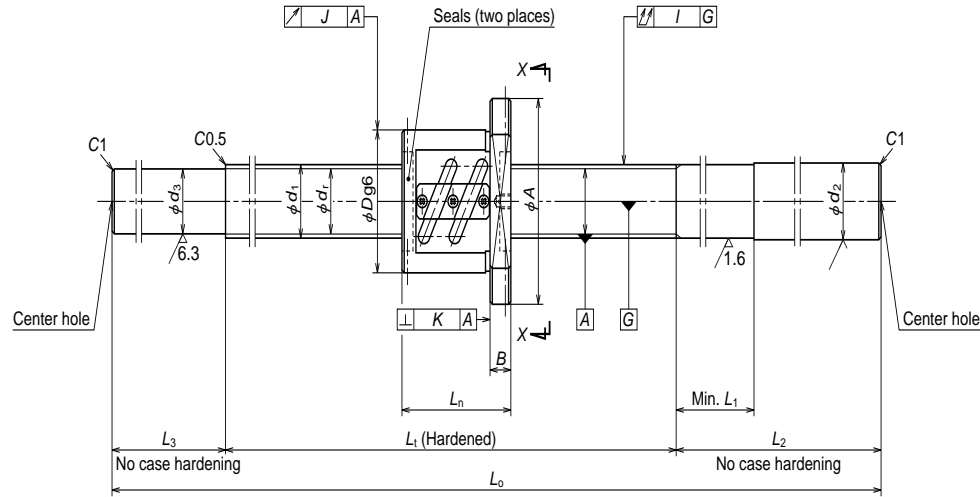
View X-X

Ball screw No.	Stroke Max. $L_1-L_n$	Screw shaft dia. $d_1$	Lead $I$	Ball dia. $D_w$	Ball circle dia. $d_m$	Root dia. $d_r$	Effective ball turns × Circuits	Basic load rating (N)		Preload (N)	Dynamic friction torque median (N·cm)	Nut						
								Dynamic $C_a$	Static $C_{0a}$			Outside dia. $D$	Flange		Overall length $L_n$	Bolt hole		
													$A$	$G$		$B$	$W$	$X$
W2003SS-1P-C5Z4	251	20	4	2.381	20.3	17.8	2.5×2	5420	10700	290	3.9	40	63	24	11	49	51	5.5
W2005SS-1P-C5Z4	451											40	63	24	11	49	51	5.5
W2008SS-1P-C5Z4	751											40	63	24	11	49	51	5.5
W2003SS-2P-C5Z5	244	20	5	3.175	20.5	17.2	2.5×2	9410	17100	490	7.8	44	67	26	11	56	55	5.5
W2005SS-2P-C5Z5	444											44	67	26	11	56	55	5.5
W2007SS-1P-C5Z5	644											44	67	26	11	56	55	5.5
W2010SS-1P-C5Z5	944											44	67	26	11	56	55	5.5

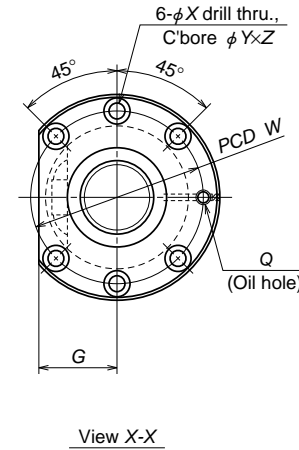
- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B383 and B51.

Unit: mm

dimensions		Screw shaft dimensions					Lead accuracy			Run out			Mass (kg)	Permissible rotational speed (N/min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )			
Bolt hole	Oil hole	Threaded length	Shaft end, right		Shaft end, left	Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity							
Y	Z	Q	$L_1$	$d_2$	$L_1$	$L_2$	$d_3$	$L_3$	$L_0$	T	$e_p$	$v_u$	I	J	K				
9.5	5.5	M6×1	300	20.2	40	150	17.8	—	450	-0.007	0.023	0.018	0.055	0.015	0.011	1.5	3000	2.7	1.4
			500			50		700	-0.012	0.027	0.020	0.085	2.0						
			800			100		1100	-0.019	0.035	0.025	0.140	2.9						
9.5	5.5	M6×1	300	20.2	40	150	17.2	—	450	-0.007	0.023	0.018	0.055	0.015	0.011	1.6	3000	4.3	2.2
			500			50		700	-0.012	0.027	0.020	0.085	2.2						
			700			100		1000	-0.017	0.035	0.025	0.110	2.8						
			1000			100		1300	-0.024	0.040	0.027	0.180	3.5						



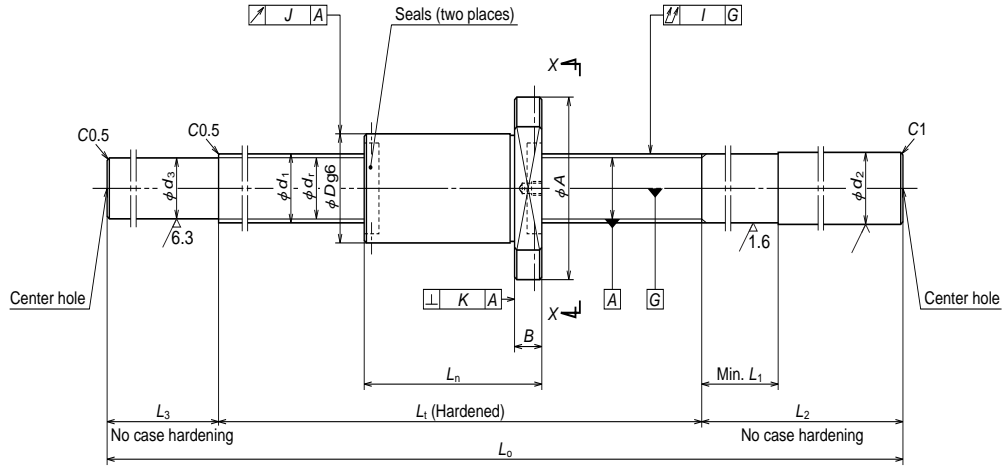
Nut type code: PFT



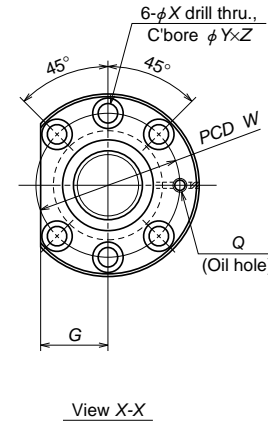
Ball screw No.	Stroke Max. L <sub>1</sub> -L <sub>n</sub>	Screw shaft dia. d <sub>1</sub>	Lead I	Ball dia. D <sub>w</sub>	Ball circle dia. d <sub>m</sub>	Root dia. d <sub>r</sub>	Effective ball turns × Circuits	Basic load rating (N)		Preload (N)	Dynamic friction torque median (N·cm)	Nut						
								Dynamic C <sub>a</sub>	Static C <sub>0a</sub>			Outside dia. D	Flange			Overall length L <sub>n</sub>	Bolt hole W	X
													A	G	B			
W2503SS-1P-C5Z4	252	25	4	2.381	25.3	22.8	2.5×2	6020	13600	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	10400	21900	540	8.8	50	73	28	11	55	61	5.5
W2505SS-1P-C5Z5	445																	
W2508SS-1P-C5Z5	745																	
W2512SS-1P-C5Z5	1145																	
W2504SS-1P-C5Z6	338																	
W2508SS-2P-C5Z6	738	25	6	3.969	25.5	21.4	2.5×2	14100	26800	690	13.8	53	76	29	11	62	64	5.5
W2512SS-2P-C5Z6	1138																	

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B383 and B51.

dimensions		Screw shaft dimensions					Lead accuracy			Run out			Mass (kg)	Permissible rotational speed N(min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )				
Bolt hole Y	Oil hole Z	Threaded length L <sub>1</sub>	Shaft end, right d <sub>2</sub>	Shaft end, left L <sub>1</sub>	Overall length L <sub>0</sub>	Travel compensation T	Deviation e <sub>p</sub>	Variation v <sub>u</sub>	Shaft straightness I	Nut O.D. eccentricity J	Flange perpendicularity K									
9.5	5.5	M6x1	300	25.2	40	150	—	450	-0.007	0.023	0.018	0.040	0.015	0.011	2.2	2800	3.2	1.6		
			600			200	100	900	-0.014	0.030	0.023	0.075							3.8	
			1000			200	100	1300	-0.024	0.040	0.027	0.120							5.2	
9.5	5.5	M6x1	300	25.2	40	200	—	500	-0.007	0.023	0.018	0.040	0.015	0.011	2.5	2800	5.2	2.6		
			500			200	50	750	-0.012	0.027	0.020	0.060							3.4	
			800			250	100	1150	-0.019	0.035	0.025	0.090							4.8	
			1200			300	100	1600	-0.029	0.046	0.030	0.120							6.3	
9.5	5.5	M6x1	400	25.2	40	200	—	600	-0.010	0.025	0.020	0.050	0.019	0.013	3.0	2800	7.0	3.5		
			800			250	21.4	100	1150	-0.019	0.035	0.025							0.090	4.8
			1200			300	100	1600	-0.029	0.046	0.030	0.120							6.3	



Nut type code: ZFD

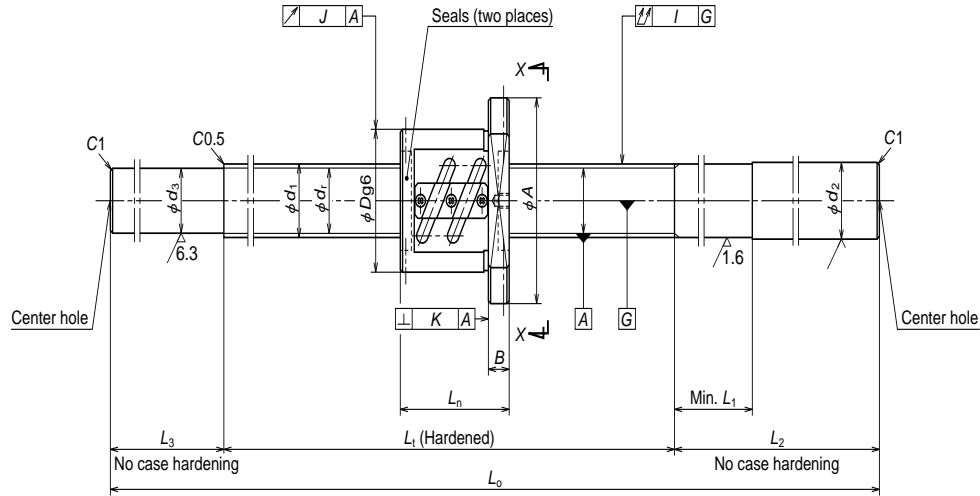


Ball screw No.	Stroke Max. L <sub>1</sub> -L <sub>n</sub>	Screw shaft dia. d <sub>1</sub>	Lead I	Ball dia. D <sub>w</sub>	Ball circle dia. d <sub>m</sub>	Root dia. d <sub>r</sub>	Effective ball turns × Circuits	Basic load rating (N)		Preload (N)	Dynamic friction torque median (N·cm)	Nut							
								Dynamic C <sub>a</sub>	Static C <sub>0a</sub>			Outside dia. D	Flange			Overall length L <sub>n</sub>	Bolt hole W X		
													A	G	B				
W2502SS-1ZY-C5Z5	184																		
W2504SS-3ZY-C5Z5	334																		
W2506SS-2ZY-C5Z5	534	25	5	3.175	25.75	22.4	1×3	9790	22900	740	13.8	40	63	24	11	66	51	5.5	
W2509SS-1ZY-C5Z5	834																		
W2512SS-3ZY-C5Z5	1134																		
W2504SS-4ZY-C5Z10	312																		
W2506SS-3ZY-C5Z10	512																		
W2508SS-3ZY-C5Z10	712	25	10	4.762	26.25	21.3	1×2	11400	21400	880	21.5	42	69	26	15	88	55	6.6	
W2511SS-1ZY-C5Z10	1012																		
W2515SS-2ZY-C5Z10	1412																		

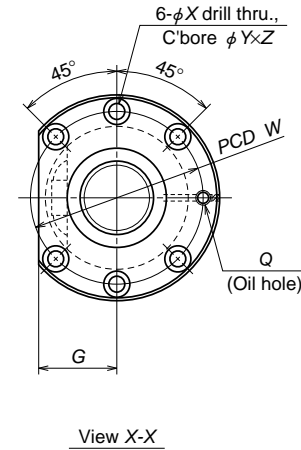
- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B383 and B51.

dimensions		Screw shaft dimensions					Lead accuracy			Run out			Mass (kg)	Permissible rotational speed N(min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )		
Bolt hole Y Z	Oil hole Q	Threaded length L <sub>1</sub>	Shaft end, right d <sub>2</sub> L <sub>1</sub> L <sub>2</sub>	Shaft end, left d <sub>3</sub> L <sub>3</sub>	Overall length L <sub>0</sub>	Travel compensation T	Deviation e <sub>p</sub>	Variation v <sub>u</sub>	Shaft straightness I	Nut O.D. eccentricity J	Flange perpendicularity K							
9.5	5.5	M6x1	250	25.2	40	200	—	450	-0.005	0.023	0.018	0.040	0.015	0.011	2800	5.4	2.7	
			400			200	50	650	-0.009	0.025	0.020	0.060						
			600			250	22.4	100	950	-0.013	0.030	0.023						0.075
			900			250	100	1250	-0.021	0.040	0.027	0.090						
			1200			300	100	1600	-0.028	0.046	0.030	0.120						
11	6.5	M6x1	400	25.2	60	200	50	650	-0.008	0.025	0.020	0.060	0.015	0.011	2800	9.0	4.5	
			600			250	100	950	-0.012	0.030	0.023	0.075						
			800			250	21.3	100	1150	-0.017	0.035	0.025						0.090
			1100			300	100	1500	-0.024	0.046	0.030	0.120						
			1500			300	100	1900	-0.034	0.054	0.035	0.150						

Unit: mm



Nut type code: PFT

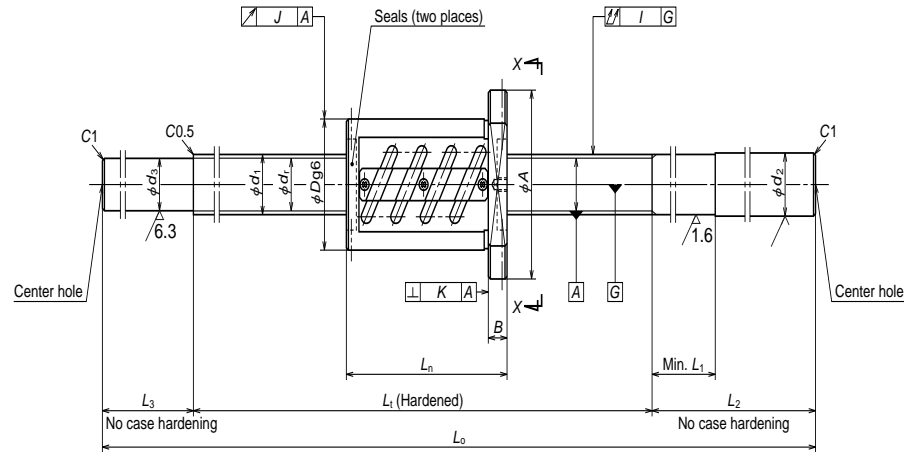


Ball screw No.	Stroke Max. L <sub>1</sub> -L <sub>n</sub>	Screw shaft dia. d <sub>1</sub>	Lead I	Ball dia. D <sub>w</sub>	Ball circle dia. d <sub>m</sub>	Root dia. d <sub>r</sub>	Effective ball turns × Circuits	Basic load rating (N)		Preload (N)	Dynamic friction torque median (N·cm)	Nut						
								Dynamic C <sub>a</sub>	Static C <sub>0a</sub>			Outside dia. D	Flange		Overall length L <sub>n</sub>	Bolt hole		
													A	G		B	L <sub>n</sub>	W
W2504SS-2P-C5Z10	319	25	10	4.762	25.5	20.5	1.5×2	11600	19000	590	13.8	58	85	32	15	81	71	6.6
W2507SS-1P-C5Z10	619																	
W2510SS-2P-C5Z10	919																	
W2515SS-1P-C5Z10	1419																	
W2804SS-1P-C5Z5	344	28	5	3.175	28.5	25.2	2.5×2	11000	24400	540	9.8	55	85	31	12	56	69	6.6
W2806SS-1P-C5Z5	544																	
W2808SS-1P-C5Z5	744																	
W2812SS-1P-C5Z5	1144																	
W2804SS-3P-C5Z6	337	28	6	3.175	28.5	25.2	2.5×2	11000	24400	540	10.8	55	85	31	12	63	69	6.6
W2806SS-3P-C5Z6	537																	
W2808SS-3P-C5Z6	737																	
W2812SS-3P-C5Z6	1137																	

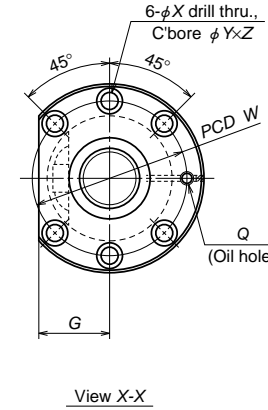
Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B383 and B51.

Unit: mm

dimensions		Screw shaft dimensions					Lead accuracy			Run out			Mass (kg)	Permissible rotational speed N(min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )		
Bolt hole Y	Oil hole Z	Threaded length L <sub>1</sub>	Shaft end, right d <sub>2</sub>	Shaft end, left L <sub>1</sub>	Overall length L <sub>0</sub>	Travel compensation T	Deviation e <sub>p</sub>	Variation v <sub>u</sub>	Shaft straightness I	Nut O.D. eccentricity J	Flange perpendicularity K							
Q			L <sub>1</sub>	L <sub>2</sub>	d <sub>3</sub>													
11	6.5	M6×1	400	25.2	60	200	50	650	-0.010	0.025	0.020	0.060	0.019	0.013	3.8	2800	9.7	4.9
			700			250	100	1050	-0.017	0.035	0.025	0.090						
			1000			250	100	1350	-0.024	0.040	0.027	0.120						
			1500			300	100	1900	-0.036	0.054	0.035	0.150						
11	6.5	M6×1	400	28.2	40	200	—	600	-0.010	0.025	0.020	0.050	0.019	0.013	3.7	2500	6.1	3.1
			600			250	100	950	-0.014	0.030	0.023	0.075						
			800			250	100	1150	-0.019	0.035	0.025	0.090						
			1200			300	100	1600	-0.029	0.046	0.030	0.120						
11	6.5	M6×1	400	28.2	40	200	—	600	-0.010	0.025	0.020	0.050	0.019	0.013	3.8	2500	6.1	3.1
			600			250	100	950	-0.014	0.030	0.023	0.075						
			800			250	100	1150	-0.019	0.035	0.025	0.090						
			1200			300	100	1600	-0.029	0.046	0.030	0.120						



Nut type code: ZFT

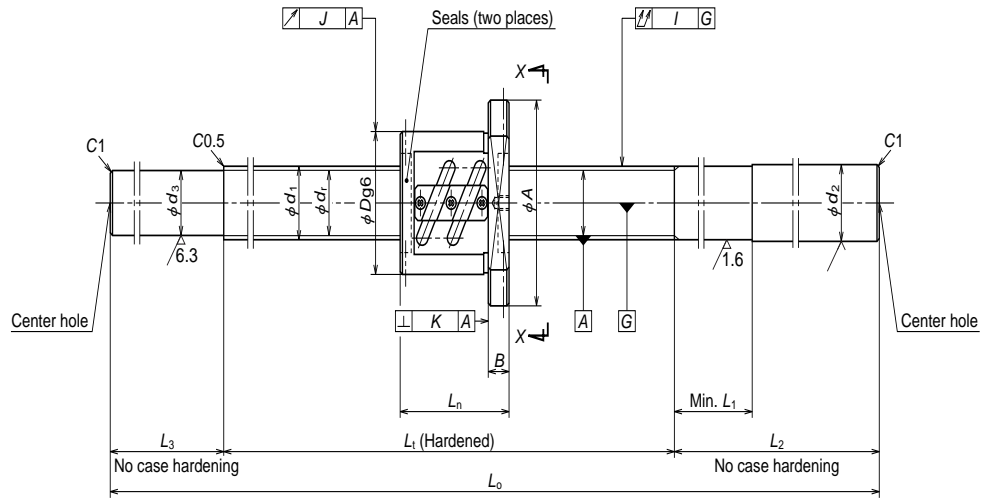


Unit: mm

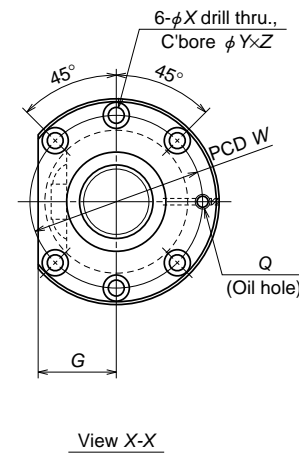
Ball screw No.	Stroke Max. L <sub>1</sub> -L <sub>n</sub>	Screw shaft dia. d <sub>1</sub>	Lead I	Ball dia. D <sub>w</sub>	Ball circle dia. d <sub>m</sub>	Root dia. d <sub>r</sub>	Effective ball turns × Circuits	Basic load rating (N)		Preload (N)	Dynamic friction torque median (N·cm)	Nut						
								Dynamic C <sub>a</sub>	Static C <sub>0a</sub>			Outside dia. D	Flange			Overall length L <sub>n</sub>	Bolt hole W X	
													A	G	B			
W2804SS-2Z-C5Z5	314	28	5	3.175	28.5	25.2	2.5×2	17400	48800	1225	21.5	55	85	31	12	86	69	6.6
W2806SS-2Z-C5Z5	514																	
W2808SS-2Z-C5Z5	714																	
W2812SS-2Z-C5Z5	1114	28	6	3.175	28.5	25.2	2.5×2	17400	48800	1225	22.5	55	85	31	12	99	69	6.6
W2804SS-4Z-C5Z6	301																	
W2806SS-4Z-C5Z6	501																	
W2808SS-4Z-C5Z6	701	1101																
W2812SS-4Z-C5Z6	1101																	

dimensions			Screw shaft dimensions					Lead accuracy			Run out			Mass (kg)	Permissible rotational speed N(min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )	
Bolt hole Y	Oil hole Z	Q	Threaded length L <sub>1</sub>	Shaft end, right		Shaft end, left		Overall length L <sub>0</sub>	Travel compensation T	Deviation e <sub>p</sub>	Variation v <sub>u</sub>	Shaft straightness I	Nut O.D. eccentricity J					Flange perpendicularity K
				d <sub>2</sub>	L <sub>1</sub>	L <sub>2</sub>	d <sub>3</sub>											
11	6.5	M6×1	400	28.2	40	200	—	600	-0.010	0.025	0.020	0.050	0.019	0.013	4.7	2500	9.2	4.6
			600			250	100	950	-0.014	0.030	0.023	0.075						
			800			250	100	1150	-0.019	0.035	0.025	0.090						
			1200			300	100	1600	-0.029	0.046	0.030	0.120						
11	6.5	M6×1	400	28.2	40	200	—	600	-0.010	0.025	0.020	0.050	0.019	0.013	4.2	2500	9.5	4.8
			600			250	100	950	-0.014	0.030	0.023	0.075						
			800			250	100	1150	-0.019	0.035	0.025	0.090						
			1200			300	100	1600	-0.029	0.046	0.030	0.120						

- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B383 and B51.



Nut type code: PFT

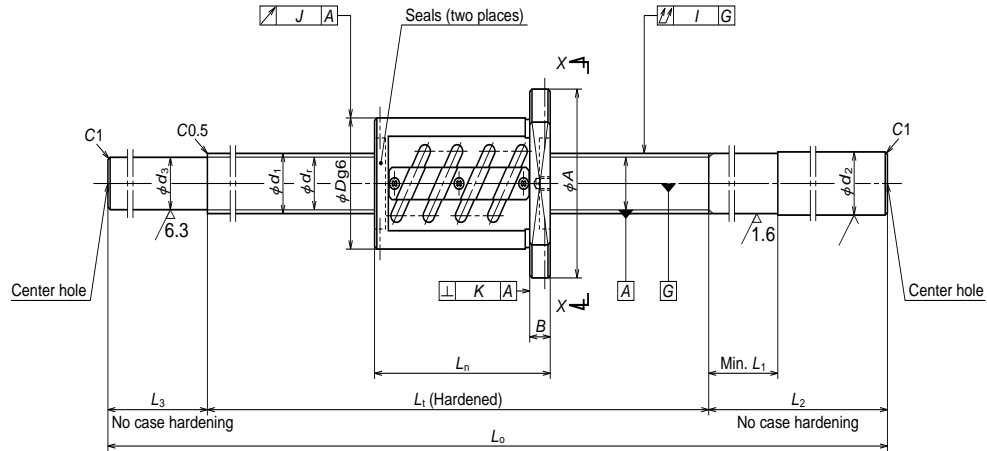


Unit: mm

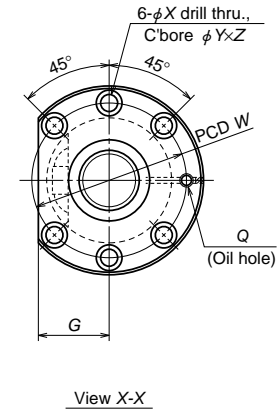
Ball screw No.	Stroke Max. $L_1-L_n$	Screw shaft dia. $d_1$	Lead $I$	Ball dia. $D_w$	Ball circle dia. $d_m$	Root dia. $d_r$	Effective ball turns $\times$ Circuits	Basic load rating (N)			Dynamic friction torque, median (N·cm)	Nut				
								Dynamic $C_a$	Static $C_{0a}$	Preload (N)		Flange			Overall length $L_n$	
												Outside dia. $D$	$A$	$G$		$B$
W3204SS-1P-C5Z5	344	32	5	3.175	32.5	29.2	2.5×2	11600	28000	590	10.8	58	85	32	12	56
W3206SS-1P-C5Z5	544															
W3208SS-1P-C5Z5	744															
W3212SS-1P-C5Z5	1144															
W3215SS-1P-C5Z5	1444															
W3206SS-3P-C5Z6	537	32	6	3.969	32.5	28.4	2.5×2	15500	34700	780	15.6	62	89	34	12	63
W3210SS-1P-C5Z6	937															
W3215SS-3P-C5Z6	1437															

- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B383 and B51.

dimensions				Screw shaft dimensions				Lead accuracy			Run out			Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )		
Bolt hole		Oil hole		Threaded length	Shaft end, right		Shaft end, left		Overall length $L_0$	Travel compensation $T$	Deviation $e_p$	Variation $v_u$	Shaft straightness $I$					Nut O.D. eccentricity $J$	Flange perpendicularity $K$
$W$	$X$	$Y$	$Z$	$Q$	$L_1$	$d_2$	$L_1$	$L_2$											
71	6.6	11	6.5	M6×1	32.3	40	250	29.2	50	650	-0.010	0.025	0.020	0.060	0.019	0.013	4.8		
									600	950	-0.014	0.030	0.023	0.075			6.5		
									800	100	1150	-0.019	0.035	0.025			0.090	7.7	
									1200	100	1600	-0.029	0.046	0.030			0.120	10.3	
									1500	100	1900	-0.036	0.054	0.035			0.150	12.1	
75	6.6	11	6.5	M6×1	32.3	40	300	28.4	600	950	-0.014	0.030	0.023	0.075	0.019	0.013	6.7		
									1000	1400	-0.024	0.040	0.027	0.120			9.2		
									1500	1900	-0.036	0.054	0.035	0.150			12.1		



Nut type code: ZFT

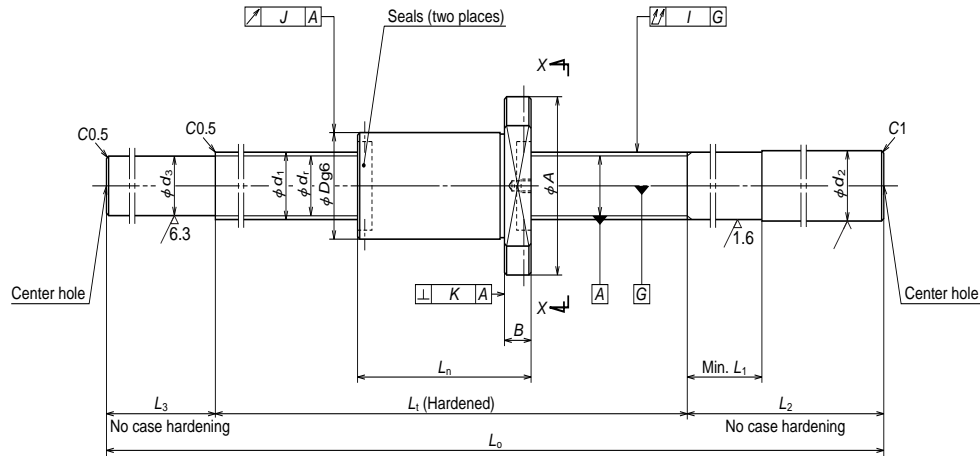


Ball screw No.	Stroke Max. L <sub>1</sub> -L <sub>n</sub>	Screw shaft dia. d <sub>1</sub>	Lead I	Ball dia. D <sub>w</sub>	Ball circle dia. d <sub>m</sub>	Root dia. d <sub>r</sub>	Effective ball turns × Circuits	Basic load rating (N)			Dynamic friction torque, median (N·cm)	Nut				
								Dynamic C <sub>a</sub>	Static C <sub>0a</sub>	Preload (N)		Flange				Overall length L <sub>n</sub>
												Outside dia. D	A	G	B	
W3204SS-2Z-C5Z5	314	32	5	3.175	32.5	29.2	2.5×2	18500	56100	1270	22.5	58	85	32	12	86
W3206SS-2Z-C5Z5	514															
W3208SS-2Z-C5Z5	714															
W3212SS-2Z-C5Z5	1114															
W3215SS-2Z-C5Z5	1414															
W3206SS-4Z-C5Z6	501	32	6	3.969	32.5	28.4	2.5×2	24700	69400	1720	34.5	62	89	34	12	99
W3210SS-2Z-C5Z6	901															
W3215SS-4Z-C5Z6	1401															
W3206SS-5Z-C5Z8	518	32	8	4.762	32.5	27.5	2.5×1	17500	41000	1320	30.5	66	100	38	15	82
W3210SS-3Z-C5Z8	918															
W3215SS-5Z-C5Z8	1418															

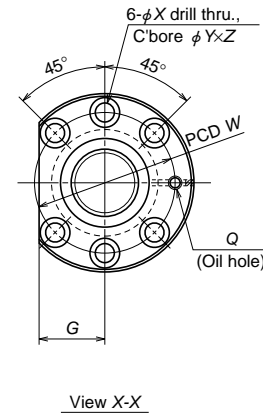
- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

dimensions				Screw shaft dimensions				Lead accuracy			Run out			Mass (kg)	Permissible rotational speed (min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )		
Bolt hole		Oil hole		Threaded length	Shaft end, right		Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness					Nut O.D. eccentricity	Flange perpendicularity
W	X	Y	Z	Q	L <sub>1</sub>	d <sub>2</sub>	L <sub>1</sub>	L <sub>2</sub>	d <sub>3</sub>	L <sub>3</sub>	L <sub>0</sub>	T	e <sub>p</sub>					v <sub>u</sub>	I
71	6.6	11	6.5	M6×1	400	32.3	40	250	29.2	50	650	-0.010	0.025	0.020	0.060	0.019	0.013	5.1	
					600					100	950	-0.014	0.030	0.023	0.075			6.9	
					800					100	1600	-0.029	0.046	0.030	0.120			10.1	
					1200					100	1900	-0.036	0.054	0.035	0.150			12.4	
75	6.6	11	6.5	M6×1	600	32.3	40	300	28.4	950	1400	-0.014	0.030	0.023	0.075	0.019	0.013	7.1	
					1000					100	1400	-0.024	0.040	0.027	0.120			9.7	
					1500					100	1900	-0.036	0.054	0.035	0.150			12.6	
82	9	14	8.5	M6×1	600	32.3	50	300	27.5	950	1400	-0.014	0.030	0.023	0.075	0.019	0.013	7.3	
					1000					100	1400	-0.024	0.040	0.027	0.120			9.8	
					1500					100	1900	-0.036	0.054	0.035	0.150			12.6	

Unit: mm



Nut type code: ZFD



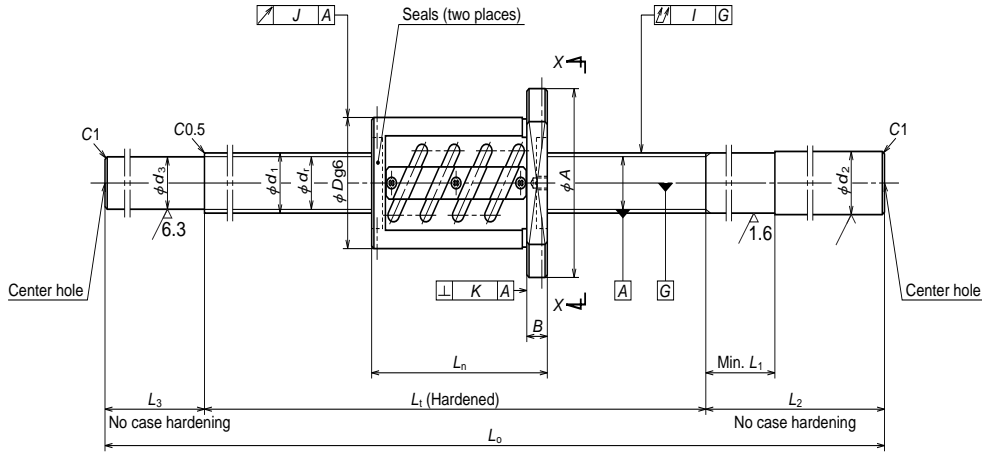
Ball screw No.	Stroke Max. $L_1-L_n$	Screw shaft dia. $d_1$	Lead $I$	Ball dia. $D_w$	Ball circle dia. $d_m$	Root dia. $d_r$	Effective ball turns $\times$ Circuits	Basic load rating (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut				
								Dynamic $C_a$	Static $C_{0a}$			Flange				Overall length $L_n$
												Outside dia. $D$	$A$	$G$	$B$	
W3204SS-3ZY-C5Z5	323	32	5	3.175	32.75	29.4	4	14200	40700	1080	19.6	48	75	29	12	77
W3206SS-6ZY-C5Z5	523															
W3209SS-1ZY-C5Z5	823															
W3212SS-3ZY-C5Z5	1123															
W3216SS-1ZY-C5Z5	1523															
W3205SS-3ZY-C5Z10	380	32	10	6.35	33.75	27.1	3	25900	52800	1860	49.0	54	88	34	15	120
W3207SS-3ZY-C5Z10	580															
W3210SS-6ZY-C5Z10	880															
W3214SS-3ZY-C5Z10	1280															
W3218SS-3ZY-C5Z10	1680															

- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d-n value and a critical speed. See page B383 and B51.

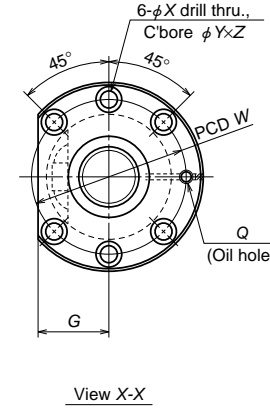
Unit: mm

dimensions				Screw shaft dimensions				Lead accuracy			Run out			Mass (kg)	Permissible rotational speed (min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )			
Bolt hole		Oil hole		Threaded length	Shaft end, right		Shaft end, left		Travel compensation	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity					Flange perpendicularity		
W	X	Y	Z		Q	$L_1$	$d_2$	$L_1$											$L_2$	$d_3$
61	6.6	11	6.5	M6x1	32.3	40	250	29.4	50	650	-0.009	0.025	0.020	0.060	0.015	0.011	8.1	2180	22	11
									200	950	-0.013	0.030	0.023	0.075						
									250	1000	-0.021	0.040	0.027	0.090						
									300	1600	-0.028	0.046	0.030	0.120						
									300	2000	-0.037	0.054	0.035	0.150						
70	9	14	8.5	M6x1	32.3	60	250	27.1	100	850	-0.010	0.027	0.020	0.075	0.019	0.013	9.3	2180	23	12
									250	1050	-0.015	0.035	0.025	0.090						
									300	1400	-0.022	0.040	0.027	0.120						
									350	1870	-0.032	0.054	0.035	0.150						
									350	2270	-0.041	0.065	0.040	0.200						





Nut type code: ZFT

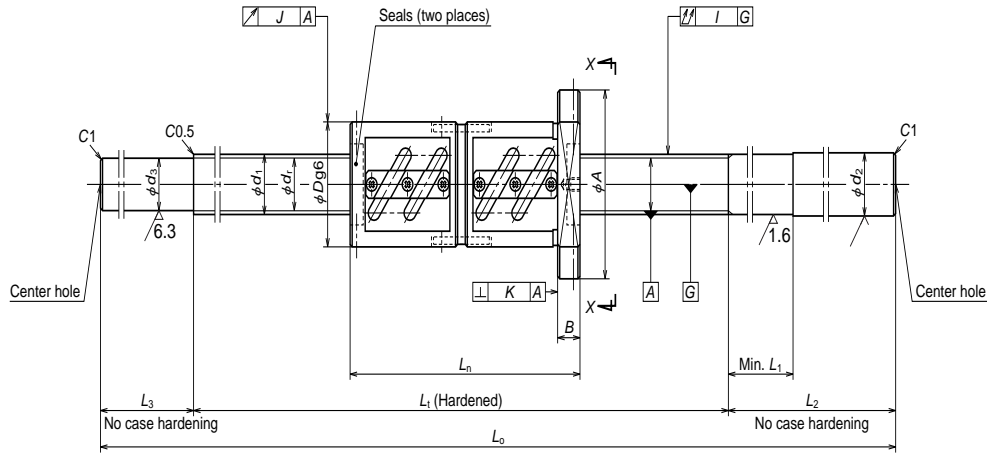


Ball screw No.	Stroke Max. L <sub>1</sub> -L <sub>n</sub>	Screw shaft dia. d <sub>1</sub>	Lead I	Ball dia. D <sub>w</sub>	Ball circle dia. d <sub>m</sub>	Root dia. d <sub>r</sub>	Effective ball turns × Circuits	Basic load rating (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut				
								Dynamic C <sub>3</sub>	Static C <sub>03</sub>			Flange				Overall length L <sub>n</sub>
												Outside dia. D	A	G	B	
W3205SS-1Z-C5Z10	400	32	10	6.350	33	26.4	2.5×1	25500	54000	1960	50	74	108	41	15	100
W3207SS-1Z-C5Z10	600															
W3210SS-4Z-C5Z10	900															
W3214SS-1Z-C5Z10	1300															
W3218SS-1Z-C5Z10	1700															
W3607SS-1Z-C5Z10	597	36	10	6.350	37	30.4	2.5×1	27200	61300	2060	56	75	120	45	18	103
W3612SS-1Z-C5Z10	1097															
W3620SS-1Z-C5Z10	1897															
W4006SS-1Z-C5Z5	511	40	5	3.175	40.5	37.2	2.5×2	20200	70600	1420	28.5	67	101	39	15	89
W4010SS-1Z-C5Z5	911															
W4016SS-1Z-C5Z5	1511															

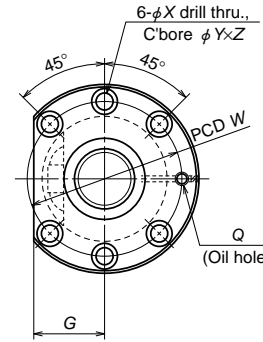
- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

Unit: mm

dimensions				Screw shaft dimensions					Lead accuracy			Run out			Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )		
Bolt hole		Oil hole		Threaded length	Shaft end, right		Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity					Flange perpendicularity	
W	X	Y	Z	Q	L <sub>1</sub>	d <sub>2</sub>	L <sub>1</sub>	L <sub>2</sub>	d <sub>3</sub>	L <sub>3</sub>	L <sub>0</sub>	T	e <sub>p</sub>	v <sub>u</sub>					I	J
90	9	14	8.5	M6×1	32.3	60	26.4	250	100	850	-0.012	0.027	0.020	0.075	0.019	0.013	7.5	2180	22	11
								700	100	1050	-0.017	0.035	0.025	0.090			8.5			
								1000	100	1400	-0.024	0.040	0.027	0.120			10.5			
								1400	120	1870	-0.034	0.054	0.035	0.150			13.1			
								1800	120	2270	-0.043	0.065	0.040	0.200			15.2			
98	11	17.5	11	M6×1	36.3	60	30.4	300	100	1100	-0.017	0.035	0.025	0.065	0.019	0.013	10.9	1940	27	14
								1200	120	1670	-0.029	0.046	0.030	0.100			14.9			
								2000	120	2470	-0.048	0.065	0.040	0.130			20.4			
83	9	14	8.5	Rc1/8	40.3	50	37.2	300	100	1000	-0.014	0.030	0.023	0.050	0.019	0.013	11.1	1750	14	7.0
								1000	1400	-0.024	0.040	0.027	0.080	14.8						
								1600	2050	-0.038	0.054	0.035	0.130	20.8						



Nut type code: DFT



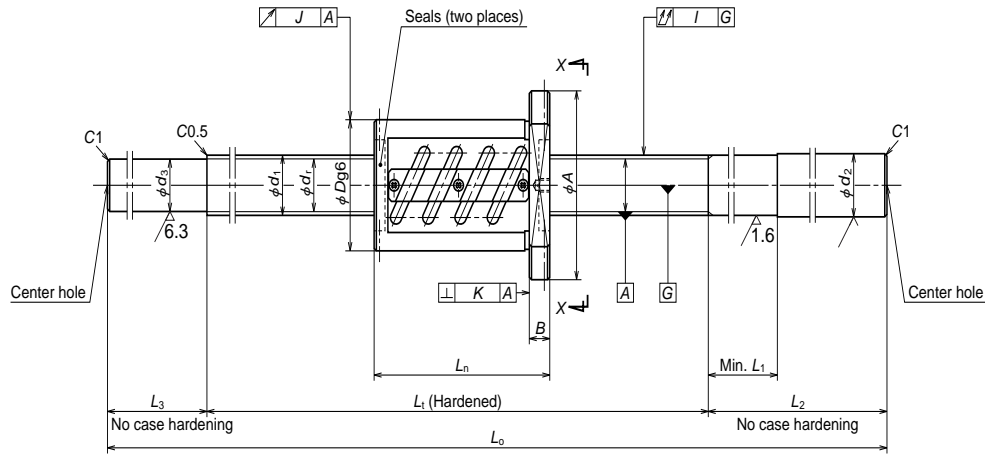
View X-X

Ball screw No.	Stroke Max. L <sub>1</sub> -L <sub>n</sub>	Screw shaft dia. d <sub>1</sub>	Lead I	Ball dia. D <sub>w</sub>	Ball circle dia. d <sub>m</sub>	Root dia. d <sub>r</sub>	Effective ball turns × Circuits	Basic load rating (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut				
								Dynamic C <sub>a</sub>	Static C <sub>0a</sub>			Flange				Overall length L <sub>n</sub>
												Outside dia. D	A	G	B	
W3205SS-2D-C5Z10	310	32	10	6.350	33	26.4	2.5×2	46300	108000	3240	83	74	108	41	15	190
W3207SS-2D-C5Z10	510															
W3210SS-5D-C5Z10	810															
W3214SS-2D-C5Z10	1210															
W3218SS-2D-C5Z10	1610															
W3607SS-2D-C5Z10	507	36	10	6.350	37	30.4	2.5×2	49300	123000	3430	93	75	120	45	18	193
W3612SS-2D-C5Z10	1007															
W3620SS-2D-C5Z10	1807															

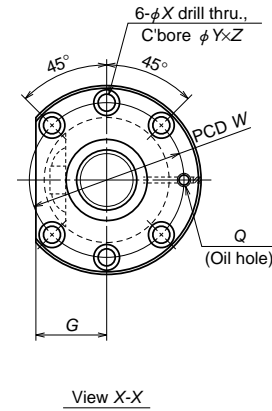
- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

Unit: mm

dimensions				Screw shaft dimensions					Lead accuracy			Run out			Mass (kg)	Permissible rotational speed (min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )		
Bolt hole		Oil hole		Threaded length	Shaft end, right		Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity					Flange perpendicularity	
W	X	Y	Z	Q	L <sub>1</sub>	d <sub>2</sub>	L <sub>1</sub>	L <sub>2</sub>	d <sub>3</sub>	L <sub>3</sub>	L <sub>0</sub>	T	e <sub>p</sub>	v <sub>u</sub>					I	J
90	9	14	8.5	M6×1	32.3	60	300	26.4	100	850	-0.012	0.027	0.020	0.075	0.019	0.013	9.5	2180	57	29
									700	1050	-0.017	0.035	0.025	0.090			10.6			
									1000	1400	-0.024	0.040	0.027	0.120			12.5			
									350	120	-0.034	0.054	0.035	0.150			15.1			
									1800	120	-0.043	0.065	0.040	0.200			17.2			
98	11	17.5	11	M6×1	36.3	60	350	30.4	100	1100	-0.017	0.035	0.025	0.065	0.019	0.013	12.8	1940	67	34
									1200	1670	-0.029	0.046	0.030	0.100			16.8			
									2000	120	-0.048	0.065	0.040	0.130			22.3			



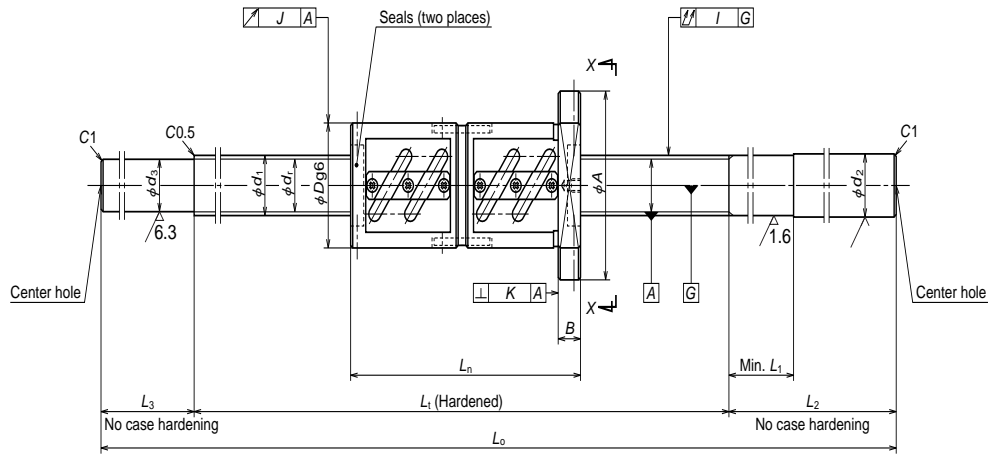
Nut type code: ZFT



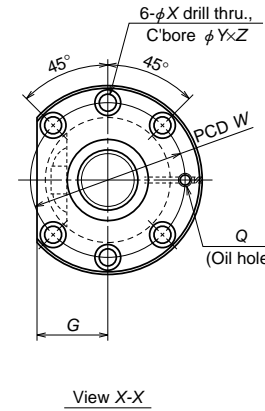
Ball screw No.	Stroke Max. L <sub>1</sub> -L <sub>n</sub>	Screw shaft dia. d <sub>1</sub>	Lead I	Ball dia. D <sub>w</sub>	Ball circle dia. d <sub>m</sub>	Root dia. d <sub>r</sub>	Effective ball turns × Circuits	Basic load rating (N)			Dynamic friction torque, median (N·cm)	Nut				
								Dynamic C <sub>a</sub>	Static C <sub>0a</sub>	Preload (N)		Flange			Overall length L <sub>n</sub>	
												Outside dia. D	A	G		B
W4007SS-1Z-C5Z8	570	40	8	4.762	40.5	35.5	2.5×2	34900	103000	2450	64	74	108	41	15	130
W4012SS-1Z-C5Z8	1070															
W4018SS-1Z-C5Z8	1670															
W4007SS-2Z-C5Z10	597	40	10	6.350	41	34.4	2.5×1	28600	68600	2160	64	82	124	47	18	103
W4010SS-2Z-C5Z10	897															
W4014SS-1Z-C5Z10	1297															
W4018SS-2Z-C5Z10	1697	40	12	7.144	41.5	34.1	2.5×1	33600	77500	2550	83	86	128	48	18	117
W4024SS-1Z-C5Z10	2297															
W4010SS-4Z-C5Z12	883															
W4016SS-2Z-C5Z12	1483	40	12	7.144	41.5	34.1	2.5×1	33600	77500	2550	83	86	128	48	18	117
W4025SS-1Z-C5Z12	2383															

- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

dimensions				Screw shaft dimensions				Lead accuracy			Run out			Mass (kg)	Permissible rotational speed N (min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )	
Bolt hole		Oil hole		Threaded length L <sub>1</sub>	Shaft end, right		Shaft end, left		Travel compensation T	Deviation e <sub>p</sub>	Variation v <sub>u</sub>	Shaft straightness I	Nut O.D. eccentricity J					Flange perpendicularity K
W	X	Y	Z		Q	L <sub>2</sub>	L <sub>1</sub>	L <sub>2</sub>										
90	9	14	8.5	Rc1/8	40.3	50	35.5	300	100	1100	-0.017	0.035	0.025	0.065	13.0	1750	27	14
								350	120	2270	-0.043	0.065	0.040	0.130	23.5			
								1800	120	2270	-0.043	0.065	0.040	0.130	23.5			
102	11	17.5	11	Rc1/8	40.3	60	34.4	300	100	1100	-0.017	0.035	0.025	0.065	13.3	1750	30	15
								1000	100	1400	-0.024	0.040	0.027	0.080	15.9			
								1400	120	1870	-0.034	0.054	0.035	0.100	20.0			
								1800	120	2270	-0.043	0.065	0.040	0.130	23.4			
106	11	17.5	11	Rc1/8	40.3	70	34.1	300	100	1400	-0.024	0.040	0.027	0.080	16.7	1750	35	18
								350	150	2100	-0.038	0.054	0.035	0.130	22.9			
								2500	150	3050	-0.060	0.077	0.046	0.170	31.1			



Nut type code: DFT

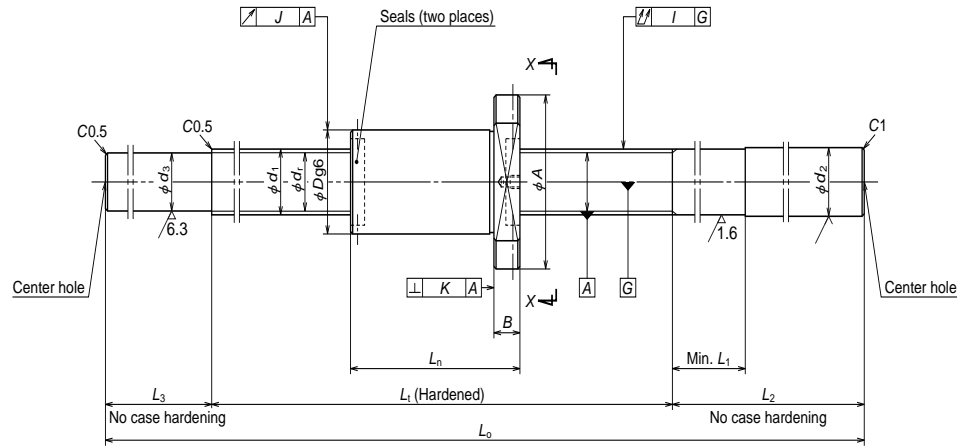


Unit: mm

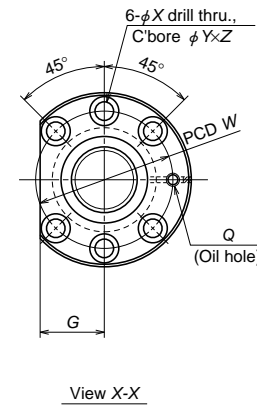
Ball screw No.	Stroke Max. L <sub>1</sub> -L <sub>n</sub>	Screw shaft dia. d <sub>1</sub>	Lead I	Ball dia. D <sub>w</sub>	Ball circle dia. d <sub>m</sub>	Root dia. d <sub>r</sub>	Effective ball turns × Circuits	Basic load rating (N)			Dynamic friction torque, median (N-cm)	Nut				
								Dynamic C <sub>a</sub>	Static C <sub>0a</sub>	Preload (N)		Flange				Overall length L <sub>n</sub>
												Outside dia. D	A	G	B	
W4007SS-3D-C5Z10	507	40	10	6.350	41	34.4	2.5×2	52000	137000	3630	108	82	124	47	18	193
W4010SS-3D-C5Z10	807															
W4014SS-2D-C5Z10	1207															
W4018SS-3D-C5Z10	1607															
W4024SS-2D-C5Z10	2207															
W4010SS-5D-C5Z12	775	40	12	7.144	41.5	34.1	2.5×2	61000	155000	4310	138	86	128	48	18	225
W4016SS-3D-C5Z12	1375															
W4025SS-2D-C5Z12	2275															

- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

dimensions				Screw shaft dimensions					Lead accuracy			Run out			Mass (kg)	Permissible rotational speed (min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )			
Bolt hole				Threaded length L <sub>1</sub>	Shaft end, right		Shaft end, left		Travel compensation T	Deviation e <sub>p</sub>	Variation v <sub>u</sub>	Shaft straightness I	Nut O.D. eccentricity J	Flange perpendicularity K							
W	X	Y	Z		Oil hole Q	L <sub>1</sub>	L <sub>2</sub>	d <sub>3</sub>											L <sub>3</sub>	L <sub>o</sub>	
102	11	17.5	11	Rc1/8	700	40.3	60	300	34.4	100	1100	-0.017	0.035	0.025	0.065	0.025	0.015	15.5	1750	74	37
					1000			300		100	1400	-0.024	0.040	0.027	0.080			18.1			
					1400			350		120	1870	-0.034	0.054	0.035	0.100			22.2			
					1800			350		120	2270	-0.043	0.065	0.040	0.130			25.6			
					2400			400		150	2950	-0.058	0.077	0.046	0.170			31.6			
106	11	17.5	11	Rc1/8	1000	40.3	70	300	34.1	100	1400	-0.024	0.040	0.027	0.080	0.025	0.015	19.7	1750	93	47
					1600			350		150	2100	-0.038	0.054	0.035	0.130			25.8			
					2500			400		150	3050	-0.060	0.077	0.046	0.170			34.0			



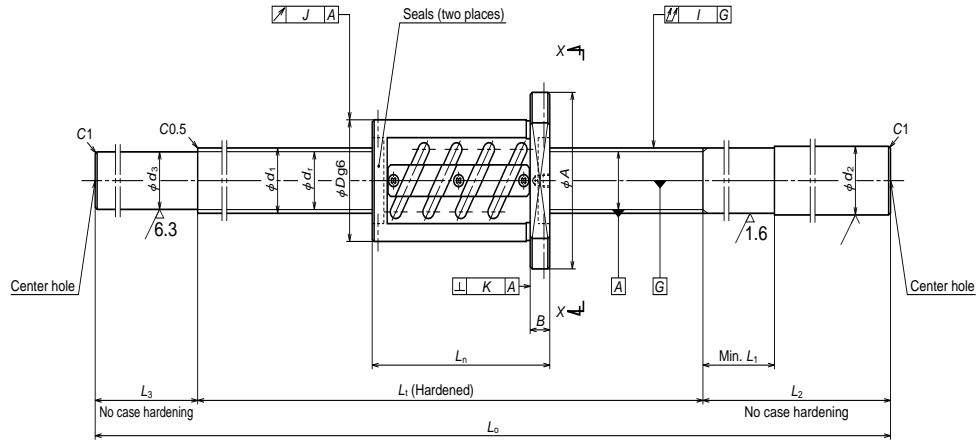
Nut type code: ZFD



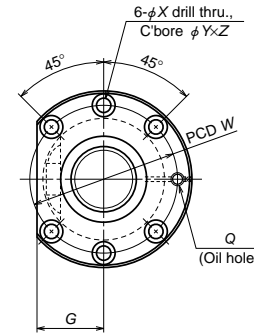
Ball screw No.	Stroke Max. $L_1-L_n$	Screw shaft dia. $d_1$	Lead $I$	Ball dia. $D_w$	Ball circle dia. $d_m$	Root dia. $d_r$	Effective ball turns	Basic load rating (N)			Dynamic friction torque, median (N·cm)	Nut				
								Dynamic $C_a$	Static $C_{0a}$	Preload (N)		Outside dia. $D$	Flange			Overall length $L_n$
													$A$	$G$	$B$	
W4007SS-4ZY-C5Z10	557	40	10	6.350	41.75	35.1	4	38400	93300	2840	83	62	104	40	18	143
W4010SS-6ZY-C5Z10	857															
W4014SS-3ZY-C5Z10	1257															
W4018SS-4ZY-C5Z10	1657															
W4024SS-3ZY-C5Z10	2257															
W5007SS-1ZY-C5Z10	557	50	10	6.350	51.75	45.1	4	43600	122000	3240	108	72	114	44	18	143
W5010SS-3ZY-C5Z10	857															
W5015SS-3ZY-C5Z10	1357															
W5020SS-3ZY-C5Z10	1857															
W5026SS-3ZY-C5Z10	2457															

- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

dimensions				Screw shaft dimensions				Lead accuracy			Run out			Mass (kg)	Permissible rotational speed (min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )					
Bolt hole		Oil hole		Threaded length $L_1$	Shaft end, right		Shaft end, left		Travel compensation $T$	Deviation $e_p$	Variation $v_u$	Shaft straightness $I$	Nut O.D. eccentricity $J$					Flange perpendicularity $K$				
$W$	$X$	$Y$	$Z$		$Q$	$d_2$	$L_1$	$L_2$											$d_3$	$L_3$	$L_o$	
82	11	17.5	11	Rc1/8	700	40.3	60	35.1	100	1100	-0.015	0.035	0.025	0.065	0.019	0.013	12.1	1750	32	16		
					1000				300	100	1400	-0.022	0.040	0.027							0.080	14.7
					1400				350	120	1870	-0.032	0.054	0.035							0.100	18.9
					1800				400	150	2270	-0.041	0.065	0.040							0.130	22.5
92	11	17.5	11	Rc1/8	700	50.3	60	45.1	100	1100	-0.015	0.035	0.025	0.065	0.019	0.013	18.3	1400	39	20		
					1000				300	100	1400	-0.022	0.040	0.027							0.080	22.5
					1500				400	150	2050	-0.034	0.054	0.035							0.130	31.8
					2000				400	150	2550	-0.046	0.065	0.040							0.170	38.9
					2600			200	3300	-0.060	0.093	0.054	0.220			49.5						



Nut type code: ZFT



View X-X

Ball screw No.	Stroke Max. $L_1-L_n$	Screw shaft dia. $d_1$	Lead $I$	Ball dia. $D_w$	Ball circle dia. $d_m$	Root dia. $d_r$	Effective ball turns $\times$ Circuits	Basic load rating (N)			Dynamic friction torque, median (N·cm)	Nut				
								Dynamic $C_a$	Static $C_{0a}$	Preload (N)		Flange				Overall length $L_n$
												Outside dia. $D$	$A$	$G$	$B$	
W4510SS-1Z-C5Z10	897	45	10	6.350	46	39.4	2.5×1	29900	77300	2260	69	88	132	50	18	103
W4516SS-1Z-C5Z10	1497															
W4525SS-1Z-C5Z10	2397															
W5010SS-1Z-C5Z10	897	50	10	6.350	51	44.4	2.5×1	31800	87400	2450	78	93	135	51	18	103
W5015SS-1Z-C5Z10	1397															
W5020SS-1Z-C5Z10	1897															
W5026SS-1Z-C5Z10	2497															
W5010SS-2Z-C5Z10	837	50	10	6.350	51	44.4	2.5×2	57700	175000	4020	138	93	135	51	18	163
W5015SS-2Z-C5Z10	1337															
W5020SS-2Z-C5Z10	1837															
W5026SS-2Z-C5Z10	2437															

- Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.  
 2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.  
 3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

Unit: mm

dimensions				Screw shaft dimensions					Lead accuracy			Run out			Mass (kg)	Permissible rotational speed (min <sup>-1</sup> )	Internal spatial volume of nut (cm <sup>3</sup> )	Standard volume of grease replenishing (cm <sup>3</sup> )			
Bolt hole		Oil hole		Threaded length	Shaft end, right		Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity					Flange perpendicularity		
W	X	Y	Z	Q	$L_1$	$d_2$	$L_1$	$L_2$	$d_3$	$L_3$	$L_0$	T	$e_p$	$v_u$					I	J	K
110	11	17.5	11	Rc1/8	1000	45.3	60	300	39.4	100	1400	-0.024	0.040	0.027	0.080	0.025	0.015	19.7	1550	34	17
					1600					150	2150	-0.038	0.054	0.035	0.130			28.1			
					2500					150	3100	-0.060	0.077	0.046	0.170			38.8			
113	11	17.5	11	Rc1/8	1000	50.3	60	300	44.4	100	1400	-0.024	0.040	0.027	0.080	0.025	0.015	23.8	1400	37	19
					1500					150	2050	-0.036	0.054	0.035	0.130			32.9			
					2000					150	2550	-0.048	0.065	0.040	0.170			39.8			
					2600					150	3200	-0.062	0.093	0.054	0.220			48.9			
113	11	17.5	11	Rc1/8	1000	50.3	60	300	44.4	100	1400	-0.024	0.040	0.027	0.080	0.025	0.015	25.5	1400	59	30
					1500					150	2050	-0.036	0.054	0.035	0.130			34.6			
					2000					150	2550	-0.048	0.065	0.040	0.170			41.5			
					2400					150	3050	-0.060	0.087	0.054	0.210			48.4			
					2600					150	3200	-0.062	0.093	0.054	0.220			50.7			

B-3-2.5 Accessories

Accessories to use with ball screw are available in stock.

Table 1 Support unit categories

Application	Shape	Support side	Bearing in use	Bearing bore seat diameter	Page
Small equipment, light load	Square	Fixed support side	Angular contact ball bearing	$\phi 6 - \phi 25$	B439 -
			Deep groove ball bearing	$\phi 6 - \phi 25$	B443 -
		Simple support side	Deep groove ball bearing	$\phi 12, \phi 15$ (Exclusive for VFA Type)	B446

① Classification

Ball screw support units are classified into categories by their shape (Table 1). Select the type that is appropriate for you to use.

Application	Shape	Support side	Bearing in use	Bearing bore seat diameter	Page
Small equipment, light load	Round	Fixed support side	Deep groove ball bearing (arranged to have angular contact)	$\phi 4, \phi 6$ (Exclusive for RMA and RMS Type)	B445
		Simple support side	Angular contact ball bearing	$\phi 6 - \phi 25$	B441 -
Machine tools, heavy load	Round	Fixed support side	Thrust angular contact ball bearing	$\phi 17 - \phi 40$	B451 -

② Features

- Short delivery time: Standardized items in stock
- Bearings and seal
  - On the fixed support side, the angular contact ball bearing is used. It has great rigidity and low friction torque which match the rigidity of the ball screw. The thrust angular contact ball bearing with high precision and great rigidity is another choice for the fixed support side.
  - An oil seal is installed on fixed support side used with an angular contact ball bearing. The seal may have fine clearance.
  - A deep-groove ball bearing with a shield on both sides is used on the simple support side.

- Lock nut is provided.
  - A lock nut of fine grade finish is provided to fix the bearing with high precision.

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 support unit

S: Simple support unit

SF: Simple support unit (for VFA)

R: Fixed support unit (support kit for miniature ball screws)

No code or A: For general use

C: For clean environment use

01: Square type

11: Round type

\* In case of simple support unit, be careful that 12 or less size codes do not represent internal bores of bearing.  
Please refer to the dimensional table for internal bore of bearing.

(For heavy load)

Example : **WBK 25 DF - 31**

Product code for support unit

Nominal size code (internal bore of bearing)

Bearing combination code

DF : Face to face duplex combination

DFD : Face to face triplex combination

DFF : Face to face quadruplex combination

(1) Support Units for Light Load 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 NSK standard ball screws, of which shaft ends are machined.

Please refer to the dimensions listed on the dimension table for configuration of standard screw shaft ends for NSK standard ball screws with blank shaft ends. For transporting ball screws, you require optional spacers when mounting fixed support side support units.

① Features

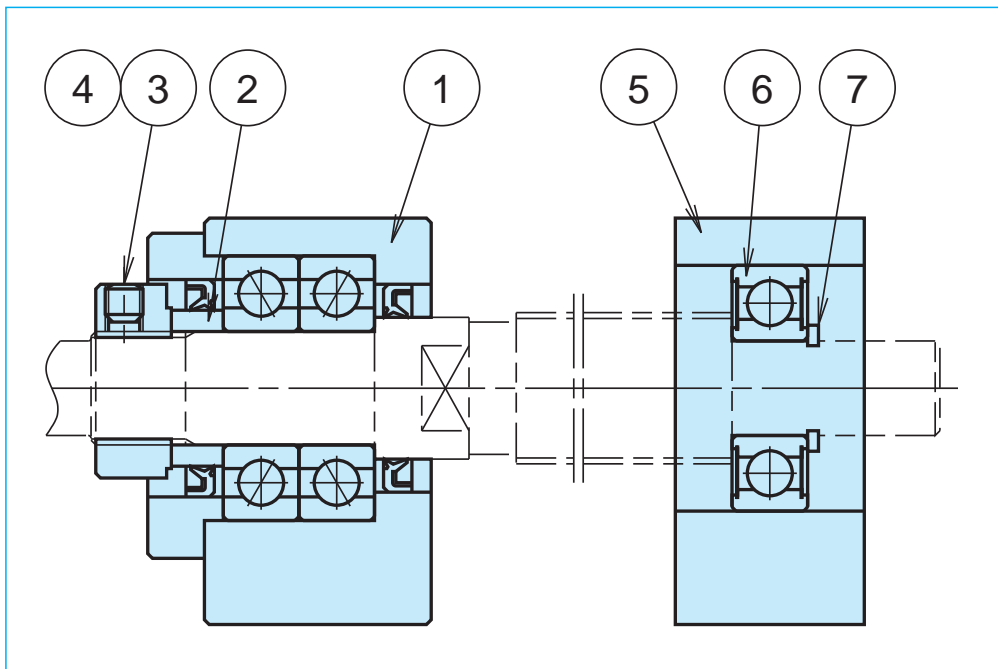
- Prompt delivery  
All support units are standard stocked items.
- Best selection of bearings for your application  
General use support units for fixed support side are equipped with highly rigid angular contact ball bearings that have been assembled with proper preload, and packed with the appropriate volume of grease. On the other hand, clean support units for fixed support side uses 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 clean environment use.



●Accessories

Support units provide everything necessary for mounting ball screws to machines. (Please refer to the table below.)

\* Do not disassemble fixed support side units as they are equipped with bearings and oil seals.



●Antirust treatment

The table on the right shows the surface treatment for the bearing housing, and material of small parts.

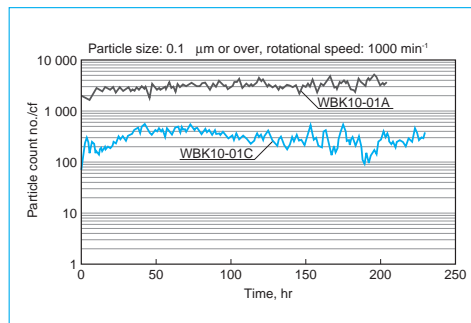
Fixed support side		Simple support side	
Part no.	Name of parts	Part no.	Name of parts
①	Bearing housing	⑤	Bearing housing
②	Spacer	⑥	Bearing
③	Locknut	⑦	Snap ring
④	Set screw with set piece		

General support unit	
Bearings and grease	Angular contact ball bearings, PS2
Surface treatment	Black oxide
Screws and snap rings	Standard material

⑥Features of Clean Support Unit

●Outstanding low dust emission

Clean support unit uses "NSK clean grease LG2" which has a proven feature of low dust emission. It reduces dust emission to 1/10 of general support units.

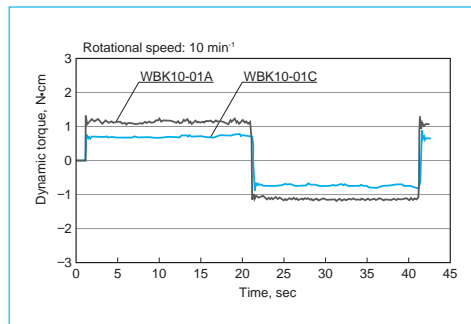


●Low torque

It features low torque characteristics because of special bearings. (50% lower than general support unit.)

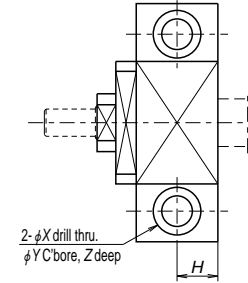
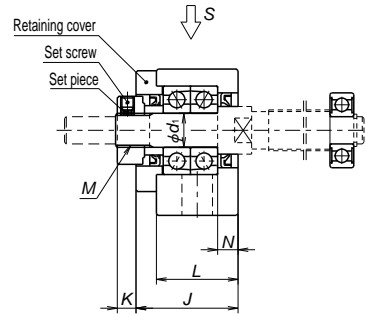
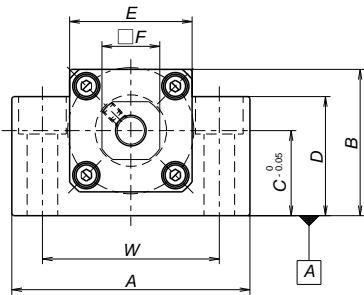
●High antirust specification

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 the surface treatment of the bearing housing and material of small parts.

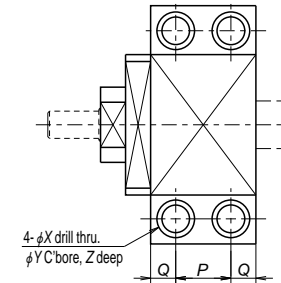


	Clean support unit
Bearing • grease	Special bearings, LG2
Surface treatment	Low temperature chrome plating
Set screw and snap ring material	Stainless steel

Support Units for Light Load and Small Equipment



View S (WBK06 - 15)



View S (WBK17 - 25)

Reference no.	Tightening torque (reference) [N · cm]	
	Locknut	Set screw
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)

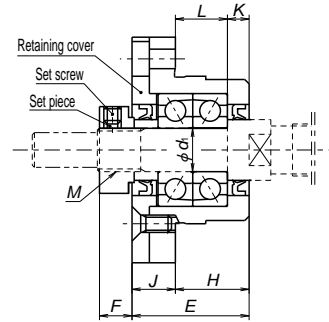
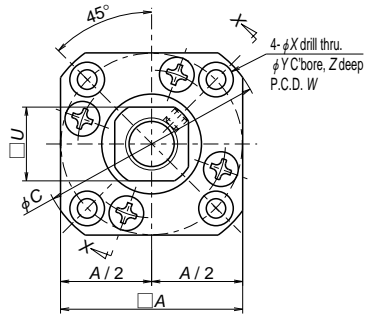
Fixed support side support unit (square type)

Units: mm

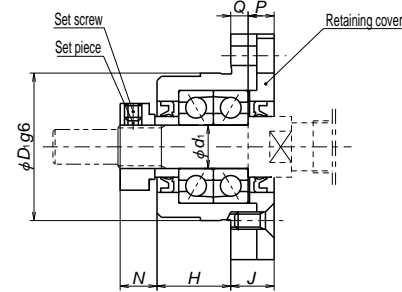
Reference no.	Use	$d_1$	A	B	C	D	E	F	L	J	K
WBK06-01A*	General	6	42	25	13	20	18	12	20	20	5.5
WBK08-01A*	General	8	52	32	17	26	25	14	23	23	7
WBK08-01B	Low type		62	31	15.5	31	—		21.5	25.5	4.5
WBK08-01C*	Clean environment		52	32	17	26	25		23	23	7
WBK10-01A	General	10	70	43	25	35	36	17	24	30	5.5
WBK10-01B	Low type			38	20	38	—				
WBK10-01C	Clean environment			43	25	35	36				
WBK12-01A	General	12	70	43	25	35	36	19	24	30	5.5
WBK12-01B	Low type			38	20	38	—				
WBK12-01C	Clean environment			43	25	35	36				
WBK15-01A	General	15	80	50	30	40	41	22	25	31	12
WBK15-01B	Low type			42	22	42	—				
WBK15-01C	Clean environment			50	30	40	41				
WBK17-01A	General	17	86	64	39	55	50	24	35	44	7
WBK20-01	General	20	95	58	30	45	56	30	42	52	10
WBK25-01	General	25	105	68	35	25	66	36	48	61	13

- Notes:
1. Use datum face A for mounting to the machine base.
  2. Tighten the set screw after the locknut has been adjusted and tightened.
  3. The brass pad (set piece), provided with the unit, is inserted into locknut set screw hole, then set screw is inserted and tightened over it.
  4. A deep groove ball bearing and a snap ring are attached.
- \*There are no seals for the retaining cover side of WBK06-01A, WBK08-01A, and WBK08-01C.

N	Counter bore dimensions							Mass (kg)	Locknut screw M	Attached bearing for support side
	H	P	Q	W	X	Y	Z			
3.5	10	—	—	30	5.5	9.5	11	0.15	M6×0.75	—
4	11.5	—	—	38	6.6	11	12	0.25	M8×1	606ZZ
3.5	11	—	—	46	9	14	18	0.3		606VV
4	11.5	—	—	38	6.6	11	12	0.25	M10×1	608ZZ
6	12	—	—	52	9	14	11	0.5		608ZZ
		—	—				19	0.45		608VV
6	12	—	—	52	9	14	11	0.5	M12×1	6000ZZ
		—	—				19	0.4		6000ZZ
		—	—				11	0.5		6000VV
5	12.5	—	—	60	11	17	15	0.7	M15×1	6002ZZ
		—	—				23	0.6		6002ZZ
		—	—				15	0.7		6002VV
7	—	19	8	68	9	14	11	1.3	M17×1	6203ZZ
10	—	22	10	75	11	17	15	1.4	M20×1	6204ZZ
14	—	30	9	85	11	—	—	1.9	M25×1.5	6205ZZ



View X-X (Example 1)



View X-X (Example 2)

Reference no.	Tightening torque (reference) [N · cm]	
	Locknut	Set screw
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)

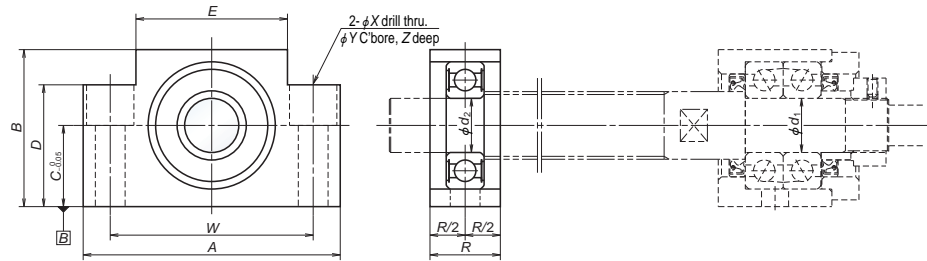
Fixed support side support unit (round type)

Units: mm

Reference no.	Use	$d_1$	A	C	$D_1$	E	H	L	K	F	N
WBK06-11*	General	6	28	35	22	20	13	9.5	3.5	5.5	6.5
WBK08-11*	General	8	35	43	28	23	14	10	4	7	8
WBK08-11B	Low type		42	52	34	25.5	15.5	12	3.5	4.5	7
WBK08-11C*	Clean environment		35	43	28	23	14	10	4	7	8
WBK10-11	General	10	42	52	34	27	17	12	5	7.5	8.5
WBK10-11C	Clean environment		42	52	34	27	17	12	5	7.5	8.5
WBK12-11	General	12	44	54	36	27	17	12	5	7.5	8.5
WBK12-11C	Clean environment		44	54	36	27	17	12	5	7.5	8.5
WBK15-11	General	15	52	63	40	32	17	11	6	12	14
WBK15-11C	Clean environment		52	63	40	32	17	11	6	12	14
WBK20-11	General	20	68	85	57	52	30	20	10	10	14
WBK25-11	General	25	79	98	63	57	30	20	10	13	20

U	P	Q	Counter bore dimensions					Mass (kg)	Locknut screw M	Attached bearing for support side
			J	W	X	Y	Z			
12	4.5	2.5	7	28	2.9	5.5	3.5	0.1	M6×0.75	—
14	5	4	9	35	3.4	6.5	4	0.15	M8×1	606ZZ
	6		10	42	4.5	8	4	0.2		608ZZ
	5		9	35	3.4	6.5	4	0.15		606VV
17	6	4	10	42	4.5	8	4	0.2	M10×1	608ZZ 608VV
19	6	4	10	44	4.5	8	4	0.25	M12×1	6000ZZ 6000VV
22	8	7	15	50	5.5	9.5	6	0.4	M15×1	6002ZZ 6002VV
30	14	8	22	70	6.6	11	10	1.1	M20×1	6204ZZ
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. The brass pad (set piece), provided with the unit, is inserted into locknut set screw hole, then set screw is inserted and tightened over it.
  3. A deep groove ball bearing and a snap ring are attached.
- \*There are no seals for the retaining cover side of WBK06-01A, WBK08-01A, and WBK08-01C.



Simple support side support unit (square type)

Units: mm

Reference no.	Use	d <sub>2</sub>	A	B	C	D	E	R	Counter bore dimensions				Mass (kg)
									W	X	Y	Z	
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	Clean environment		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	Clean environment												
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	Clean environment			43	25	35	36					11	0.35
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	Clean environment			50	30	40	41					11	0.45
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
WBK25S-01	General	25	105	68	35	25	66	30	85	11	—	—	0.9

Notes: 1. Use datum face B for mounting to the machine base.

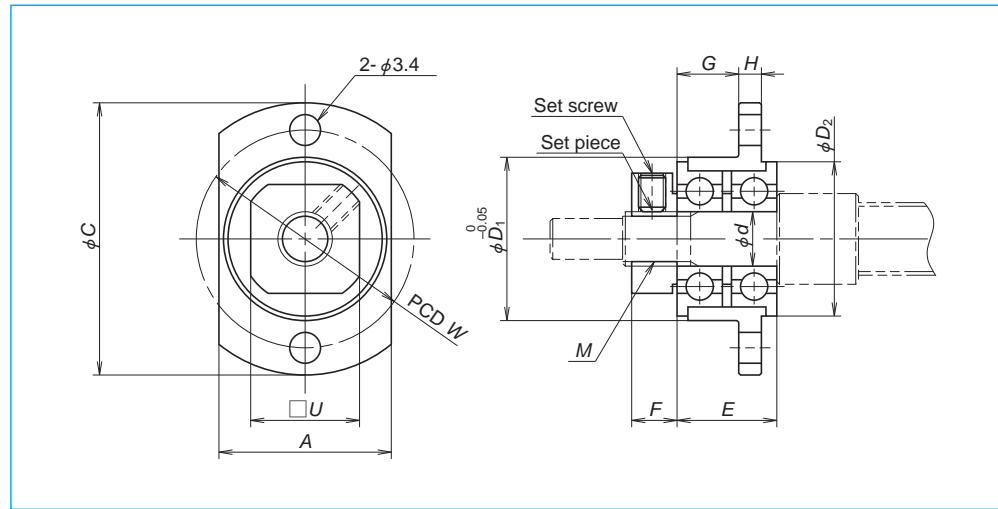
Specifications of support unit

Reference no.	Use	Fixed support side support unit				Simple support side support unit		
		Basic dynamic load rating Ca [N]	Load limit [N]	Stiffness [N / μm]	Maximum starting torque [N · cm]	Reference no.	Bearing reference no.	Radial direction Basic dynamic load rating C [N]
WBK06-01A	General	2670	1040	28	0.49	—	—	—
WBK06-11	General	2670	1040	28	0.49	—	—	—
WBK08-01A	General	4400	1450	49	0.88	WBK08S-01	606ZZ	2260
WBK08-01B	Low type	6600	2730	94	1.9	WBK08S-01B	606ZZ	2260
WBK08-01C	Clean environment	3100	1100	36	0.52	WBK08S-01C	606VV	2260
WBK08-11	General	4400	1450	49	0.88	WBK08S-01	606ZZ	2260
WBK08-11B	Low type	6600	2730	94	1.9	—	606ZZ	2260
WBK08-11C	Clean environment	3100	1100	36	0.52	WBK08S-01C	606VV	2260
WBK10-01A	General	6600	2730	94	1.9	WBK10S-01	608ZZ	3300
WBK10-01B	Low type	6600	2730	94	1.9	—	608ZZ	3300
WBK10-01C	Clean environment	4250	1364	50	1.1	WBK10S-01C	608VV	3300
WBK10-11	General	6600	2730	94	1.9	WBK10S-01	608ZZ	3300
WBK10-11C	Clean environment	4250	1364	50	1.1	WBK10S-01C	608VV	3300
WBK12-01A	General	7100	3040	104	2.1	WBK12S-01	6000ZZ	4550
WBK12-01B	Low type	7100	3040	104	2.1	WBK12S-01B	6000ZZ	4550
WBK12-01C	Clean environment	4700	2443	57	1.2	WBK12S-01C	6000VV	4550
WBK12-11	General	7100	3040	104	2.1	WBK12S-01	6000ZZ	4550
WBK12-11C	Clean environment	4700	2443	57	1.2	WBK12S-01C	6000VV	4550
WBK15-01A	General	7600	3380	113	2.4	WBK15S-01	6002ZZ	5600
WBK15-01B	Low type	7600	3380	113	2.4	WBK15S-01B	6002ZZ	5600
WBK15-01C	Clean environment	5100	2757	63	1.3	WBK15S-01C	6002VV	5600
WBK15-11	General	7600	3380	113	2.4	WBK15S-01	6002ZZ	5600
WBK15-11C	Clean environment	5100	2757	63	1.3	WBK15S-01C	6002VV	5600
WBK17-01A	General	13400	5800	120	3.5	WBK17S-01	6203ZZ	9550
WBK20-01	General	17900	8240	155	6.2	WBK20S-01	6204ZZ	12800
WBK20-11	General	17900	8240	155	6.2	WBK20S-01	6204ZZ	12800
WBK25-01	General	20200	10000	192	7.2	WBK25S-01	6205ZZ	14000
WBK25-11	General	20200	10000	192	7.2	WBK25S-01	6205ZZ	14000
WBK04R-11	General	615	490	6.5	0.59	—	—	—
WBK06R-11	General	1280	930	9	0.59	—	—	—

Support kits for ball screws for transfer equipment

Support kits are for the RMS type ball screw.

However, please use support units for general use in case of RMA1002 or larger rolled ball screws.



Units: mm

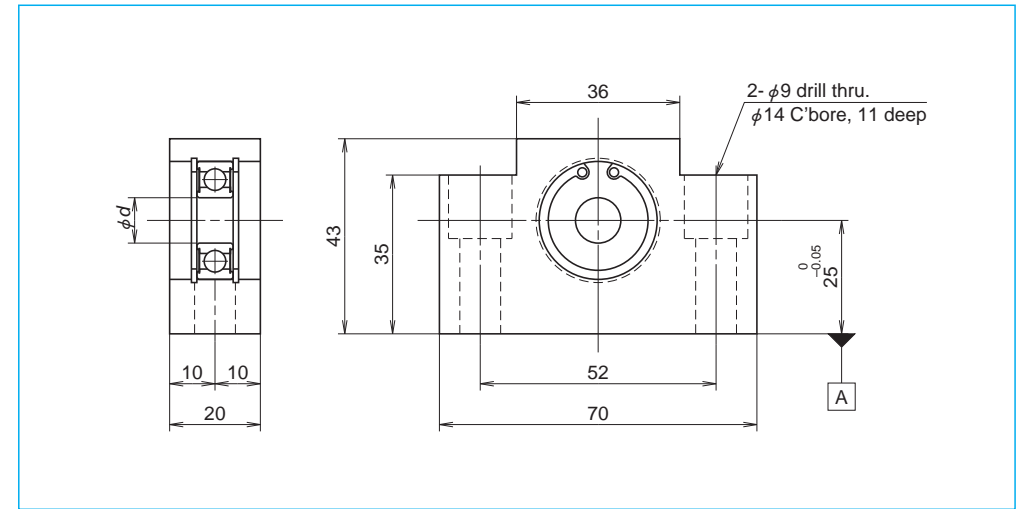
Reference no.	A	C	d	D <sub>1</sub>	D <sub>2</sub>	E	F	G	H	W	U	M
<b>WBK04R-11</b>	14	25	4	13	12.5	9	5	5	2.5	19	10	M4×0.5
<b>WBK06R-11</b>	19	30	6	18	17	11	5	6.8	2.5	24	12	M6×0.75

Reference no.	Applicable ball screw	Locknut tightening torque (reference) [N·cm]	Set screw tightening torque (reference) [N·cm]
<b>WBK04R-11</b>	RMA0601	100	38 (M2.5)
<b>WBK06R-11</b>	RMA0801 RMA0801.5 RMA0802	190	69 (M3)

Notes:

- Oscillate bearings slowly so that they fall into a place to make run-out of mounting face minimal, and then tighten a locknut.
- A support kit is put on a provisional shaft (bolt) for shipping.
- When securing support unit on the shaft, insert the set piece (brass pad) that is provided with the support unit into the lock nut screw hole, and then tighten the set screw.

Simple support side support units for VFA type ball screws



Units: mm

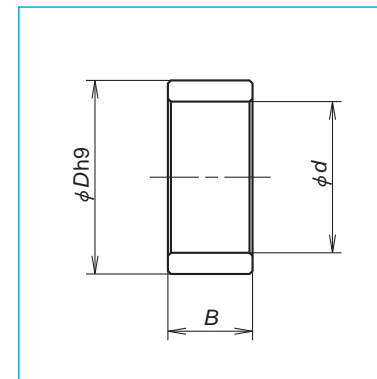
Reference no.	d	Applicable ball screw
<b>WBK12SF-01</b>	12	VFA1210
<b>WBK15SF-01</b>	15	VFA1510 VFA1520

Notes:

- Use datum face A for mounting to the machine base.
- This type of simple side support unit is made exclusively for NSK VFA ball screws. This unit supports the outer diameter of the screw shaft.

Spacer

The shaft requires an optional spacer on the journal where the ball thread is cut through the bearing shoulder. This is common for R series for transportation ball screw shaft, when mounting the support unit for fixed support side.



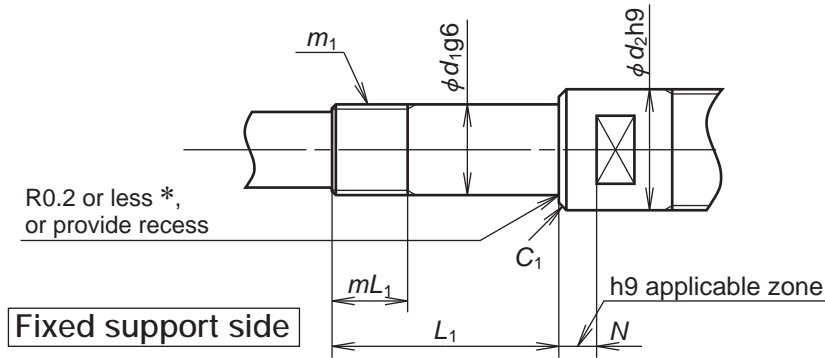
Units: mm

Reference no.	Internal diameter, d	Outside diameter, D	Width B	Applicable support unit
<b>WBK06K</b>	6	9.5	5.0	WBK06- **
<b>WBK08K</b>	8	11.5	5.5	WBK08- **
<b>WBK10K</b>	10	14.5	5.5	WBK10- **
<b>WBK12K</b>	12	15.0	5.6	WBK12- **
<b>WBK15K</b>	15	19.5	10.0	WBK15- **
<b>WBK17K</b>	17	24.4	7.0	WBK17- **
<b>WBK20K</b>	20	25.5	11.0	WBK20- **
<b>WBK25K</b>	25	32.0	14.0	WBK25- **

Screw shaft end configuration

Dimensions of the shaft end configurations for the light load and small equipment support units, are shown in the table below. When using a spacer

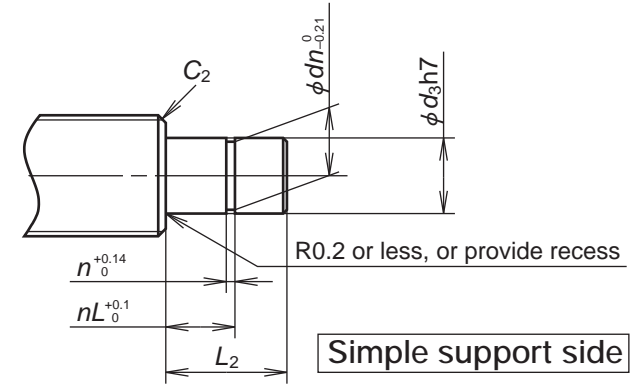
for a ball screw for transportation, add the width of the spacer (B from table of spacer dimensions on page B446) to the  $L_1$  dimension below.



Radius marked with \* above is 0.15 or less for WBK04R-11 and WBK06R-11.

Units: mm

Reference no.	Fixed support side						
	Bearing journal		Locknut thread		Sealing part		Chamfer
	$d_1$	$L_1$	$m_1$	$mL_1$	$d_2$	$N$	$C_1$
<b>WBK06- **</b>	6	22.5	M6x0.75	7	9.5	3.5	0.2
<b>WBK08- **</b>	8	27	M8x1	9	11.5	4	0.2
<b>WBK10- **</b>	10	30	M10x1	10	14	6	0.2
<b>WBK12- **</b>	12	30	M12x1	10	15	6	0.2
<b>WBK15- **</b>	15	40	M15x1	15	19.5	5	0.3
<b>WBK17- **</b>	17	46	M17x1	17	24	7	0.3
<b>WBK20- **</b>	20	53	M20x1	16	25	10	0.3
<b>WBK25- **</b>	25	62	M25x1.5	20	32	14	0.5
<b>WBK04R-11</b>	4	15	M4x0.5	7.5	—	—	0.3
<b>WBK06R-11</b>	6	17	M6x0.75	7.5	—	—	0.3



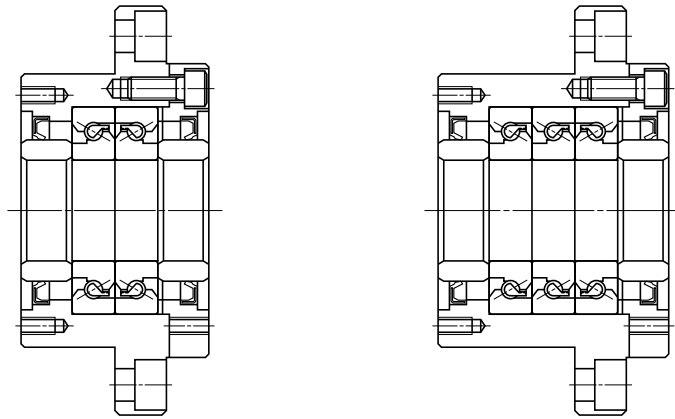
Units: mm

Reference no.	Simple support side					
	Bearing journal		Snap ring groove			Chamfer
	$d_3$	$L_2$	$n$	$dn$	$nL$	$C_2$
—	—	—	—	—	—	—
<b>WBK08S- **</b>	6	9	0.8	5.7	6.8	0.2
<b>WBK10S- **</b>	8	10	0.9	7.6	7.9	0.2
<b>WBK12S- **</b>	10	22	1.15	9.6	9.15	0.5
<b>WBK15S- **</b>	15	25	1.15	14.3	10.15	0.5
<b>WBK17S- **</b>	17	16	1.15	16.2	13.15	0.5
<b>WBK20S- **</b>	20	19	1.35	19	15.35	0.5
<b>WBK25S- **</b>	25	20	1.35	23.9	16.35	0.5

(2) Dimensions of support unit for ball screws for heavy-load/machine tools

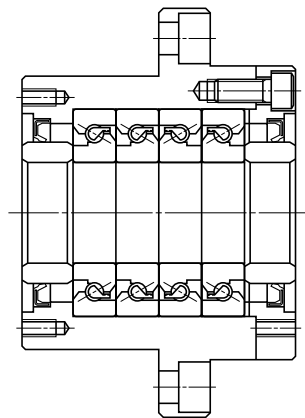
Support units for heavy-load/machine tools use a thrust angular contact ball bearing (TAC Series) with high rigidity and accuracy. The thrust angular contact ball bearing has very

suitable functions and structure as a ball screw support bearing. There are three combinations as shown below.

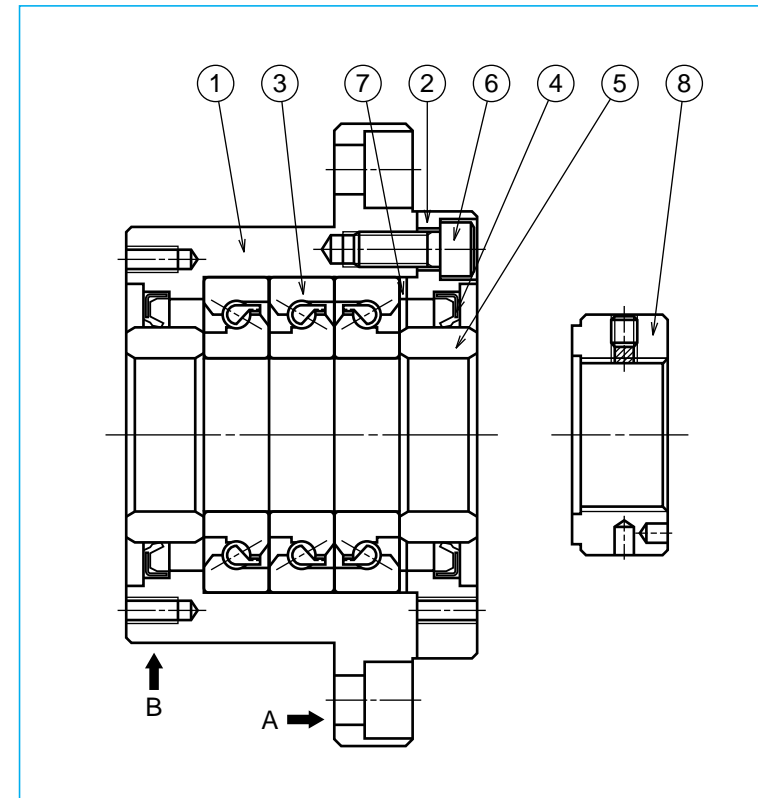


DF combination

DFD combination



DFF combination

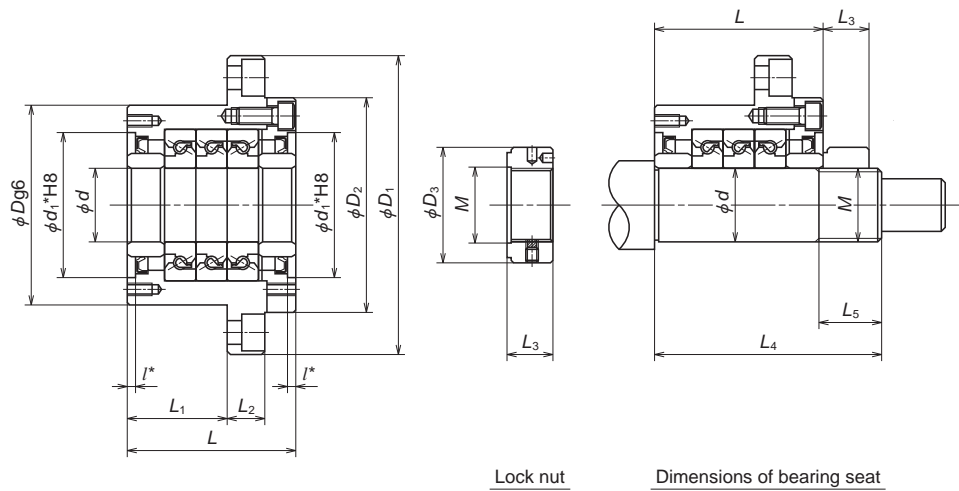


Parts list

Part number	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

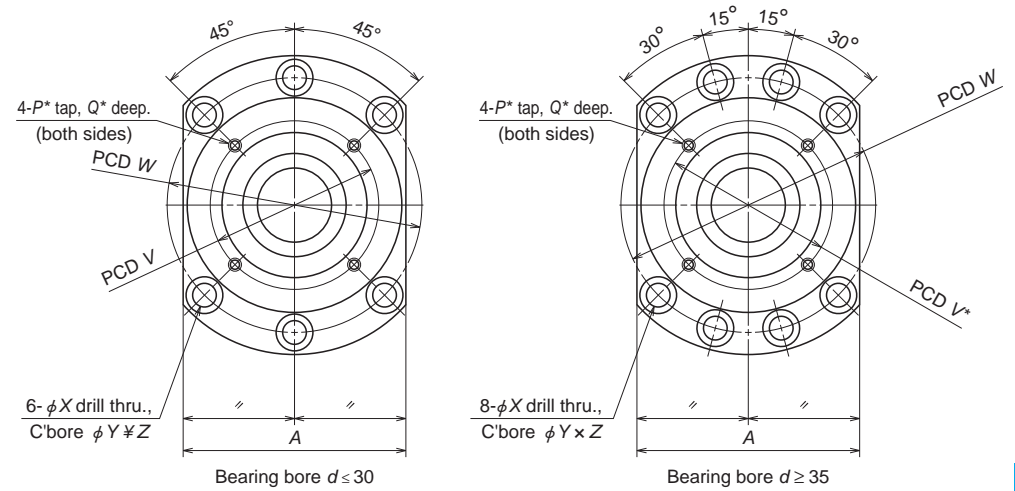
Remarks

1. Mount sections A and B to the machine base.
2. NSK support units are precisely preloaded and adjusted. Components ①, ②, ③, ④, ⑥, ⑦ are assembled into a unit. Do not disassemble.
3. Grease is packed into the bearings.
4. Lock nut ⑧ is exclusively prepared for ball screw. The end face of the nut is in strict control being precisely perpendicular to the V thread. Secure the lock nut using the set screw. Lock nut is also available as an accessory (See page B453). Refer to Page B457 as well for high-precision thrust angular contact ball bearing (TAC Series).



Lock nut

Dimensions of bearing seat



Bearing bore  $d \leq 30$

Bearing bore  $d \geq 35$

Support unit No.	Support unit																
	d	D	D <sub>1</sub>	D <sub>2</sub>	L	L <sub>1</sub>	L <sub>2</sub>	A	W	X	Y	Z	d <sub>1</sub> *	I*	V*	P*	Q*
WBK 17DF-31	17	70	106	72	60	32	15	80	88	9	14	8.5	45	3	58	M5	10
WBK 20DF-31	20	70	106	72	60	32	15	80	88	9	14	8.5	45	3	58	M5	10
WBK 25DF-31	25	85	130	90	66	33	18	100	110	11	17.5	11	57	4	70	M6	12
WBK 25DFD-31					81	48											
WBK 30DF-31	30	85	130	90	66	33	18	100	110	11	17.5	11	57	4	70	M6	12
WBK 30DFD-31					81	48											
WBK 35DF-31	35	95	142	102	66	33	18	106	121	11	17.5	11	69	4	80	M6	12
WBK 35DFD-31					81	48											
WBK 35DFD-31					96	48											
WBK 40DF-31	40	95	142	102	66	33	18	106	121	11	17.5	11	69	4	80	M6	12
WBK 40DFD-31					81	48											
WBK 40DFD-31					96	48											

- Remarks**
1. Rigidity  
Values in the Table are theoretical values obtained from the elastic deformation between the groove and the balls.
  2. Starting torque  
Starting torque indicates torque due to the preload of the bearing. It does not include seal torque.
  3. The tolerance of the shaft bearing seat  
We recommend h5 class of the fits tolerance.

Unit: mm

Basic dynamic load rating C <sub>3</sub> (N)	Permissible axial load (N)	Preload (N)	Axial rigidity (N/μm)	Maximum Starting torque (N·cm)	Lock nut			Mass (kg)	Bearing seat for unit		
					M	D <sub>3</sub>	L <sub>3</sub>		d	L <sub>4</sub>	L <sub>5</sub>
21900	26600	2150	750	19	M17×1	37	18	1.9	17	81	23
21900	26600	2150	750	19	M20×1	40	18	1.9	20	81	23
28500	40500	3150	1000	29	M25×1.5	45	20	3.1	25	89	26
46500	81500	4300	1470	39				3.4		104	
29200	43000	3350	1030	30	M30×1.5	50	20	3.0	30	89	26
47500	86000	4500	1520	40				3.3		104	
31000	50000	3800	1180	34	M35×1.5	55	22	3.4	35	92	30
50500	100000	5200	1710	45				4.3		107	
50500	100000	7650	2350	59				5.0		122	
31500	52000	3900	1230	36	M40×1.5	60	22	3.6	40	92	30
51500	104000	5300	1810	47				4.2		107	
51500	104000	7850	2400	61				4.7		122	

- Remarks**
4. Dimensions with \* (asterisk) mark  
\*Pilot diameter and tapped screws marked with "asterisk \*\*" are used for seal unit installation for NSK standard hollow shaft ball screws. They also can be used for dust cover and damper installation.
  5. Grease is packed into the bearing. It is not necessary to apply grease before use.

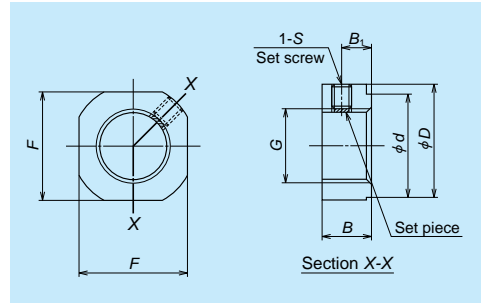


In addition to the support units, NSK has other components for the ball screw as shown below.

**(3) Lock nuts**

Ball screw support bearing must be installed

with minimum inclination. NSK lock nuts exclusive for ball screw help to reduce this inclination.



A Type Shapes and dimensions

A Type lock nuts

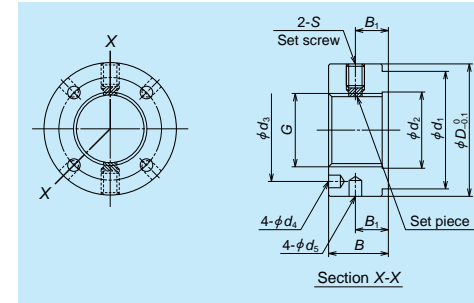
**A Type lock nuts**

Lock nut reference number	G	D	F	B	d
WBK06L-01	M6×0.75	14.5	12	5	10
WBK08L-01	M8×1	17	14	6.5	13
WBK10L-01	M10×1	20	17	8	16
WBK12L-01	M12×1	22	19	8	17
WBK15L-01	M15×1	25	22	10	21
WBK17L-01	M17×1	29	24	13	24
WBK20L-01	M20×1	35	30	13	26
WBK25L-01	M25×1.5	42	36	16	34

Remarks: Insert a set piece (brass pad) and tighten the securing set screw.

**S Type lock nuts**

Lock nut reference number	G	D <sub>3.1</sub>	B	d <sub>1</sub>	d <sub>2</sub>	d <sub>3</sub>
WBK17L-31	M17×1	37	18	30	18	27
WBK20L-31	M20×1	40	18	30	21	30
WBK25L-31	M25×1.5	45	20	40	26	35
WBK30L-31	M30×1.5	50	20	40	31	40
WBK35L-31	M35×1.5	55	22	50	36	45
WBK40L-31	M40×1.5	60	22	50	41	50



S Type Shapes and dimensions

S Type lock nuts

B <sub>1</sub>	S	Tightening torque (N · cm) (for reference)	Set screw tightening torque (reference) [N · cm]
2.75	M3, with brass made set piece	190	69 (M3)
4	M3, with brass made set piece	230	69 (M3)
5	M4, with brass made set piece	280	147 (M4)
5	M4, with brass made set piece	630	147 (M4)
6	M4, with brass made set piece	790	147 (M4)
8	M4, with brass made set piece	910	147 (M4)
8	M4, with brass made set piece	1670	147 (M4)
10	M6, with brass made set piece	2060	490 (M6)

d <sub>1</sub>	d <sub>2</sub>	B <sub>1</sub>	S	Tightening torque (N · cm) (for reference)	Set screw tightening torque (reference) [N · cm]
4.3	4	10	M6	4100	490 (M6)
4.3	4	10	M6	4500	490 (M6)
4.3	4	11	M6	8500	490 (M6)
4.3	5	11	M6	10100	490 (M6)
4.3	5	12	M6	13800	490 (M6)
4.3	5	12	M6	15500	490 (M6)

(4) Grease unit

NSK has numerous grease types that are exclusive for ball screw lubrication. They come in bellows-shaped tubes, that can be attached

to a grease gun quickly. For details of grease types, refer to Page D13 or for grease pump and nozzles, refer to Page D20.



NSK greases

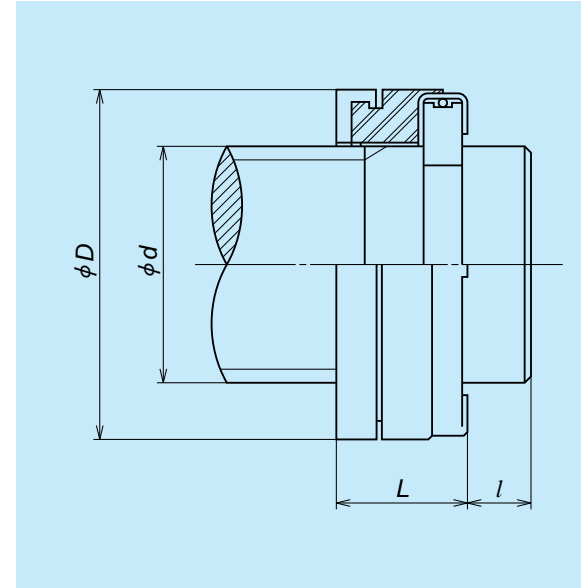
Lubricant greases

Name	Use	Base oil viscosity mm <sup>2</sup> /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 stopper (by order)

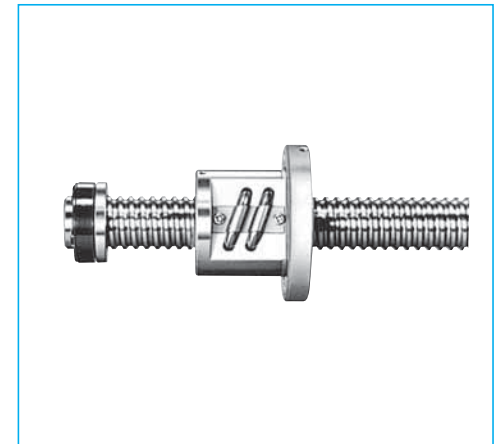
A travel stopper is installed in some cases to prevent the nut from overrunning due to the malfunction of the safety system of the equipment or by human error. NSK has several types of series of shock-absorbing travel stoppers. Please request NSK for installation.

The travel stopper is not sold as a single item since it does not have a general use. Also, a travel stopper cannot be used for end cap type recirculation system, because the stopper would come directly into contact with the ball recirculating portion.



stopper No.	Applicable shaft dia.	Outer dia.	Length	Shaft end width (Min.)
	<i>d</i>	<i>D</i>	<i>L</i>	<i>l</i>
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

Remarks: This stopper is patented by NSK Ltd.



Shock-absorbing travel stopper

Thrust Angular Contact Ball Bearing for Ball Screw

(1) Features

This is highly rigid and accurate ball screw support bearing often used for the machine tool driving mechanism.

- ① High axial rigidity  
Uses many balls, and set high contact angle at 60 degrees.
- ② Small friction torque  
Friction torque is smaller than that of tapered or cylindrical roller bearing. This contributes to accurate rotation by a small driving power.
- ③ Axial play is pre-adjusted  
Combination bearings are already adjusted to a suitable preload. Universal combination bearing (SU) furnishes certain preload for all combinations (DB, DF, and other).
- ④ Simple mounting structure  
A duplex combination of bearings can receive axial and radial loads. Therefore, the installation structure is simpler than when both a thrust bearing and a radial bearing are used.
- ⑤ Easy handling  
Inner and outer rings are inseparable, and are easy to handle.
- ⑥ Superb polyamide resin retainer  
Uses polyamide resin retainer which is superb to friction and furnishes high precision rotations.

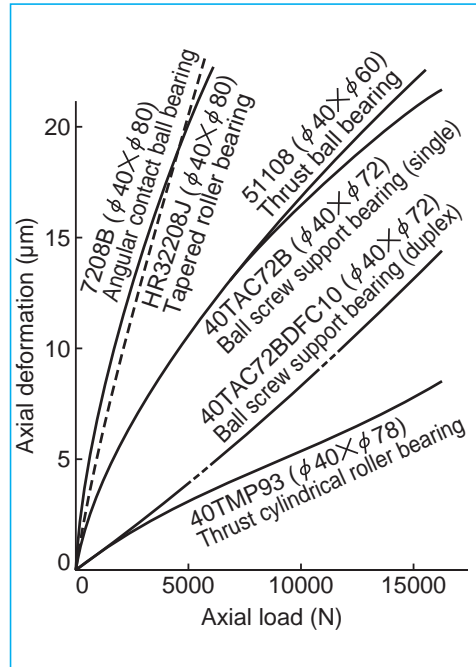


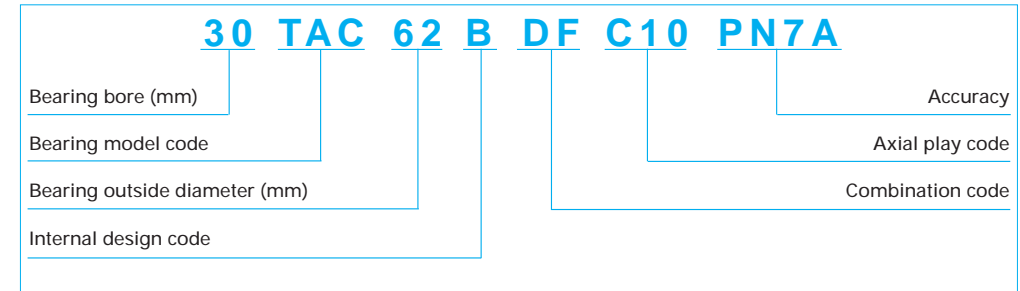
Fig. 1 Axial rigidity of various bearings

Table 2 Comparison with other types of bearings

Bearing type	Bearing rigidity (See Fig. 1)	Starting torque	Preload adjustment	Installation structure
Thrust angular contact ball bearing for NSK precision ball screw support unit	High	Low	Not required	Simple
Combined angular contact ball bearing	Low	Low	Not required	Simple
Combination of tapered roller bearings	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 when you use these bearings other than the purpose of ball screw support.

(2) Composition of reference number



Remark : As "30 TAC 62 B," any part of the first half of the reference number is referred to as "nominal size" in this catalog.

### (3) Bearing combinations

Generally, a set uses more than two pieces (referred to as 'two rows') of bearings and, thus the preload is applied.

There are two types of combination:

#### ● Bearing combination

Bearings are adjusted as a single combined set. Since the bearing alignment is pre-set, there is no interchangeability;

#### ● Universal combination bearing (SU)

A combination of independent bearings, which is manufactured as a single bearing. Bearings are randomly-matched to obtain required preload by more than one of randomly picked up bearings.

#### ① Bearing combination

- Figure 2 shows examples of combinations. There is "V" mark on the outside surface of the bearing to avoid misarrangement. A complete letter "V" should be formed when all bearings align correctly to form a set.
- DF combination which easily absorbs misalignment with the ball screw nut is used in general.

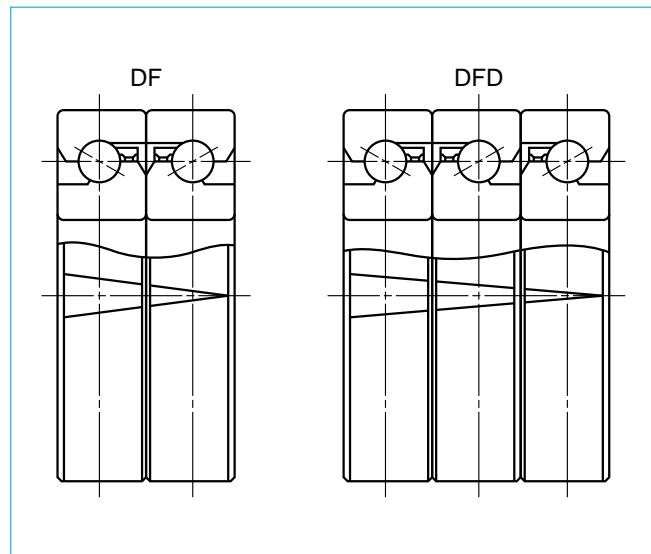


Fig. 2 Examples of combination and "V" mark

#### ② Universal combination bearing (SU)

- Unlike the above case, marks on the bearing outside surface do not form a letter "V." The tip of the "V" on each bearing simply indicates the direction to which axial load can be applied.

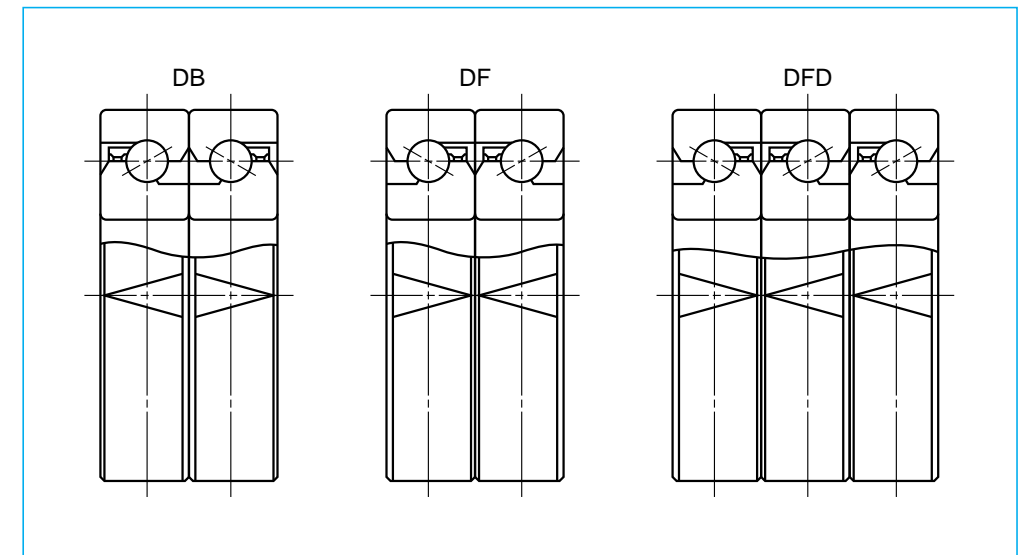


Fig. 3 Example of universal combination (SU) and "V" mark

(4) Preload, rigidity, and starting torque

The table 3 shows preload, rigidity (spring modulus), and starting torque with grease lubrication. (The starting torque should be 1.4 times higher when oil is used as a lubricant.) Consult NSK for the bearing combinations not included in the Table below.

(5) Accuracy

① Accuracy grades

Uses NSK standard PN7A and PN7B which are equivalent to JIS4 grade of the radial ball bearing. Combined bearing ————— PN7A Universal combination bearing — PN7B However, PN7A is stricter than JIS4 grade regarding axial run out of inner and outer rings. PN7B is stricter regarding the tolerance of the bore and outside diameter (Table 4).

Table 3 Preload, rigidity, and starting torque

Reference number	Duplex combination DF				Triplex combination DFD	
	Axial play code	Preload (N)	Rigidity (N/μm)	Starting torque (N · m)	Axial play code	Preload (N)
15TAC 47B	C10	2150	750	0.14	C10	2950
17TAC 47B	C10	2150	750	0.14	C10	2950
20TAC 47B	C10	2150	750	0.14	C10	2950
25TAC 62B	C10	3150	1000	0.23	C10	4300
30TAC 62B	C10	3350	1030	0.24	C10	4500
35TAC 72B	C10	3800	1180	0.28	C10	5200
40TAC 72B	C10	3900	1230	0.28	C10	5300
40TAC 90B	C10	5000	1320	0.48	C10	6750
45TAC 75B	C10	4100	1270	0.29	C10	5600
45TAC 100B	C10	5900	1520	0.58	C10	8050
50TAC 100B	C10	6100	1570	0.60	C10	8250
55TAC 100B	C10	6100	1570	0.60	C10	8250
55TAC 120B	C10	6650	1810	0.64	C10	9100
60TAC 120B	C10	6650	1810	0.64	C10	9100

Table 4 Tolerance: thrust angular contact ball bearing for ball screw support

Unit: μm

Nominal size of bearing bore or outside diameter (mm)		Tolerance of bore				Tolerance of outside diameter				Tolerance of inner ring width		Axial run out of inner or outer ring
		Accuracy grade				Accuracy grade				Accuracy grade		Accuracy grade
		PN7A		PN7B		PN7A		PN7B		PN7A	PN7B	PN7A
over	or less	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower	Maximum
10	18	0	-4	0	-4	-	-	-	-	0	-80	2.5
18	30	0	-5	0	-4	-	-	-	-	0	-120	2.5
30	50	0	-6	0	-4	0	-6	0	-4	0	-120	2.5
50	80	0	-7	0	-5	0	-7	0	-5	0	-150	2.5
80	120	0	-8	0	-6	0	-8	0	-6	0	-200	2.5

Remarks : The tolerance of the outer ring width is the same as that of the inner ring width of the same bearing.

② Fits

Table 5 shows recommended values of the tolerance of shaft and housing bore.

Rigidity (N/μm)		Starting torque (N · m)		Quadruplet combination DFF	
				Axial play code	Preload (N)
1080	0.20	C10	4300	1470	0.29
1080	0.20	C10	4300	1470	0.29
1080	0.20	C10	4300	1470	0.29
1470	0.31	C10	6250	1960	0.46
1520	0.33	C10	6650	2010	0.49
1710	0.37	C10	7650	2350	0.55
1810	0.38	C10	7850	2400	0.57
1960	0.65	C10	10300	2650	0.96
1910	0.40	C10	8250	2550	0.59
2210	0.78	C10	11800	3000	1.16
2300	0.80	C10	12300	3100	1.18
2300	0.80	C10	12300	3100	1.18
2650	0.86	C10	13200	3550	1.27
2650	0.86	C10	13200	3550	1.27

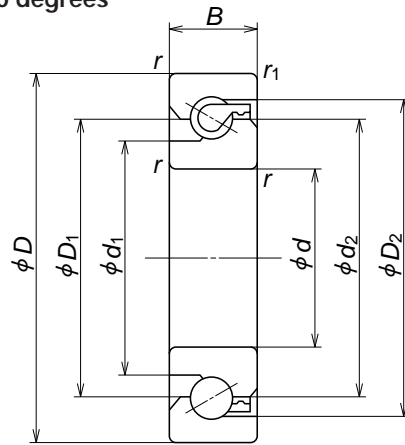
Table 5 Tolerance of shaft bearing seat and housing bore

Unit: μm

Size of shaft or housing bore (mm)		Tolerance of shaft bearing seat h5		Tolerance of housing hole H6	
		upper	lower	upper	lower
10	18	0	-8	-	-
18	30	0	-9	-	-
30	50	0	-11	+16	0
50	80	0	-13	+19	0
80	120	0	-15	+22	0

\*\*TAC\*\*B

Nominal contact angle 60 degrees



Dynamic equivalent load  $P_a = X F_r \times F_a$

Bearing configuration Combination code Number of the row that receives axial load	Duplex		Triplex			Quadruplet			
	DF	DT	DFD	DTD	DFT	DFF	DFT		
$e=2.17$	One row	Two rows	One row	Two rows	Three rows	One row	Two rows	Three rows	
$F_a/F_r \leq e$	X	1.9	-	1.43	2.33	-	1.17	2.33	2.53
	Y	0.54	-	0.77	0.35	-	0.89	0.35	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

External dimensions (mm)					Dimensions (mm)				Permissible rotational speed (min <sup>-1</sup> )		Bearing No.
<i>d</i>	<i>D</i>	<i>B</i>	<i>r</i> Min.	<i>r</i> <sub>1</sub> Min.	<i>d</i> <sub>1</sub>	<i>d</i> <sub>2</sub>	<i>D</i> <sub>1</sub>	<i>D</i> <sub>2</sub>	Grease lubrication	Oil lubrication	
15	47	15	1	0.6	27.2	34	34	39.6	6000	8000	<b>15TAC 47B</b>
17	47	15	1	0.6	27.2	34	34	39.6	6000	8000	<b>17TAC 47B</b>
20	47	15	1	0.6	27.2	34	34	39.6	6000	8000	<b>20TAC 47B</b>
25	62	15	1	0.6	37	45	45	50.7	4500	6000	<b>25TAC 62B</b>
30	62	15	1	0.6	39.5	47	47	53.2	4300	5600	<b>30TAC 62B</b>
35	72	15	1	0.6	47	55	55	60.7	3600	5000	<b>35TAC 72B</b>
40	72	15	1	0.6	49	57	57	62.7	3600	4800	<b>40TAC 72B</b>
40	90	20	1	0.6	57	68	68	77.2	3000	4000	<b>40TAC 90B</b>
45	75	15	1	0.6	54	62	62	67.7	3200	4300	<b>45TAC 75B</b>
45	100	20	1	0.6	64	75	75	84.2	2600	3600	<b>45TAC 100B</b>
50	100	20	1	0.6	67.5	79	79	87.7	2600	3400	<b>50TAC 100B</b>
55	100	20	1	0.6	67.5	79	79	87.7	2600	3400	<b>55TAC 100B</b>
55	120	20	1	0.6	82	93	93	102.2	2200	3000	<b>55TAC 120B</b>
60	120	20	1	0.6	82	93	93	102.2	2200	3000	<b>60TAC 120B</b>

Note : (1) Values are based on a standard preload (C10).

Basic dynamic load rating $C_a$			Permissible axial load			Mass (kg) (Reference)
One row sustaining load DF (N)	Two rows sustaining load DT, DFD, DFF (N)	Three rows sustaining load DTD, DFT (N)	One row sustains load DF (N)	Two rows sustain load DT, DFD, DFF (N)	Three rows sustain load DTD, DFT (N)	
21900	35500	47500	26600	53000	79500	0.144
21900	35500	47500	26600	53000	79500	0.144
21900	35500	47500	26600	53000	79500	0.135
28500	46500	61500	40500	81500	122000	0.252
29200	47500	63000	43000	86000	129000	0.224
31000	50500	67000	50000	100000	150000	0.310
31500	51500	68500	52000	104000	157000	0.275
59000	95500	127000	89500	179000	269000	0.674
33000	53500	71000	57000	114000	170000	0.270
61500	100000	133000	99000	198000	298000	0.842
63000	102000	136000	104000	208000	310000	0.778
63000	102000	136000	104000	208000	310000	0.714
67500	109000	145000	123000	246000	370000	1.23
67500	109000	145000	123000	246000	370000	1.16

\* "Row" means the quantity of bearings that receive axial load.

"Two rows" means two bearings are receiving axial load.

End Deflector Type B467

Tube Type B473

Deflector Type B507

End Cap Type B521

### B-3-3 Dimension Table and Reference Number of Standard Nut Ball Screws

### B-3-3.1 End Deflector Type Ball Screw

NSK has a patent for this product.

#### 1. Features

##### ●Silent and high quality of sound

The average noise level is reduced by more than 6 dB compared with our conventional products. At low-speed rotation, the ball screws are nearly silent, while the lowest noise level is achieved at high-speed rotation.

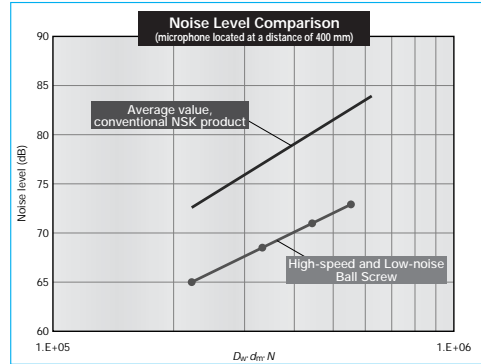


Fig. 1 Comparison of noise level

##### ●High-speed operation

Realizes at d·n 180000 outstanding for ball screws and far surpassing the 100000 d·n performance of conventional return tube type products. For high lead ball screws, high-speed operation at over 200m/min is also possible.

##### ●Compact

The external diameter of the ball nut is 30% smaller than our conventional models. Compact configurations are possible for low-profile XY tables as well as for other devices and equipment.

##### ●Grease fitting provided as standard equipment

The ball screws with shaft diameters of less than ø25 are standardly equipped with a grease fitting (M5 × 0.8). Lubrication ports are provided in 2 places to facilitate maintenance. The ball screws can be easily connected to an integrated lubrication system.

#### 2. Specifications

##### (1) Recirculation system

Fig. 2 shows the structure of the end-deflector recirculation system.

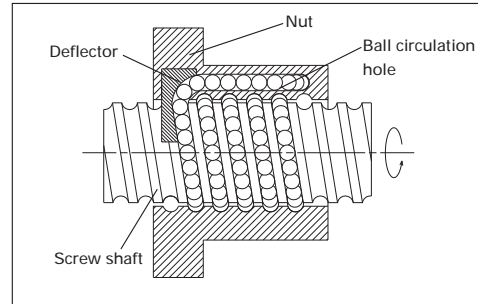


Fig. 2 Structure of end-deflector recirculation system

##### (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	C0, C1, C2, C3, C5, Ct7
Axial play	Z, 0 mm (Preload); 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

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.

Allowable d·n value : 180000 or less

Standard of rotational speed: 5000 min<sup>-1</sup>

Note: Please also review the critical speed. See "Technical Description: Permissible rotational speed" (Page B51) for details.

##### (4) Seal

Compact, thin plastic seal is available. Nut outside diameter is compact compare with the return tube recirculation system.

##### (5) Option

Optional NSK K1 lubrication unit, molded from resin and impregnated 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 precautions

When designing the shaft end of a ball screw which 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 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 "dr" specified on the dimension table.

For general precautions regarding ball screws, refer to "Design Precautions"(Page B84) and "Handling Precautions"(Page B103).

#### 4. Product categories

End deflector type has a model as follows.

Table 2 End-deflector type ball screw product categories

Nut model	Shape	Flang shape	Nut shape	Preload system
BSS		Circular II, III	Circular	Non-preload, Slight axial play
				P preload (light preload)

##### 5. Example of model number in dimension tables

A structure of "Model number" and "Reference number for ball screw" are as follows.

##### ◇Model number

**BSS 10 10 - 2E**

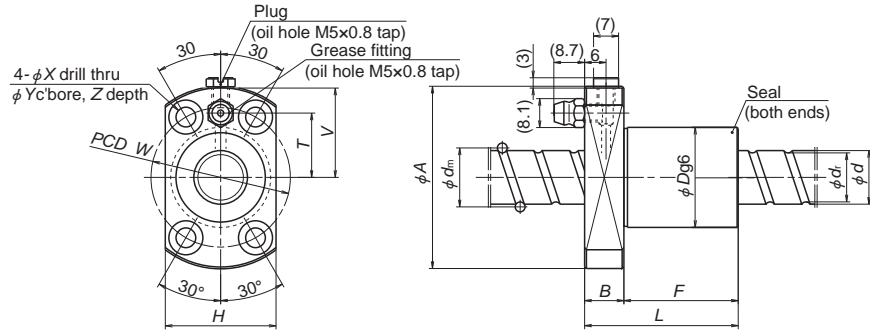
Nut model: BSS      Effective turns of balls  
Screw shaft diameter (mm)      Lead (mm)

##### ◇Reference number for ball screw

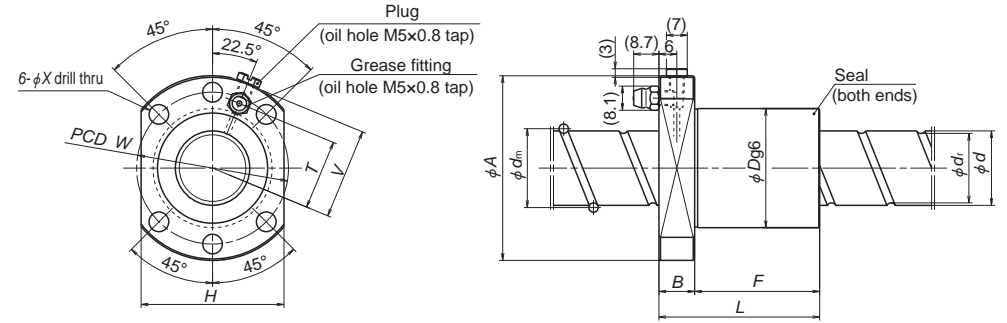
**W 10 01 - \*\* P SS - C5 Z 10**

Product code      Lead (mm)  
Screw shaft diameter (mm)  
Effective threaded length (in the unit of 100 mm)  
NSK design serial number  
Preload code: No code, non-preload; P, P preload      Axial play code: Z, T, S, N  
Accuracy grade: C0, C1, C2, C3, C5, C7 (Ct7)  
End-deflector recirculation system





Flange TYPE I



Flange TYPE II

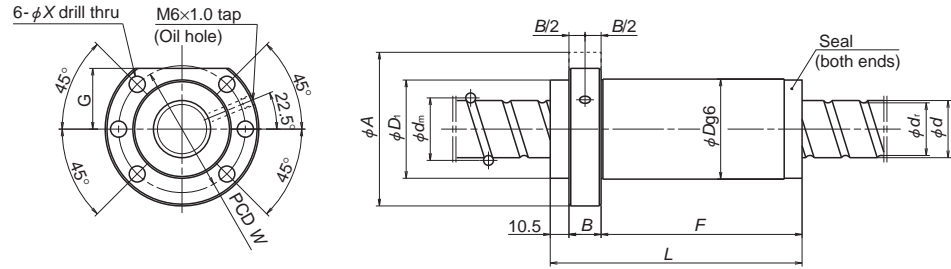
Unit: mm

Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)
							Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	
BSS1005-3E	10	5	2.000	10.3	8.2	3	2930	4790	126
BSS1010-2E		10				2	1970	3010	77
BSS1205-3E	12	5	2.000	12.3	10.2	3	3200	5860	146
BSS1210-3E		10				3	3200	5860	142
BSS1220-2E		20				2	2150	3610	83
BSS1230-2E		30				2	2150	3610	75
BSS1505-3E	15	5	2.778	15.5	12.6	3	5460	10200	183
BSS1510-3E		10	3			5460	10200	181	
BSS1520-2E		20	3.175	12.2	2	5070	8730	127	
BSS1530-2E		30				2	5070	8730	116
BSS2005-3E	20	5	3.175	20.5	17.2	3	8790	18500	268
BSS2010-3E		10				3	8790	18500	268
BSS2020-2E		20				2	5900	11700	167
BSS2030-2E		30				2	5900	11700	159
BSS2040-2E		40				2	5900	11700	147
BSS2060-2E		60				2	5900	11700	128
BSS2505-3E		25				5	3.175	25.5	22.2
BSS2510-4E	10		4	12800	32300	437			
BSS2520-2E	20		2	6560	14600	203			
BSS2525-2E	25		2	6560	14600	197			
BSS2530-2E	30		2	6560	14600	194			
BSS2550-2E	50		2	6560	14600	177			

Note: The axial rigidity in the table above is a theoretical value derived from elastic displacement 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*). For ball screws with shaft diameters less than ø25, the standard Compact FA PSS can be available.

Nut entire length <i>L</i>	Nut diameter <i>D</i>	Flange diameter <i>A</i>	Flange width <i>B</i>	Nut length <i>F</i>	Flange dimension		Flange <i>TYPE</i>	Bolt hole PCD <i>W</i>	Bolt hole dimension				Oil hole distance <i>T</i>								
					<i>H</i>	<i>V</i>			<i>X</i>	<i>Y</i>	<i>Z</i>										
29	23	43	11	18	26	21	I	33	4.5	8	4.5	14									
32				21																	
30	24	44	11	19	27	21.5	I	34	4.5	8	4.5	14.5									
43				32																	
50				39																	
70				59																	
30	28	51	11	19	31	25	I	39	5.5	9.5	5.5	18									
43				32																	
51				32				55					40	33	27	43	43	5.5	9.5	5.5	20
71																					
31	36	62	13	18	38	30.5	I	49	6.6	11	6.5	23.5									
45				32																	
54				41																	
74				61																	
92				79																	
129				116																	
32				40									62	12	20	48	30.5	II	51	6.6	—
56	44																				
54	42																				
63	51																				
74	62																				
114	102																				

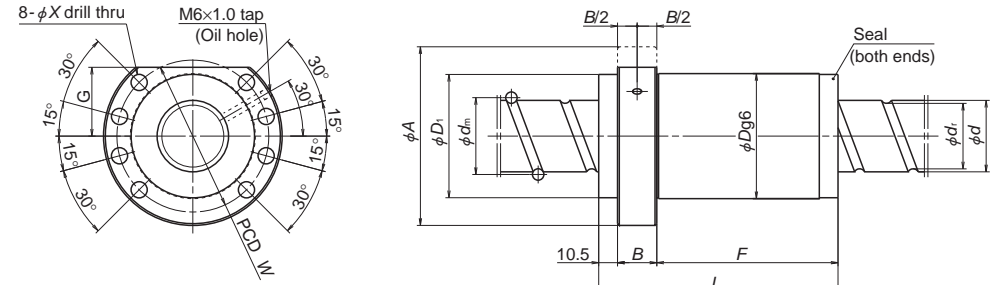
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Flange TYPE III

Model No.	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)				
							Dynamic <i>C<sub>n</sub></i>	Static <i>C<sub>0n</sub></i>					
BSS3205-4E	32	5	3.175	32.5	29.2	4	14200	41400	534				
BSS3210-6E		10				6	43300	111000	865				
BSS3212-5E		12				5	36700	90800	716				
BSS3216-5E		16				5	36700	90800	716				
BSS3220-5E		20				5	36700	90800	708				
BSS3232-2E		32				2	15300	32400	261				
BSS3264-2E		64				2	15300	32400	232				
BSS3605-3E	36	5	3.175	36.5	33.2	3	11400	34100	433				
BSS3610-6E		10				6	55200	142000	970				
BSS3612-6E		12				6	55200	142000	967				
BSS3616-6E		16				6	55200	142000	961				
BSS3620-6E		20				6	55200	142000	959				
BSS4010-5E	40	10	6.35	41	34.4	5	49300	130000	875				
BSS4012-5E		12				5	49300	130000	873				
BSS4016-5E		16				5	49300	130000	875				
BSS4020-5E		20				5	49300	130000	868				
BSS4025-4E		25				4	40100	103000	686				
BSS4030-3E		30				3	30600	74000	505				
BSS4040-2E		40				2	20600	46600	319				
BSS4080-2E		80				2	20600	46600	286				
BSS4510-5E		45				10	6.35	46	39.4	5	51400	146000	961
BSS4512-5E						12				5	51400	146000	959
BSS4516-5E	16		5	51400	146000	955							
BSS4520-5E	20		5	51400	146000	950							
BSS4525-5E	25		5	51400	146000	954							
BSS4530-4E	30		4	41800	116000	752							
BSS5010-4E	50		10	6.35	51	44.4				4	44600	129000	836
BSS5012-4E		12	4				44600	129000	944				
BSS5016-4E		16	4				44600	129000	832				
BSS5020-4E		20	4				44600	129000	837				
BSS5025-4E		25	4				44600	129000	828				
BSS5030-4E		30	4				44600	129000	821				
BSS5050-2E		50	2				22800	58300	383				
BSS50100-2E		100	2				22800	58300	342				

Note: The axial rigidity in the table above is a theoretical value derived from elastic displacement 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*).



Flange TYPE IV

Nut entire length <i>L</i>	Nut diameter <i>D</i>	Seal section diameter <i>D<sub>1</sub></i>	Flange diameter <i>A</i>	Flange width <i>B</i>	Nut length <i>F</i>	Notched flange <i>G</i>	Flange <i>TYPE</i>	Bolt hole PCD <i>W</i>	Bolt hole dimension <i>X</i>	
55	56	55	86	12	32.5	34	III	71	9	
104										75.5
103										74.5
122										93.5
141										112.5
94										65.5
153										124.5
50	65	64	95	22	27.5	36	IV	80	9	
109										76.5
120										87.5
143										110.5
166										133.5
99										66.5
108	75.5									
127	94.5									
146	113.5									
145	112.5									
134	101.5									
110	77.5									
184	151.5									
99	75	74	110	22	66.5	43	IV	93	11	
108										75.5
127										94.5
146										113.5
146										113.5
170										137.5
164										131.5
89	56.5									
96	63.5									
111	78.5									
126	93.5									
145	112.5									
164	131.5									
130	97.5									
224	191.5									

Unit: mm

### B-3-3.2 Return Tube Type Ball Screw

#### 1. Features

Return tube type is standard recirculation system for ball screws. It has various combinations of shaft dia. and lead.

#### 2. Specifications

##### (1) Recirculation system

The structure of return tube recirculation system is shown below.

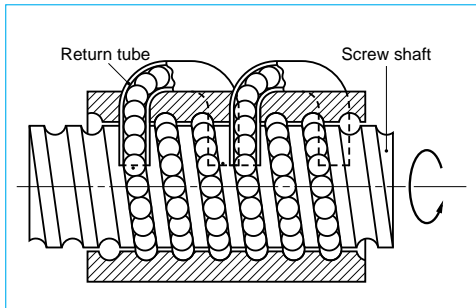


Fig.1 Structure of return tube recirculation system

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 (Preload); T, 0.005 mm or less S, 0.020 mm or less; N, 0.050 mm or less

Table 2 Return tube type ball screws product categories

Nut model	Shape	Flange shape	Nut shape	Preload system
SFT		Flanged d=16mm or under	Circle dia.	Non-preload, Slight axial play
PFT		Rectangle d=20mm or over Circular I, II		P preload (light preload) Spacer ball 1:1
ZFT		Flanged Circular I, II	Circle dia.	Z preload (medium preload)

##### (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

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. Basic measure must be taken for the high speed ball screws respectively.

Allowable d·n value :

Standard specification : 70000 or less

High-speed specification; 100000 or less

Standard of rotational speed : 3000 min<sup>-1</sup>

Note: Please also review the critical speed. Refer to "Technical Description: Permissible rotational speed" (Page B51) for details.

##### (4) Other specifications

Please consult NSK for other specifications not listed in the dimension tables.

#### 3. Product categories

There are four different preloaded systems with several models. Since the leads are in the range from 1/2 to the same length of the shaft diameter (medium-high helix lead), LSFT, LPFT, LDFT Type ball screws are suitable for high-speed operation.

Nut model	Shape	Flange shape	Nut shape	Preload system
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	Non-preload, Slight axial play  P preload (light preload) Spacer ball 1:1
LPFT			d=25mm or over Tube- projecting type	
LDFT		Flanged Circular II	Circular	D preload (medium preload) (heavy preload)

#### 4. Example of model number in dimension tables

A structure of "Model number" and "Reference number for ball screw" are as follows.

##### ◇ Model number

**SFT 14 05 - 2.5**

Nut model:  
SFT, PFT, ZFT, DFT  
LSFT, LPFT, LDFT

Screw shaft diameter (mm)

Effective turns of balls (Note)

Lead (mm)

Note: In case of Z preload, the number here is twice as large as the effective turns of balls.

##### ◇ Reference number for ball screw

**W 14 01 - \*\* P - C3 Z 5**

Product code

Screw shaft diameter (mm)

Effective threaded length (in the unit of 100 mm)

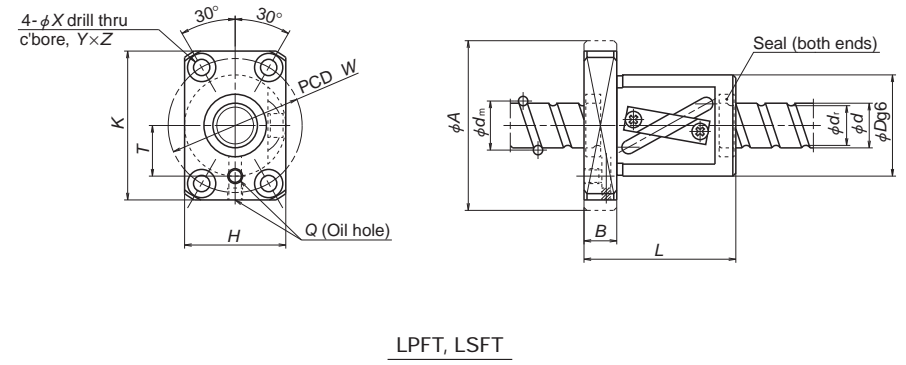
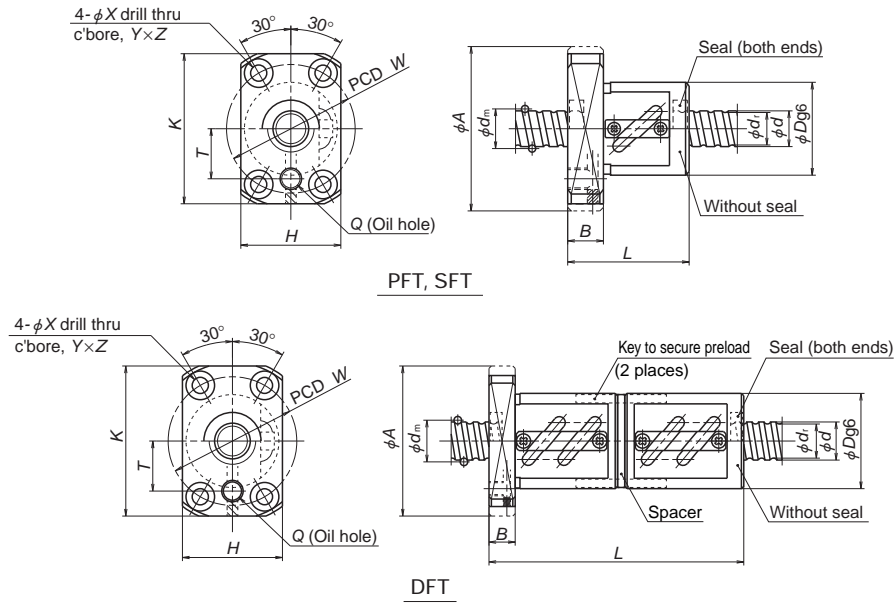
NSK design serial number

Preload code:  
No code, non-preload; P, P preload  
Z, Z preload; D, D preload

Lead (mm)

Axial play code: Z, T, S, N

Accuracy grade code:  
C0, C1, C2, C3, C5, C7 (Ct7)



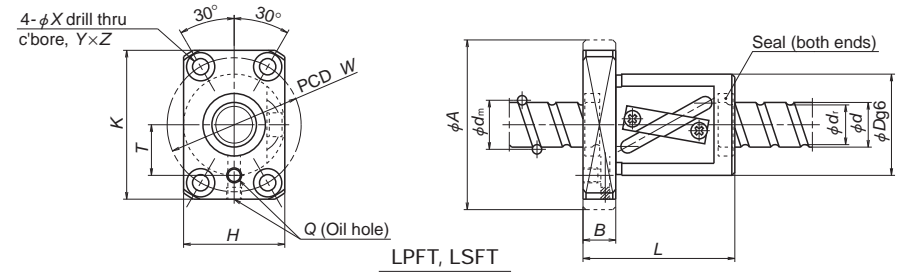
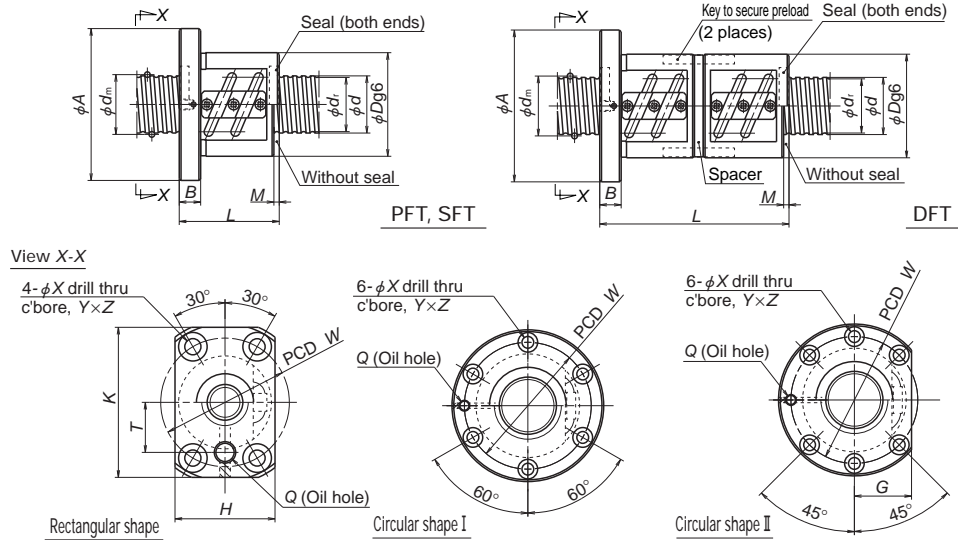
Unit: mm

Model No.	Preload system	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)
								Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	
* PFT 1004-2.5 SFT 1004-2.5	P Clearance	10	4	2.000	10.3	8.2	2.5×1	1730 2740	2230 4450	76 90
PFT 1204-2.5 PFT 1204-3 SFT 1204-2.5 SFT 1204-3	P Clearance Clearance	12	4	2.381	12.3	9.8	2.5×1	2370	3160	89
	1.5×2						2770	3790	106	
	2.5×1						3760	6310	106	
	1.5×2						4390	7580	126	
* PFT 1205-2.5 PFT 1205-3 SFT 1205-2.5 SFT 1205-3	P Clearance Clearance	12	5	2.381	12.3	9.8	2.5×1	2370	3160	89
	1.5×2						2770	3790	106	
	2.5×1						3760	6310	106	
	1.5×2						4390	7580	126	
* LPFT 1210-2.5 LSFT 1210-2.5	P Clearance	10	10	2.381	12.5	10.0	2.5×1	2360 3750	3240 6480	90 110
* PFT 1405-2.5 SFT 1405-2.5 PFT 1405-5 SFT 1405-5	P Clearance Clearance	14	5	3.175	14.5	11.2	2.5×1	4280	5840	116
	2.5×1						6790	11700	140	
	2.5×2						7770	11700	225	
	2.5×2						12300	23400	274	
* LPFT 1408-2.5 LSFT 1408-2.5	P Clearance	14	8	3.175	14.5	11.2	2.5×1	4280 6790	5840 11700	120 140
* LPFT 1510-2.5 LSFT 1510-2.5	P Clearance	15	10	3.175	15.5	12.2	2.5×1	4450 7070	6380 12800	127 150
PFT 1604-3 SFT 1604-2.5 DFT 1604-2.5 PFT 1604-5 SFT 1604-3 DFT 1604-3	P Clearance D P Clearance D	16	4	2.381	16.3	13.8	1.5×2	3170	5150	135
	2.5×1						4300	8530	134	
	2.5×1						4300	8530	263	
	2.5×2						4920	8530	215	
	1.5×2						5040	10300	160	
	1.5×2						5040	10300	315	

- Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape.  
 2. Seals are equipped as a standard for LSFT and LPFT of shaft diameter 12 mm or smaller. The outside dimensions are the same as those of without seals.  
 3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.

Ball nut dimensions											
Nut entire length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Rectangle flanged diameter			Bolt hole dimension			Oil hole length <i>T</i>	Oil hole <i>O</i>
				<i>H</i>	<i>K</i>	<i>X</i>	<i>Y</i>	<i>Z</i>	Bolt hole PCD <i>W</i>		
34	26	46	10	28	42	4.5	8	4.5	36	14	M6×1
38	30	50	10	32	45	4.5	8	4.5	40	15	M6×1
44											
38											
44											
40	30	50	10	32	45	4.5	8	4.5	40	15	M6×1
48											
40											
48											
50	30	50	10	32	45	4.5	8	4.5	40	15	M6×1
40	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
40											
55											
55											
46	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
51	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
45	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
38											
70											
50											
45											
85											

- Remarks: 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (*C<sub>a</sub>*) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.  
 5. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.  
 6. The models marked with \* are in FA type of standard ball screw with finished shaft end.  
 7. Preload system: P, Oversize ball preload; D, Double nut preload (Refer to Page B5)



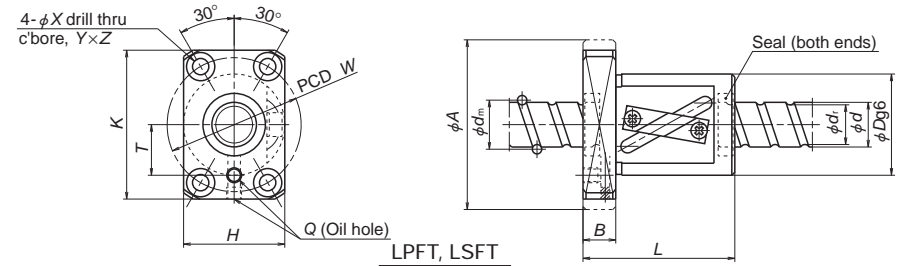
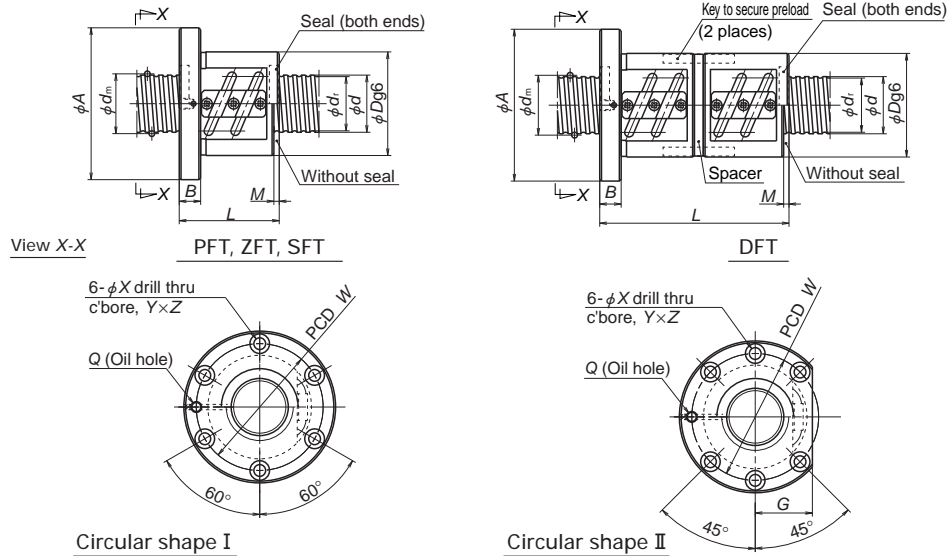
Unit: mm

Model No.	Preload system	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)
								Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	
PFT 1605-3	P	16	5	3.175	16.5	13.2	1.5×2	5400	8100	158
SFT 1605-2.5	Clearance						2.5×1	7330	13500	158
DFT 1605-2.5	D						2.5×1	7330	13500	311
PFT 1605-5	P						2.5×2	8380	13500	258
SFT 1605-3	Clearance						1.5×2	8570	16200	188
DFT 1605-3	D						1.5×2	8570	16200	370
SFT 1605-5	Clearance		2.5×2	13300	27000	307				
DFT 1605-5	D		2.5×2	13300	27000	603				
* PFT 1606-2.5	P		6	3.175	16.5	13.2	2.5×1	4620	6750	133
SFT 1606-2.5	Clearance						2.5×1	7330	13500	158
DFT 1606-2.5	D						2.5×1	7330	13500	311
SFT 1606-3	Clearance						1.5×2	8570	16200	188
DFT 1606-3	D	1.5×2					8570	16200	370	
* LPFT 1616-1.5	P	16					3.175	16.75	13.4	1.5×1
LSFT 1616-1.5	Clearance		1.5×1	4710	8110	100				
SFT 2004-2.5	Clearance	20	4	2.381	20.3	17.8	2.5×1	4740	10700	160
DFT 2004-2.5	D						2.5×1	4740	10700	315
* PFT 2004-5	P						2.5×2	5420	10700	260
SFT 2004-5	Clearance						2.5×2	8600	21500	309
DFT 2004-5	D						2.5×2	8600	21500	608
PFT 2005-3	P						5	3.175	20.5	17.2
SFT 2005-2.5	Clearance	2.5×1	8230	17100	190					
DFT 2005-2.5	D	2.5×1	8230	17100	376					
* PFT 2005-5	P	2.5×2	9410	17100	311					
SFT 2005-3	Clearance	1.5×2	9620	20600	227					
DFT 2005-3	D	1.5×2	9620	20600	446					
SFT 2005-5	Clearance	2.5×2	14900	34300	370					
DFT 2005-5	D	2.5×2	14900	34300	726					

- Remarks:
- Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
  - If there is no seal for PFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".
  - Seals are equipped as a standard for LSFT and LPFT of shaft diameter 12 mm or smaller. The outside dimensions are the same as those of without seals.
  - The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.

Nut entire length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Notched flange <i>G</i>	Rectangle flanged diameter		Seal dimension <i>M</i>	Bolt hole dimension			Bolt hole PCD <i>W</i>	Oil hole length <i>T</i>	Oil hole <i>Q</i>
					<i>H</i>	<i>K</i>		<i>X</i>	<i>Y</i>	<i>Z</i>			
52	40	63	11	—	40	55	—	5.5	9.5	5.5	51	20	M6×1
42													
77													
57													
52													
97													
57	40	63	11	—	40	55	—	5.5	9.5	5.5	51	20	M6×1
107													
44													
86													
56													
110													
56	40	63	12	—	40	55	—	5.5	9.5	5.5	51	17	M6×1
56													
37													
69													
49													
93													
52	44	67	11	26	—	—	3	5.5	9.5	5.5	55	—	M6×1
41													
76													
56													
52													
97													
56													
106													

- Remarks:
- The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (*C<sub>a</sub>*) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.
  - For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.
  - The models marked with \* are in FA or SA type of standard ball screw with finished shaft end.
  - Preload system: P, Oversize ball preload; D, Double nut preload (Refer to Page B5)



Unit: mm

Model No.	Preload system	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d</i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)								
								Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>									
PFT 2006-2.5	P	20	6	3.969	20.5	16.4	2.5×1	6900	10500	164								
PFT 2006-3	P						1.5×2	8080	12700	195								
SFT 2006-2.5	Clearance D						2.5×1	11000	21100	195								
DFT 2006-2.5	D						2.5×1	11000	21100	384								
SFT 2006-3	Clearance D						1.5×2	12800	25300	232								
DFT 2006-3	D						1.5×2	12800	25300	456								
PFT 2008-2.5	P		8	3.969	20.5	16.4	2.5×1	6900	10500	164								
SFT 2008-2.5	P						2.5×1	11000	21100	195								
DFT 2008-2.5	Clearance D						2.5×1	11000	21100	384								
SFT 2008-3	Clearance D						1.5×2	12800	25300	232								
DFT 2008-3	D						1.5×2	12800	25300	456								
* LPFT 2010-2.5	P						10	3.969	21.0	16.9	2.5×1	6800	10800	169				
LSFT 2010-2.5	Clearance	2.5×1	10900	21700	202													
LPFT 2016-2.5	P	16	3.969	21.0	16.9	2.5×1					6880	10800	169					
LSFT 2016-2.5	Clearance					2.5×1					10900	21700	202					
* LPFT 2020-1.5	P					20					3.969	21.0	16.9	1.5×1	5370	8450	137	
LSFT 2020-1.5	Clearance													1.5×1	7040	12700	127	
SFT 2504-2.5	Clearance Z						25	4	2.381	25.3				22.8	2.5×1	5270	13600	193
ZFT 2504-5	Z														2.5×1	5270	13600	379
* PFT 2504-5	P	2.5×2	6020	13600	312													
SFT 2504-5	Clearance Z	2.5×2	9560	27200	374													
ZFT 2504-10	Z	2.5×2	9560	27200	735													
PFT 2505-3	P	5	3.175	25.5	22.2	1.5×2					6730	12800	223					
SFT 2505-2.5	Clearance Z					2.5×1		9130	21900	231								
ZFT 2505-5	Z					2.5×1		9130	21900	454								
* PFT 2505-5	P					2.5×2		10400	21900	372								
SFT 2505-3	Clearance D					1.5×2		10700	25700	271								
DFT 2505-3	D					1.5×2		10700	25700	532								
SFT 2505-5	Clearance Z	5	3.175	25.5	22.2	2.5×2		16600	43700	447								
ZFT 2505-10	Z					2.5×2	16600	43700	876									

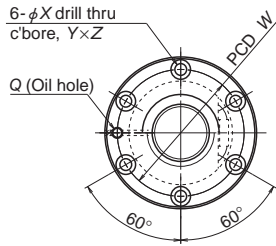
- Remarks:
- Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
  - If there is no seal for PFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".
  - Seals are equipped as a standard for LPFT and LSFT of shaft diameter 12 mm or smaller. The outside dimensions are the same as those of without seals.
  - The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.

Ball nut dimensions													
Nut entire length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Notched flange <i>G</i>	Rectangle flanged diameter <i>H</i>	<i>K</i>	Seal dimension <i>M</i>	Bolt hole dimension			Bolt hole PCD <i>W</i>	Oil hole length <i>T</i>	Oil hole <i>Q</i>
								<i>X</i>	<i>Y</i>	<i>Z</i>			
44	48	71	11	27	—	—	3	5.5	9.5	5.5	59	—	M6×1
56													
110													
54													
54													
102													
64	48	75	13	28	—	—	5	6.6	11	6.5	61	—	M6×1
64													
120													
54													
54													
72													
72	46	74	13	—	46	66	—	6.6	11	6.5	59	24	M6×1
63													
63													
36													
48													
48													
48	46	69	11	26	—	—	3	5.5	9.5	5.5	57	—	M6×1
48													
72													
52													
40													
55													
55	50	73	11	28	—	—	3	5.5	9.5	5.5	61	—	M6×1
52													
102													
55													
55													
85													

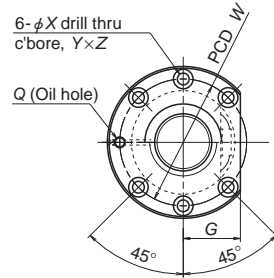
- Remarks:
- The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (*C*) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.
  - For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.
  - The models marked with \* are in FA or SA type of standard ball screw with finished shaft end.
  - Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

# Return tube type

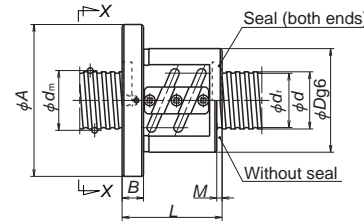
View X-X



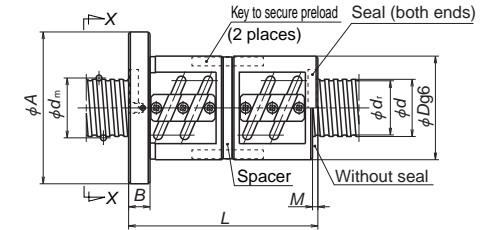
Circular shape I



Circular shape II



PFT, ZFT, SFT



DFT

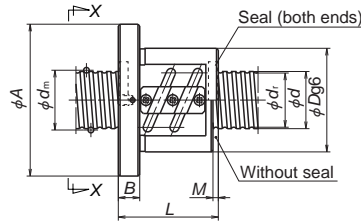
Model No.	Preload system	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)					
								Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>						
PFT 2506-3	P	25	6	3.969	25.5	21.4	1.5×2	9070	16100	235					
SFT 2506-2.5	Clearance Z						2.5×1	12300	26800	235					
ZFT 2506-5	P						2.5×1	12300	26800	462					
* PFT 2506-5	P						2.5×2	14100	26800	383					
SFT 2506-3	Clearance D						1.5×2	14400	32100	280					
DFT 2506-3	D						1.5×2	14400	32100	551					
SFT 2506-5	Clearance Z						2.5×2	22300	53500	456					
ZFT 2506-10	Z						2.5×2	22300	53500	896					
PFT 2508-2.5	P						25	8	4.762	25.5	20.5	2.5×1	9940	16000	203
PFT 2508-3	P											1.5×2	11600	19000	234
SFT 2508-2.5	Clearance Z	2.5×1	15800	32000	242										
ZFT 2508-5	Z	2.5×1	15800	32000	476										
SFT 2508-3	Clearance D	1.5×2	18500	38100	286										
DFT 2508-3	D	1.5×2	18500	38100	562										
PFT 2510-2.5	P	25	10	4.762	25.5	20.5						2.5×1	9940	16000	203
ZFT 2510-3	Z											1.5×1	10200	19000	291
PFT 2510-3	P											1.5×2	11600	19000	234
SFT 2510-2.5	Clearance Z											2.5×1	15800	32000	242
DFT 2510-2.5	D						2.5×1	15800	32000	475					
SFT 2510-3	Clearance D						1.5×2	18500	38100	286					
DFT 2510-3	D						1.5×2	18500	38100	562					
SFT 2510-3.5	Clearance Z						3.5×1	21100	44200	330					
DFT 2510-3.5	D						3.5×1	21100	44200	649					

Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.  
2. If there is no seal for PFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".  
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.

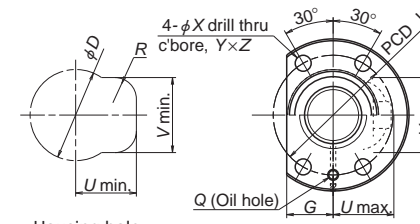
Unit: mm

Nut entire length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Notched flange <i>G</i>	Seal dimension <i>M</i>	Bolt hole dimension			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>
						<i>X</i>	<i>Y</i>	<i>Z</i>		
56	53	76	11	29	3	5.5	9.5	5.5	64	M6×1
44										
62										
62										
56										
110										
62										
98										
56	58	85	13	32	5	6.6	11	6.5	71	M6×1
69										
56										
80										
69										
133										
67										
81	58	85	15	32	8	6.6	11	6.5	71	M6×1
81										
81										
67										
127										
81										
151										
77										
147										

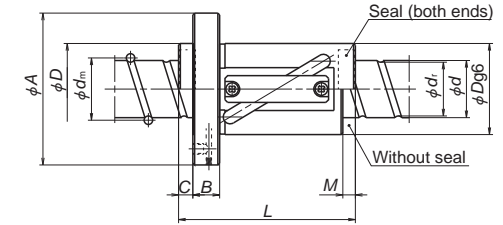
Remarks: 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (*C*) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.  
5. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.  
6. The models marked with \* are in SA type of standard ball screw with finished shaft end.  
7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)



PFT, ZFT, SFT

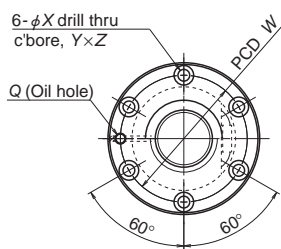


Housing hole and its clearance

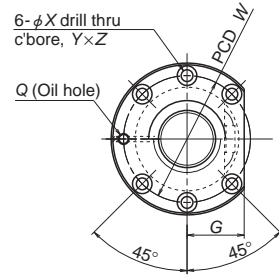


LPFT, LSFT

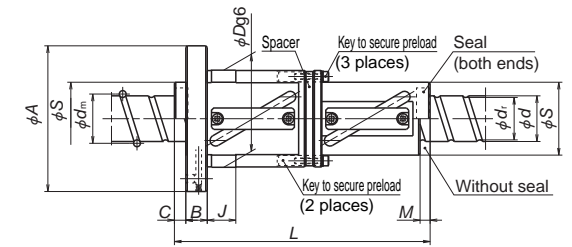
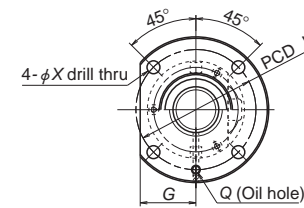
View X-X



Circular shape I



Circular shape II



LDFT

Unit: mm

Model No.	Preload system	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>t</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)	Nut entire length <i>L</i>	
								Dynamic <i>C<sub>d</sub></i>	Static <i>C<sub>s</sub></i>			
LPFT 2516-2.5	P	25	16	4.762	26.25	21.3	2.5×1	9900	16400	210	84	
LPFT 2516-3	P						1.5×2	11600	19100	247	100	
LSFT 2516-2.5	Clearance D						2.5×1	15700	32800	250	84	
LDFT 2516-2.5	Clearance D						1.5×2	15700	32800	490	152	
LSFT 2516-3	Clearance D						1.5×2	18400	38200	295	100	
LDFT 2516-3	Clearance D						1.5×2	18400	38200	577	181	
* LPFT 2520-2.5	P		20	16	4.762	26.25	21.3	2.5×1	9900	16400	210	96
LPFT 2520-3	P							1.5×2	11600	19100	247	116
LSFT 2520-2.5	Clearance D							2.5×1	15700	32800	250	96
LDFT 2520-2.5	Clearance D							1.5×2	15700	32800	490	177
LSFT 2520-3	Clearance D							1.5×2	18400	38200	295	116
LDFT 2520-3	Clearance D							1.5×2	18400	38200	577	217
* LPFT 2525-1.5	P	25	5	3.175	28.5	25.2	2.5×1	6380	9540	127	90	
LDFT 2525-1.5	D						1.5×1	10100	19100	308	166	
LSFT 2525-1.5	Clearance						2.5×2	10100	19100	157	90	
ZFT 2805-2.5	Clearance Z	28	5	3.175	28.5	25.2	2.5×1	9600	24400	252	41	
ZFT 2805-5	Clearance Z						2.5×1	9600	24400	495	56	
PFT 2805-5	Clearance Z						2.5×2	11000	24400	410	56	
SFT 2805-5	Clearance Z						2.5×2	17400	48800	487	56	
* ZFT 2805-10	Clearance Z						2.5×2	17400	48800	959	86	

- Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.  
 2. If there is no seal for PFT, ZFT, and SFT, the nut length "L" is shortened by dimension "M".  
 3. If there is no seal for LSFT and LDFT of shaft diameter 25 mm or larger, the nut length "L" is shortened by dimension "M" and "C".  
 4. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.

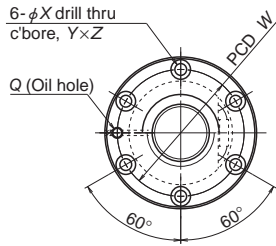
Ball nut dimensions															
Nut diameter		Flanged diameter	Flanged width	Notched flange	Tube projecting type			Seal dimension		Diameter g6	Bolt hole dimension			Bolt hole PCD	Oil hole
<i>D</i>	<i>S</i>	<i>A</i>	<i>B</i>	<i>G</i>	<i>U</i>	<i>V</i>	<i>R</i>	<i>M</i>	<i>C</i>	<i>J</i>	<i>X</i>	<i>Y</i>	<i>Z</i>	<i>W</i>	<i>Q</i>
44	—	71	—	23	31	35	12	—	—	—	—	—	—	57	—
44	—	71	—	23	31	35	12	—	—	—	—	—	—	57	—
44	—	71	12	23	31	35	12	6	8	—	6.6	—	—	57	M6×1
62	44	89	—	34	—	—	—	—	—	18	—	—	—	75	—
44	—	71	—	23	31	35	12	—	—	—	—	—	—	57	—
62	44	89	—	34	—	—	—	—	—	18	6.6	—	—	57	M6×1
44	—	71	12	23	31	35	12	7	8	—	—	—	—	75	—
62	44	89	—	34	—	—	—	—	—	18	—	—	—	75	—
44	—	71	—	23	32	34	12	—	—	—	—	—	—	57	—
62	44	89	12	34	—	—	—	10	10	18	6.6	—	—	75	M6×1
44	—	71	—	23	32	34	12	—	—	—	—	—	—	57	—
55	—	85	12	31	—	—	—	3	—	—	6.6	11	6.5	69	M6×1

- Remarks: 5. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (*C<sub>d</sub>*) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.  
 6. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.  
 7. The models marked with \* are in FA and SA type of standard ball screw with finished shaft end.  
 8. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

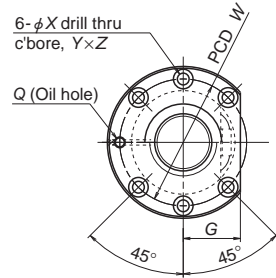


# Return tube type

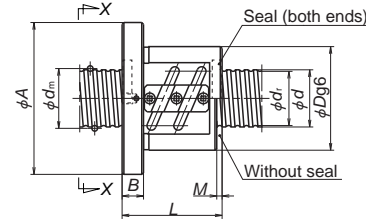
View X-X



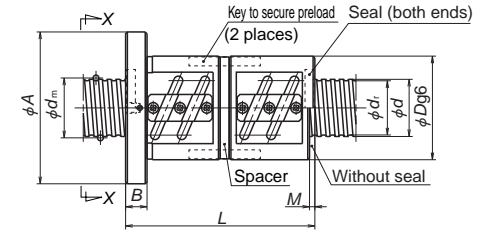
Circular shape I



Circular shape II



PFT, ZFT, SFT



DFT

Unit: mm

Model No.	Preload system	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)				
								Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>					
PFT 2806-3	P	28	6	3.175	28.5	25.2	1.5×2	7080	14600	252				
SFT 2806-2.5	Clearance Z						2.5×1	9600	24400	252				
ZFT 2806-5	P						2.5×1	9600	24400	495				
PFT 2806-5	P						2.5×2	11000	24400	410				
SFT 2806-3	Clearance Z						1.5×2	11200	29300	300				
DFT 2806-3	D						1.5×2	11200	29300	590				
SFT 2806-5	Clearance Z						2.5×2	17400	48800	487				
* ZFT 2806-10	Z						2.5×2	17400	48800	959				
PFT 2810-2.5	P						10	4.762	28.5	23.5	2.5×1	10500	18000	220
ZFT 2810-3	Z										1.5×1	10800	21500	320
PFT 2810-3	P	1.5×2	12300	21500	265									
SFT 2810-2.5	Clearance Z	2.5×1	16700	36100	265									
DFT 2810-2.5	D	2.5×1	16700	36100	522									
SFT 2810-3	Clearance Z	1.5×2	19500	43000	314									
DFT 2810-3	D	1.5×2	19500	43000	618									
SFT 3204-2.5	Clearance Z	32	4	2.381	32.3	29.8					2.5×1	5800	17500	234
ZFT 3204-5	Z										2.5×1	5800	17500	461
PFT 3204-5	P										2.5×2	6630	17500	382
SFT 3204-5	Clearance Z						2.5×2	10500	35100	454				
ZFT 3204-10	Z						2.5×2	10500	35100	892				
PFT 3205-3	P						1.5×2	7490	16800	281				
SFT 3205-2.5	Clearance Z						2.5×1	10200	28000	281				
ZFT 3205-5	Z						2.5×1	10200	28000	552				
* PFT 3205-5	P						2.5×2	11600	28000	455				
SFT 3205-3	Clearance Z						1.5×2	11900	33600	333				
DFT 3205-3	D	1.5×2	11900	33600	655									
PFT 3205-7.5	P	2.5×3	16500	42100	672									
SFT 3205-5	Clearance Z	2.5×2	18500	56100	543									
* ZFT 3205-10	Z	2.5×2	18500	56100	1070									
SFT 3205-7.5	Clearance Z	2.5×3	26200	84100	799									
DFT 3205-7.5	D	2.5×3	26200	84100	1572									

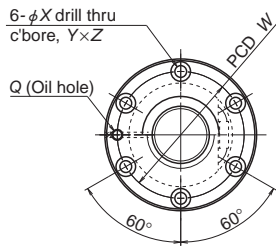
Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.  
2. If there is no seal for PFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".  
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.

Ball nut dimensions																				
Nut entire length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Notched flange <i>G</i>	Seal dimension <i>M</i>	Bolt hole dimension			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>										
						<i>X</i>	<i>Y</i>	<i>Z</i>												
57	55	85	12	31	3	6.6	11	6.5	69	M6×1										
45																				
63																				
63																				
57																				
111																				
63																				
99																				
68											60	94	15	36	7	9	14	8.5	76	M6×1
82																				
82																				
68																				
128																				
82																				
152																				
37	54	81	12	31	3	6.6	11	6.5	67	M6×1										
49																				
49																				
49																				
73																				
53											58	85	12	32	3	6.6	11	6.5	71	M6×1
41																				
56																				
56																				
53																				
103																				
71																				
56																				
86																				
71																				
136																				

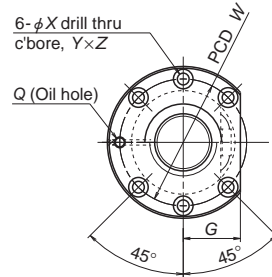
Remarks: 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (*C<sub>a</sub>*) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.  
5. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.  
6. The models marked with \* are in SA type of standard ball screw with finished shaft end.  
7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

# Return tube type

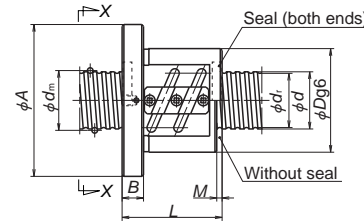
View X-X



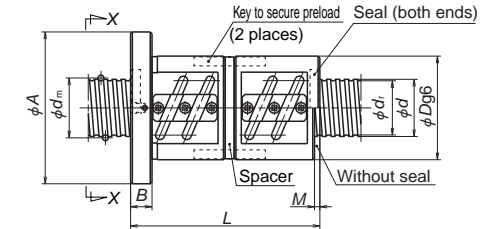
Circular shape I



Circular shape II



PFT, ZFT, SFT



DFT

Unit: mm

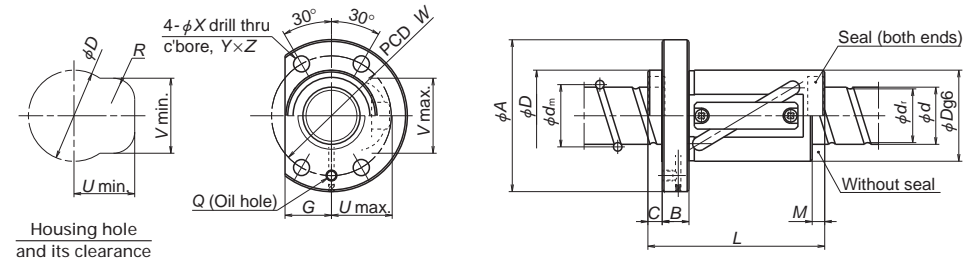
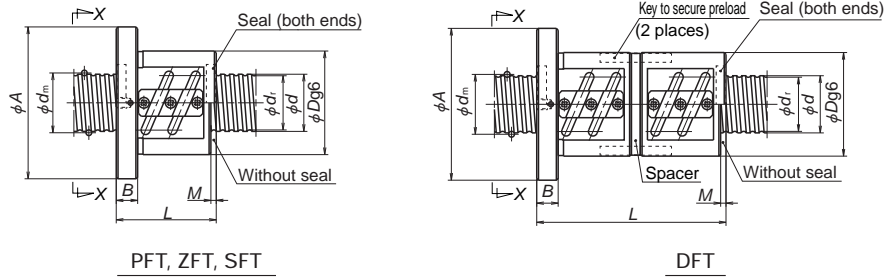
Model No.	Preload system	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)	
								Dynamic <i>C<sub>d</sub></i>	Static <i>C<sub>s</sub></i>		
PFT 3206-3	P	32	6	3.969	32.5	28.4	1.5×2	10000	20600	285	
SFT 3206-2.5	Clearance Z						2.5×1	13600	34700	287	
ZFT 3206-5	P						2.5×1	13600	34700	563	
PFT 3206-5	P						2.5×2	15500	34700	468	
SFT 3206-3	Clearance Z						1.5×2	15900	41200	339	
DFT 3206-3	D						1.5×2	15900	41200	666	
SFT 3206-5	Clearance Z		2.5×2	24700	69400	555					
ZFT 3206-10	Z		2.5×2	24700	69400	1090					
PFT 3208-3	P		32	8	4.762	32.5	27.5	1.5×2	12900	24800	294
SFT 3208-2.5	Clearance Z							2.5×1	17500	41000	292
ZFT 3208-5	P							2.5×1	17500	41000	573
PFT 3208-5	P							2.5×2	20000	41000	470
SFT 3208-3	Clearance Z	1.5×2						20400	49500	349	
ZFT 3208-6	Z	1.5×2						20400	49500	686	
SFT 3208-5	Clearance D	2.5×2		31700	82000	565					
DFT 3208-5	D	2.5×2		31700	82000	1110					
PFT 3210-2.5	P	32		10	6.35	33.0	26.4	2.5×1	16100	27000	255
ZFT 3210-3	Z							1.5×1	16400	32400	365
PFT 3210-3	P							1.5×2	18800	32400	303
SFT 3210-2.5	Clearance Z							2.5×1	25500	54000	302
ZFT 3210-5	P		2.5×1					25500	54000	594	
PFT 3210-5	P		2.5×2					29200	54000	494	
SFT 3210-3	Clearance D		1.5×2	29900	64800	360					
DFT 3210-3	D		1.5×2	29900	64800	707					
SFT 3210-3.5	Clearance D		3.5×1	34100	77000	422					
DFT 3210-3.5	D		3.5×1	34100	77000	829					
SFT 3210-5	Clearance D		2.5×2	46300	108000	585					
DFT 3210-5	D		2.5×2	46300	108000	1150					
PFT 3212-2.5	P	32	12	6.35	33.0	26.4	2.5×1	16100	27000	255	
ZFT 3212-3	Z						1.5×1	16400	32400	365	
PFT 3212-3	P						1.5×2	18800	32400	303	
SFT 3212-2.5	Clearance Z						2.5×1	25500	54000	302	
DFT 3212-2.5	D						2.5×1	25500	54000	603	
SFT 3212-3	Clearance D						1.5×2	29900	64800	360	
DFT 3212-3	D		1.5×2	29900	64800	707					

- Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.  
 2. If there is no seal for PFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".  
 3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.

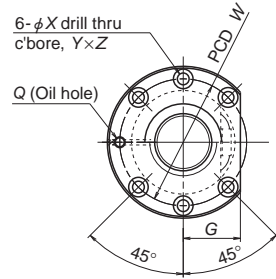
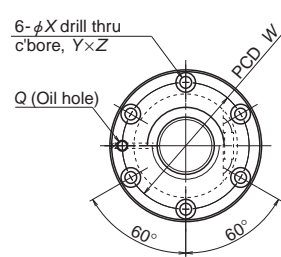
## Ball nut dimensions

Nut entire length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Notched flange <i>G</i>	Seal dimension <i>M</i>	Bolt hole dimension			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>
						<i>X</i>	<i>Y</i>	<i>Z</i>		
57	62	89	12	34	3	6.6	11	6.5	75	M6×1
45										
63										
63										
57										
111										
63	66	100	15	38	5	9	14	8.5	82	M6×1
99										
71										
58										
82										
82										
71	74	108	15	41	7	9	14	8.5	90	M6×1
111										
82										
167										
80										
150										
100	74	108	18	41	9	9	14	8.5	90	M6×1
100										
190										
81										
97										
153										
97										
181										

- Remarks: 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (*C<sub>d</sub>*) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.  
 5. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.  
 6. The models marked with \* are in SA type of standard ball screw with finished shaft end.  
 7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)



View X-X

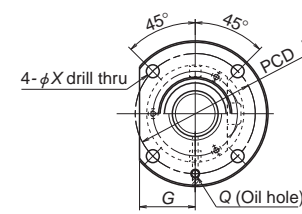


Circular shape I

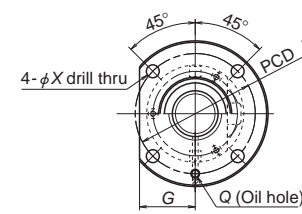
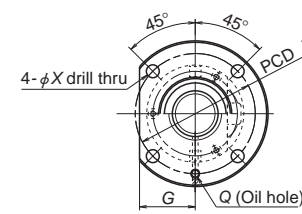
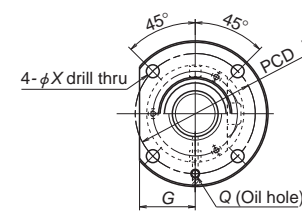
Circular shape II

Model No.	Preload system	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls × Circuits	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)	Nut entire length <i>L</i>
								Dynamic <i>C<sub>s</sub></i>	Static <i>C<sub>0s</sub></i>		
LPFT 3220-2.5	P	32	20	4.762	33.25	28.3	2.5×1	11300	20900	251	99
LPFT 3220-3	P						1.5×2	13200	24800	297	119
LSFT 3220-2.5	Clearance D						2.5×1	17900	41800	300	99
LDFT 3220-2.5	Clearance D						2.5×1	17900	41800	604	179
LSFT 3220-3	Clearance D						1.5×2	21000	49600	360	119
LDFT 3220-3	Clearance D						1.5×2	21000	49600	708	219
LPFT 3225-2.5	P	32	25	4.762	33.25	28.3	2.5×1	11300	20900	251	117
LPFT 3225-3	P						1.5×2	13200	24800	297	142
LSFT 3225-2.5	Clearance D						2.5×1	17900	41800	300	117
LDFT 3225-2.5	Clearance D						2.5×1	17900	41800	604	218
LSFT 3225-3	Clearance D						1.5×2	21000	49600	360	142
LDFT 3225-3	Clearance D						1.5×2	21000	49600	708	268
LPFT 3232-1.5	P	32	32	4.762	33.25	28.3	1.5×1	7280	12400	161	109
LSFT 3232-1.5	Clearance D						1.5×1	11500	24800	190	109
LDFT 3232-1.5	Clearance D						1.5×1	11500	24800	376	205
ZFT 3605-5	Z						36	5	3.175	36.5	33.2
PFT 3605-5	P	2.5×2	12200	31700	504	59					
PFT 3605-7.5	P	2.5×3	17300	47500	740	74					
SFT 3605-5	Clearance Z	2.5×2	19400	63300	597	59					
ZFT 3605-10	Z	2.5×2	19400	63300	1170	89					
SFT 3605-7.5	Clearance Z	2.5×3	27500	95000	878	74					
DFT 3605-7.5	D	2.5×3	27500	95000	1730	139					

Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.  
 2. If there is no seal for PFT, ZFT, and SFT, the nut length "L" is shortened by dimension "M".  
 3. If there is no seal for LSFT and LDFT of shaft diameter 25 mm or larger, the nut length "L" is shortened by dimension "M" and "C".  
 4. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



Housing hole and its clearance



LPFT, LSFT

LDFT

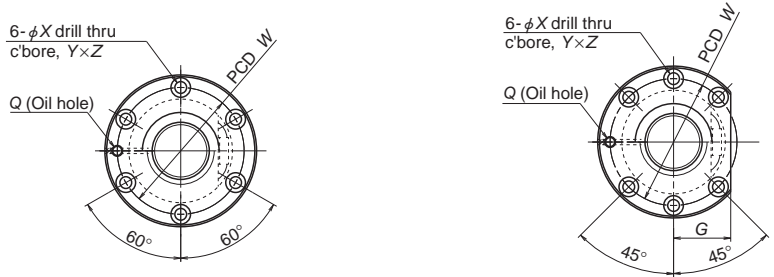
Unit: mm

Ball nut dimensions															
Nut diameter		Flanged diameter <i>A</i>	Flanged width <i>B</i>	Notched flange <i>G</i>	Tube projecting type			Seal dimension		Diameter g6 <i>J</i>	Bolt hole dimension			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>
<i>D</i>	<i>S</i>				<i>U</i>	<i>V</i>	<i>R</i>	<i>M</i>	<i>C</i>		<i>X</i>	<i>Y</i>	<i>Z</i>		
51	—	85	15	26	34	42	12	7	8	20	9	—	—	67	M6×1
51	—	85		26	34	42	12								
51	—	85		26	34	42	12								
68	51	102		39	—	—	—								
51	—	85		26	34	42	12								
68	51	102		39	—	—	—								
51	—	85	15	26	34	42	12	10	10	20	9	—	—	67	M6×1
51	—	85		26	34	42	12								
51	—	85		26	34	42	12								
68	51	102		39	—	—	—								
51	—	85		26	34	42	12								
68	51	102		39	—	—	—								
51	—	85	15	26	34	42	12	13	12	20	9	—	—	67	M6×1
51	—	85		26	34	42	12								
51	—	85		26	34	42	12								
68	51	102		39	—	—	—								
65	—	100	15	38	—	—	—	3	—	—	9	14	8.5	82	M6×1

Remarks: 5. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (*C<sub>s</sub>*) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.  
 6. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.  
 7. The models marked with \* are in FA type of standard ball screw with finished shaft end.  
 8. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

# Return tube type

View X-X

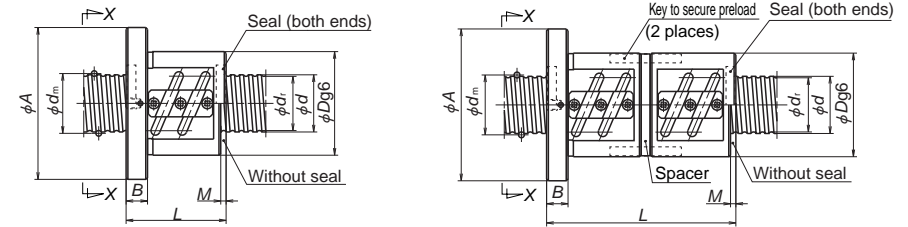


Circular shape I

Circular shape II

Model No.	Preload system	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)	
								Dynamic <i>C<sub>d</sub></i>	Static <i>C<sub>0a</sub></i>		
ZFT 3606-5	Z	36	6	3.969	36.5	32.4	2.5×1	14600	39300	625	
PFT 3606-5	P						2.5×2	16700	39300	518	
PFT 3606-7.5	P						2.5×3	23700	58900	763	
SFT 3606-5	Clearance						2.5×2	26500	78500	615	
ZFT 3606-10	Z						2.5×2	26500	78500	1210	
SFT 3606-7.5	Clearance						2.5×3	37600	118000	905	
DFT 3606-7.5	D		2.5×3	37600	118000	1780					
PFT 3610-2.5	P		36	10	6.35	37.0	30.4	2.5×1	17100	30600	278
ZFT 3610-3	Z							1.5×1	17500	36800	404
PFT 3610-3	P							1.5×2	20000	36800	327
SFT 3610-2.5	Clearance							2.5×1	27200	61300	334
ZFT 3610-5	Z							2.5×1	27200	61300	657
PFT 3610-5	P	2.5×2						31100	61300	537	
SFT 3610-3	Clearance	1.5×2		31800	73500	397					
DFT 3610-3	D	1.5×2		31800	73500	781					
SFT 3610-5	Clearance	2.5×2		49300	123000	647					
DFT 3610-5	D	2.5×2		49300	123000	1270					
PFT 4005-3	P	40		5	3.175	40.5	37.2	1.5×2	8210	21200	337
SFT 4005-2.5	Clearance							2.5×1	11100	35300	336
ZFT 4005-5	Z		2.5×1					11100	35300	661	
PFT 4005-5	P		2.5×2					12700	35300	548	
SFT 4005-3	Clearance		1.5×2					13000	42400	399	
DFT 4005-3	D		1.5×2					13000	42400	785	
PFT 4005-7.5	P		2.5×3	18100	53000	806					
SFT 4005-5	Clearance		2.5×2	20200	70600	649					
* ZFT 4005-10	Z		2.5×2	20200	70600	1280					
SFT 4005-7.5	Clearance		2.5×3	28700	106000	956					
DFT 4005-7.5	D		2.5×3	28700	106000	1870					
ZFT 4006-5	Z		40	6	3.969	40.5	36.4	2.5×1	15200	43800	679
PFT 4006-5	P	2.5×2						17400	43800	564	
SFT 4006-3	Clearance	1.5×2						17800	52600	411	
DFT 4006-3	D	1.5×2						17800	52600	807	
PFT 4006-7.5	P	2.5×3						24600	65700	827	
SFT 4006-5	Clearance	2.5×2						27600	87600	668	
ZFT 4006-10	Z	2.5×2		27600	87600	1320					
SFT 4006-7.5	Clearance	2.5×3		39100	131000	984					
DFT 4006-7.5	D	2.5×3		39100	131000	1940					

- Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.  
 2. If there is no seal for PFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".  
 3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



PFT, ZFT, SFT

DFT

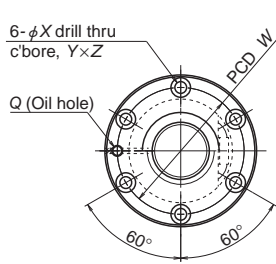
Unit: mm

Ball nut dimensions										
Nut entire length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Notched flange <i>G</i>	Seal dimension <i>M</i>	Bolt hole dimension			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>
						<i>X</i>	<i>Y</i>	<i>Z</i>		
66	65	100	15	38	3	9	14	8.5	82	M6×1
66										
84										
66										
102										
84										
162										
73	75	120	18	45	7	11	17.5	11	98	M6×1
90										
90										
73										
103										
103										
90										
170										
103										
193										
56	67	101	15	39	3	9	14	8.5	83	Rc1/8
44										
59										
59										
56										
106										
74										
59										
89										
74										
139										
66	70	104	15	40	3	9	14	8.5	86	Rc1/8
66										
60										
114										
84										
66										
102										
84										
162										

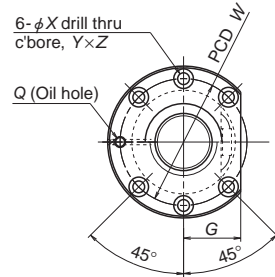
- Remarks: 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (*C<sub>d</sub>*) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.  
 5. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.  
 6. The models marked with \* are in SA type of standard ball screw with finished shaft end.  
 7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

# Return tube type

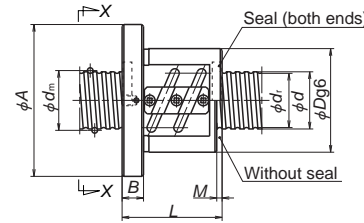
View X-X



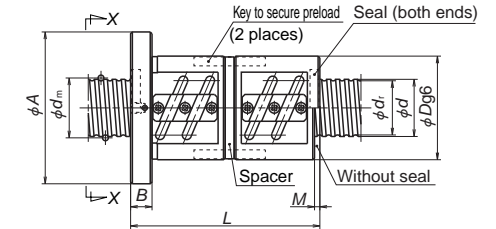
Circular shape I



Circular shape II



PFT, ZFT, SFT



DFT

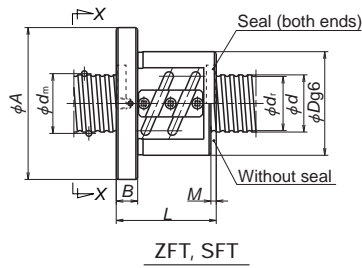
Unit: mm

Model No.	Preload system	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls × Circuits	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)					
								Dynamic <i>C<sub>d</sub></i>	Static <i>C<sub>0a</sub></i>						
PFT 4008-3	P	40	8	4.762	40.5	35.5	1.5×2	14200	31300	352					
SFT 4008-2.5	Clearance Z						2.5×1	19200	51600	349					
ZFT 4008-5	Z						2.5×1	19200	51600	687					
PFT 4008-5	P						2.5×2	22000	51600	570					
SFT 4008-3	Clearance Z						1.5×2	22500	62600	418					
DFT 4008-3	D						1.5×2	22500	62600	822					
SFT 4008-5	Clearance Z						2.5×2	34900	103000	675					
ZFT 4008-10	Z						2.5×2	34900	103000	1330					
PFT 4010-2.5	P						40	10	6.35	41	34.4	2.5×1	18000	34300	307
PFT 4010-3	P											1.5×2	21100	41100	366
SFT 4010-2.5	Clearance Z	2.5×1	28600	68600	365										
ZFT 4010-5	Z	2.5×1	28600	68600	717										
PFT 4010-5	P	2.5×2	32800	68600	595										
SFT 4010-3	Clearance Z	1.5×2	33500	82300	434										
ZFT 4010-6	Z	1.5×2	33500	82300	854										
ZFT 4010-7	Z	3.5×1	38300	96000	988										
SFT 4010-3.5	Clearance Z	3.5×1	38300	96000	503										
SFT 4010-5	Clearance Z	2.5×2	52000	137000	706										
* DFT 4010-5	D	2.5×2	52000	137000	1390										
PFT 4012-2.5	P	40	12	7.144	41.5	34.1						2.5×1	21200	38800	310
SFT 4012-2.5	Clearance Z											2.5×1	33600	77500	373
ZFT 4012-5	Z											2.5×1	33600	77500	733
PFT 4012-5	P						2.5×2	38400	77500	600					
SFT 4012-5	Clearance Z						2.5×2	61000	155000	722					
* DFT 4012-5	D						2.5×2	61000	155000	1420					
ZFT 4016-3	Z						40	16	7.144	41.5	34.1	1.5×1	21700	46500	451
SFT 4016-2.5	Clearance Z											2.5×1	33600	77500	373
DFT 4016-2.5	D	2.5×1	33600	77500	733										
SFT 4016-3	Clearance Z	1.5×2	39300	93100	440										
DFT 4016-3	D	1.5×2	39300	93100	872										

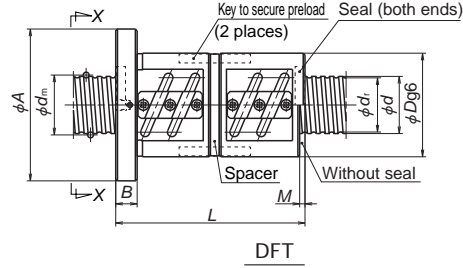
- Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.  
 2. If there is no seal for PFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".  
 3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.

Nut entire length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Notched flange <i>G</i>	Seal dimension <i>M</i>	Ball nut dimensions			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>										
						Bolt hole dimension														
						<i>X</i>	<i>Y</i>	<i>Z</i>												
71	74	108	15	41	5	9	14	8.5	90	Rc1/8										
58																				
82																				
82																				
71																				
135																				
82																				
130																				
73											82	124	18	47	7	11	17.5	11	102	Rc1/8
90																				
73																				
103																				
103																				
90																				
140																				
123																				
83																				
103																				
193																				
81	86	128	18	48	9	11	17.5	11	106	Rc1/8										
81																				
117																				
117																				
117																				
225																				
118											86	128	22	48	14	11	17.5	11	106	Rc1/8
102																				
182																				
118																				
214																				

- Remarks: 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (*C<sub>d</sub>*) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.  
 5. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.  
 6. The models marked with \* are in SA type of standard ball screw with finished shaft end.  
 7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

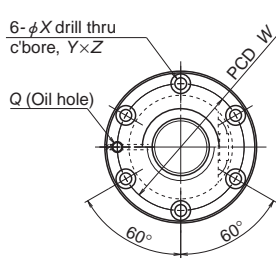


ZFT, SFT

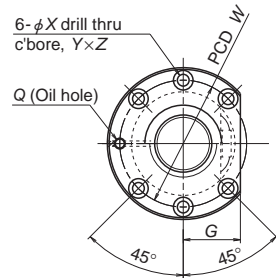


DFT

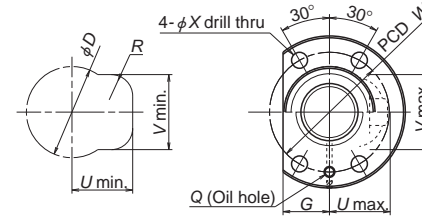
View X-X



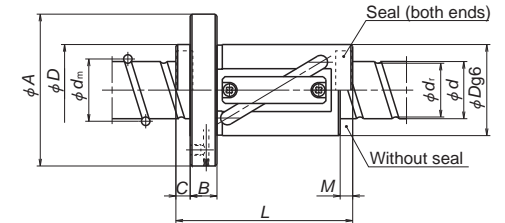
Circular shape I



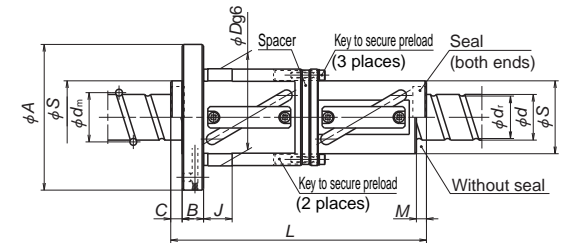
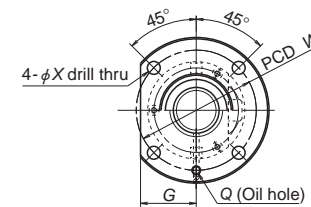
Circular shape II



Housing hole and its clearance



LPFT, LSFT



LDFT

Unit: mm

Model No.	Preload system	Shaft dia. d	Lead I	Ball dia. D <sub>w</sub>	Ball circle dia. d <sub>m</sub>	Root dia. d <sub>r</sub>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity K (N/μm)	Nut entire length L					
								Dynamic C <sub>s</sub>	Static C <sub>0s</sub>							
LPFT 4025-2.5	P	40	25	6.35	41.75	35.1	2.5×1	18000	35000	315	123					
LPFT 4025-3	P						1.5×2	21000	41200	347	148					
LSFT 4025-2.5	D						2.5×1	28500	70000	375	123					
LDFT 4025-2.5	D						2.5×1	28500	70000	737	223					
LSFT 4025-3	D						1.5×2	33400	82400	444	148					
LDFT 4025-3	D						1.5×2	33400	82400	873	273					
LPFT 4032-2.5	P		32	6.35	41.75	35.1	2.5×1	18000	35000	315	146					
LPFT 4032-2.5	P							28500	70000	375	146					
LSFT 4032-2.5	D							28500	70000	737	274					
LDFT 4032-2.5	D							11600	20600	199	133					
LPFT 4040-1.5	P							40	6.35	41.75	35.1	1.5×1	18400	41200	237	133
LSFT 4040-1.5	D												18400	41200	465	253
LDFT 4040-1.5	D	29900	77300	784	103											
ZFT 4510-5	Z	45	10	6.35	46.0	39.4	2.5×2						54200	155000	772	103
SFT 4510-5	D						2.5×2						54200	155000	1520	193
DFT 4510-5	D						2.5×3						76800	232000	1140	133
SFT 4510-7.5	D						2.5×3	76800	232000	2230	253					
DFT 4510-7.5	D						2.5×1	35400	88500	412	83					
SFT 4512-2.5	Z						12	7.144	46.5	39.1	2.5×1	35400	88500	811	119	
ZFT 4512-5	D		2.5×2	64200	177000	798						119				
SFT 4512-5	D		2.5×2	64200	177000	1570						227				
DFT 4512-5	D		2.5×2	64200	177000	1570						227				

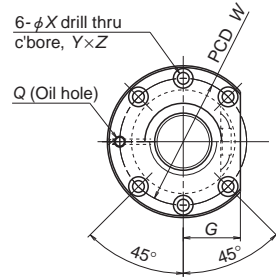
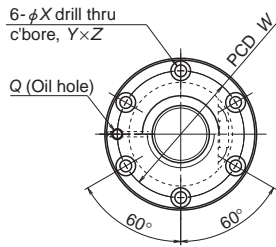
- Remarks:
1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
  2. If there is no seal for PFT, ZFT, and SFT, the nut length "L" is shortened by dimension "M".
  3. If there is no seal for LSFT and LDFT of shaft diameter 25 mm or larger, the nut length "L" is shortened by dimension "M" and "C".
  4. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.

Ball nut dimensions															
Nut diameter		Flanged diameter	Flanged width	Notched flange	Tube projecting type			Seal dimension	Diameter g6	Bolt hole dimension			Bolt hole PCD	Oil hole	
D	S	A	B	G	U	V	R	M	C	J	X	Y	Z	W	Q
64	—	106	—	33	42	52	15	—	—	—	—	—	—	84	—
64	—	106	—	33	42	52	15	—	—	—	—	—	—	84	—
64	—	106	18	33	42	52	15	10	10	—	11	—	—	104	Rc1/8
84	64	126	—	48	—	—	—	—	—	—	—	—	—	104	—
64	—	106	—	33	42	52	15	—	—	—	—	—	—	84	—
64	—	106	18	33	42	52	15	13	12	—	11	—	—	84	Rc1/8
84	64	126	—	48	—	—	—	—	—	—	—	—	—	104	—
64	—	106	—	33	42	52	15	—	—	—	—	—	—	84	—
64	—	106	18	33	42	52	15	16	14	—	11	—	—	84	Rc1/8
84	64	126	—	48	—	—	—	—	—	—	—	—	—	104	—
88	—	132	18	50	—	—	—	7	—	—	11	17.5	11	110	Rc1/8
90	—	132	18	50	—	—	—	8	—	—	11	17.5	11	110	Rc1/8

- Remarks:
5. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C<sub>s</sub>) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.
  6. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.
  7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

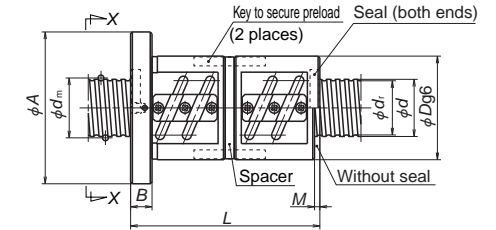
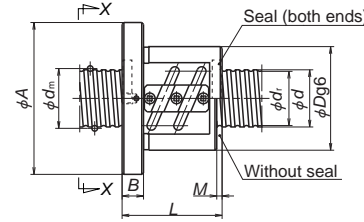
# Return tube type

View X-X



Circular shape I

Circular shape II



ZFT, SFT

DFT

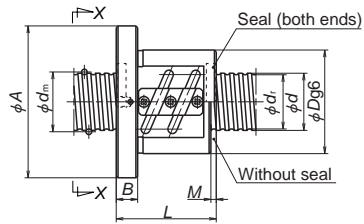
Unit: mm

Model No.	Preload system	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)				
								Dynamic <i>C<sub>d</sub></i>	Static <i>C<sub>0</sub></i>					
SFT 5005-3	Clearance Z	50	5	3.175	50.5	47.2	1.5×2	14200	52500	472				
ZFT 5005-6							1.5×2	14200	52500	930				
SFT 5005-4.5							1.5×3	20200	78800	696				
ZFT 5005-9	1.5×3						20200	78800	1360					
SFT 5006-3	Clearance D						6	3.969	50.5	46.4	1.5×2	19500	65100	486
DFT 5006-3											1.5×2	19500	65100	956
SFT 5006-5			2.5×2	30300	109000	794								
ZFT 5006-10	2.5×2		30300	109000	1562									
SFT 5006-7.5	Clearance D		8	4.762	50.5	45.5					2.5×3	42900	164000	1170
DFT 5006-7.5											2.5×3	42900	164000	2300
SFT 5008-3	Clearance D						10	6.35	51.0	44.4	1.5×2	25000	77400	496
DFT 5008-3											1.5×2	25000	77400	975
SFT 5008-5		2.5×2									38700	131000	815	
ZFT 5008-10	2.5×2	38700									131000	1600		
SFT 5008-7.5	Clearance D	12	7.938	51.5	43.2	2.5×3					54900	197000	1200	
DFT 5008-7.5						2.5×3					54900	197000	2350	
SFT 5010-2.5	Clearance Z					16	7.938	51.5	43.2	2.5×1	31800	87400	440	
ZFT 5010-5										2.5×1	31800	87400	866	
SFT 5010-3										1.5×2	37200	103000	517	
DFT 5010-3	1.5×2									37200	103000	1010		
ZFT 5010-7	Clearance Z	20	7.938	51.5	43.2					3.5×1	42500	122000	1190	
SFT 5010-5										2.5×2	57700	175000	853	
ZFT 5010-10						2.5×2	57700	175000	1677					
SFT 5010-7.5	Clearance D					28	7.938	51.5	43.2	2.5×3	81800	262000	1250	
DFT 5010-7.5										2.5×3	81800	262000	2460	
SFT 5012-2.5	Clearance Z									28	7.938	51.5	43.2	2.5×1
ZFT 5012-5		2.5×1	42800	107000	883									
SFT 5012-5		2.5×2	77600	214000	869									
DFT 5012-5	2.5×2	77600	214000	1710										
SFT 5016-2.5	Clearance Z	32	7.938	51.5	43.2	2.5×1	42800	107000	449					
ZFT 5016-5						2.5×1	42800	107000	883					
SFT 5016-5						2.5×2	77600	214000	869					
DFT 5016-5	2.5×2					77600	214000	1710						
ZFT 5020-3	Clearance Z					36	7.938	51.5	43.2	1.5×1	27600	64300	542	
SFT 5020-2.5										2.5×1	42800	107000	449	
DFT 5020-2.5		2.5×1	42800	107000	883									
SFT 5020-3	Clearance D	40	7.938	51.5	43.2					1.5×2	50000	129000	534	
DFT 5020-3										1.5×2	50000	129000	1050	

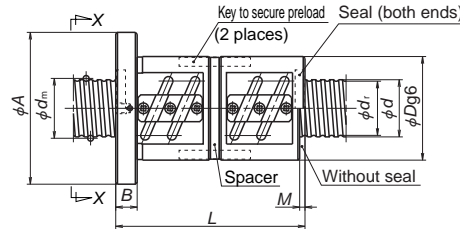
Ball nut dimensions										
Nut entire length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Notched flange <i>G</i>	Seal dimension <i>M</i>	Bolt hole dimension			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>
						<i>X</i>	<i>Y</i>	<i>Z</i>		
58	80	114	15	43	3	9	14	8.5	96	Rc1/8
83										
68										
103										
62										
116	84	118	15	45	3	9	14	8.5	100	Rc1/8
68										
104										
86										
164										
74	87	129	18	49	5	11	17.5	11	107	Rc1/8
138										
85										
133										
205										
73	93	135	18	51	7	11	17.5	11	113	Rc1/8
103										
90										
170										
123										
103	100	146	22	55	8	14	20	13	122	Rc1/8
163										
133										
253										
87										
123	100	146	22	55	14	14	20	13	122	Rc1/8
123										
231										
104										
152										
147	100	146	28	55	17	14	20	13	122	Rc1/8
127										
227										
147										
267										

Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.  
 2. If there is no seal for PFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".  
 3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.

Remarks: 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (*C<sub>d</sub>*) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.  
 5. The models marked with \* are in SA type of standard ball screw with finished shaft end.  
 6. Preload system: Z, Offset preload; D, Double nut preload (Refer to Page B5)

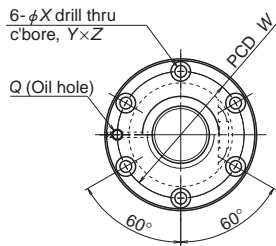


ZFT, SFT

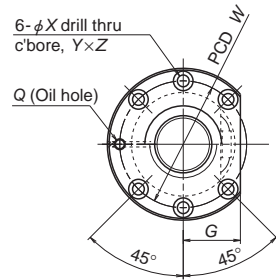


DFT

View X-X



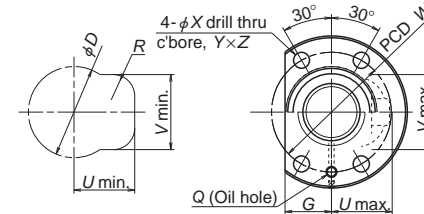
Circular shape I



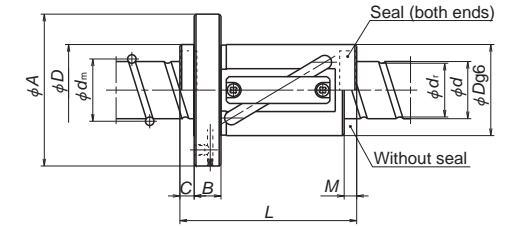
Circular shape II

Model No.	Preload system	Shaft dia. $d$	Lead $l$	Ball dia. $D_w$	Ball circle dia. $d_m$	Root dia. $d_r$	Effective turns of balls $\times$ Circuits	Basic load rating (N)		Axial rigidity $K$ (N/ $\mu$ m)	Nut entire length $L$
								Dynamic $C_d$	Static $C_{st}$		
LPFT 5025-2.5	P	25	7.938	52.25	44	44	2.5x1	26900	54700	388	129
LPFT 5025-3	P						1.5x2	31400	66500	450	154
LSFT 5025-2.5	Clearance D						2.5x1	42700	109000	462	129
LDFT 5025-2.5	D						2.5x1	42700	109000	905	229
LSFT 5025-3	Clearance D						1.5x2	49900	133000	547	154
LDFT 5025-3	D						1.5x2	49900	133000	1070	279
LPFT 5032-2.5	P	50	32	7.938	52.25	44	2.5x1	26900	54700	388	151
LPFT 5032-3	P						1.5x2	31400	66500	450	183
LSFT 5032-2.5	Clearance D						2.5x1	42700	109000	462	151
LDFT 5032-2.5	D						2.5x1	42700	109000	905	279
LSFT 5032-3	Clearance D						1.5x2	49900	133000	547	183
LDFT 5032-3	D						1.5x2	49900	133000	1070	343
LPFT 5040-2.5	P	40	7.938	52.25	44	44	2.5x1	26900	54700	388	178
LSFT 5040-2.5	Clearance D						42700	109000	462	178	
LDFT 5040-2.5	D						42700	109000	922	338	
LPFT 5050-1.5	P	50	7.938	52.25	44	44	1.5x1	17300	33200	245	161
LSFT 5050-1.5	Clearance D						27500	66500	290	161	
LDFT 5050-1.5	D						27500	66500	572	312	
ZFT 5510-5	Z	55	10	6.35	56.0	49.4	2.5x1	32800	96100	929	103
SFT 5510-5	Clearance Z						2.5x2	59500	192000	916	103
ZFT 5510-10	Z						2.5x2	59500	192000	1800	163
DFT 5510-5	D						2.5x2	59500	192000	1800	193
SFT 5510-7.5	Clearance D						2.5x3	84300	288000	1350	133
DFT 5510-7.5	D						2.5x3	84300	288000	2650	253

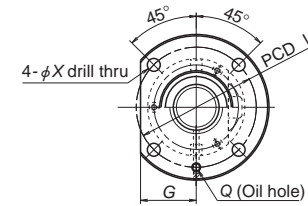
- Remarks:
1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
  2. If there is no seal for PFT, ZFT, and SFT, the nut length "L" is shortened by dimension "M".
  3. If there is no seal for LSFT and LDFT of shaft diameter 25 mm or larger, the nut length "L" is shortened by dimension "M" and "C".
  4. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



Housing hole and its clearance



LPFT, LSFT



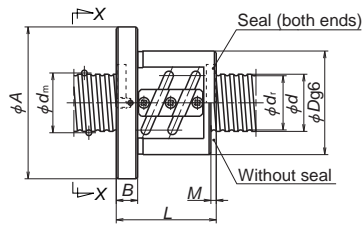
LDFT

Unit: mm

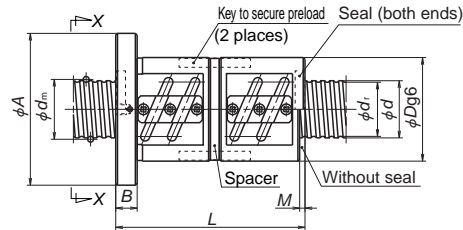
Ball nut dimensions															
Nut diameter		Flanged diameter	Flanged width	Notched flange	Tube projecting type			Seal dimension		Diameter	Bolt hole dimension			Bolt hole	Oil hole
$D$	$S$	$A$	$B$	$G$	$U$	$V$	$R$	$M$	$C$	$g6$	$X$	$Y$	$Z$	PCD $W$	$Q$
80	—	126	—	41	52	64	19	—	—	—	—	—	—	102	—
80	—	126	—	41	52	64	19	—	—	—	—	—	—	102	—
80	—	126	—	41	52	64	19	—	—	—	—	—	—	102	—
106	80	152	22	56	—	—	—	11	11	25	14	—	—	128	Rc1/8
80	—	126	—	41	52	64	19	—	—	—	—	—	—	102	—
80	—	126	—	41	52	64	19	—	—	—	—	—	—	102	—
80	—	126	—	41	52	64	19	14	12	—	14	—	—	102	Rc1/8
106	80	152	—	56	—	—	—	—	—	25	—	—	—	128	—
80	—	126	—	41	52	64	19	—	—	—	—	—	—	102	—
80	—	126	—	41	52	64	19	17	14	—	14	—	—	102	Rc1/8
106	80	152	—	56	—	—	—	—	—	25	—	—	—	128	—
80	—	126	—	41	52	64	19	—	—	—	—	—	—	102	—
80	—	126	—	41	52	64	19	21	16	—	14	—	—	102	Rc1/8
106	80	152	—	56	—	—	—	—	—	25	—	—	—	128	—
102	—	144	18	54	—	—	—	7	—	—	11	17.5	11	122	Rc1/8

- Remarks:
5. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating ( $C_d$ ) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.
  6. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.
  7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)



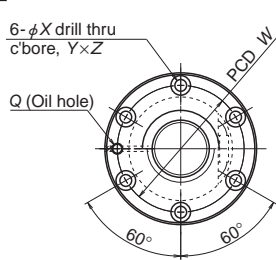


SFT, ZFT

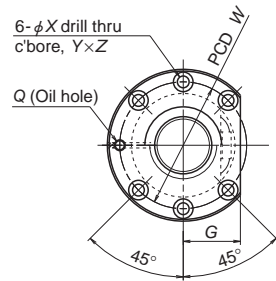


DFT

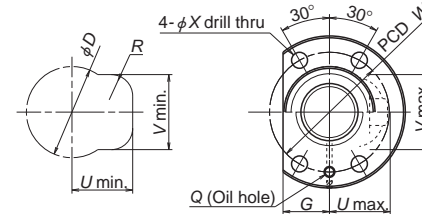
View X-X



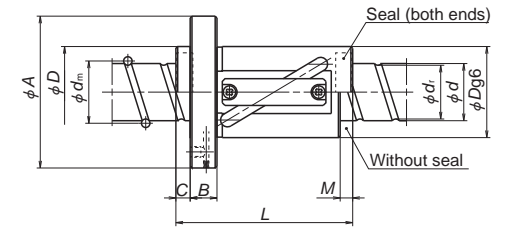
Circular shape I



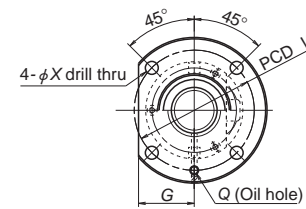
Circular shape II



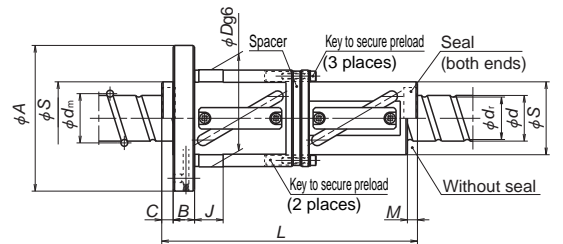
Housing hole and its clearance



LPFT, LSFT



LDFT



Unit: mm

Model No.	Preload system	Shaft dia. d	Lead I	Ball dia. Dw	Ball circle dia. dm	Root dia. dt	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity K (N/μm)	Nut entire length L			
								Dynamic Cs	Static Csa					
SFT 6310-2.5	Clearance Z	63	10	6.35	64.0	57.4	2.5×1	34800	111000	528	77			
ZFT 6310-5							2.5×1	34800	111000	1038	107			
SFT 6310-5	2.5×2						63200	221000	1020	107				
ZFT 6310-10	2.5×2						63200	221000	2000	167				
SFT 6310-7.5	2.5×3						89500	332000	1500	137				
DFT 6310-7.5	2.5×3						89500	332000	2950	257				
SFT 6320-2.5	Clearance D		20	9.525	65.0	55.2	2.5×1	79500	228000	713	127			
DFT 6320-2.5							2.5×1	79500	228000	1400	227			
SFT 6320-5	2.5×2						144000	455000	1380	187				
DFT 6320-5	2.5×2						144000	455000	2710	347				
LPFT 6340-2.5	P	40					7.938	65.25	57	2.5×1	30600	69500	466	178
LPFT 6340-3										1.5×2	35800	82500	551	218
LSFT 6340-2.5	2.5×1		48500	139000	560	178								
LDFT 6340-2.5	2.5×1		48500	139000	1100	339								
LSFT 6340-3	1.5×2		56800	165000	667	218								
LDFT 6340-3	1.5×2		56800	165000	1310	419								
LPFT 6350-1.5	P	50	7.938	65.25	57	1.5×1	19700	41200	285	161				
LPFT 6350-2.5						2.5×1	30600	69500	478	211				
LSFT 6350-1.5	1.5×1					31300	82500	346	161					
LDFT 6350-1.5	1.5×1					31300	82500	678	311					
LSFT 6350-2.5	2.5×1					48500	139000	560	211					
LDFT 6350-2.5	2.5×1					48500	139000	1120	411					

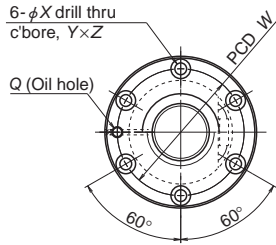
- Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.  
 2. If there is no seal for PFT, ZFT, and SFT, the nut length "L" is shortened by dimension "M".  
 3. If there is no seal for LSFT and LDFT of shaft diameter 25 mm or larger, the nut length "L" is shortened by dimension "M" and "C".  
 4. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.

Ball nut dimensions																
Nut diameter		Flanged diameter	Flanged width	Notched flange	Tube projecting type			Seal dimension		Diameter g6	Bolt hole dimension			Bolt hole PCD	Oil hole	
D	S	A	B	G	U	V	R	M	C	J	X	Y	Z	W	Q	
108	—	154	22	58	—	—	—	7	—	—	14	20	13	130	Rc1/8	
122	—	180	28	69	—	—	—	17	—	—	18	26	17.5	150	Rc1/8	
97	—	144	22	49	58	77	19	15	14	29	14	—	—	120	Rc1/8	
97	—	144		49	58	77	19									
97	—	144		49	58	77	19									
122	97	168		62	—	—	—									15
97	—	144		49	58	77	19									
122	97	168		62	—	—	—									15
97	—	144	22	49	58	77	19	19	16	29	14	—	120	Rc1/8		
97	—	144		49	58	77	19									
97	—	144		49	58	77	19									
122	97	168		62	—	—	—								19	
97	—	144		49	58	77	19									
122	97	168		62	—	—	—								19	

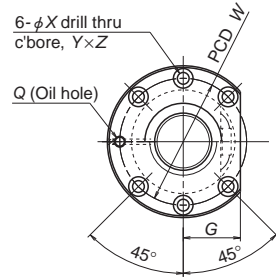
- Remarks: 5. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.  
 6. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.  
 7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

# Return tube type

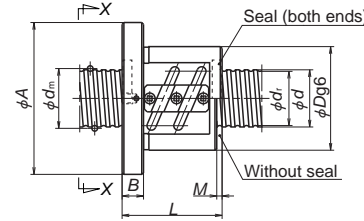
View X-X



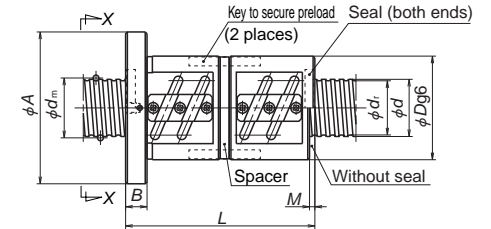
Circular shape I



Circular shape II



SFT



DFT

Unit: mm

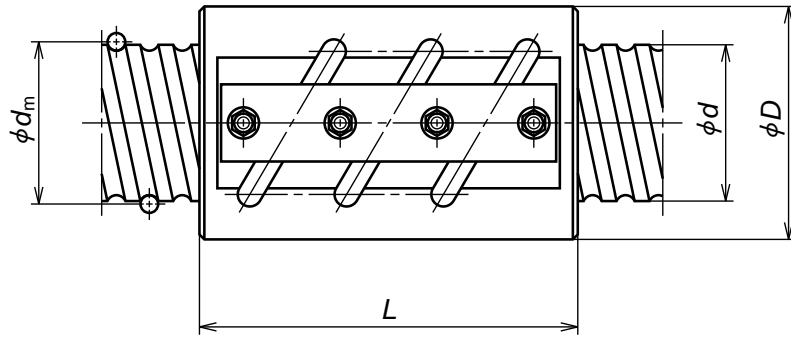
Model No.	Preload system	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)						
								Dynamic <i>C<sub>d</sub></i>	Static <i>C<sub>0a</sub></i>							
SFT 8010-5 DFT 8010-5 SFT 8010-7.5 DFT 8010-7.5	Clearance D Clearance D	80	10	6.35	81.0	74.4	2.5×2	70500	282000	1240						
SFT 8012-5 DFT 8012-5 SFT 8012-7.5 DFT 8012-7.5	Clearance D Clearance D		80	12	7.938	81.5	73.2	2.5×2	96000	350000	1280					
SFT 8016-5 DFT 8016-5 SFT 8016-7.5 DFT 8016-7.5	Clearance D Clearance D			80	16	9.525	82.0	72.2	2.5×2	162000	582000	1680				
SFT 8020-5 DFT 8020-5 SFT 8020-7.5 DFT 8020-7.5	Clearance D Clearance D	80			20	9.525	82.0	72.2	2.5×2	162000	582000	1680				
SFT 10012-5 DFT 10012-5 SFT 10012-7.5 DFT 10012-7.5	Clearance D Clearance D		100		12	7.938	101.5	93.2	2.5×2	105000	441000	1530				
SFT 10016-5 DFT 10016-5 SFT 10016-7.5 DFT 10016-7.5	Clearance D Clearance D			100	16	9.525	102	92.2	2.5×2	176000	737000	2010				
SFT 10020-5 DFT 10020-5 SFT 10020-7.5 DFT 10020-7.5	Clearance D Clearance D	100			20	9.525	102	92.2	2.5×2	176000	737000	2010				
SFT 12516-5 DFT 12516-5 SFT 12516-7.5 DFT 12516-7.5	Clearance D Clearance D		125		16	9.525	127	117.2	2.5×2	195000	918000	2390				
SFT 12520-5 DFT 12520-5 SFT 12520-7.5 DFT 12520-7.5	Clearance D Clearance D			125	20	9.525	127	117.2	2.5×2	195000	918000	2390				

Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.  
2. If there is no seal for PFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".  
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.

Ball nut dimensions										
Nut entire length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Notched flange <i>G</i>	Seal dimension <i>M</i>	Bolt hole dimension			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>
						<i>X</i>	<i>Y</i>	<i>Z</i>		
107	130	176	22	66	7	14	20	13	152	Rc1/8
197										
137										
257										
123	136	182	22	68	8	14	20	13	158	Rc1/8
231										
159										
303										
158	143	204	28	77	10	18	26	17.5	172	Rc1/8
302										
206										
398										
187	143	204	28	77	17	18	26	17.5	172	Rc1/8
347										
247										
467										
129	160	220	28	82	8	18	26	17.5	188	Rc1/8
237										
165										
309										
162	170	243	32	91	10	22	32	21.5	205	Rc1/8
306										
210										
402										
191	170	243	32	91	17	22	32	21.5	205	Rc1/8
351										
251										
471										
170	200	290	36	109	10	26	39	25.5	243	Rc1/8
314										
218										
410										
199	200	290	36	109	12	26	39	25.5	243	Rc1/8
379										
259										
499										

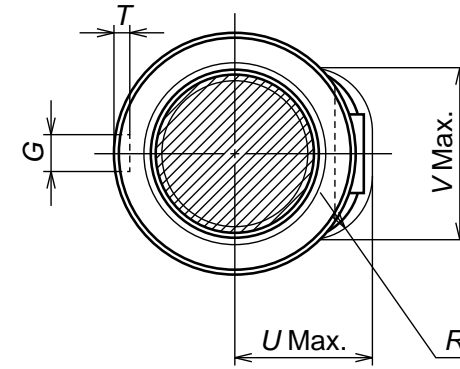
Remarks: 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (*C<sub>d</sub>*) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.  
5. Preload system: D: Double nut preload (Refer to Page B5)

## Return tube type



## Nut model GSCT (non-preload)

**NSK**



Model No.	Axial play (Max.)	Shaft dia. <i>d</i>	Lead <i>I</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d</i>	Effective turns of balls Turns × Circuits	Basic load rating (N)	
								Dynamic <i>C<sub>s</sub></i>	Static <i>C<sub>0s</sub></i>
GSCT14025-5	0.25	140	25	15.875	143	126.0	2.5×2 2.5×3	272000	1400000
GSCT14025-7.5								362000	2090000
GSCT14032-5	0.35	140	32	22.225	144	121.0	2.5×2 2.5×3	428000	1920000
GSCT14032-7.5								568000	2880000
GSCT14040-5	0.35	140	40	22.225	144	121.0	2.5×2 2.5×3	428000	1920000
GSCT14040-7.5								568000	2880000
GSCT14050-5	0.40	140	50	25.4	145	119.0	2.5×2 2.5×3	518000	2190000
GSCT14050-7.5								688000	3290000
GSCT16032-5	0.35	160	32	22.225	164	141.0	2.5×2 2.5×3	458000	2210000
GSCT16032-7.5								608000	3310000
GSCT16040-5	0.35	160	40	22.225	164	141.0	2.5×2 2.5×3	458000	2210000
GSCT16040-7.5								608000	3310000
GSCT16050-5	0.40	160	50	25.4	165	139.0	2.5×2 2.5×3	544000	2560000
GSCT16050-7.5								722000	3840000
GSCT20032-5	0.35	200	32	22.225	204	181.0	2.5×2 2.5×3	509000	2820000
GSCT20032-7.5								676000	4230000
GSCT20040-5	0.35	200	40	22.225	204	181.0	2.5×2 2.5×3	509000	2820000
GSCT20040-7.5								676000	4230000
GSCT20050-5	0.40	200	50	25.4	205	179.0	2.5×2 2.5×3	604000	3200000
GSCT20050-7.5								802000	4800000
GSCT25040-5	0.40	250	40	25.4	255	229.0	2.5×2 2.5×3	662000	4000000
GSCT25040-7.5								879000	6000000
GSCT25050-5	0.51	250	50	31.75	256	223.0	2.5×2 2.5×3	825000	5000000
GSCT25050-7.5								1100000	7500000

Remarks 1. Precision grade is equivalent to Ct10 grade of JIS B1192 (Refer to Page B41)  
2. The entire nut length (L) is the size without seal. The size with a seal is longer by the size of "MS."

Unit: mm

Nut dimensions							
Nut entire length <i>L</i>	Nut diameter <i>D</i>	Key dimension		Tube projecting dimension			Seal dimension (MS)
		<i>G</i>	<i>T</i>	<i>U</i>	<i>V</i>	<i>R</i>	
200 275	210	32	11	115	154	50	40
252 348	220			135	163	60	48
306 426	220			135	163	60	58
377 527	225			141	167	70	70
252 348	245	36	12	141	180	60	48
306 426	245			141	180	60	58
377 527	250			147	185	70	70
252 348	295	45	15	162	216	70	48
306 426	295			162	216		58
377 527	300			168	221	70	
312 432	355	50	17	194	266	70	58
385 535	370			206	274	90	70

### B-3-3.3 Deflector Type Ball Screws

#### 1. Features

Deflector type has the smallest nut compared to the other recirculation systems, and suitable for fine lead operation.

#### 2. Specifications

##### (1) Recirculation system

It has a compact nut outside diameter, and suits for small lead driving. Fig.1 shows the structure of the deflector recirculation system.

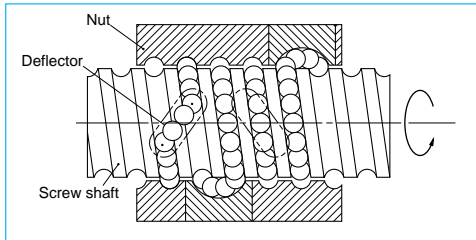


Fig. 1 Structure of deflector recirculation system

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 (Preload); T, 0.005 mm or less S, 0.020 mm or less; N, 0.050 mm or less

Table 2 Deflector type ball screw product categories

Nut model	Shape	Flange shape	Preload system
MSFD		Flanged Circular III	Non-preload, 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 Circular I, II	Non-preload, Slight axial play
ZFD		Flanged Circular I, II	Z preload (medium preload)
DFD		Flanged Circular I, II	D preload (medium preload) (heavy preload)

##### (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

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. Basic measure must be taken for the high speed ball screws respectively.

Allowable d·n value:

Standard specification : 84000 or less

High-speed specification; 100000 or less

Standard of rotational speed : 3000 min<sup>-1</sup>

Note: Please also review the critical speed. Refer to "Technical Description: Permissible rotational speed" (Page B51) for details.

##### (4) Other specifications

Please consult NSK for other specifications not listed in the dimension tables.

#### 3. Product categories

There are four different preload systems (Table 2). Synthetic resin that shows superb characteristics against wear is used in the recirculation deflector for MSFD, MPFD, and has enhanced the smooth recirculation of balls.

NSK has a patent for this product.

#### 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 "dr" specified on the dimension table.

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B103).

#### 5. Example of model number in dimension tables

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇Model number

**SFD 40 08 - 4**

Nut model: SFD, ZFD, DFD  
MSFD, MPFD

Screw shaft diameter (mm)

Effective turns of balls (Note)

Lead (mm)

Note: In case of ZFD, the number here is twice as large as the effective turns of balls.

◇Reference number for ball screw

**W 40 08 - \*\* D Y - C3 Z 5**

Product code

Screw shaft diameter (mm)

Effective threaded length (in the unit of 100mm)

NSK design serial number

Preload code:  
No code, non-preload;  
Z, Z preload; D, D preload; P, P preload

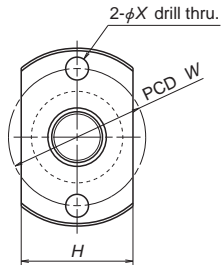
Lead (mm)

Axial play code: Z, T, S, N

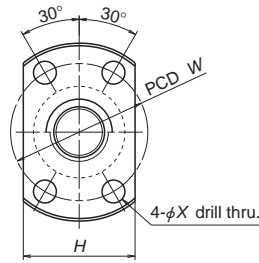
Accuracy grade code:  
C0, C1, C2, C3, C5, C7(Ct7)

Deflector recirculation system

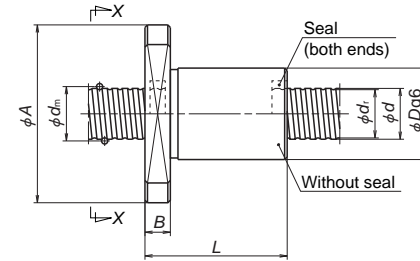
View X-X



Lead  $l = 0.5\text{mm}$



Lead  $l > 1\text{mm}$



Unit: mm

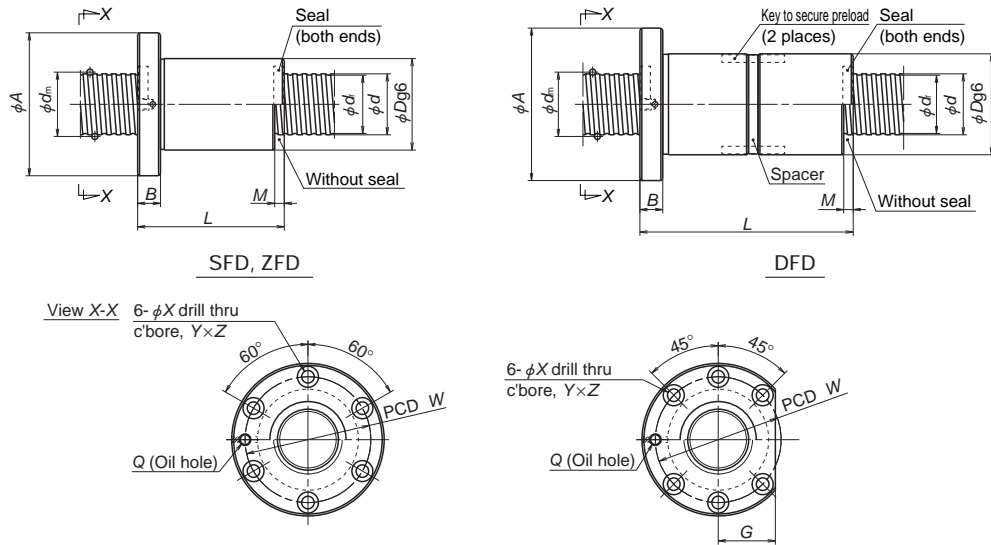
Model No.	Preload system	Shaft dia. $d$	Lead $l$	Ball dia. $D_w$	Ball circle dia. $d_m$	Root dia. $d_r$	Effective turns of balls Turns $\times$ Circuits	Basic load rating (N)	
								Dynamic $C_a$	Static $C_{0a}$
MSFD 0400.5-3 MPFD 0400.5-3	Clearance P	4	0.5	0.400	4.1	3.6	1 $\times$ 3	170	280
MSFD 0401-2 MPFD 0401-2	Clearance P		1	0.800	4.2	3.2	1 $\times$ 2	315	370
MSFD 0600.5-3 MPFD 0600.5-3	Clearance P	6	0.5	0.400	6.1	5.6	1 $\times$ 3	205	430
MSFD 0601-3 MPFD 0601-3	Clearance P		1	0.800	6.2	5.2	1 $\times$ 3	575	925
MSFD 0602-3 MPFD 0602-3	Clearance P		2	0.800	6.2	5.2	1 $\times$ 3	575	925
MSFD 0800.5-3 MPFD 0800.5-3	Clearance P	8	0.5	0.400	8.1	7.6	1 $\times$ 3	230	595
MSFD 0801-3 MPFD 0801-3	Clearance P		1	0.800	8.2	7.2	1 $\times$ 3	670	1290
MSFD 0801.5-3 MPFD 0801.5-3	Clearance P		1.5	1.000	8.3	7.0	1 $\times$ 3	1080	1980
MSFD 0802-3 MPFD 0802-3	Clearance P		2	1.200	8.3	6.9	1 $\times$ 3	1320	2210
MSFD 1001-3 MPFD 1001-3	Clearance P	10	1	0.800	10.2	9.2	1 $\times$ 3	745	1660
MSFD 1002-3 MPFD 1002-3	Clearance P		2	1.200	10.3	8.9	1 $\times$ 3	1490	2850
MSFD 1002.5-3 MPFD 1002.5-3	Clearance P		2.5	1.588	10.4	8.6	1 $\times$ 3	2130	3640
MSFD 1201-3 MPFD 1201-3	Clearance P	12	1	0.800	12.2	11.2	1 $\times$ 3	795	1980
MSFD 1202-3 MPFD 1202-3	Clearance P		2	1.200	12.3	10.9	1 $\times$ 3	1660	3620
MSFD 1202.5-3 MPFD 1202.5-3	Clearance P		2.5	1.588	12.4	10.6	1 $\times$ 3	2360	4540
MSFD 1203-3 MPFD 1203-3	Clearance P		3	2.000	12.5	10.2	1 $\times$ 3	3120	5420
MSFD 1402-3 MPFD 1402-3	Clearance P	14	2	1.200	14.3	12.9	1 $\times$ 3	1780	4270
MSFD 1403-3 MPFD 1403-3	Clearance P		3	2.000	14.5	12.2	1 $\times$ 3	3400	6490

Remarks 1. If the shaft OD is less than 6 mm or the lead is less than 1 mm, a seal is not installed in the nut. (Refer to Page B72 for dust protection.)  
 2. Ball nuts with shaft diameters under 14 mm do not have oil holes.  
 3. Right turn screw is standard. Please consult NSK for left turn screw.

Axial rigidity $K$ (N/ $\mu\text{m}$ )	Ball nut dimensions						
	Nut entire length $L$	Nut diameter $D$	Flanged diameter $A$	Flanged width $B$	Flanged dimension $H$	Bolt hole dimension $X$	Bolt hole PCD $W$
30	13	10	22	3	11	3.4	16
47							
22	12	10	20	3	14	2.9	15
34							
42	13	12	24	3	13	3.4	18
66							
49	15	12	24	3.5	16	3.4	18
76							
49	17	13	25	4	17	3.4	19
76							
54	13	14	27	3	15	3.4	21
85							
64	16	14	27	4	18	3.4	21
99							
76	22	15	28	4	19	3.4	22
117							
73	26	16	29	4	20	3.4	23
113							
77	16	16	29	4	20	3.4	23
120							
91	28	18	35	5	22	4.5	27
138							
90	32	19	36	5	23	4.5	28
140							
88	16	18	31	4	22	3.4	25
137							
108	28	20	37	5	24	4.5	29
168							
107	32	21	38	5	25	4.5	30
167							
107	36	22	39	5	26	4.5	31
166							
122	29	22	41	6	26	5.5	32
191							
127	37	24	43	6	28	5.5	34
196							

Remarks 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating ( $C_a$ ) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.  
 5. The models marked with \* are in MA type of standard ball screw with finished shaft end.  
 6. Preload system: P: Oversize ball preload (Refer to Page B5)

# Deflector type

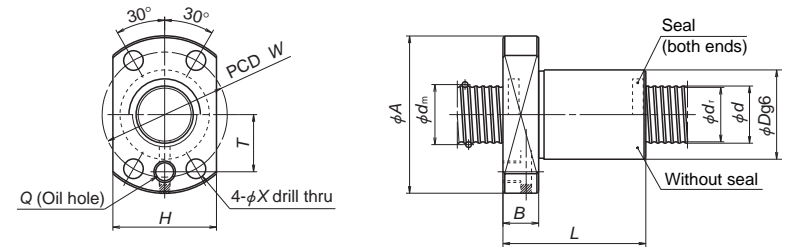


Circular shape I

Circular shape II

Model No.	Preload system	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d</i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)
								Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	
* MSFD 1602-4	Clearance P	16	2	1.588	16.4	14.6	1×4	3510	8450	185
MPFD 1602-4										288
* MSFD 1602.5-4	Clearance P	16	2.5	1.588	16.4	14.6	1×4	3510	8450	185
MPFD 1602.5-4										288
* MSFD 2002-4	Clearance P	20	2	1.588	20.4	18.6	1×4	3910	10900	225
MPFD 2002-4										351
SFD 2005-3	Clearance Z	20	5	3.175	20.75	17.4	1×3	8620	17500	196
ZFD 2005-6							1×3	8620	17500	382
SFD 2005-4	Clearance D	20	5	3.175	20.75	17.4	1×4	11000	23300	255
DFD 2005-4							1×4	11000	23300	509
SFD 2006-3	Clearance Z	20	6	3.969	21	16.9	1×3	11100	20600	196
ZFD 2006-6							1×3	11100	20600	382
SFD 2006-4	Clearance D	20	6	3.969	21	16.9	1×4	14300	27500	255
DFD 2006-4							1×4	14300	27500	498
* MSFD 2502-4	Clearance P	25	2	1.588	25.4	23.6	1×4	4310	13900	273
MPFD 2502-4										425
* SFD 2505-3	Clearance Z	25	5	3.175	25.75	22.4	1×3	9790	22900	245
ZFD 2505-6							1×3	9790	22900	480
SFD 2505-4	Clearance D	25	5	3.175	25.75	22.4	1×4	12500	30500	323
DFD 2505-4							1×4	12500	30500	630
SFD 2506-3	Clearance Z	25	6	3.969	26	21.9	1×3	12900	27300	245
ZFD 2506-6							1×3	12900	27300	470
SFD 2506-4	Clearance D	25	6	3.969	26	21.9	1×4	16500	36500	323
DFD 2506-4							1×4	16500	36500	626
ZFD 2510-4	Clearance Z	25	10	4.762	26.25	21.3	1×2	11400	21400	323
SFD 2510-3							1×3	16100	32000	245
DFD 2510-3	Clearance D	25	10	4.762	26.25	21.3	1×3	16100	32000	479

- Remarks
1. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
  2. If there is no seal for SFD, ZFD, and DFD, the nut length "L" is shortened by dimension "M". For MSFD and MPFD, the nut length is the same as those with seal.
  3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw. Please consult NSK for MSFD, MPFD.

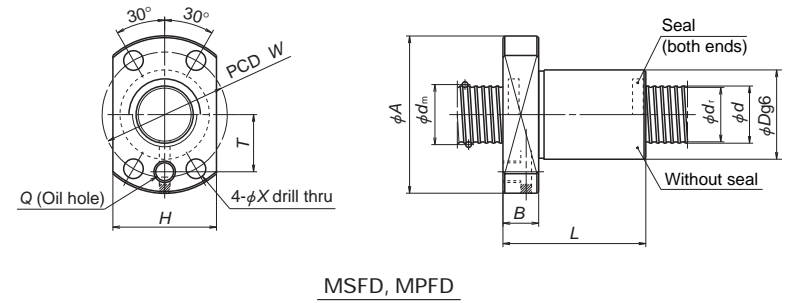
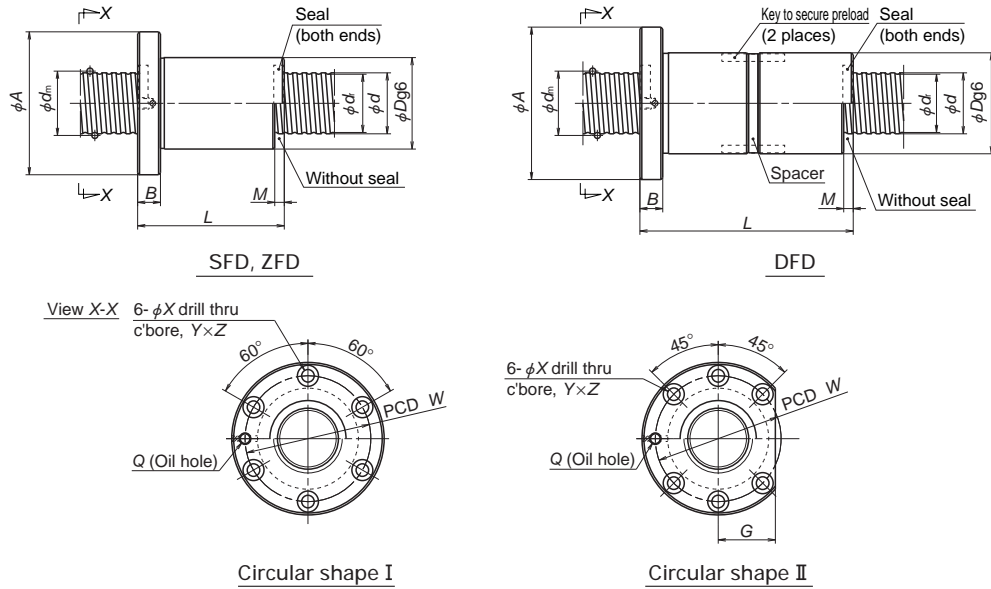


MSFD, MPFD

Ball nut dimensions												
Nut entire length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Notched flange		Seal dimension <i>M</i>	Bolt hole dimension			Bolt hole PCD <i>W</i>	Oil hole dimension <i>T</i>	Oil hole <i>Q</i>
				<i>G</i>	<i>H</i>		<i>X</i>	<i>Y</i>	<i>Z</i>			
40	25	44	10	—	29	—	5.5	—	—	35	16	M6×1
44	25	44	10	—	29	—	5.5	—	—	35	16	M6×1
40	30	49	10	—	34	—	5.5	—	—	40	18.5	M6×1
46	35	58	—	22.5	—	5	5.5	9.5	5.5	46	—	M6×1
66	35	58	11	22.5	—							
51	35	58	—	22.5	—	6	5.5	9.5	5.5	46	—	M6×1
91	41	64	11	25	—							
52	35	58	—	22.5	—	6	5.5	9.5	5.5	46	—	M6×1
76	35	58	11	22.5	—							
60	35	58	—	22.5	—	10	6.6	11	6.5	55	—	M6×1
108	42	65	15	25	—							
40	36	55	10	—	40	—	5.5	—	—	46	21.5	M6×1
46	40	63	—	24	—	5	5.5	9.5	5.5	51	—	M6×1
66	40	63	11	24	—							
51	40	63	—	24	—	6	5.5	9.5	5.5	51	—	M6×1
91	46	69	11	26	—							
52	40	63	—	24	—	6	5.5	9.5	5.5	51	—	M6×1
76	40	63	11	24	—							
60	40	63	—	24	—	10	6.6	11	6.5	55	—	M6×1
108	47	70	15	27	—							
88	42	69	—	26	—	10	6.6	11	6.5	55	—	M6×1
80	42	69	15	26	—							
140	47	74	—	28	—	10	6.6	11	6.5	55	—	M6×1
140	47	74	15	28	—							

- Remarks
4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (*C<sub>a</sub>*) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.
  5. It is recommended to use with seal when shaft diameter is 16 mm or larger and have oil hole.
  6. The models marked with \* are in MA type of standard ball screw with finished shaft end.
  7. Preload system: Z, Offset preload; P, Oversize ball preload; D, Double nut preload (Refer to Page B5)

# Deflector type



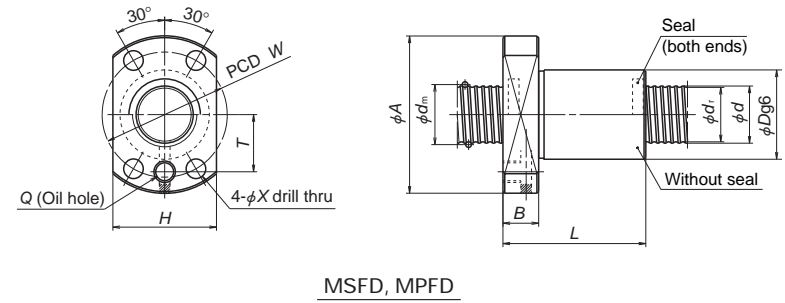
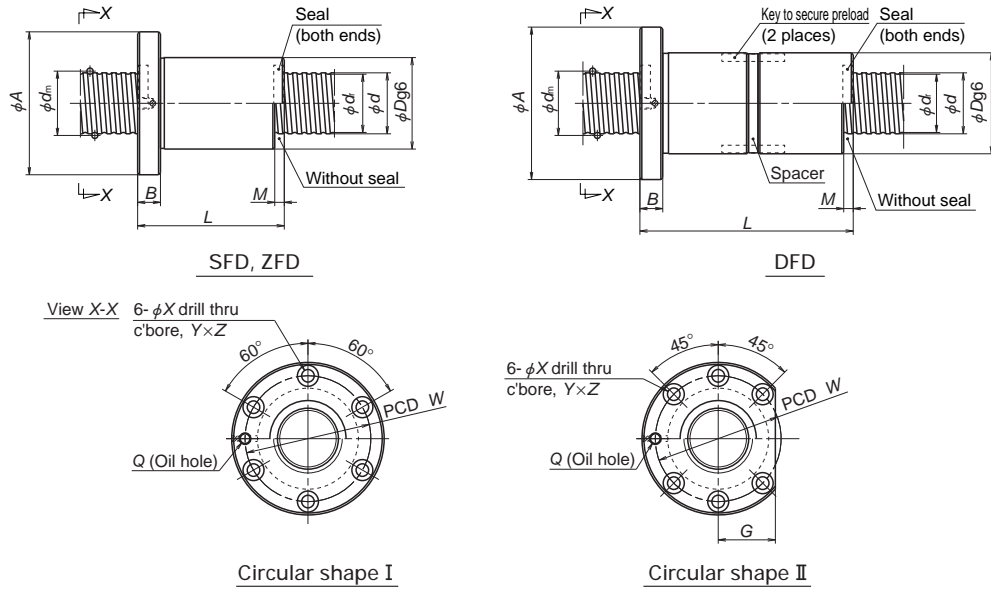
Model No.	Preload system	Shaft dia. $d$	Lead $I$	Ball dia. $D_w$	Ball circle dia. $d_m$	Root dia. $d_r$	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity $K$ (N/ $\mu$ m)	
								Dynamic $C_a$	Static $C_{0a}$		
<b>MSFD 3202-6</b> <b>MPFD 3202-6</b>	Clearance P	32	2	1.588	32.4	30.6	1×6	6790	27200	494	
<b>SFD 3205-3</b> <b>ZFD 3205-6</b>	Clearance Z									304	
<b>SFD 3205-4</b> <b>ZFD 3205-8</b> <b>SFD 3205-6</b> <b>DFD 3205-6</b>	Clearance Z Clearance D									598 409 784 588 1160	
<b>SFD 3206-3</b> <b>ZFD 3206-6</b> <b>SFD 3206-4</b> <b>ZFD 3206-8</b> <b>SFD 3206-6</b> <b>DFD 3206-6</b>	Clearance Z Clearance Z Clearance D		6	3.969	33	28.9	1×4 1×4 1×6 1×6	15000 15000 19200 19200 27200 27200	37500 37500 49900 49900 74900 74900	314 608 412 804 598 1190	314
<b>SFD 3208-3</b> <b>ZFD 3208-6</b> <b>SFD 3208-4</b> <b>ZFD 3208-8</b>	Clearance Z Clearance Z										304 588 392 774
<b>SFD 3210-3</b> <b>ZFD 3210-6</b> <b>SFD 3210-4</b> <b>DFD 3210-4</b>	Clearance Z Clearance D										300 588 392 773
			8	4.762	33.25	28.3	1×3 1×3 1×4 1×4	18300 18300 23500 23500	41800 41800 55800 55800	304 588 392 774	304
											588
											392
			10	6.35	33.75	27.1	1×3 1×3 1×4 1×4	25900 25900 33200 33200	52800 52800 70300 70300	300 588 392 773	300
											588
											392

Remarks 1. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.  
2. If there is no seal for SFD, ZFD, and DFD, the nut length "L" is shortened by dimension "M". For MSFD and MPFD, the nut length is the same as those with seal.  
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw. Please consult NSK for MSFD, MPFD.

Ball nut dimensions												
Nut entire length $L$	Nut diameter $D$	Flanged diameter $A$	Flanged width $B$	Notched flange		Seal dimension $M$	Bolt hole dimension			Bolt hole PCD $W$	Oil hole dimension $T$	Oil hole $Q$
				$G$	$H$		$X$	$Y$	$Z$			
50	42	65	10	—	46	—	6.6	—	—	54	26.5	M6×1
47	48	75	—	29	—	5	6.6	11	6.5	61	—	M6×1
67	48	75	—	29	12							
52	48	75	12	29						61		
77	48	75	—	29						61		
62	48	75	—	29						61		
112	53	80	—	30						66		
53	48	75	—	29	6	6.6	11	6.5	61	—	M6×1	
77	48	75	—	29								
61	48	75	12	29					61			
90	48	75	—	29					61			
73	48	75	—	29					61			
133	54	81	—	31					67			
67	50	84	15	32	—	8	9	14	8.5	66	—	M6×1
99	—	—	—	—								
76	—	—	—	—								
116	—	—	—	—								
80	54	88	15	34	—	10	9	14	8.5	70	—	M6×1
120												
90												
160												

Remarks 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating ( $C_a$ ) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.  
5. It is recommended to use with seal when shaft diameter is 16 mm or larger and have oil hole.  
6. The models marked with \* are in SS type of standard ball screw with blank shaft end.  
7. Preload system: Z, Offset preload; P, Oversize ball preload; D, Double nut preload (Refer to Page B5)

# Deflector type



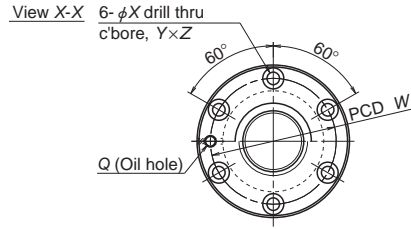
Model No.	Preload system	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)	
								Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>		
<b>MSFD 4002-6</b> <b>MPFD 4002-6</b>	Clearance P	40	2	1.588	40.4	38.6	1×6	7380	33900	588 916	
<b>SFD 4005-4</b> <b>ZFD 4005-8</b> <b>SFD 4005-6</b> <b>ZFD 4005-12</b>	Clearance Z		5	3.175	40.75	37.4	1×4 1×4 1×6 1×6	15800 15800 22400 22400	52300 52300 78400 78400	490 960 725 1410	
<b>SFD 4006-4</b> <b>ZFD 4006-8</b> <b>SFD 4006-6</b> <b>ZFD 4006-12</b>	Clearance Z		6	3.969	41.0	36.9	1×4 1×4 1×6 1×6	21300 21300 30100 30100	63500 63500 95300 95300	490 970 725 1431	
<b>SFD 4008-4</b> <b>ZFD 4008-8</b> <b>SFD 4008-6</b> <b>DFD 4008-6</b>	Clearance Z		8	4.762	41.25	36.3	1×4 1×4 1×6 1×6	27200 27200 38500 38500	75200 75200 113000 113000	500 990 735 1460	
<b>SFD 4010-3</b> <b>ZFD 4010-6</b> <b>SFD 4010-4</b> <b>ZFD 4010-8</b>	Clearance Z		10	6.35	41.75	35.1	1×3 1×3 1×4 1×4	30000 30000 38400 38400	70000 70000 93300 93300	372 735 490 970	
<b>SFD 5005-4</b> <b>ZFD 5005-8</b> <b>SFD 5005-6</b> <b>ZFD 5005-12</b>	Clearance Z		50	5	3.175	50.75	47.4	1×4 1×4 1×6 1×6	17500 17500 24800 24800	66800 66800 100000 100000	593 1170 872 1720
<b>SFD 5006-4</b> <b>ZFD 5006-8</b> <b>SFD 5006-6</b> <b>ZFD 5006-12</b>	Clearance Z			6	3.969	51.0	46.9	1×4 1×4 1×6 1×6	23600 23600 33500 33500	81700 81700 122000 122000	598 1190 892 1750

Remarks 1. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.  
 2. If there is no seal for SFD, ZFD, and DFD, the nut length "L" is shortened by dimension "M". For MSFD and MPFD, the nut length is the same as those with seal.  
 3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw. Please consult NSK for MSFD, MPFD.

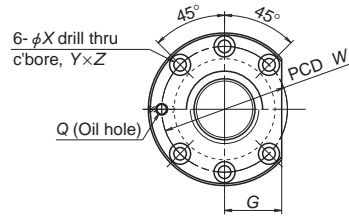
Ball nut dimensions													
Nut entire length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Notched flange		Seal dimension <i>M</i>	Bolt hole dimension			Bolt hole PCD <i>W</i>	Oil hole dimension <i>T</i>	Oil hole	
				<i>G</i>	<i>H</i>		<i>X</i>	<i>Y</i>	<i>Z</i>				
50	51	74	10	—	55	—	6.6	—	—	63	31	M6×1	
55	56	90	15	34	—	5	9	14	8.5	72	—	Rc1/8	
80													
65													
101	56	90	15	34	—	6	9	14	8.5	72	—	Rc1/8	
64													
93													
76													
118													
118													
76	60	94	15	36	—	8	9	14	8.5	76	—	Rc1/8	
116													
93													
168	62	96	37	37	—	8	9	14	8.5	78	—	Rc1/8	
143													
83	62	104	18	40	—	10	11	17.5	11	82	—	Rc1/8	
123													
93													
143													
55	66	100	15	38	—	5	9	14	8.5	82	—	Rc1/8	
80													
65													
101													
64	66	100	15	38	—	6	9	14	8.5	82	—	Rc1/8	
93													
76													
118													

Remarks 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (*C<sub>a</sub>*) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.  
 5. It is recommended to use with seal when shaft diameter is 16 mm or larger and have oil hole.  
 6. Preload system: Z, Offset preload; P, Oversize ball preload; D, Double nut preload (Refer to Page B5)

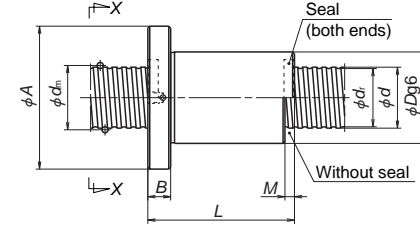




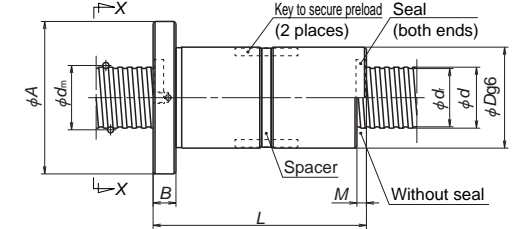
Circular shape I



Circular shape II



SFD, ZFD



DFD

Unit: mm

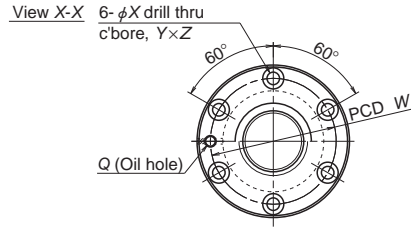
Model No.	Preload system	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)				
								Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>					
SFD 5008-4	Clearance Z	50	8	4.762	51.25	46.3	1×4	29900	94800	598				
ZFD 5008-8							1×4	29900	94800	1180				
SFD 5008-6	Clearance D						1×6	42400	142000	887				
DFD 5008-6							1×6	42400	142000	1740				
SFD 5010-3	Clearance Z						10	6.35	51.75	45.1	1×3	34100	91600	461
ZFD 5010-6											1×3	34100	91600	914
SFD 5010-4	Clearance D		1×4	43600	122000	608								
ZFD 5010-8			1×4	43600	122000	1200								
SFD 5010-6	Clearance D		1×6	61800	183000	902								
DFD 5010-6			1×6	61800	183000	1770								
SFD 5012-3	Clearance Z		12	7.938	52.25	44	1×3	44800	109000	461				
ZFD 5012-6							1×3	44800	109000	906				
SFD 5012-4	Clearance D	1×4					57300	146000	608					
DFD 5012-4		1×4					57300	146000	1200					
SFD 5020-3	Clearance D	20					7.938	52.25	44	1×3	44800	109000	461	
DFD 5020-3										1×3	44800	109000	908	
SFD 6306-4	Clearance Z		63	6	3.969	64.0				59.9	1×4	26100	104000	735
ZFD 6306-8											1×4	26100	104000	1430
SFD 6306-6	Clearance D										1×6	36900	157000	1180
ZFD 6306-12											1×6	36900	157000	2110
SFD 6308-4	Clearance Z	8					4.762	64.25	59.3		1×4	33600	124000	745
ZFD 6308-8											1×4	33600	124000	1460
SFD 6308-6	Clearance D			1×6	47600	186000				1100				
DFD 6308-6				1×6	47600	186000				2150				
SFD 6310-4	Clearance Z			10	6.35	64.75				58.1	1×4	49700	163000	764
ZFD 6310-8											1×4	49700	163000	1510
SFD 6310-6	Clearance D	1×6					70500	244000	1130					
DFD 6310-6		1×6					70500	244000	2210					
SFD 6312-6	Clearance Z	12	7.938				65.25	57	1×3		50800	143000	1120	
ZFD 6312-4									1×4		65100	191000	755	
SFD 6312-4	Clearance D			1×4	65100	191000			1480					
DFD 6312-4				1×6	92200	286000			1110					
SFD 6312-6	Clearance D			1×6	92200	286000			2180					
DFD 6312-6				1×6	92200	286000			2180					
SFD 6320-3	Clearance D	20	9.525	65.75	56	1×3	83700	232000	735					
DFD 6320-3						1×3	83700	232000	1440					

- Remarks
1. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
  2. If there is no seal for SFD, ZFD, and DFD, the nut length "L" is shortened by dimension "M". For MSFD and MPFD, the nut length is the same as those with seal.
  3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.

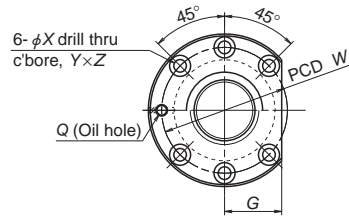
Ball nut dimensions													
Nut entire length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Notched flange <i>G</i>	Seal dimension <i>M</i>	Bolt hole dimension			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>			
						<i>X</i>	<i>Y</i>	<i>Z</i>					
79	70	112		43	8	11	17.5	11	90	Rc1/8			
119	70	112	18	43									
96	70	112		43									
171	72	114		44									
83				461									
123				914									
93	72	114	18	44	10	11	17.5	11	92	Rc1/8			
143													1200
114													902
205													1770
99													461
147	75	121	22	47	12	14	20	13	97	Rc1/8			
111													608
195													1200
146													461
253													908
67	80	122	18	47	6	11	17.5	11	100	Rc1/8			
96													1430
79													1180
121													2110
79									82		124	18	47
119				1460									
96				1100									
175				2150									
97	85	131	22	50	10	14	20	13		107			
147												1510	
118												1130	
214												2210	
147									90	136	22	52	12
111				755									
195				1480									
136				1110									
248				2180									
146	95	153	28	59	20	18	26	17.5	123	Rc1/8			
253													1440

- Remarks
4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (*C<sub>a</sub>*) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.
  5. It is recommended to use with seal when shaft diameter is 16 mm or larger and have oil hole.
  6. Preload system: Z, Offset preload; D, Double nut preload (Refer to Page B5)

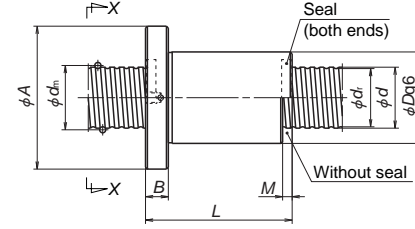
## Deflector type



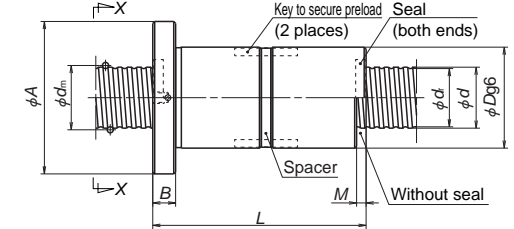
Circular shape I



Circular shape II



SFD



DFD

Unit: mm

Model No.	Preload system	Shaft dia. <i>d</i>	Lead <i>l</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)
								Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	
SFD 8010-4	Clearance D	80	10	6.35	81.75	75.1	1×4	55100	209000	931
DFD 8010-4	Clearance D						1×4	55100	209000	1840
SFD 8010-6	Clearance D						1×6	78000	314000	1370
DFD 8010-6	Clearance D		1×6	78000	314000	2710				
SFD 8012-4	Clearance D		12	7.938	82.25	74	1×4	74000	254000	941
DFD 8012-4	Clearance D						1×4	74000	254000	1860
SFD 8012-6	Clearance D	1×6					105000	381000	1392	
DFD 8012-6	Clearance D	1×6	105000	381000	2730					
SFD 8020-3	Clearance D	20	9.525	82.75	73	1×3	96600	313000	931	
DFD 8020-3	Clearance D					1×3	96600	313000	1830	
SFD 8020-4	Clearance D					1×4	124000	417000	1230	
DFD 8020-4	Clearance D					1×4	124000	417000	2410	
SFD 10010-6	Clearance D	100	10	6.35	101.75	95.1	1×6	86200	401000	1670
DFD 10010-6	Clearance D									3270
SFD 10012-6	Clearance D									12
DFD 10012-6	Clearance D	3320								
SFD 10020-4	Clearance D	20	9.525	102.75	93	1×4	136000	526000	1470	
DFD 10020-4	Clearance D								2890	

- Remarks
1. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
  2. If there is no seal for SFD, ZFD, and DFD, the nut length "L" is shortened by dimension "M". For MSFD and MPFD, the nut length is the same as those with seal.
  3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.

Ball nut dimensions										
Nut entire length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Notched flange <i>G</i>	Seal dimension <i>M</i>	Bolt hole dimension			Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>
						<i>X</i>	<i>Y</i>	<i>Z</i>		
97	105	151	22	57	10	14	20	13	127	Rc1/8
172										
118										
214										
111	110	156	22	59	12	14	20	13	132	Rc1/8
195										
136										
248										
146	115	173	28	66	20	18	26	17.5	143	Rc1/8
253										
168										
297										
118	125	171	22	64	10	14	20	13	147	Rc1/8
214										
142	130	188	28	71	12	18	26	17.5	158	Rc1/8
254										
172	135	205	32	79	20	22	32	21.5	169	Rc1/8
301										

- Remarks
4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (*C<sub>a</sub>*) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.
  5. It is recommended to use with seal when shaft diameter is 16 mm or larger and have oil hole.
  6. Preload system: D; Double nut preload (Refer to Page B5)

### B-3-3.4 End Cap Type Ball Screw

#### 1. Features

End cap recirculation system is suitable for high helix lead and multiple start threads. Since the leads are 1 to 3 times larger than their screw shaft diameter, it makes them more suitable for high speed operation.

#### 2. Specifications

##### (1) Recirculation system

The structure of end cap recirculation system is shown in Fig. 1.

##### (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.

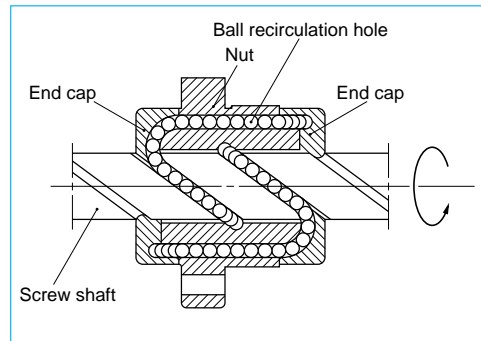


Fig. 1 Structure of end cap recirculation system

Table 1 Accuracy grade and axial play

Accuracy grade	LSFC, LPFC: C1, C2, C3, C5, Ct7 USFC, UPFC: C3, C5, Ct7 (Three times lead or over are C5, Ct7)
Axial play	Z, 0 mm (Preload); 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.

Allowable d-n value and the criterion of maximum rotational speed are shown below. Please consult NSK for high-speed specification. Basic measure must be taken for the high speed ball screws respectively.

Allowable d-n value:

Standard specification : 80000 or less

High-speed specification; 100000 or less

Standard of rotational speed : 3000 min<sup>-1</sup>

※Please also review the critical speed. Refer to "Technical Description: Permissible rotational speed" (Page B51) for details.

##### (4) Other specifications

Please consult NSK for other specifications not listed in the dimension tables.

#### 3. Product categories

There are two different preload systems with several models (Table 2).

Table 2 End cap type ball screws product categories

Nut model	Shape	Flange shape	Nut shape	Preload system
LSFC		Flanged Circular III	Circular	Non-preload, Slight axial play
LPFC			Circular	P preload (light preload) no spacer ball
USFC		Flanged Rectangular	Circular	Non-preload, Slight axial play
UPFC			Circular	P preload (light preload) no spacer ball

#### 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 "dr" specified on the dimension table.

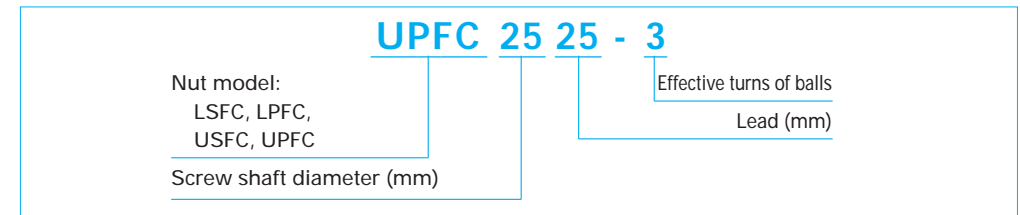
Special bearings which have higher-load carrying capacity are available.

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B103).

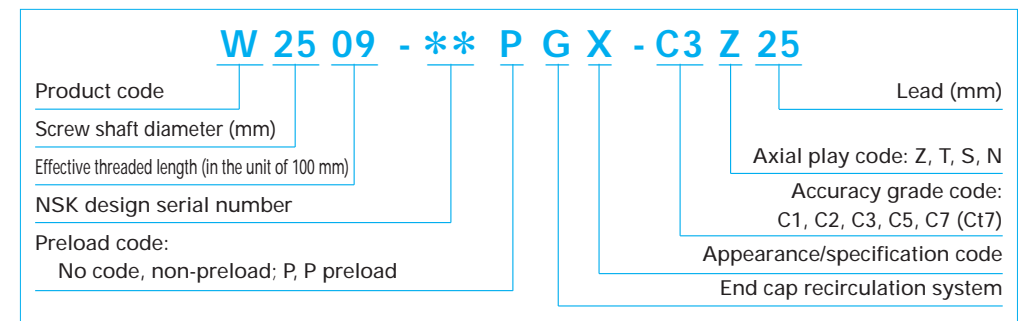
#### 5. Example of model number in dimension tables

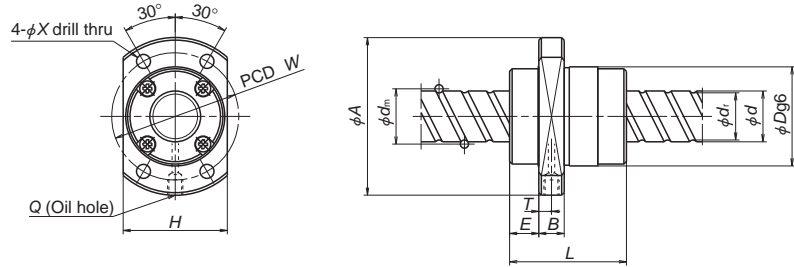
A structure of "Model number" and "Reference number for ball screw" are as follows.

##### ◇Model number

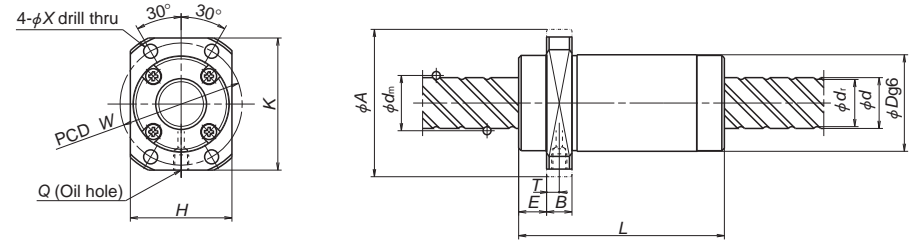


##### ◇Reference number for ball screw





LSFC, LPFC



USFC, UPFC

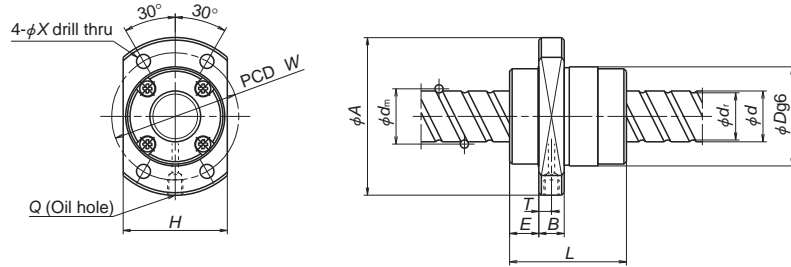
Unit: mm

Model No.	Preload system	Shaft dia. <i>d</i>	Lead <i>I</i>	Ball dia. <i>D<sub>v</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)
								Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>	
USFC 1220-1.5 UPFC 1220-1.5	Clearance P	12	20	2.381	12.5	9.9	1.7×1	2690	4420	66 103
* USFC 1520-1.5 UPFC 1520-1.5	Clearance P	15	20	3.175	15.5	12.2	1.7×1	5070	8730	97 151
USFC 1540-1 UPFC 1540-1	Clearance P		40	3.175	15.75	12.2	0.7×2 0.7×2	3860 3860	6050 6050	62 97
USFC 1540-2 UPFC 1540-2	Clearance P	16	16	2.778	16.65	13.7	0.7×4	7000	12100	121
USFC 1616-3 LPFC 1616-3	Clearance P						0.7×4	7000	12100	188
USFC 1616-6 LPFC 1616-6	Clearance P	16	32	3.175	16.75	13.4	1.7×2	6380	12500	172
USFC 1632-1 UPFC 1632-1	Clearance P						1.7×2	4000	6690	74
USFC 1632-3 UPFC 1632-3	Clearance P	16	50	3.175	16.75	13.4	0.7×2	4000	6690	102
USFC 1632-6 UPFC 1632-6	Clearance P						0.7×2	4000	6690	126
USFC 1650-1 UPFC 1650-1	Clearance P	20	20	3.175	20.75	17.4	0.7×4	7260	13400	126
USFC 1650-2 UPFC 1650-2	Clearance P						0.7×4	7260	13400	197
USFC 2020-3 LPFC 2020-3	Clearance P	20	40	3.175	20.75	17.4	1.7×2	9620	21000	238
USFC 2020-6 LPFC 2020-6	Clearance P						1.7×2	9620	21000	370
* USFC 2040-1 UPFC 2040-1	Clearance P	20	60	3.175	20.75	17.4	1.7×4	17500	42000	462
USFC 2040-3 UPFC 2040-3	Clearance P						1.7×4	17500	42000	718
USFC 2040-6 UPFC 2040-6	Clearance P	20	40	3.175	20.75	17.4	0.7×2	4490	8640	89
USFC 2060-1 UPFC 2060-1	Clearance P						0.7×2	4490	8640	138
USFC 2060-2 UPFC 2060-2	Clearance P	20	60	3.175	20.75	17.4	1.7×2	9620	21000	211
USFC 2060-3 UPFC 2060-3	Clearance P						1.7×2	9620	21000	328
USFC 2060-6 UPFC 2060-6	Clearance P	20	40	3.175	20.75	17.4	1.7×4	17500	42000	409
USFC 2060-1 UPFC 2060-1	Clearance P						1.7×4	17500	42000	636
USFC 2060-2 UPFC 2060-2	Clearance P	20	60	3.175	20.75	17.4	0.7×2	4490	8640	78
USFC 2060-3 UPFC 2060-3	Clearance P						0.7×2	4490	8640	121
USFC 2060-6 UPFC 2060-6	Clearance P	20	60	3.175	20.75	17.4	0.7×4	8140	17300	151
USFC 2060-1 UPFC 2060-1	Clearance P						0.7×4	8140	17300	235

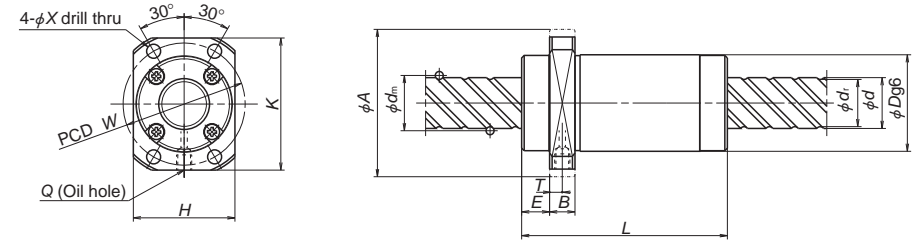
Remarks 1. For LSFC and USFC type ball screws, rigidities in the table are theoretical values obtained from the elastic deformation between the screw groove and the ball when the axial load is 30% of the basic dynamic load rating (*C<sub>a</sub>*). For LPFC and UPFC type, rigidities are theoretical values when the preload is 10% of the basic dynamic load rating (*C<sub>a</sub>*) and an axial load is applied to it. Refer to the "Technical Description" (Page B41) if the preload differs from the conditions above, or when considering a change in the deformation of the ball nut itself.

Nut entire length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Ball nut dimensions		End cap dimension <i>E</i>	Bolt hole dimension <i>X</i>	Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>	Oil hole position <i>T</i>
				Flanged dimension <i>H</i>	Flanged dimension <i>K</i>					
44	26	44	10	28	40	9	4.5	35	M6×1	5
45	34	55	10	36	50	11	5.5	45	M6×1	5
40	32	53	10	33	48	12	5.5	43	M6×1	5
38	32	53	10	34	—	10	4.5	42	M6×1	5
34 34 66 66 66 66	34	55	10	36	50	10.5	5.5	45	M6×1	5
50	34	55	10	36	50	12	5.5	45	M6×1	5
46	39	62	10	41	—	11.5	5.5	50	M6×1	5
41 41 81 81 81 81	38	58	10	40	52	11	5.5	48	M6×1	5.5
58	38	58	10	40	52	12.3	5.5	48	M6×1	5

Remarks 2. The right turn screw is standard. Please consult NSK for left turn screw.  
3. The models marked with \* are in FA type of standard ball screw with finished shaft end.  
4. Preload system: P; Oversize ball preload (Refer to Page B5)



LSFC, LPFC



USFC, UPFC

Unit: mm

Model No.	Preload system	Shaft dia. <i>d</i>	Lead <i>I</i>	Ball dia. <i>D<sub>w</sub></i>	Ball circle dia. <i>d<sub>m</sub></i>	Root dia. <i>d<sub>r</sub></i>	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity <i>K</i> (N/μm)					
								Dynamic <i>C<sub>a</sub></i>	Static <i>C<sub>0a</sub></i>						
LSFC 2525-3	Clearance P	25	25	3.969	26.0	21.9	1.7×2	14400	32800	293					
LPFC 2525-3							1.7×2	14400	32800	456					
LSFC 2525-6	1.7×4						26100	65600	568						
LPFC 2525-6	1.7×4						26100	65600	883						
USFC 2550-1	Clearance P						0.7×2	6700	13500	109					
UPFC 2550-1							0.7×2	6700	13500	170					
USFC 2550-3	Clearance P		1.7×2	14400	32800	264									
UPFC 2550-3			1.7×2	14400	32800	412									
USFC 2550-6	Clearance P		1.7×4	26100	65600	512									
UPFC 2550-6			1.7×4	26100	65600	796									
USFC 2580-1	Clearance P		80	3.969	26.0	21.9	0.7×2	6700	13500	94					
UPFC 2580-1							0.7×2	6700	13500	147					
USFC 2580-2	0.7×4	12200					27000	184							
UPFC 2580-2	0.7×4	12200					27000	285							
LSFC 3232-3	Clearance P	32					4.762	33.25	28.3	1.7×2	21000	51600	366		
LPFC 3232-3										1.7×2	21000	51600	570		
LSFC 3232-6	1.7×4		38100	103000	709										
LPFC 3232-6	1.7×4		38100	103000	1104										
USFC 3264-1	Clearance P		64	4.762	33.25	28.3				0.7×2	9800	20900	143		
UPFC 3264-1										0.7×2	9800	20900	222		
USFC 3264-3	1.7×2						21000	51600	329						
UPFC 3264-3	1.7×2						21000	51600	512						
USFC 3264-6	1.7×4						38100	103000	636						
UPFC 3264-6	1.7×4						38100	103000	991						
LSFC 4040-3	Clearance P		40	40	6.350	41.75	35.2	1.7×2	33500	86500	455				
LPFC 4040-3								1.7×2	33500	86500	708				
LSFC 4040-6	1.7×4	60800						173000	880						
LPFC 4040-6	1.7×4	60800						173000	1370						
LSFC 5050-3	Clearance P	50						50	7.938	52.25	44.1	1.7×2	50000	135000	560
LPFC 5050-3												1.7×2	50000	135000	871
LSFC 5050-6	1.7×4		90800	270000	1084										
LPFC 5050-6	1.7×4		90800	270000	1688										

Remarks 1. For LSFC and USFC type ball screws, rigidities in the table are theoretical values obtained from the elastic deformation between the screw groove and the ball when the axial load is 30% of the basic dynamic load rating (*C<sub>a</sub>*). For LPFC and UPFC type, rigidities are theoretical values when the preload is 10% of the basic dynamic load rating (*C<sub>a</sub>*) and an axial load is applied to it. Refer to the "Technical Description" (Page B41) if the preload differs from the conditions above, or when considering a change in the deformation of the ball nut itself.

Nut entire length <i>L</i>	Nut diameter <i>D</i>	Flanged diameter <i>A</i>	Flanged width <i>B</i>	Ball nut dimensions		End cap dimension <i>E</i>	Bolt hole dimension <i>X</i>	Bolt hole PCD <i>W</i>	Oil hole <i>Q</i>	Oil hole position <i>T</i>	
				Flanged dimension <i>H</i>	<i>K</i>						
55	47	74	12	49	—	13	6.6	60	M6×1	6	
50	46	70	12	48	63	13	6.6	58	M6×1	7	
50											
100											
100											
100	75	46	70	12	48	63	14.5	6.6	58	M6×1	6
75											
70	58	92	12	60	—	16	9	74	M6×1	5.5	
62	58	92	12	60	82	15.5	9	74	M6×1	7.5	
62											
126											
126											
126											
126											
85	73	114	15	75	—	19.5	11	93	M6×1	6.5	
107	90	135	20	92	—	21.5	14	112	M6×1	7	

Remarks 2. The right turn screw is standard. Please consult NSK for left turn screw.  
3. The models marked with \* are in FA type of standard ball screw with finished shaft end.  
4. Preload system: P; Oversize ball preload (Refer to Page B5)

## C-1 Monocarrier™

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## C-2 MCM Series

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2. MCM Series Dimension Table of Standard Products ..... C26
3. MCM Series Option Part ..... C37

## C-3 MCH Series

1. MCH Series Reference Number Coding ..... C63
2. MCH Series Dimension Table of Standard Products ..... C64
3. MCH Series Option Part ..... C71

# Monocarrier™

**C** BLOCK

C1-C22

C23-C59

C61-C80

# 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.

### 4 Long term maintenance free

- Use of NSK K1 Lubrication Units and grease maintains a smooth lubricating performance for long periods in mechanical environments where lubrication is difficult to apply, 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.

### 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.

### 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  
The design has minimal space requirements.

### 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.



# MONOCARRIER™

C-1-2 Classification and Series

Table 2.1

	Light Weight	Beam Rigidity	Moment Rigidity
MCM Series	○	○	○
MCH Series	○	◎	○

	Accuracy	Long Stroke	Size Variation
	○	○	◎
	◎	◎	○

[MCM Series Cross-sections]

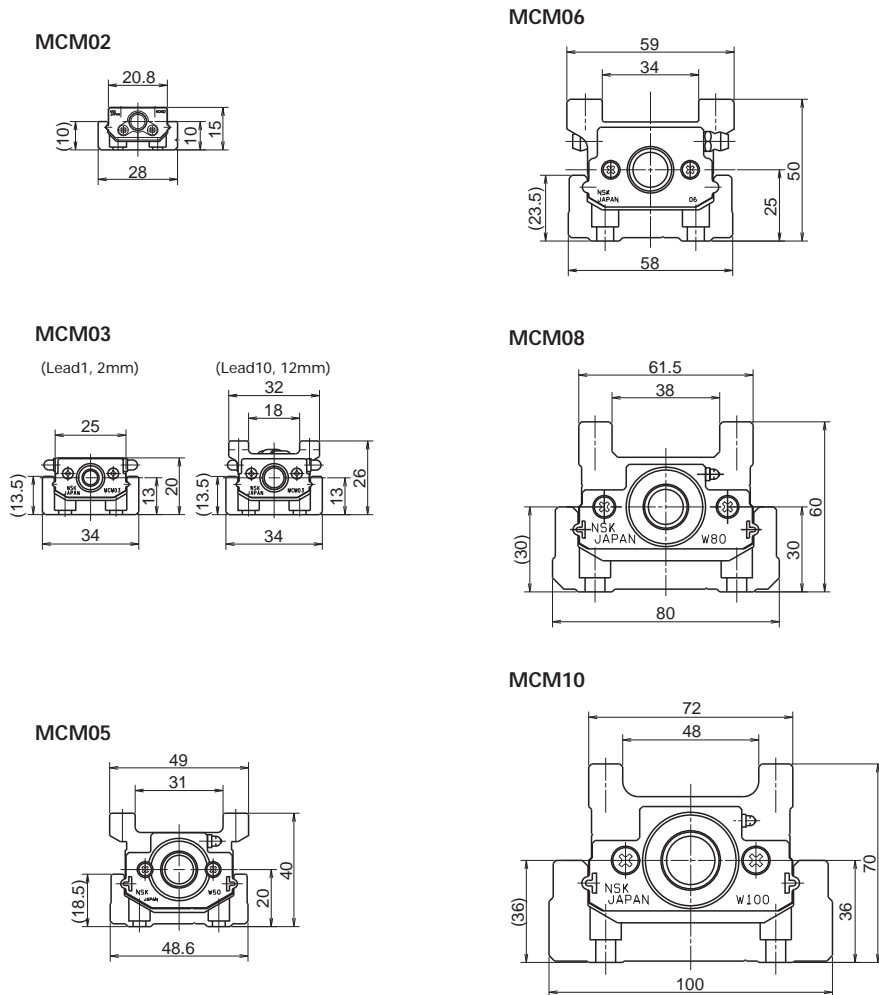


Fig. 2.1

[MCH Series Cross-sections]

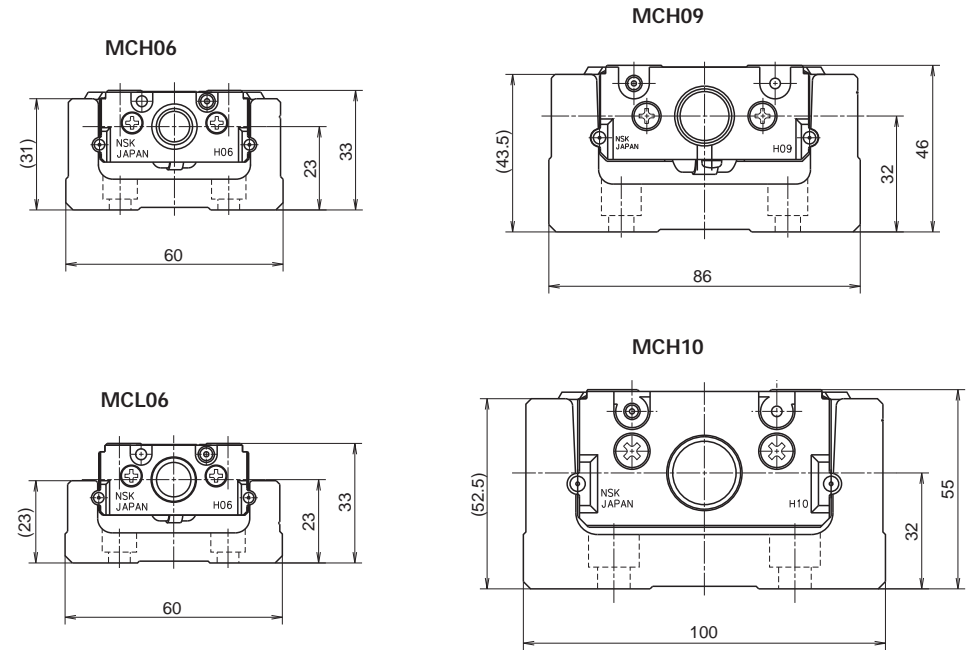


Fig. 2.2



### C-1-3 Optional Components

#### MCM Series

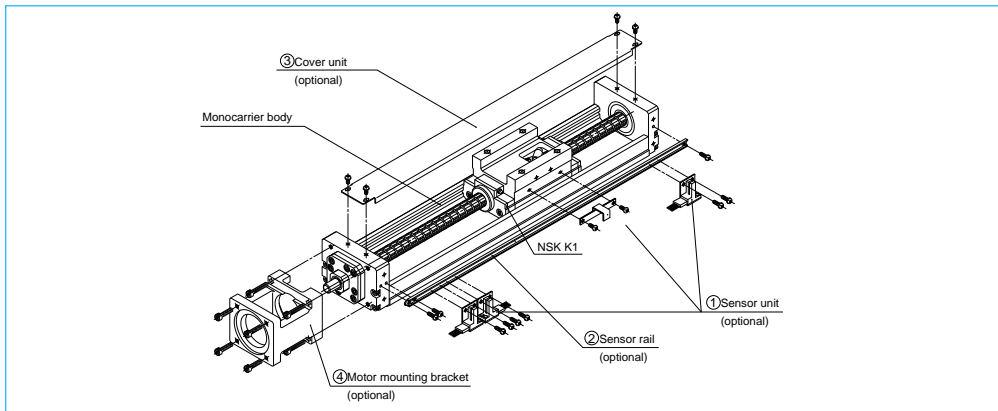


Fig. 3.1 Assembly Optional components for MCM10 (example)

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 optional components upon request.

#### MCH Series

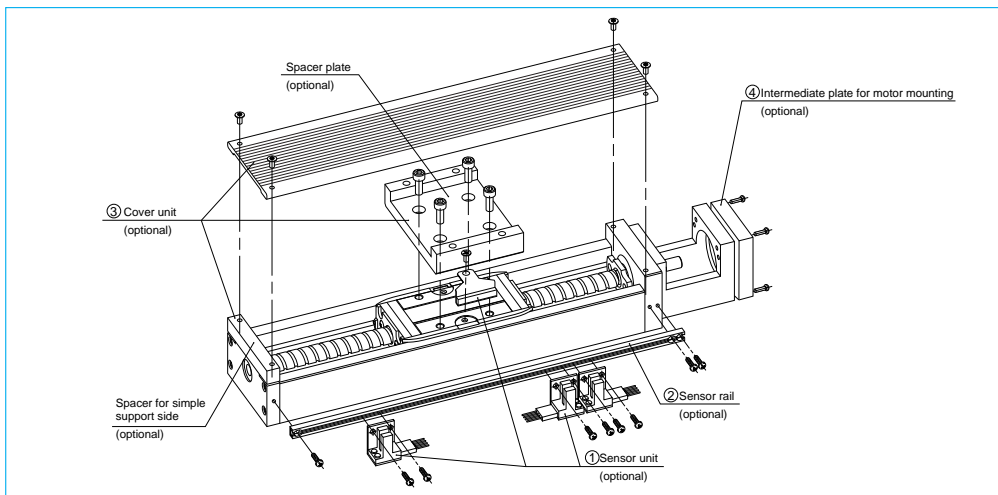


Fig. 3.2 Assembly Optional components for MCH10 (example)

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 optional components upon request.

### C-1-4 Selection of Monocarrier

#### C-1-4. 1 Procedures for Selecting Monocarrier

Select a reference type of Monocarrier based on stroke and rigidity (Refer to Fig. 4.2, 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 C13. Obtain the mean effective load ( $F_m$ ) substituting them for equation ③ on Page C14, 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 C14, then calculate the life.

#### C-1-4. 2 Rigidity

##### Rigidity of rail

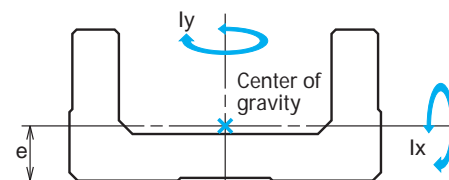


Fig. 4.1

Table 4.1 Rigidity of rail

Nominal size	Geometrical moment of inertia $\times 10^4$ (mm <sup>4</sup> )		Center of gravity (mm)	Mass (kg/100mm)
	$I_x$	$I_y$	$e$	$w$
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
MCH06	6.5	38.2	10.8	0.67
MCL06	2.58	29.6	7.8	0.56
MCH09	28.7	172	15.5	1.48
MCH10	54.0	307	18	1.93

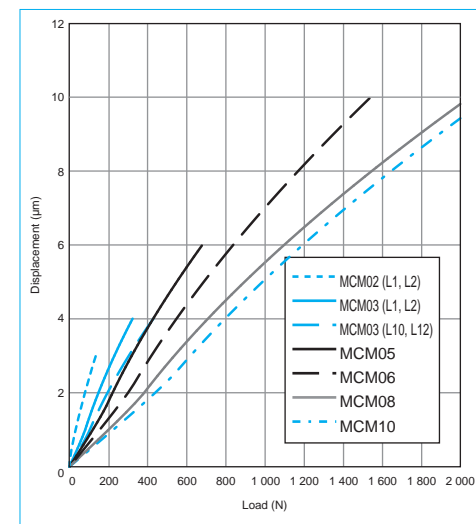


Fig. 4.2 MCM Series Rigidity in radial direction

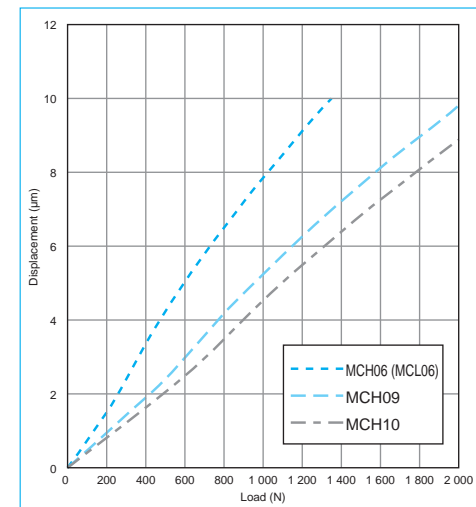


Fig. 4.3 MCH Series Rigidity in radial direction

C-1-4. 3 Maximum Speed

(1) Maximum Speed of MCM Series

Maximum speed of the Monocarrier is determined by the critical speed of the ball screw shaft and the  $d \cdot n$  value. Do not exceed the maximum speeds on the table below.

Table 4.2

	Ball screw lead	stroke (mm)	Rail length L <sub>2</sub> (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	
	10	100	190	500
		250	340	
		100	190	
12	100	190	600	
	250	340		
	50	180		
MCM05 Single slider	5	200	330	250
		50	180	
	10	600	730	500
		300	430	
	20	600	730	1000
		60	280	
MCM05 Double slider	10	510	730	500
		210	430	
		510	730	
	20	510	730	1000
		50	190	
		500	640	
MCM06 Single slider	5	50	190	250
		600	740	
		700	840	
		800	940	
	10	300	440	500
		600	740	
		700	840	
		800	940	
		770	910	
MCM06 Double slider	5	110	340	250
		410	640	
		110	340	
	10	610	840	500
		710	940	
		210	440	
	20	610	840	1000
		710	940	
		710	940	

Note: When operating the Monocarriers near the critical speed or exceeding the maximum speed in the table, please consult NSK.

	Ball screw lead	stroke (mm)	Rail length L <sub>2</sub> (mm)	Maximum speed (mm/s)
MCM08 Single slider	5	50	220	250
		200	370	
		100	270	
	10	700	870	500
		800	970	
		300	470	
20	700	870	1000	
	800	970		
	80	370		
MCM08 Double slider	10	680	970	500
		180	470	
		680	970	
	20	680	970	1000
		200	380	
		800	980	
MCM10 Single slider	10	900	1080	440
		1000	1180	
		300	480	
	20	800	980	1000
		900	1080	
		1000	1180	
MCM10 Double slider	10	70	380	500
		670	980	
		870	1180	
	20	170	480	1000
		670	980	
		870	1180	

Note: When operating the Monocarriers near the critical speed or exceeding the maximum speed in the table, please consult NSK.

(2) Maximum Speed of MCH Series

Maximum speed of the Monocarrier is determined by the critical speed of the ball screw shaft and the  $d \cdot n$  value. Do not exceed the maximum speeds on the table below.

Table 4.3

	Ball screw lead	stroke (mm)	Rail length L <sub>2</sub> (mm)	Maximum speed (mm/s)
MCH06 MCL06 Single slider	5	50	150	250
		500	600	
		50	150	
	10	500	600	500
		50	150	
		500	600	
20	50	150	1000	
	500	600		
	100	300		
MCH06 Double slider	5	400	600	250
		100	300	
		400	600	
	10	100	300	500
		400	600	
		100	300	
20	100	300	1000	
	400	600		
	200	340		
MCH09 Single slider	5	600	740	250
		800	940	
		200	340	
	10	600	740	500
		800	940	
		200	340	
20	600	740	1000	
	800	940		
	200	340		
MCH09 Double slider	5	150	440	250
		650	940	
		150	440	
	10	650	940	500
		150	440	
		650	940	
20	150	440	1000	
	650	940		
	150	440		

Note: When operating the Monocarriers near the critical speed or exceeding the maximum speed in the table, please consult NSK.

	Ball screw lead	stroke (mm)	Rail length L <sub>2</sub> (mm)	Maximum speed (mm/s)
MCH10 Single slider	10	400	580	500
		900	1080	
		800	980	
		900	1080	
		1000	1180	
	20	1100	1280	1000
		1200	1380	
		400	580	
		800	980	
		900	1080	
MCH10 Double slider	10	1000	1180	720
		1100	1280	
		1200	1380	
		250	580	
		750	1080	
	20	850	1180	480
		950	1280	
		1050	1380	
		250	580	
		750	1080	
MCH10 Single slider	5	600	740	250
		800	940	
		200	340	
		600	740	
		800	940	
	10	600	740	500
		800	940	
		200	340	
		600	740	
		800	940	
20	200	340	1000	
	600	740		
	800	940		
	200	340		
	600	740		
MCH09 Double slider	5	150	440	250
		650	940	
		150	440	
		650	940	
		150	440	
	10	650	940	500
		150	440	
		650	940	
		150	440	
		650	940	
20	150	440	1000	
	650	940		
	150	440		
	650	940		
	150	440		

Note: When operating the Monocarriers near the critical speed or exceeding the maximum speed in the table, please consult NSK.

C-1-4. 4 Accuracy Grade

The accuracy grade of Monocarrier standard inventories is high grade (H), except for lead 1 and 2 of MCM02, and 03.

When you require strokes longer than 1200 mm, please consult NSK about the accuracy grade.

Table 4.4 (Unit : μm)

Grade Stroke (mm)	High grade			Precision			
	Repeatability	Running Parallelism (vertical)	Backlash	Repeatability	Positioning accuracy	Running Parallelism (vertical)	Backlash
- 200	±10	14	20 or less	±3	20	8	3 or less
- 400		16			25	10	
- 600		20			30	12	
- 700		23			30	15	
- 1000		23			35	15	
- 1200		30			40	20	

C-1-4. 5 Stroke and Ball Screw Lead

(1) MCM Series Standard Combinations of Stroke and Ball Screw Lead

Table 4.5 Single slider (Unit : mm)

Nominal size lead stroke	MCM02		MCM03		MCM05			MCM06			MCM08			MCM10			
	1	2	1	2	10	12	5	10	20	5	10	20	5	10	20	10	20
50	○	○	○	○	☆	☆	○	○	☆	○	☆	☆	☆	☆			
100	○	○	○	○	○	○	○	○	☆	○	○	☆	☆	○	☆	☆	☆
150	○		☆	☆	☆	☆	☆	○	☆	☆	☆	☆	☆	☆	☆	☆	☆
200					○	☆	○	☆	○	☆	☆	☆	○	☆	○	☆	☆
250					☆	☆	☆	○	☆	☆	☆	☆	☆	☆	☆	☆	☆
300							☆	○	○	○	○	☆	○	○	○	○	○
400							☆	○	○	○	○	☆	○	○	○	○	○
500							☆	○	○	☆	○	☆	○	○	☆	☆	☆
600							☆	○	○	☆	☆	☆	○	☆	○	☆	☆
700										☆	○	○	☆	☆	☆	☆	☆
800										☆	☆	☆	☆	☆	○	☆	☆
900																☆	☆
1000																☆	☆

Table 4.6 Double slider (Unit : mm)

Nominal size lead stroke	MCM05			MCM06			MCM08			MCM10		
	10	20	5	10	20	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 slider of MCM 02 and 03.

(2) MCH Series Standard Combinations of Stroke and Ball Screw Lead

Table 4.7 Single slider

(○mark, Standard inventory; ☆mark, Short-term delivery) (Unit : mm)

Nominal size lead stroke	MCH06			MCH09			MCH10	
	5	10	20	5	10	20	10	20
50	○	○	☆					
100	○	○	☆	☆	☆	☆	☆	☆
200	○	○	○	○	○	☆	☆	☆
300	☆	○	○	○	○	☆	☆	☆
400	☆	○	○	○	○	☆	○	○
500	☆	○	○	☆	○	○	○	○
600				☆	○	○	○	○
700				☆	☆	☆	○	○
800				☆	○	○	○	○
900							☆	○
1000							☆	○
1100							☆	☆
1200							☆	☆

Table 4.8 Double slider

(☆mark, Short-term delivery) (Unit : mm)

Nominal size lead stroke	MCH06			MCH09			MCH10	
	5	10	20	5	10	20	10	20
100	☆	☆						
150				☆	☆			
200	☆	☆						
250				☆	☆		☆	☆
300	☆	☆						
350				☆	☆		☆	☆
400		☆	☆					
450					☆	☆	☆	☆
550							☆	☆
650					☆	☆	☆	☆
750								☆
850								☆
950								☆
1050								☆

Table 4.9 Limitations

	Nominal size	lead (mm)	slider	stroke (mm)
MCM series	MCM02	1, 2	Single	150
		1, 2	Single	150
	MCM03	10, 12	Single	350
			Single	900
	MCM05	5, 10, 20	Double	810
			Single	1000
	MCM06	5, 10, 20	Double	910
			Single	1000
MCM08	5, 10, 20	Double	880	
		Single	1800	
MCM10	10, 20	Double	1670	
		Single	600	
MCH series	MCH06	5, 10, 20	Double	500
			Single	1000
	MCH09	5, 10, 20	Double	850
			Single	1800
	MCH10	10, 20	Double	1650
			Single	500
MCL06	5, 10, 20	Single	500	

C-1-4. 6 Basic Load Rating

(1) MCM Series Basic Load Rating

Table 4.10 Basic Load Rating

Nominal size	Lead $\ell$ (mm)	Shaft dia $d$ (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit Limit load (N)
			Ball screw $C_a$	Linear guide $C$	Support unit $C_a$	Rated running distance $L_a$ (km)	Ball screw $C_{0a}$	Linear guide $C_0$	
MCM02	1	$\phi 6$	340 (High grade) 405 (Precision)	4910	615	1	555 (High grade) 615 (Precision)	2120	490
	2		340 (High grade) 405 (Precision)	3900		2	555 (High grade) 615 (Precision)		
MCM03	1	$\phi 6$	735	10900	2670	1	1230	4900	1040
	2		735	8650		2			
	10	1230	6250	10					
	12	1230	5880	12					
MCM05	5	$\phi 12$	3760	15600	4400	5	6310	10900	1450
	10		2260	12400		10	3780		
	20		2260	9850		20	3780		
MCM06	5	$\phi 16$	7310	25200	6550	5	13500	17000	2730
	10		7060	20000		10	12700		
	20		4560	15900		20	7750		
MCM08	5	$\phi 16$	7310	30800	7100	5	13500	22800	3040
	10		7060	24400		10	12700		
	20		4560	19400		20	7750		
MCM10	10	$\phi 20$	10900	33500	7600	10	21700	29400	3380
	20		7060	26600		20	12700		

Notes: ● Basic dynamic and static load ratings indicate the values for one slider. ● Basic dynamic load rating of the linear guide is the load of perpendicular direction to the axis that allows 90% of a group of the same Monocarriers to operate "Rated running distance" in the table, that is equivalent to 1 million revolutions of the ball screw and the support unit, under the same condition without causing flaking by rolling contact fatigue. ● Basic dynamic load rating of the ball screw is a load to axial direction that allows 90% of ball screws of a group of the same Monocarriers to rotate 1 million revolutions under the same condition without causing flaking by rolling contact fatigue. ● Basic dynamic load rating of the support unit is a constant load to axial direction that allows 90% of support units of the same group of Monocarriers to rotate 1 million revolutions under the same condition without causing flaking by rolling contact fatigue. ● Basic static load rating is a load that results in combined permanent deformations at the contact points of balls and ball grooves of respective parts is 0.01% of the diameter.

Table 4.11 Basic static moment load of linear guide

Nominal size	Lead (mm)	Slider	Basic static moment (N · m)		
			Rolling $M_{RO}$	Pitching $M_{PO}$	Yawing $M_{YO}$
MCM02	1, 2	Single	24	8	8
			MCM03	1, 2	68
10, 12	92				51
	MCM05		5, 10, 20	229	89
455				765	765
MCM06	5, 10, 20		415	174	174
		825	1220	1220	
MCM08	5, 10, 20	770	300	300	
		1540	2050	2050	
MCM10	10, 20	1170	425	425	
		2340	2940	2940	

Notes: ● Basic static moment of double slider is a value when two sliders equipped with NSK K1 are butted against each other. ● The basic static moment is the value when a rolling contact pressure of balls exceeds 4000 N/mm<sup>2</sup>. ● If you plan to apply extremely heavy load, please consult NSK for estimation of fatigue life.

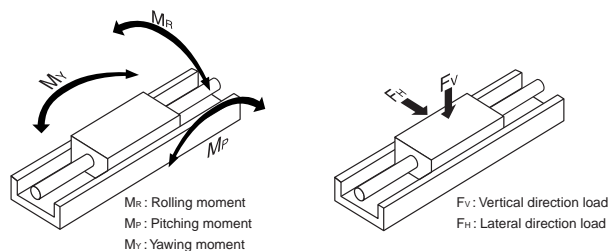


Fig. 4.4

(2) MCH Series Basic Load Rating

Table 4.12 Basic Load Rating

Nominal size	Lead $\ell$ (mm)	Shaft dia $d$ (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit Limit load (N)
			Ball screw $C_a$	Linear guide $C$	Support unit $C_a$	Rated running distance $L_a$ (km)	Ball screw $C_{0a}$	Linear guide $C_0$	
MCH06 (MCL06)	5	$\phi 12$	3000 (High grade) 3760 (Precision)	22800	4400	5	5410 (High grade) 6310 (Precision)	16300	1450
	10		1930 (High grade) 2260 (Precision)	18100		10	3160 (High grade) 3780 (Precision)		
	20		1930 (High grade) 2260 (Precision)	14400		20	3160 (High grade) 3780 (Precision)		
MCH09	5	$\phi 15$	6820 (High grade) 7100 (Precision)	40600	7100	5	13200 (High grade) 13000 (Precision)	30500	3040
	10		5110 (High grade) 7060 (Precision)	32200		10	9290 (High grade) 12700 (Precision)		
	20		3290 (High grade) 4560 (Precision)	25500		20	5620 (High grade) 7750 (Precision)		
MCH10	10	$\phi 20$	8230 (High grade) 10900 (Precision)	44600	7600	10	17100 (High grade) 21700 (Precision)	42000	3380
	20		5300 (High grade) 7060 (Precision)	35400		20	10300 (High grade) 12700 (Precision)		

Notes: ● Basic dynamic and static load ratings indicate the values for one slider. ● Basic dynamic load rating of the linear guide is the load of perpendicular direction to the axis that allows 90% of a group of the same Monocarriers to operate "Rated running distance" in the table, that is equivalent to 1 million revolutions of the ball screw and the support unit, under the same condition without causing flaking by rolling contact fatigue. ● Basic dynamic load rating of the ball screw is a load to axial direction that allows 90% of ball screws of a group of the same Monocarriers to rotate 1 million revolutions under the same condition without causing flaking by rolling contact fatigue. ● Basic dynamic load rating of the support unit is a constant load to axial direction that allows 90% of support units of the same group of Monocarriers to rotate 1 million revolutions under the same condition without causing flaking by rolling contact fatigue. ● Basic static load rating is a load that results in combined permanent deformations at the contact points of balls and ball grooves of respective parts is 0.01% of the diameter.

Table 4.13 Basic static moment load of linear guide

Nominal size	Slider	Basic static moment (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	1780	2070	2070
MCH10	Single	1460	610	610
	Double	2920	3430	3430

Notes: ● Basic static moment of double slider is a value when two sliders equipped with NSK K1 are butted against each other. ● The basic static moment is the value when a rolling contact pressure of balls exceeds 4000 N/mm<sup>2</sup>. ● If you plan to apply extremely heavy load, please consult NSK for estimation of fatigue life.

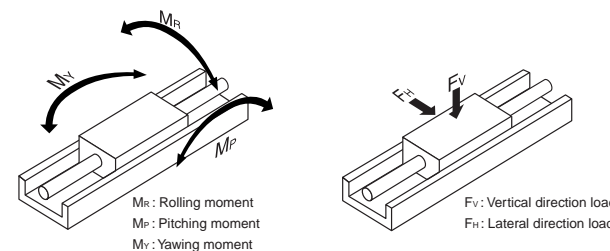


Fig. 4.5

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). The equivalent load (Fe) is determined by substituting the load for equation ① (Eq.② : in case of the tightly coupled double slider type).

● In case of the single slider

$$F_e = Y_H F_H + Y_V F_V + Y_R \epsilon_{Rd} M_R + Y_P \epsilon_{Pd} M_P + Y_Y \epsilon_{Yd} M_Y \dots ①$$

● In case of the double slider

$$F_e = \frac{Y_H F_H}{2} + \frac{Y_V F_V}{2} + Y_R \epsilon_{Rd} M_R + Y_P \epsilon_{Pd} M_P + Y_Y \epsilon_{Yd} M_Y \dots ②$$

- F<sub>H</sub> : Lateral direction load acting on the slider (N)
- F<sub>V</sub> : Vertical direction load acting on the slider (N)
- M<sub>R</sub> : Rolling moment acting on the slider (N · m)
- M<sub>P</sub> : Pitching moment acting on the slider (N · m)
- M<sub>Y</sub> : Yawing moment acting on the slider (N · m)

- ε<sub>Rd</sub> ε<sub>Rd</sub> : Dynamic equivalent coefficient to rolling moment
- ε<sub>Pd</sub> ε<sub>Pd</sub> : Dynamic equivalent coefficient to pitching moment
- ε<sub>Yd</sub> ε<sub>Yd</sub> : Dynamic equivalent coefficient to yawing moment

Refer to Table 4.14 about Dynamic equivalent coefficient.

- Y<sub>H</sub>, Y<sub>V</sub>, Y<sub>R</sub>, Y<sub>P</sub>, Y<sub>Y</sub> : 1.0 or 0.5

At equations ① and ② for obtaining equivalent load Fe, among F<sub>H</sub>, F<sub>V</sub>, ε<sub>Pd</sub>M<sub>P</sub>, ε<sub>Rd</sub>M<sub>R</sub>, ε<sub>Yd</sub>M<sub>Y</sub>, the maximum load is assumed to be 1.0, and others are to be 0.5.

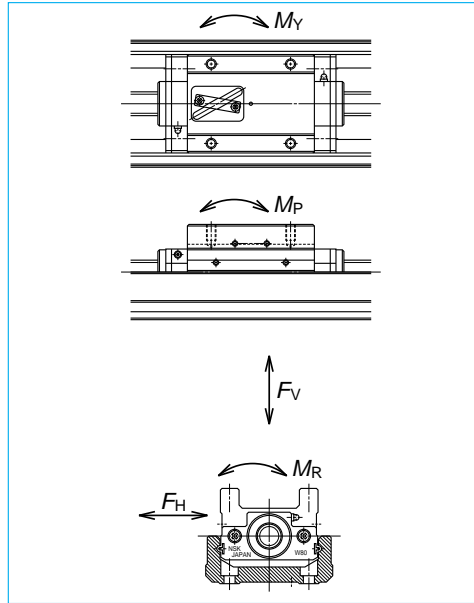


Fig. 4.6 Direction of load

Table 4.14 Dynamic equivalent coefficient

Nominal size	MCM02	MCM03		MCM05	MCM06	MCM08	MCM10	MCH06 MCL06	MCH09	MCH10
		lead 1, 2	lead 10, 12							
ε <sub>R</sub>	95.2	79.4	79.4	52.6	45.5	32.5	27.8	48.3	34.5	28.6
ε <sub>P</sub>	174	113.9	84.2	81.3	65.1	48.8	45.2	75.1	47.9	41.0
ε <sub>Y</sub>	174	113.9	84.2	81.3	65.1	48.8	45.2	75.1	47.9	41.0
ε <sub>Rd</sub>	-	-	-	26.3	22.7	16.3	13.9	24.2	17.2	14.3
ε <sub>Pd</sub>	-	-	-	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 <sub>Yd</sub>	-	-	-	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 coefficient in case of the Monocarrier without NSK K1.

In case when the load acting on the slider may fluctuate (In general, M<sub>p</sub>, M<sub>r</sub> may fluctuate with the acceleration/deceleration of slider), the mean effective load is determined by Eq. ③.

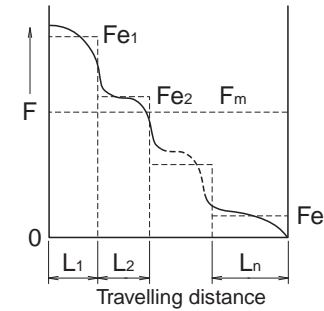


Fig. 4.7 Stepwise Fluctuating Load

- Travelling distance under the equivalent load Fe<sub>1</sub> : L<sub>1</sub>
- Travelling distance under the equivalent load Fe<sub>2</sub> : L<sub>2</sub>
- .....
- Travelling distance under the equivalent load Fe<sub>n</sub> : L<sub>n</sub>

$$F_m = \sqrt[3]{\frac{1}{L} (F_{e1}^3 L_1 + F_{e2}^3 L_2 + \dots + F_{en}^3 L_n) \dots} ③$$

- F<sub>m</sub> : Mean effective load of fluctuating loads
- L : Total travelling distance

The life of linear guide is calculated by Eq. ④

$$L = L_a \times \left( \frac{C}{f_w \cdot F_m} \right)^3 \dots ④$$

- L : Life of linear guide (km)
- F<sub>m</sub> : Mean effective load acting on the linear guide (N)
- C : Basic dynamic load rating of the linear guide (N)
- L<sub>a</sub> : Travelling distance (km)
- f<sub>w</sub> : 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 the single slider type to double slider type.
2. Use a larger size Monocarrier.

(2) Life of Ball Screw (Support unit)

The mean effective load is determined from the axial loads.

For calculation of the mean effective load, use Eq.③.

The life of ball screw is calculated by Eq. ⑤.

$$L = \ell \times \left( \frac{C_a}{f_w \cdot F_m} \right)^3 \times 10^6 \dots ⑤$$

- ℓ : Lead of ball screw (mm)
- L : Life of ball screw (mm)
- C<sub>a</sub> : Basic dynamic load rating of the ball screw (N)
- F<sub>m</sub> : Mean effective load acting on the ball screw (N)
- f<sub>w</sub> : 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<sub>w</sub>

Operating conditions	Load factor f <sub>w</sub>
At smooth operation with no mechanical shock	1.0 – 1.2
At normal operation	1.2 – 1.5
At operation with mechanical shock and vibrations	1.5 – 3.0

C-1-4. 8 Example of Life Estimation

This section offers an example how to estimate the life of Monocarrier based on the life of each component.

<<Example of calculation-1>>

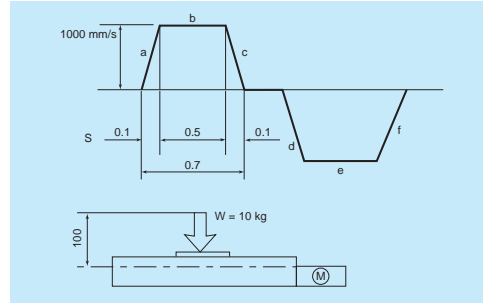


Fig. 4.8

1. Use condition

- Stroke : 600 mm
- Maximum Speed : 1000 mm/s
- Load Mass : W = 10 kg
- Acceleration : g = 9.8 m/s<sup>2</sup>
- Setting Position : Horizontal
- Operating Profile : See above figure

2. Selection of Nominal size (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 the Eq. ① by the dynamic equivalent coefficient (Table 4.14 single slider) to convert the load volume. From above operation profile,

- i) Constant speed  $F_{e1} = Y_V F_V = Y_V W_g = 1 \cdot 10 \cdot 9.8 = 98 \text{ N}$
- ii) Accelerating  $F_{e2} = Y_V F_V + Y_P \epsilon_P M_p = 0.5 \cdot 10 \cdot 9.8 + 1 \cdot 65.1 \cdot 0.1 \cdot 100 = 700 \text{ N}$
- iii) Decelerating  $F_{e3} = Y_V F_V + Y_P \epsilon_P M_p = 0.5 \cdot 10 \cdot 9.8 + 1 \cdot 65.1 \cdot 0.1 \cdot 100 = 700 \text{ N}$

Mean effective load  $F_m$

$$F_m = \sqrt[3]{\frac{1}{L} (F_{e1}^3 \cdot L_1 + F_{e2}^3 \cdot L_2 + F_{e3}^3 \cdot L_3)}$$

$$= \sqrt[3]{\frac{1}{600} (98^3 \cdot 500 + 700^3 \cdot 50 + 700^3 \cdot 50)}$$

$$= 387 \text{ N}$$

$$L = \left( \frac{C}{f_w \cdot F_m} \right)^3 \times L_a$$

$$= \left( \frac{15900}{1.2 \cdot 387} \right)^3 \times 20$$

$$= 8.02 \times 10^5 \text{ km}$$

3-1-2. Static safety factor; Divide the basic static load rating by the maximum axial load.

$$F_s = \frac{C_0}{F_e} = \frac{C_0}{F_{e2}} = \frac{17000}{700} = 24.2$$

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  $F_{e2} = F_{e1} + W\alpha = 101 \text{ N}$
- iii) Decelerating  $F_{e3} = F_{e1} - W\alpha = 99 \text{ N}$

Axial mean effective load  $F_m$

$$F_m = \sqrt[3]{\frac{1}{L} (F_{e1}^3 \cdot L_1 + F_{e2}^3 \cdot L_2 + F_{e3}^3 \cdot L_3)}$$

$$= \sqrt[3]{\frac{1}{600} (0.98^3 \cdot 500 + 101^3 \cdot 50 + 99^3 \cdot 50)}$$

$$= 55 \text{ N}$$

$$L = \left( \frac{C_a}{f_w \cdot F_m} \right)^3 \times \ell \times 10^6$$

$$= \left( \frac{4560}{1.2 \cdot 55} \right)^3 \times 20 \times 10^6 \text{ (mm)}$$

$$= 6.5 \times 10^6 \text{ km}$$

3-2-2. Static safety factor; Divide the basic static load rating by the maximum axial load.

$$F_s = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{7750}{101} = 76.7$$

3-2-3. Maximum rotational speed; According to the table of maximum speed on page C7, MCM06 with 20 mm lead and 600 mm stroke, is possible to operate under the maximum speed of 1000 mm/s.

3-3. Support unit

3-3-1. Fatigue life; Use the axial load  $F_m = 55 \text{ N}$ , that is the result of above calculation 3-2-1.

$$L = \left( \frac{C_a}{f_w \cdot F_m} \right)^3 \times \ell \times 10^6 = \left( \frac{6550}{1.2 \times 55} \right)^3 \times 20 \times 10^6 \text{ (mm)}$$

$$= 1.95 \times 10^7 \text{ km}$$

3-3-2. Static safety factor; Divide the limit load by the maximum axial load.

$$F_s = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{2730}{101} = 27.0$$

3-4. Result

MCM06060H20K00	Linear guide	Ball screw	Support unit
Fatigue life	8.02 × 10 <sup>5</sup> km	6.5 × 10 <sup>6</sup> km	1.95 × 10 <sup>7</sup> km
Static safety factor	24.2	76.7	27.0

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 of calculation-2>>

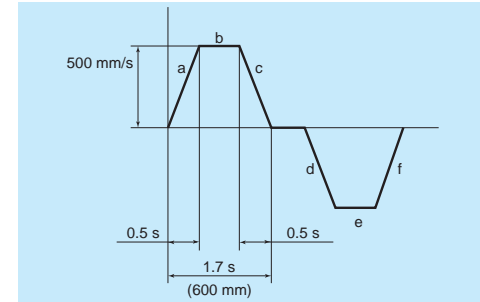


Fig. 4.9

1. Use condition

- Stroke : 600 mm
- Maximum Speed : 500 mm/s
- Load Mass : W = 20 kg
- Acceleration : 9.8 m/s<sup>2</sup>
- Setting Position : Vertical
- Operating Profile : See above figure

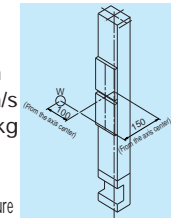


Fig. 4.10

2. Selection of Nominal size (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/s<sup>2</sup>.

- i) Constant speed  $F_{e1} = Y_p \times \epsilon_{pd} \times M_p + Y_v \times \epsilon_{vd} \times M_v$   
 $= 1 \cdot 7.6 \cdot 20 \cdot 9.8 \cdot 0.15 + 0.5 \cdot 7.6 \cdot 20 \cdot 9.8 \cdot 0.1 = 298 \text{ N}$
- ii) Accelerating  $F_{e2} = Y_p \times \epsilon_{pd} \times M_p + Y_v \times \epsilon_{vd} \times M_v$   
 $= 1 \cdot 7.6 \cdot 20 \cdot (9.8 + 0.15) \cdot 0.15 + 0.5 \cdot 7.6 \cdot 20 \cdot (9.8 + 1.0) \cdot 0.1 = 329 \text{ N}$
- iii) Decelerating  $F_{e3} = Y_p \times \epsilon_{pd} \times M_p + Y_v \times \epsilon_{vd} \times M_v$   
 $= 1 \cdot 7.6 \cdot 20 \cdot (9.8 - 1.0) \cdot 0.15 + 0.5 \cdot 7.6 \cdot 20 \cdot (9.8 - 1.0) \cdot 0.1 = 268 \text{ N}$

Mean effective load  $F_m$

$$F_m = \sqrt[3]{\frac{1}{L} (F_{e1}^3 \cdot L_1 + F_{e2}^3 \cdot L_2 + F_{e3}^3 \cdot L_3)}$$

$$= \sqrt[3]{\frac{1}{600} (298^3 \cdot 350 + 329^3 \cdot 125 + 268^3 \cdot 125)}$$

$$= 300 \text{ N}$$

$$L = L_a \times \left( \frac{C}{f_w \cdot F_m} \right)^3$$

$$= 10 \times \left( \frac{24400}{1.2 \cdot 300} \right)^3$$

$$= 3.11 \times 10^6 \text{ km}$$

3-1-2. Static safety factor; Divide the basic static load rating by the maximum axial load.

$$F_s = \frac{C_0}{F_e} = \frac{C_0}{F_{e2}} = \frac{22800}{329} = 69.3$$

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  $F_{e1} = W \cdot g = 20 \cdot 9.8 = 196 \text{ N}$
- ii) Accelerating  $F_{e2} = F_{e1} + W \cdot \alpha = 196 + 20 \cdot 1 = 216 \text{ N}$
- iii) Decelerating  $F_{e3} = F_{e1} - W \cdot \alpha = 196 - 20 \cdot 1 = 176 \text{ N}$

Axial mean effective load  $F_m$

$$F_m = \sqrt[3]{\frac{1}{L} (Fe_1^3 \cdot L_1 + Fe_2^3 \cdot L_2 + Fe_3^3 \cdot L_3)}$$

$$= \sqrt[3]{\frac{1}{600} (196^3 \cdot 350 + 216^3 \cdot 125 + 176^3 \cdot 125)}$$

$$= 197 \text{ N}$$

$$L = \ell \times \left( \frac{C_a}{f_w \cdot F_m} \right)^3 \times 10^6$$

$$= 10 \times \left( \frac{7060}{1.2 \cdot 197} \right)^3 \times 10^6$$

$$= 2.66 \times 10^5 \text{ km}$$

3-2-2. Static safety factor; Divide the basic static load rating by the maximum axial load.

$$F_s = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{12700}{216} = 58.7$$

### C-1-5 Maintenance

#### C-1-5.1 Maintenance Method

- For standard Monocarrier, we pack grease in the slider, linear guides and ball screw.
- Monocarriers 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 preceded grease may extend its life substantially.
- 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. In such a case, it requires increasing the frequency of replenishment.

3-3. Support unit

3-3-1. Fatigue life; Use the axial load  $F_m = 197 \text{ N}$ , that is the result of above calculation 3-2-1.

$$L = \ell \times \left( \frac{C_a}{f_w \cdot F_m} \right)^3 \times 10^6 = 10 \times \left( \frac{7100}{1.2 \times 197} \right)^3 \times 10^6$$

$$= 2.70 \times 10^5 \text{ km}$$

3-3-2. Static safety factor; Divide the limit load by the maximum axial load.

$$F_s = \frac{C_{0a}}{F_e} = \frac{C_{0a}}{F_{e2}} = \frac{3040}{216} = 14.0$$

3-4. Result

MCM08068H10D00	Linear guide	Ball screw	Support unit
Fatigue life	3.11 × 10 <sup>6</sup> km	2.66 × 10 <sup>6</sup> km	2.70 × 10 <sup>6</sup> km
Static safety factor	69.3	58.7	14.0

4. A Nozzle for the NSK grease gun for MCH Monocarriers is available as an option. NSK reference number: NSK HGP NZ8

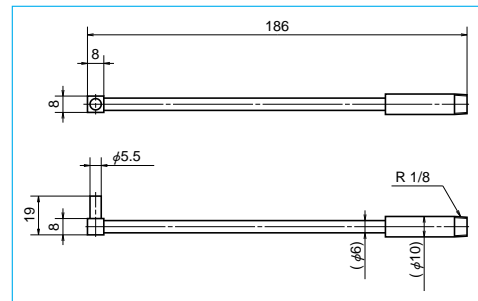


Fig. 5.1 NSK HGP NZ8

#### Precautions for handling

- 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.
- To extend high performance of NSK K1 lubrication unit, please observe the following.

- Temperature range    Ambient temperature: 50°C  
Max. instantaneous temperature: 80°C
- Use of chemicals        Never leave a Monocarrier 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-1-5. 2 NSK K1™ Lubricant Unit

NSK K1 lubrication unit exhibits outstanding features, confirmed by abundant experimental data, along with proven performance of linear guides and ball screws that are 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. 5.2. While the linear guide cannot be operated without lubricant for even short periods without damage, the installation of the NSK K1 permits the linear guide to run over 25 000 km without any problem.

Conditions	Test piece: LH30AN (Preload Z1)
	Speed: 3.3 m/s
	Stroke: 1800 mm
No lubricant	All grease removed
NSK K1	All grease removed + NSK K1

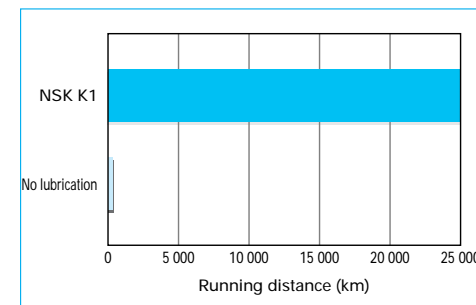


Fig. 5.2 Results of high-speed durability test of linear guides without lubricant

##### (2) High-Speed Durability Test of Ball Screws without Lubricant

Results of high-speed durability testing of ball screw without lubrication are shown in Fig.5.3. While the ball screw cannot be operated without a lubricant at 8.5 km without damage, the installation of the NSK K1 permits the ball screw to run over 21 000 km without any problem.

Conditions	Test piece: BS2020 (ball screw)
	Shaft diameter: 20 mm
	Lead: 20 mm
	Load: none
	Speed: 1.3 m/s (4 000 min <sup>-1</sup> )
No lubricant	All grease removed
	NSK K1
	All grease removed + NSK K1

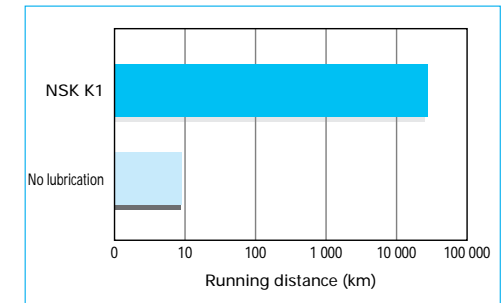


Fig. 5.3 Results of high-speed durability test of ball screws without lubricant

●NSK K1 Lubrication Units for food processing and medical devices are available.

For safety equipment of food processing and medical care, NSK provides the Monocarrier equipped with special NSK K1 Lubrication Unit that is made of materials approved by the FDA. Dimensions are the same as the standard NSK K1 Lubrication Unit, and special handling care is not required.

## C-1-6 NSK Clean Grease LG2 Specification

### ● Features

This grease was developed by NSK to be exclusively used for linear guides and ball screws in clean rooms. Compared to the fluoride grease which are commonly used in clean rooms, LG2 has several advantages such as: higher in 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 LCD which require highly clean environment 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	207
Dropping point	200°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	30 mm <sup>2</sup> /s (40°C)

## C-1-7 Characteristics and Evaluation Method

### C-1-7. 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 value 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.

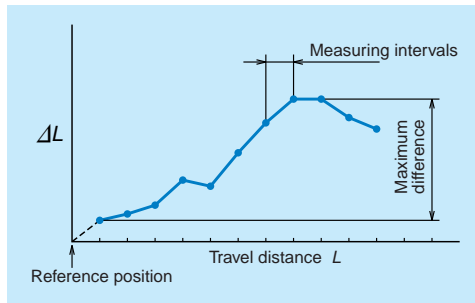


Fig. 7.1

### C-1-7. 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 ( $\pm$ ) sign.

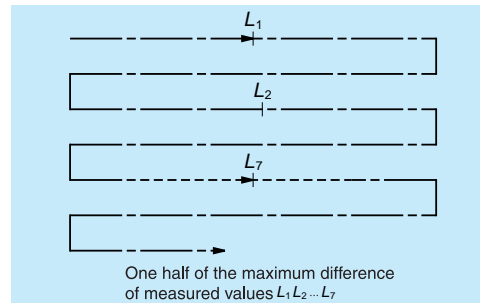


Fig. 7.2

### C-1-7. 3 Running Parallelism (Vertical direction)

We specify the parallelism of slider to the datum bottom face of rail. An indicator is fixed on the slider making its stylus slightly touching on the rail bottom surface. The slider is moved in the axial direction for the checking. We define the total indicator reading as the running parallelism. During the checking, the rail is not fixed to the table base. Please be aware that, in general application, the rail is fixed to the machine base, and thus the wobbly rolling error will be added to the running parallelism.

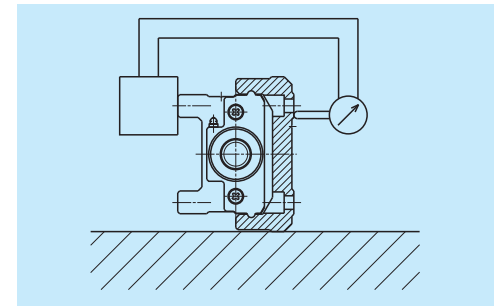


Fig. 7.3 Setting of indicator

## C-1-8 Special Specifications

Please consult NSK if your requirement is not in the standard products.

### (1) Surface Treatment

- Fluoride low temperature chrome plating

Note: Ball screw parts (including low temperature chrome plating.)

### (2) Special Machining (Processing)

- ① Shaft end processing
  - Key way processing
  - One flat or two flats processing
- ② Pin hole processing
  - Slider
  - Rail

Note: Due to interference with the internal construction, the position of pin hole is limited. Please consult NSK for the pin position.

### (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 motor upon request, if the motor is provided in advance.

Note: Motion check of the motor is unavailable.

### (4) Reversed Motor Mount

The reversed motor mount is available. Please consult NSK.

Notes: 1) We don't check motor running condition.

- 2) Please refer to the bottom of page C77 to 79 for the configuration of reversed motor mounting of the MCH series.

### (5) Right and Left Turn Thread

Right and left turn ball screw is available. Please consult 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 a height adjustment work compared with a construction with two standard Monocarriers.

Note: Height grinding adjustment of the two axes assembly is not available.



## C-1-9 Sensor Specification

### C-1-9. 1 Proximity Switch

#### Use of OMRON E2S-W13, 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 object type	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 (a-contact)	NC (b-contact)
Wire lead length	1000 mm	

Notes: 1) Do not make a wrong connection.  
2) Please contact NSK for PNP output type.

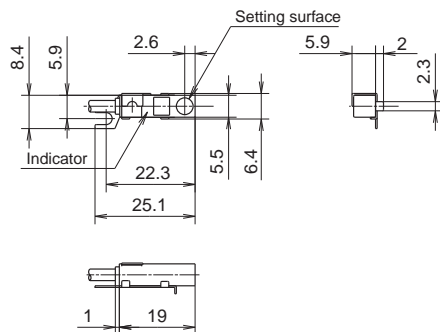
Movement mode	Output type	Type	Time chart	Output circuit
NO	NPN	E2S-W13 type		
		E2S-W14 type		
NC	NPN	E2S-W14 type		

E2S-W13 (a-contact)

E2S-W14 (b-contact)

The external appearances are the same.

A connector is mounted to the sensor in the right figure.



### C-1-9. 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 a 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, At 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	Operating, -25°C to 55°C (-13°F to 131°F); Storage, -30°C to 80°C (-22°F to 176°F)
Ambient humidity	Operating, 5 to 85% RH; Storage, 5 to 95% RH
Connecting method	EE-1001/1006 Connectors, soldering terminals

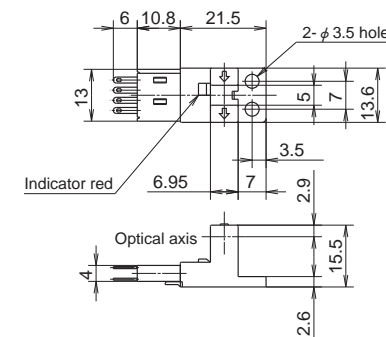
Notes: 1) Do not make a wrong connection.  
2) Please contact NSK for PNP output type.

Type	Movement mode	Time chart	Connection terminal	Output circuit
EE-SX674 type	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.





1	MCM Series Reference Number Coding	C25
2	MCM Series Dimension Table of Standard Products	
	MCM02	C26
	MCM03	C27
	MCM05	C29
	MCM06	C31
	MCM08	C33
	MCM10	C35
3	MCM Series Option Part	
3.1	Sensor Unit	C37
3.2	Cover Unit	C41
3.3	Motor Bracket	C43

# MCM Series

# C-2 MCM Series

## C-2-1 MCM Series Reference Number Coding

[Body]  
 Reference number : **MC M 08 040 H 10 K 0 0**  
 Monocarrier  
 M type: MCM Series  
 Nominal size (rail width, Unit: 10 mm)  
 Stroke (Unit: 10 mm)  
 Accuracy grade (H, High grade; P, Precision grade)

NSK management number  
 Grease specification: O (standard AS2)  
 Clean grease specification: B (LG2)  
 Slider specification K: Single slider  
 (See page C9) D: Double slider  
 Ball screw lead (mm)

[With Option part]  
 Reference number : **MC E 08 040 H 10 K 0 0 K 0 0 0**  
 E: With MCM option part  
 NSK management number  
 Sensor unit  
 Cover unit  
 Motor bracket

Note : Optional components are available separately.

**Table 1 Sensor unit (See page C37)**

Reference number code	Specification	Reference number
0	N/A	—
1	Proximity switch (b-contact 3 pieces)	MC - SRxx - 10
2	Proximity switch (a-contact 3 pieces)	MC - SRxx - 11
3	Proximity switch (a-contact 1 piece, b-contact 2 pieces)	MC - SRxx - 12
4	Photo sensor 3 pieces	MC - SRxx - 13

xx: Reference number  
 Note: Sensor rail is not included in a sensor unit. If you require the rail, please request separately. (See page C38 to 40.)

**Table 2 Cover unit (See page C41 - 42)**

Reference number code	Specification	Reference number
0	N/A	—
1	With top cover	MC - CVxxxx - 01 (02) *
2	Full cover	MC - CVxxxx - 00

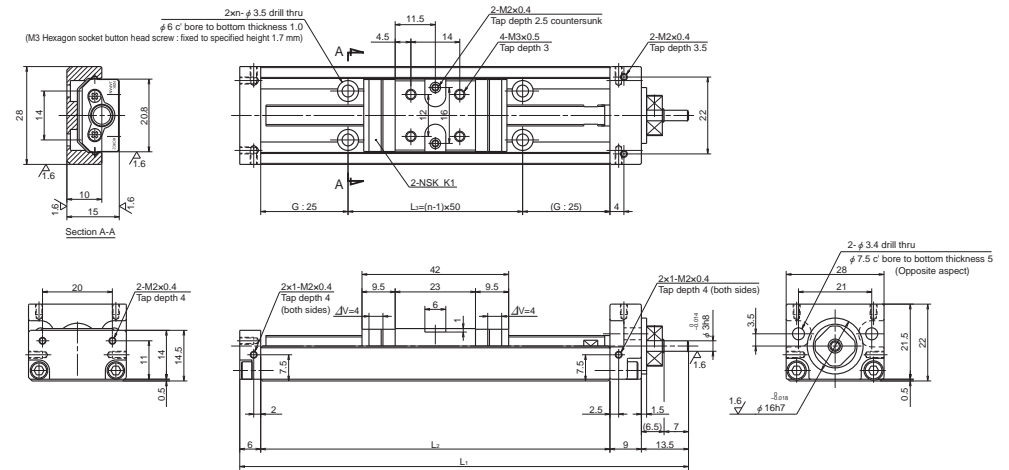
xxxx: Reference number and stroke number  
 \*: Monocarrier ".02" is only used for MCM03  
 Note: When a sensor unit is used, the full cover unit cannot be used.

**Table 3 The reference number of motor bracket (See page C43 - 58)**

Reference number code	Reference number				
	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	—

## C-2-2 MCM Series Dimension Table of Standard Products

### MCM02



Dimension of MCM02 (Single slider)

Reference number	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)			No. of mounting hole <i>n</i>	Inertia $\times 10^7$ (kg · m <sup>2</sup> )	Mass (kg)
				L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>			
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									

Note: Items not marked are available from standard stock.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	High grade		Precision
	1	0.1 - 1.3	
2	0.1 - 1.3		

- Notes:
- Frictional resistance of NSK K1 is included in the dynamic torque in the table.
  - Grease is packed into ball screw, linear guide parts and support unit.
  - Consult NSK for life estimates under large moment loads.
  - Stroke limit = stroke + (4 [margin] × 2)

### Basic load rating

Lead $l$ (mm)	Shaft dia $d$ (mm)	Basic dynamic load rating (N)				Basic static load rating (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 $C_0$	
1	$\phi 6$	340 (High grade)	4910	615	1	555 (High grade)	2120	490
		405 (Precision)				615 (Precision)		
2	$\phi 6$	340 (High grade)	3900	615	2	555 (High grade)	2120	490
		405 (Precision)				615 (Precision)		

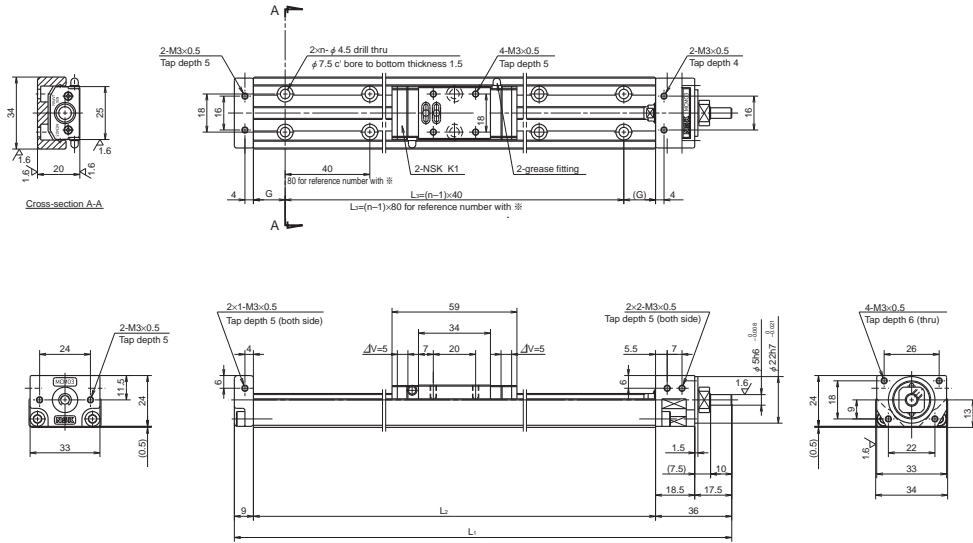
### Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling $M_{R0}$	Pitching $M_{P0}$	Yawing $M_{Y0}$
Single	24	8	8

MCM03

Accuracy grade: Precision (P)

Ball screw lead 1 and 2



Dimension of MCM03 (Single slider)

$\Delta V$  is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm)				No. of mounting hole $n$	Inertia $\times 10^{-5}$ (kg · m <sup>2</sup> )	Mass (kg)
				L <sub>1</sub>	L <sub>2</sub>	G	L <sub>3</sub>			
※MCM03005P01K00	50	56 (66)	1	160	115	17.5	80	2	0.015	0.6
※MCM03005P02K00			2							
MCM03010P01K00	100	131 (141)	1	235	190	15	160	5	0.021	0.7
MCM03010P02K00			2							
☆MCM03015P01K00	150	181 (191)	1	285	240	20	200	6	0.025	0.8
☆MCM03015P02K00			2							

- Notes: 1. Items not marked are available from standard stock.  
 2. Items marked with ☆ are designated as "quick delivery item" upon request.  
 3. Bolt hole pitch L<sub>3</sub> on the items marked with ※ is 80 mm.

Monocarrier dynamic torque specification (N · cm)

Notes:

Ball screw lead (mm)	0.2 – 1.7	
	1	2
Ball screw lead (mm)	10	12

Notes:  
 1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.  
 2. Grease is packed into ball screw, linear guide parts and support unit.  
 3. Consult NSK for life estimates under large moment loads.  
 4. Optional spacer is required, when using a cover unit, sensor unit or the both together in ball screw lead of 1 and 2 mm (See page C41).  
 5. Stroke limit = stroke + (3 [margin] × 2)

Basic load rating

Lead $l$ (mm)	Shaft dia $d$ (mm)	Basic dynamic load rating (N)				Basic static load rating (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 $C_0$	
1	φ6	735	10900	2670	1	1230	4900	1040
2					2			

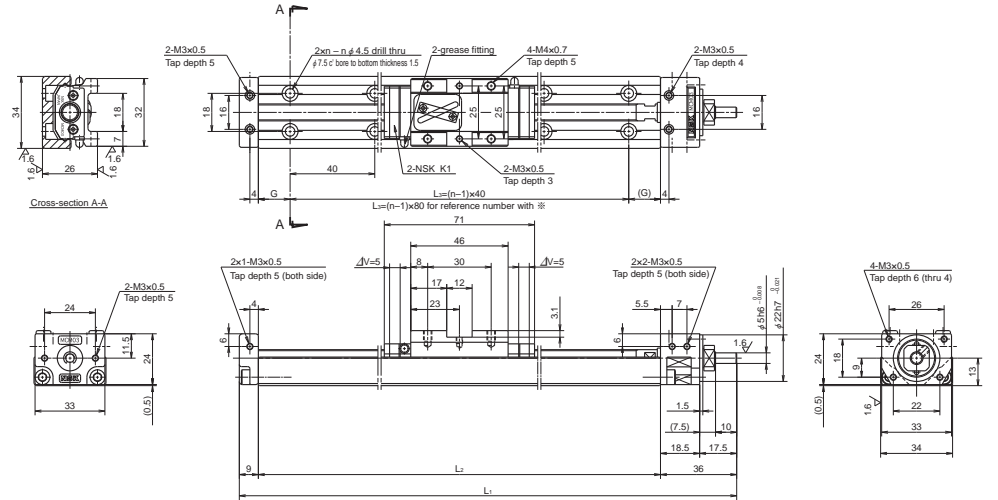
Basic static moment load of linear guide

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 lead 10 and 12



Dimension of MCM03 (Single slider)

$\Delta V$  is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm)				No. of mounting hole $n$	Inertia $\times 10^{-5}$ (kg · m <sup>2</sup> )	Mass (kg)
				L <sub>1</sub>	L <sub>2</sub>	G	L <sub>3</sub>			
☆※MCM03005H10K00	50	69 (79)	10	185	140	30	80	2	0.080	0.6
☆※MCM03005H12K00			12							
MCM03010H10K00	100	119 (129)	10	235	190	15	160	5	0.092	0.7
MCM03010H12K00			12							
☆MCM03015H10K00	150	169 (179)	10	285	240	20	200	6	0.105	0.8
☆MCM03015H12K00			12							
MCM03020H10K00	200	219 (229)	10	335	290	25	240	7	0.118	0.9
☆MCM03020H12K00			12							
☆MCM03025H10K00	250	269 (279)	10	385	340	30	280	8	0.131	1.0
☆MCM03025H12K00			12							

- Notes: 1. Items not marked are available from standard stock.  
 2. Items marked with ☆ are designated as "quick delivery item" upon request.  
 3. Bolt hole pitch L<sub>3</sub> on the items marked with ※ is 80 mm.

Monocarrier dynamic torque specification (N · cm)

Notes:

Ball screw lead (mm)	0.3 – 3.0	
	10	12
Ball screw lead (mm)	10	12

Notes:  
 1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.  
 2. Grease is packed into ball screw, linear guide parts and support unit.  
 3. Consult NSK for life estimates under large moment loads.  
 4. Stroke limit = stroke + (9.5 [margin] × 2)

Basic load rating

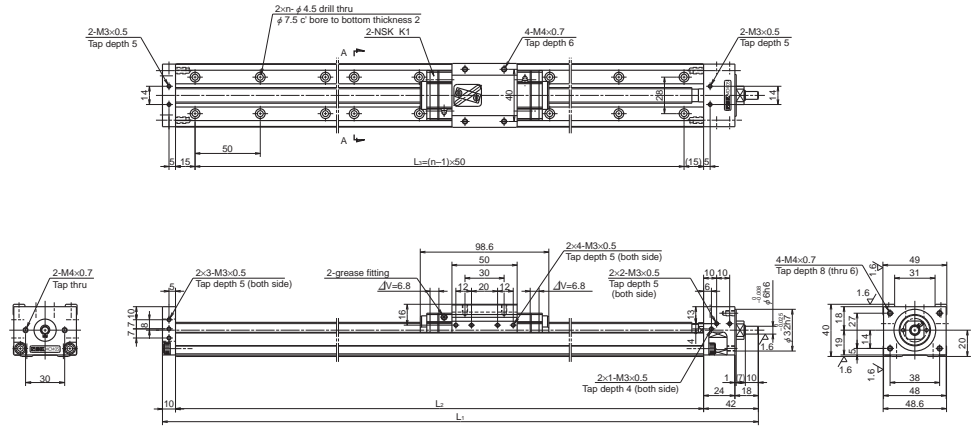
Lead $l$ (mm)	Shaft dia $d$ (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
		Ball screw $C_a$	Linear guides $C$	Support unit $C_a$	Rated running distance $L_a$ (km)	Ball screw $C_{0a}$	Linear guides $C_0$	
10	φ8	1230	6250	2670	10	1690	6620	1040
12					12			

Basic static moment load 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)



Dimension of MCM05 (Single slider)

$\Delta V$  is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit (mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm)			No. of mounting hole $n$	Inertia $\times 10^{-4}$ (kg · m <sup>2</sup> )	Mass (kg)
				$L_1$	$L_2$	$L_3$			
MCM05005H05K00	50	(95)	5	232	180	150	4	0.025	1.4
MCM05005H10K00			10						
MCM05005H20K00			20						
MCM05010H05K00	100	(145)	5	282	230	200	5	0.031	1.6
MCM05010H10K00			10						
MCM05010H20K00			20						
MCM05015H05K00	150	(195)	5	332	280	250	6	0.036	1.8
MCM05015H10K00			10						
MCM05015H20K00			20						
MCM05020H05K00	200	(245)	5	382	330	300	7	0.042	2.0
MCM05020H10K00			10						
MCM05020H20K00			20						
MCM05025H05K00	250	(295)	5	432	380	350	8	0.047	2.2
MCM05025H10K00			10						
MCM05025H20K00			20						
MCM05030H05K00	300	(345)	5	482	430	400	9	0.053	2.3
MCM05030H10K00			10						
MCM05030H20K00			20						
MCM05040H05K00	400	(445)	5	582	530	500	11	0.064	2.7
MCM05040H10K00			10						
MCM05040H20K00			20						
MCM05050H05K00	500	(545)	5	682	630	600	13	0.076	3.1
MCM05050H10K00			10						
MCM05050H20K00			20						
MCM05060H05K00	600	(645)	5	782	730	700	15	0.087	3.5
MCM05060H10K00			10						
MCM05060H20K00			20						

Notes: 1. Items not marked are available from standard stock.  
2. Items marked with ☆ are designated as "quick delivery item" upon request.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	Stroke limit (mm)	
	5	1.0 – 4.8
	10	1.1 – 5.8
20	1.6 – 7.9	

Notes:

- Frictional resistance of NSK K1 is included in the dynamic torque in the table.
- Grease is packed into ball screw, linear guide parts and support unit.
- Consult NSK for life estimates under large moment loads.
- Stroke limit = stroke + (15 [margin] × 2)

Basic load rating

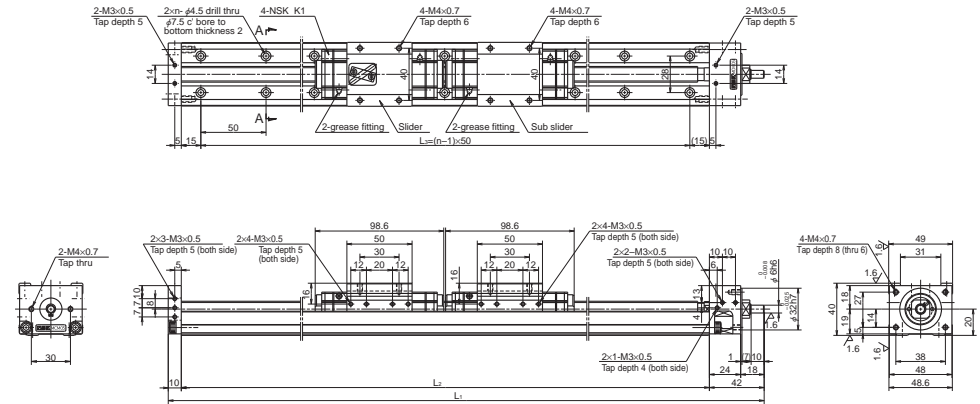
Lead $l$ (mm)	Shaft dia $d$ (mm)	Basic dynamic load rating (N)				Rated running distance $L_a$ (km)	Basic static load rating (N)		Support unit load limit (N)
		Ball screw $C_a$	Linear guides $C$	Support unit $C_a$	Ball screw $C_{0a}$		Linear guides $C_0$		
5	$\phi 12$	3760	15600	4400	5	6310	10900	1450	
10		2260	12400		10	3780			
20		2260	9850		20	3780			

Basic static moment load 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)



Dimension of MCM05 (Double slider)

$\Delta V$  is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit (mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm)			No. of mounting hole $n$	Inertia $\times 10^{-4}$ (kg · m <sup>2</sup> )	Mass (kg)
				$L_1$	$L_2$	$L_3$			
☆MCM05006H10D00	60	83 (110)	10	332	280	250	6	0.058	2.3
☆MCM05011H10D00	110	133 (160)	10	382	330	300	7	0.064	2.5
☆MCM05016H10D00	160	183 (210)	10	432	380	350	8	0.070	2.7
☆MCM05021H10D00	210	233	10	482	430	400	9	0.075	2.8
☆MCM05021H20D00		(260)	20						
☆MCM05031H10D00	310	333	10	582	530	500	11	0.086	3.2
☆MCM05031H20D00		(360)	20						
☆MCM05041H10D00	410	433	10	682	630	600	13	0.098	3.6
☆MCM05041H20D00		(460)	20						
☆MCM05051H10D00	510	533	10	782	730	700	15	0.109	4.2
☆MCM05051H20D00		(560)	20						

Notes: 1. Items not marked are available from standard stock.  
2. Items marked with ☆ are designated as "quick delivery item" upon request.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	Stroke limit (mm)	
	10	1.5 – 7.6
20	2.3 – 11.8	

Notes:

- Frictional resistance of NSK K1 is included in the dynamic torque in the table.
- Grease is packed into ball screw, linear guide parts and support unit.
- Consult NSK for life estimates under large moment loads.
- Stroke limit = stroke + (11.4 [margin] × 2)

Basic load rating

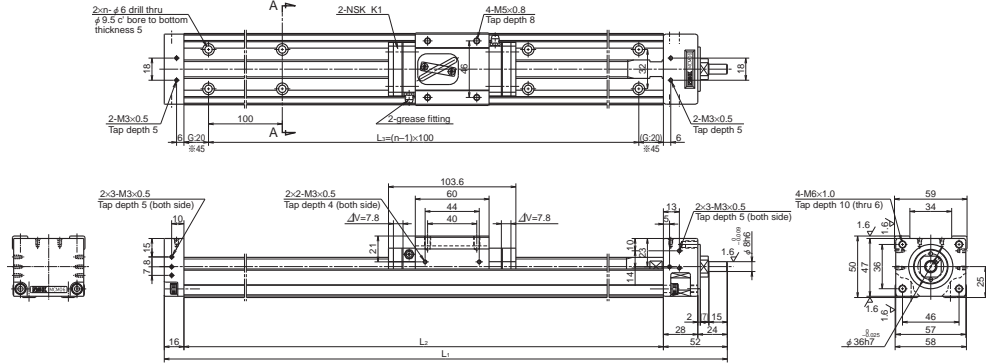
Lead $l$ (mm)	Shaft dia $d$ (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
		Ball screw $C_a$	Linear guides $C$	Support unit $C_a$	Rated running distance $L_a$ (km)	Ball screw $C_{0a}$	Linear guides $C_0$	
5	$\phi 12$	3760	15600	4400	5	6310	10900	1450
10		2260	12400		10	3780		
20		2260	9850		20	3780		

Basic static moment load 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)



Dimension of MCM06 (Single slider)

$\Delta V$  is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit (mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm)			No. of mounting hole $n$	Inertia $\times 10^{-4}$ (kg · m <sup>2</sup> )	Mass (kg)
				$L_1$	$L_2$	$L_3$			
※MCM06005H05K00	50	85 (102)	5	258	190	100	2	0.083	2.7
☆MCM06005H10K00			10					0.077	
☆MCM06005H20K00			20					0.122	
MCM06010H05K00	100	135 (152)	5	308	240	200	3	0.103	3.0
MCM06010H10K00			10					0.092	
☆MCM06010H20K00			20					0.137	
☆MCM06015H05K00	150	185 (202)	5	358	290	200	3	0.122	3.5
☆MCM06015H10K00			10					0.106	
☆MCM06015H20K00			20					0.152	
MCM06020H05K00	200	235 (252)	5	408	340	300	4	0.142	3.8
MCM06020H10K00			10					0.121	
☆MCM06020H20K00			20					0.167	
☆MCM06025H05K00	250	285 (302)	5	458	390	300	4	0.161	4.2
☆MCM06025H10K00			10					0.136	
☆MCM06025H20K00			20					0.181	
MCM06030H05K00	300	335 (352)	5	508	440	400	5	0.180	4.5
MCM06030H10K00			10					0.150	
MCM06030H20K00			20					0.196	
MCM06040H05K00	400	435 (452)	5	608	540	500	6	0.219	5.2
MCM06040H10K00			10					0.180	
MCM06040H20K00			20					0.225	
☆MCM06050H05K00	500	535 (552)	5	708	640	600	7	0.258	6.0
MCM06050H10K00			10					0.209	
MCM06050H20K00			20					0.255	
☆MCM06060H05K00	600	635 (652)	5	808	740	700	8	0.297	6.7
☆MCM06060H10K00			10					0.239	
☆MCM06060H20K00			20					0.284	
☆MCM06070H05K00	700	735 (752)	5	908	840	800	9	0.335	7.4
MCM06070H10K00			10					0.268	
MCM06070H20K00			20					0.314	
☆MCM06080H05K00	800	835 (852)	5	1008	940	900	10	0.374	8.1
☆MCM06080H10K00			10					0.298	
☆MCM06080H20K00			20					0.343	

Notes: 1. Items not marked are available from standard stock.  
 2. Items marked with ☆ are designated as "quick delivery item" upon request.  
 3. Dimension G is 45 for those marked with ※.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	5		1.9 – 7.4	
	10		2.2 – 8.6	
	20		2.8 – 11.0	

Notes:

- Frictional resistance of NSK K1 is included in the dynamic torque in the table.
- Grease is packed into ball screw, linear guide parts and support unit.
- Consult NSK for life estimates under large moment loads.
- Stroke limit = stroke + (17.5 [margin] × 2)

Basic load rating

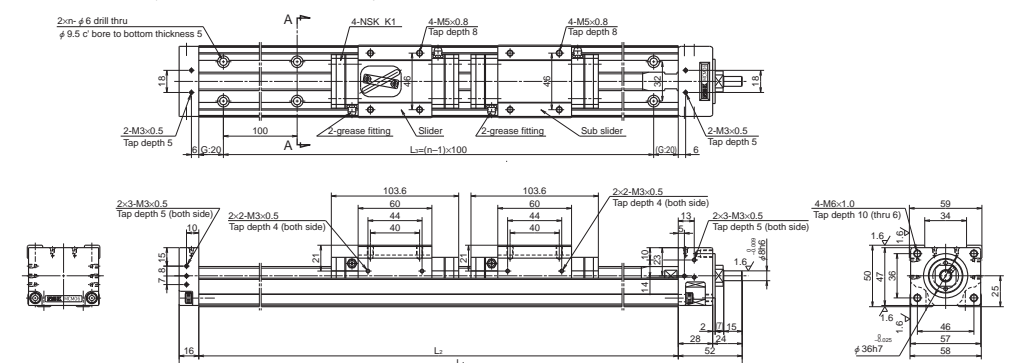
Lead $l$ (mm)	Shaft dia $d$ (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
		Ball screw $C_a$	Linear guides $C$	Support unit $C_a$	Rated running distance $L_a$ (km)	Ball screw $C_{0a}$	Linear guides $C_0$	
5	$\phi 16$	7310	25200	6550	5	13500	17000	2730
10	$\phi 15$	7060	20000		10	12700		
20		4560	15900		20	7750		

Basic static moment load 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)



Dimension of MCM06 (Double slider)

$\Delta V$  is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit (mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm)			No. of mounting hole $n$	Inertia $\times 10^{-4}$ (kg · m <sup>2</sup> )	Mass (kg)
				$L_1$	$L_2$	$L_3$			
☆MCM06011H05D00	110	133 (164)	5	408	340	300	4	0.145	4.4
☆MCM06011H10D00			10					0.136	
☆MCM06021H05D00			5					0.184	
☆MCM06021H10D00	210	233 (264)	10	508	440	400	5	0.166	5.1
☆MCM06021H20D00			20					0.257	
☆MCM06031H05D00			5					0.223	
☆MCM06031H10D00	310	333 (364)	10	608	540	500	6	0.195	5.8
☆MCM06031H20D00			20					0.286	
☆MCM06041H05D00			5					0.262	
☆MCM06041H10D00	410	433 (464)	10	708	640	600	7	0.224	6.6
☆MCM06041H20D00			20					0.316	
☆MCM06051H10D00			510					533 (564)	
☆MCM06051H20D00	20	0.345							
☆MCM06061H10D00	610	633 (664)		10	908	840	800		9
☆MCM06061H20D00			20	0.375					
☆MCM06071H10D00			710	733 (764)				10	
☆MCM06071H20D00	20	0.404							

Notes: 1. Items not marked are available from standard stock.  
 2. Items marked with ☆ are designated as "quick delivery item" upon request.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	5		2.3 – 8.5	
	10		2.7 – 10.9	
	20		4.0 – 15.9	

Notes:

- Frictional resistance of NSK K1 is included in the dynamic torque in the table.
- Grease is packed into ball screw, linear guide parts and support unit.
- Consult NSK for life estimates under large moment loads.
- Stroke limit = stroke + (11.4 [margin] × 2)

Basic load rating

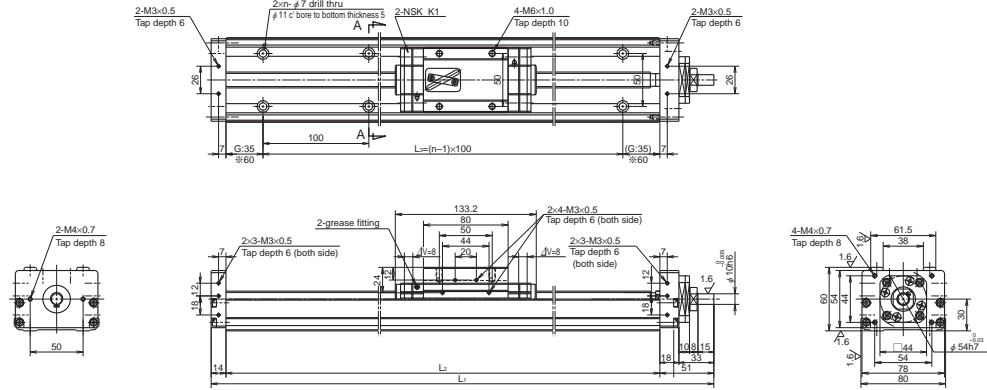
Lead $l$ (mm)	Shaft dia $d$ (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
		Ball screw $C_a$	Linear guides $C$	Support unit $C_a$	Rated running distance $L_a$ (km)	Ball screw $C_{0a}$	Linear guides $C_0$	
5	$\phi 16$	7310	25200	6550	5	13500	17000	2730
10	$\phi 15$	7060	20000		10	12700		
20		4560	15900		20	7750		

Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling $M_{RO}$	Pitching $M_{PO}$	Yawing $M_{YO}$
Double	825	1220	1220

MCM08

Accuracy grade: High grade (H)



Dimension of MCM08 (Single slider)

$\Delta V$  is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm)			No. of mounting hole $n$	Inertia $\times 10^{-4}$ (kg · m <sup>2</sup> )	Mass (kg)
				L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>			
☆※MCM08005H05K00	50	85 (101)	5	285	220	100	2	0.101	4.1
☆※MCM08005H10K00			10					0.100	
☆MCM08010H10K00	100	135 (151)	5	335	270	200	3	0.120	4.6
☆MCM08010H20K00			10					0.114	
☆MCM08010H20K00			20					0.190	
☆※MCM08015H05K00	150	185 (201)	5	385	320	200	3	0.139	5.1
☆※MCM08015H10K00			10					0.129	
☆※MCM08015H20K00			20					0.205	
☆MCM08020H05K00			5					0.159	
☆MCM08020H10K00	200	235 (251)	10	435	370	300	4	0.144	5.5
☆MCM08020H20K00			20					0.220	
☆MCM08025H05K00			5					0.178	
☆MCM08025H10K00	250	285 (301)	10	485	420	300	4	0.159	6.0
☆MCM08025H20K00			20					0.235	
☆MCM08030H05K00			5					0.198	
☆MCM08030H10K00	300	335 (351)	10	535	470	400	5	0.173	6.5
☆MCM08030H20K00			20					0.249	
☆MCM08040H05K00			5					0.236	
☆MCM08040H10K00	400	435 (451)	10	635	570	500	6	0.203	7.4
☆MCM08040H20K00			20					0.279	
☆MCM08050H05K00			5					0.275	
☆MCM08050H10K00	500	535 (551)	10	735	670	600	7	0.232	8.4
☆MCM08050H20K00			20					0.308	
☆MCM08060H05K00			5					0.314	
☆MCM08060H10K00	600	635 (651)	10	835	770	700	8	0.262	9.3
☆MCM08060H20K00			20					0.338	
☆MCM08070H05K00			5					0.353	
☆MCM08070H10K00	700	735 (751)	10	935	870	800	9	0.291	10.5
☆MCM08070H20K00			20					0.367	
☆MCM08080H05K00			5					0.391	
☆MCM08080H10K00	800	835 (851)	10	1035	970	900	10	0.320	11.2
☆MCM08080H20K00			20					0.396	

Notes: 1. Items not marked are available from standard stock.  
 2. Items marked with ☆ are designated as "quick delivery item" upon request.  
 3. Dimension G is 60 for those marked with ※.

Monocarrier dynamic torque specification (N · cm)

Notes:

Ball screw lead (mm)	5	1.0 - 5.9
	10	2.0 - 7.8
	20	2.5 - 10.8

- Frictional resistance of NSK K1 is included in the dynamic torque in the table.
- Grease is packed into ball screw, linear guide parts and support unit.
- Consult NSK for life estimates under large moment loads.
- Stroke limit = stroke + (17.5 [margin] × 2)

Basic load rating

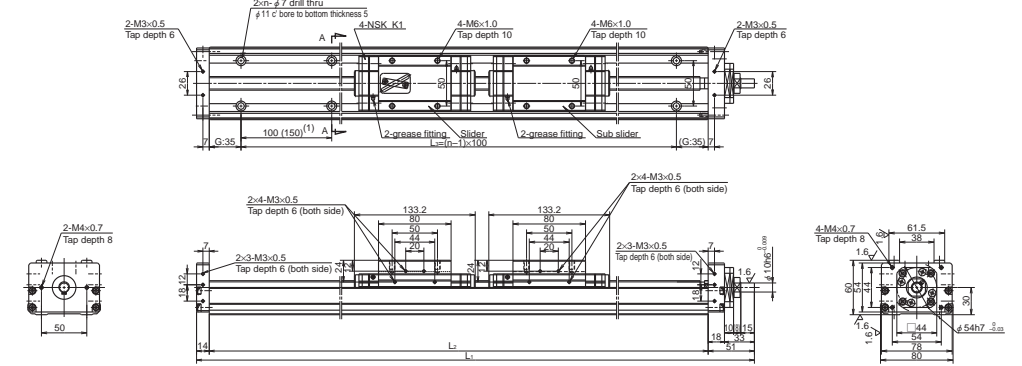
Lead $l$ (mm)	Shaft dia $d$ (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
		Ball screw $C_a$	Linear guides $C$	Support unit $C_s$	Rated running distance $L_a$ (km)	Ball screw $C_{0a}$	Linear guides $C_0$	
5	$\phi 16$	7310	30800	7100	5	13500	3040	
10	$\phi 15$	7060	24400		10	12700		
20		4560	19400	20	7750			

Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling $M_{RO}$	Pitching $M_{PO}$	Yawing $M_{VO}$
Single	770	300	300

MCM08 (Double slider)

Accuracy grade: High grade (H)



Dimension of MCM08 (Double slider)

$\Delta V$  is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm)			No. of mounting hole $n$	Inertia $\times 10^{-4}$ (kg · m <sup>2</sup> )	Mass (kg)
				L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>			
☆※MCM08008H10D00	80	104 (136)	10	435	370	300	3	0.169	6.5
☆MCM08018H10D00			20					0.199	
☆MCM08018H20D00	180	204 (236)	10	535	470	400	5	0.351	7.5
☆MCM08028H10D00			20					0.228	
☆MCM08028H20D00			20					0.380	
☆MCM08038H10D00	280	304 (336)	10	635	570	500	6	0.257	8.4
☆MCM08038H20D00			20					0.409	
☆MCM08048H10D00			10					0.287	
☆MCM08048H20D00	480	504 (536)	20	835	770	700	8	0.439	10.3
☆MCM08058H10D00			10					0.316	
☆MCM08058H20D00			20					0.468	
☆MCM08068H10D00	680	704 (736)	10	1035	970	900	10	0.346	12.2
☆MCM08068H20D00			20					0.498	

Notes: 1. Items not marked are available from standard stock.  
 2. Items marked with ☆ are designated as "quick delivery item" upon request.  
 3. Dimension (1) is 150mm for those marked with ※.

Monocarrier dynamic torque specification (N · cm)

Notes:

Ball screw lead (mm)	10	2.5 - 10.8
	20	4.0 - 17.2

- Frictional resistance of NSK K1 is included in the dynamic torque in the table.
- Grease is packed into ball screw, linear guide parts and support unit.
- Consult NSK for life estimates under large moment loads.
- Stroke limit = stroke + (11.8 [margin] × 2)

Basic load rating

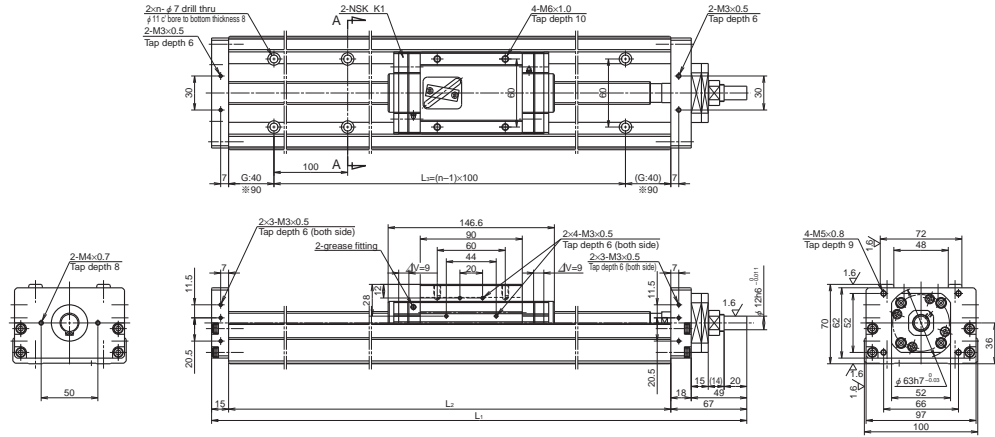
Lead $l$ (mm)	Shaft dia $d$ (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
		Ball screw $C_a$	Linear guides $C$	Support unit $C_s$	Rated running distance $L_a$ (km)	Ball screw $C_{0a}$	Linear guides $C_0$	
5	$\phi 16$	7310	30800	7100	5	13500	3040	
10	$\phi 15$	7060	24400		10	12700		
20		4560	19400	20	7750			

Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling $M_{RO}$	Pitching $M_{PO}$	Yawing $M_{VO}$
Double	1540	2050	2050

MCM10

Accuracy grade: High grade (H)



Dimension of MCM10 (Single slider)

ΔV is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm)			No. of mounting hole n	Inertia × 10 <sup>-4</sup> (kg · m <sup>2</sup> )	Mass (kg)
				L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>			
☆ MCM10010H10K00	100	130	10	362	280	200	3	0.332	7.8
☆ MCM10010H20K00		(15.1)	20						
☆ MCM10015H10K00	150	180	10	412	330	300	4	0.378	8.7
☆ MCM10015H20K00		(20.1)	20						
☆ MCM10020H10K00	200	230	10	462	380	300	4	0.425	9.5
☆ MCM10020H20K00		(25.1)	20						
☆ MCM10025H10K00	250	280	10	512	430	400	5	0.472	10.4
☆ MCM10025H20K00		(30.1)	20						
☆ MCM10030H10K00	300	330	10	562	480	400	5	0.519	11.2
☆ MCM10030H20K00		(35.1)	20						
☆ MCM10040H10K00	400	430	10	662	580	500	6	0.612	13.0
☆ MCM10040H20K00		(45.1)	20						
☆ MCM10050H10K00	500	530	10	762	680	600	7	0.726	14.6
☆ MCM10050H20K00		(55.1)	20						
☆ MCM10060H10K00	600	630	10	862	780	700	8	0.800	16.3
☆ MCM10060H20K00		(65.1)	20						
☆ MCM10070H10K00	700	730	10	962	880	800	9	0.893	18.0
☆ MCM10070H20K00		(75.1)	20						
☆ MCM10080H10K00	800	830	10	1062	980	900	10	0.987	19.7
☆ MCM10080H20K00		(85.1)	20						
☆ MCM10090H10K00	900	930	10	1162	1080	1000	11	1.081	21.4
☆ MCM10090H20K00		(95.1)	20						
☆ MCM10100H10K00	1000	1030	10	1262	1180	1000	11	1.174	23.1
☆ MCM10100H20K00		(105.1)	20						

- Notes: 1. Items not marked are available from standard stock.  
 2. Items marked with ☆ are designated as "quick delivery item" upon request.  
 3. Dimension G is 90 for those marked with ※.  
 4. Dimension G is 15 for those marked with ◇.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	10	2.7 - 10.8
	20	3.1 - 12.7

Notes:

- Frictional resistance of NSK K1 is included in the dynamic torque in the table.
- Grease is packed into ball screw, linear guide parts and support unit.
- Consult NSK for life estimates under large moment loads.
- Stroke limit = stroke + (15 [margin] × 2)

Basic load rating

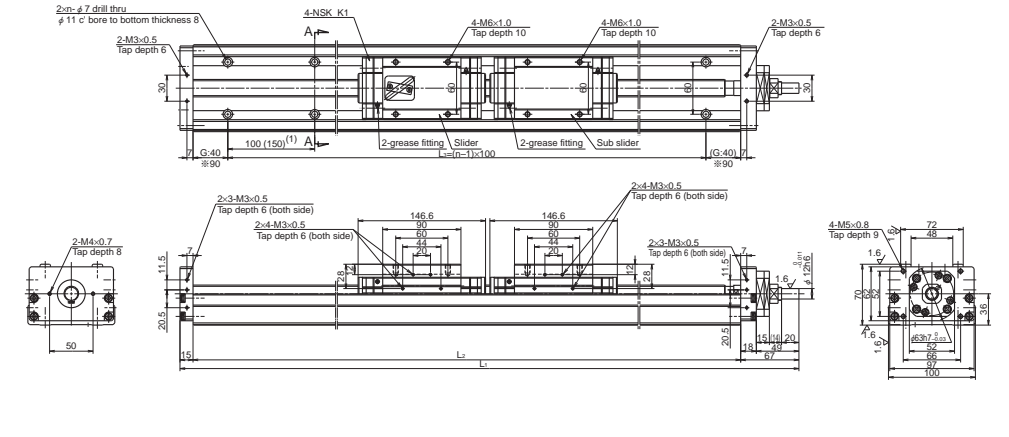
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
		Ball screw C <sub>a</sub>	Linear guides C	Support unit C <sub>a</sub>	Rated running distance L <sub>a</sub> (km)	Ball screw C <sub>0a</sub>	Linear guides C <sub>0</sub>	
10	φ 20	10900	33500	7600	10	21700	29400	3380
20		7060	26600		20	12700		

Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M <sub>RO</sub>	Pitching M <sub>PO</sub>	Yawing M <sub>YO</sub>
Single	1170	425	425

MCM10 (Double slider)

Accuracy grade: High grade (H)



Dimension of MCM10 (Double slider)

ΔV is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm)			No. of mounting hole n	Inertia × 10 <sup>-4</sup> (kg · m <sup>2</sup> )	Mass (kg)
				L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>			
☆ MCM10007H10D00	70	86 (122)	10	462	380	300	3	0.463	11.0
☆ MCM10017H10D00									
☆ MCM10017H20D00	170	(222)	20	562	480	400	5	0.785	12.7
☆ MCM10027H10D00									
☆ MCM10027H20D00	270	(322)	20	662	580	500	6	0.650	13.4
☆ MCM10037H10D00									
☆ MCM10037H20D00	370	(422)	20	762	680	600	7	0.972	15.1
☆ MCM10047H10D00									
☆ MCM10047H20D00	470	(522)	20	862	780	700	8	1.066	17.8
☆ MCM10057H10D00									
☆ MCM10057H20D00	570	(622)	20	962	880	800	9	0.931	19.5
☆ MCM10067H10D00									
☆ MCM10067H20D00	670	(722)	20	1062	980	900	10	1.253	21.2
☆ MCM10087H10D00									
☆ MCM10087H20D00	870	(922)	20	1262	1180	1000	11	1.212	23.6
☆ MCM10087H20D00									

- Notes: 1. Items not marked are available from standard stock.  
 2. Items marked with ☆ are designated as "quick delivery item" upon request.  
 3. Dimension G is 90 for those marked with ※.  
 4. Dimension (1) is 150mm for those marked with ◇.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	10	4.2 - 15.6
	20	5.0 - 19.6

Notes:

- Frictional resistance of NSK K1 is included in the dynamic torque in the table.
- Grease is packed into ball screw, linear guide parts and support unit.
- Consult NSK for life estimates under large moment loads.
- Stroke limit = stroke + (8.4 [margin] × 2)

Basic load rating

Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
		Ball screw C <sub>a</sub>	Linear guides C	Support unit C <sub>a</sub>	Rated running distance L <sub>a</sub> (km)	Ball screw C <sub>0a</sub>	Linear guides C <sub>0</sub>	
10	φ 20	10900	33500	7600	10	21700	29400	3380
20		7060	26600		20	12700		

Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M <sub>RO</sub>	Pitching M <sub>PO</sub>	Yawing M <sub>YO</sub>
Double	2340	2940	2940

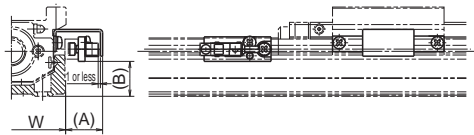


## C-2-3 MCM Series Option Part

### C-2-3. 1 Sensor Unit



#### ● Proximity switch



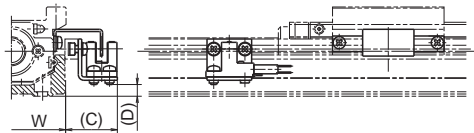
(Example of assembly)

Type	Reference number			Dimension (A) (mm)	Dimension (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 (a-contact)	—	3	1	E2S-W13 (OMRON Corp.)	
	Proximity switch (b-contact)	3	—	2	E2S-W14 (OMRON Corp.)	

Note: 1. See page C21 for specification of proximity switch. 2. A sensor unit consists of sensors, a sensor dog and sensor mounting parts.

You require an optional spacer plate when you use a cover unit or a sensor unit for an MCM03 with the lead of 1 or 2 mm. (Refer to page C41.)

#### ● Photo sensor



(Example of assembly)

Type	Reference number	Dimension (C) (mm)	Dimension (D) (mm)	Body width W (mm)	Remarks
MCM03	MC-SR03-13	24	0.5	34	EE-SX674 (OMRON Corp.) 3 sets
MCM05	MC-SR05-13	24	5	48.6	
MCM06	MC-SR06-13	24	9	58	
MCM08	MC-SR08-13	23	17	80	(EE-1001 connector attachment)
MCM10	MC-SR10-13	22	24	100	

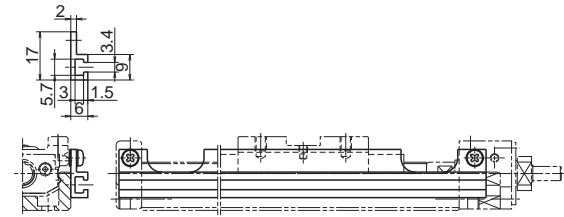
Note: 1. See page C22 for specification of photo sensor. 2. A sensor unit consists of sensors, a sensor dog and sensor mounting parts.

You require an optional spacer plate when you use a cover unit or a sensor unit for an MCM03 with the lead of 1 or 2 mm. (Refer to page C41.)

### (1) Sensor Rail

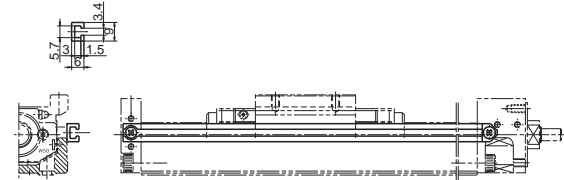


Sensor rail for MCM03: MC-SRL3- \* \* \* \*



(Example of assembly)

Sensor rail for MCM05: MC-SRL5- \* \* \* \*



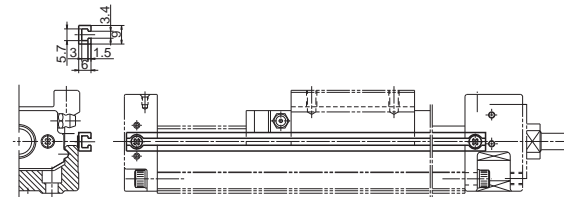
(Example of assembly)

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 of assembly)

\* \* \* \* is the same as rail dimension L<sub>2</sub>

Please place and assemble the seat during the attachment of the sensor rail and the support unit attaching part for MCM03, MCM05, MCM06 and MCM08.

Body of MCM Series and Sensor Rail Combination Table

Table 4

Nominal size	Body length L <sub>2</sub> (mm)	Reference number	Sensor rail reference number	
MCM02	100	MCM02005H01K MCM02005P01K MCM02005H02K MCM02005P02K	MC-SRL2-0100	
		150	MCM02010H01K MCM02010P01K MCM02010H02K MCM02010P02K	MC-SRL2-0150
			200	MCM02015H01K MCM02015P01K MCM02015H02K MCM02015P02K
	115			MCM03005P01K00 MCM03005P02K00
		140		MCM03005H10K00 MCM03005H12K00
	MCM03	190	MCM03010P01K00 MCM03010P02K00 MCM03010H10K00 MCM03010H12K00	MC-SRL3-0190
240			MCM03015P01K00 MCM03015P02K00 MCM03015H10K00 MCM03015H12K00	MC-SRL3-0240
		290	MCM03020H10K00 MCM03020H12K00	MC-SRL3-0290
340			MCM03025H10K00 MCM03025H12K00	MC-SRL3-0340
		MCM05	180	MCM05005H05K00 MCM05005H10K00 MCM05005H20K00
230				MCM05010H05K00 MCM05010H10K00 MCM05010H20K00
	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 MCM05021H10D00 MCM05021H20D00	MC-SRL5-0430
	530		MCM05040H05K00 MCM05040H10K00 MCM05040H20K00 MCM05031H10D00 MCM05031H20D00	MC-SRL5-0530
630			MCM05050H05K00 MCM05050H10K00 MCM05050H20K00 MCM05041H10D00 MCM05041H20D00	MC-SRL5-0630
	730		MCM05060H05K00 MCM05060H10K00 MCM05060H20K00 MCM05051H10D00 MCM05051H20D00	MC-SRL5-0730

Nominal size	Body length L <sub>2</sub> (mm)	Reference number	Sensor rail reference number	
MCM06	190	MCM06005H05K00 MCM06005H10K00 MCM06005H20K00	MC-SRL6-0190	
		240	MCM06010H05K00 MCM06010H10K00 MCM06010H20K00	MC-SRL6-0240
			290	MCM06015H05K00 MCM06015H10K00 MCM06015H20K00
	340			MCM06020H05K00 MCM06020H10K00 MCM06020H20D00 MCM06011H05D00 MCM06011H10D00
		390		MCM06025H05K00 MCM06025H10K00 MCM06025H20K00
			440	MCM06030H05K00 MCM06030H10K00 MCM06030H20K00 MCM06021H05D00 MCM06021H10D00 MCM06021H20D00
	540	MCM06040H05K00 MCM06040H10K00 MCM06040H20K00 MCM06031H05D00 MCM06031H10D00 MCM06031H20D00		MC-SRL6-0540
		640	MCM06050H05K00 MCM06050H10K00 MCM06050H20K00 MCM06041H05D00 MCM06041H10D00 MCM06041H20D00	MC-SRL6-0640
	740		MCM06060H05K00 MCM06060H10K00 MCM06060H20K00 MCM06051H10D00 MCM06051H20D00	MC-SRL6-0740
		840	MCM06070H05K00 MCM06070H10K00 MCM06070H20K00 MCM06061H10D00 MCM06061H20D00	MC-SRL6-0840
940	MCM06080H05K00 MCM06080H10K00 MCM06080H20K00 MCM06071H10D00 MCM06071H20D00		MC-SRL6-0940	

Nominal size	Body length L <sub>2</sub> (mm)	Reference number	Sensor rail reference number
MCM08	220	MCM08005H05K00 MCM08005H10K00	MC-SRL8-0220
		270	MCM08010H05K00 MCM08010H10K00 MCM08010H20K00
	320		MCM08015H05K00 MCM08015H10K00 MCM08015H20K00
		370	MCM08020H05K00 MCM08020H10K00 MCM08020H20K00 MCM08008H10D00
	420		MCM08025H05K00 MCM08025H10K00 MCM08025H20K00
		470	MCM08030H05K00 MCM08030H10K00 MCM08030H20K00 MCM08018H10D00 MCM08018H20D00
	570		MCM08040H05K00 MCM08040H10K00 MCM08040H20K00 MCM08028H10D00 MCM08028H20D00
		670	MCM08050H05K00 MCM08050H10K00 MCM08050H20K00 MCM08038H10D00 MCM08038H20D00
	770		MCM08060H05K00 MCM08060H10K00 MCM08060H20K00 MCM08048H10D00 MCM08048H20D00
		870	MCM08070H05K00 MCM08070H10K00 MCM08070H20K00 MCM08058H10D00 MCM08058H20D00
	970		MCM08080H05K00 MCM08080H10K00 MCM08080H20K00 MCM08068H10D00 MCM08068H20D00

Nominal size	Body length L <sub>2</sub> (mm)	Reference number	Sensor rail reference number
MCM10	280	MCM10010H10K00 MCM10010H20K00	MC-SRL1-0280
		330	MCM10015H10K00 MCM10015H20K00
	380		MCM10020H10K00 MCM10020H20K00 MCM10007H10D00
		430	MCM10025H10K00 MCM10025H20K00
	480		MCM10030H10K00 MCM10030H20K00 MCM10017H10D00 MCM10017H20D00
		580	MCM10040H10K00 MCM10040H20K00 MCM10027H10D00 MCM10027H20D00
	680		MCM10050H10K00 MCM10050H20K00 MCM10037H10D00 MCM10037H20D00
		780	MCM10060H10K00 MCM10060H20K00 MCM10047H10D00 MCM10047H20D00
	880		MCM10070H10K00 MCM10070H20K00 MCM10057H10D00 MCM10057H20D00
		980	MCM10080H10K00 MCM10080H20K00 MCM10067H10D00 MCM10067H20D00
	1080		MCM10090H10K00 MCM10090H20K00
		1180	MCM10100H10K00 MCM10100H20K00 MCM10087H10D00 MCM10087H20D00

C-2-3. 2 Cover Unit



Cover Unit for MCM02

Stroke	Reference number	Length(L)
50	MC-CV02005-00	115
100	MC-CV02010-00	165
150	MC-CV02015-00	215

(Unit: mm)  
Note: Height of screw head is not included.

Cover Unit for MCM03

Optional spacer (MC-SP03-00) is required for a main unit with ball screw lead of 1 and 2 mm.

Stroke	Reference number		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 10, 12)	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

(Unit: mm)  
Notes: 1. The full-cover unit cannot be used when the sensor unit is used. 2. Height of screw head is not included.

Spacer for MCM03 (Optional) MC-SP03-00 (for ball screw lead 1 and 2 mm)

<<Example of assembly>>

Cover Unit for MCM05, 06, 08, and 10

(1) Circular extrusion height of cover mounting plate  
Section X-X  
Top cover Unit

Note: A cover mounting plate is not used to MCM06.

(Unit: mm)

Reference number	Stroke		Cover unit Reference number		Cover length			
	Single slider	Double slider	Top cover Unit	*Full cover Unit	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	MC-CV05060-00	750			
	MCM06	50	—	MC-CV06005-01	MC-CV06005-00			
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			
MCM08	800	710	MC-CV06080-01	MC-CV06080-00	975	56.5	90	2.6
	50	—	MC-CV08005-01	MC-CV08005-00	248			
	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			
MCM10	700	580	MC-CV08070-01	MC-CV08070-00	898	66.5	110	3.6
	800	680	MC-CV08080-01	MC-CV08080-00	998			
	100	—	MC-CV10010-01	MC-CV10010-00	308			
	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	MC-CV10100-00	1208				

\*When a sensor unit is used, the full-cover unit cannot be used. Not include height such as screw  
Note: The dimensions of cover 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.

C-2-3. 3 Motor Bracket

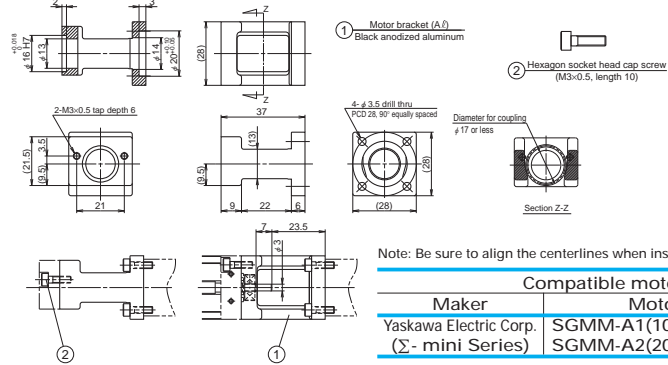
● Motor models are subject to change at the motor manufacturers. For details, please contact the manufacture.

Motor Bracket for MCM02



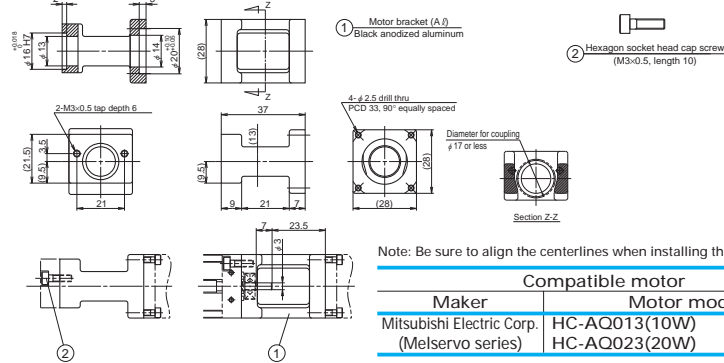
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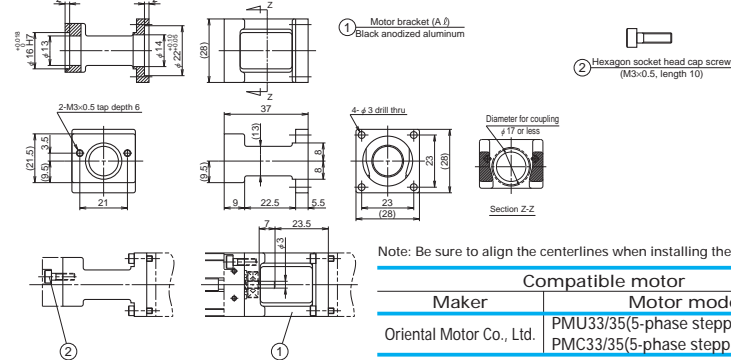
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Reference number

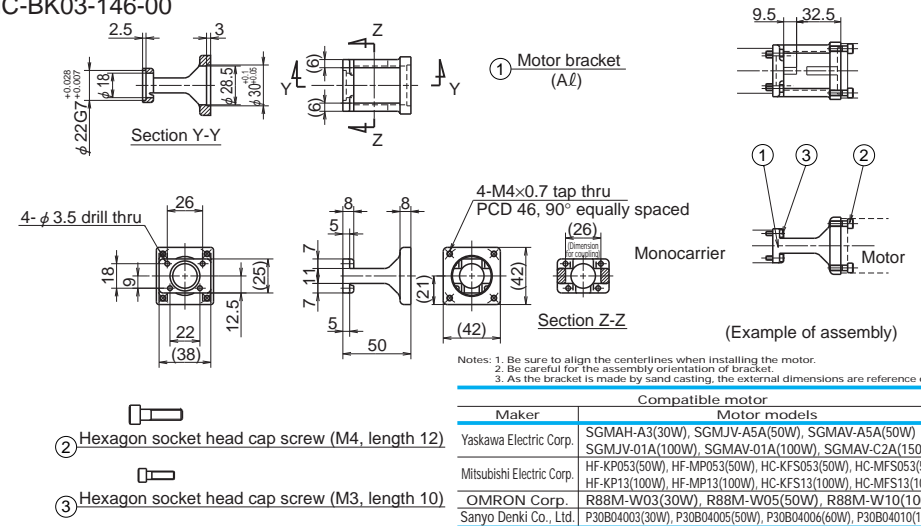
MC-BK02-223-00



Motor Bracket for MCM03

Reference number

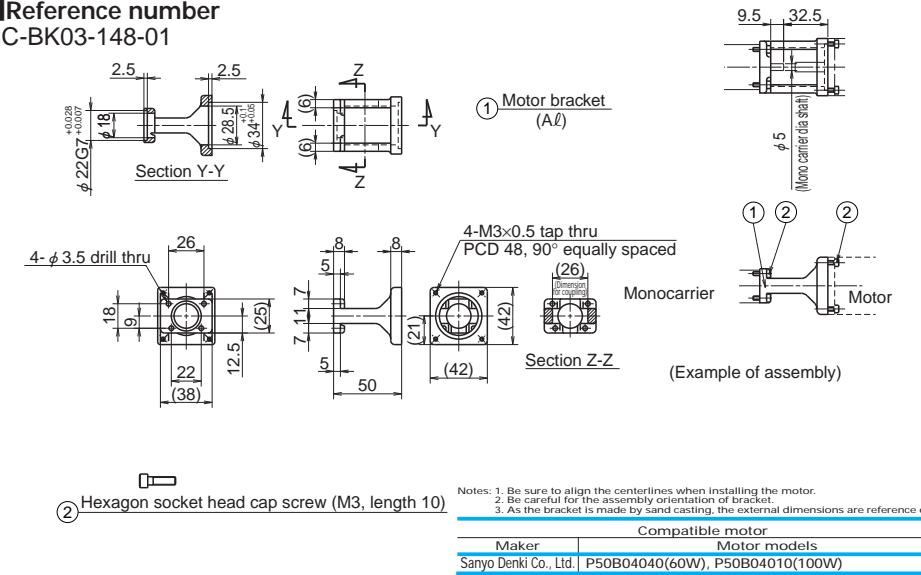
MC-BK03-146-00



Motor Bracket for MCM03

Reference number

MC-BK03-148-01

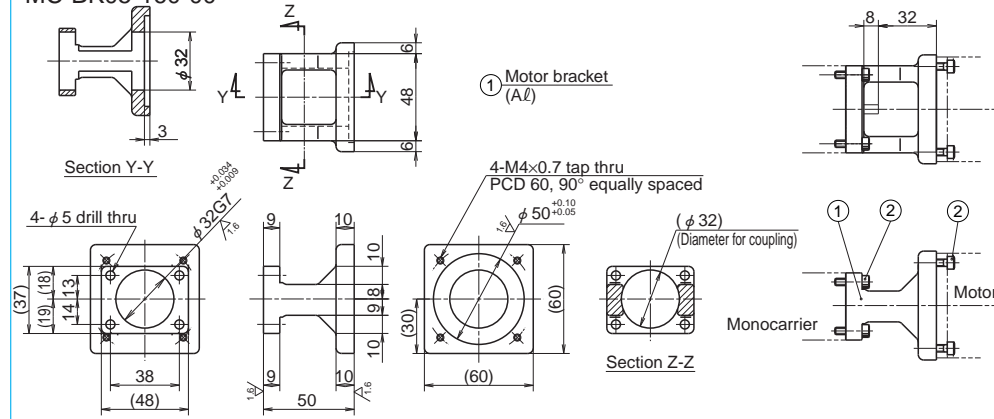




Motor Bracket for MCM05

Standard stock

Reference number  
MC-BK05-160-00



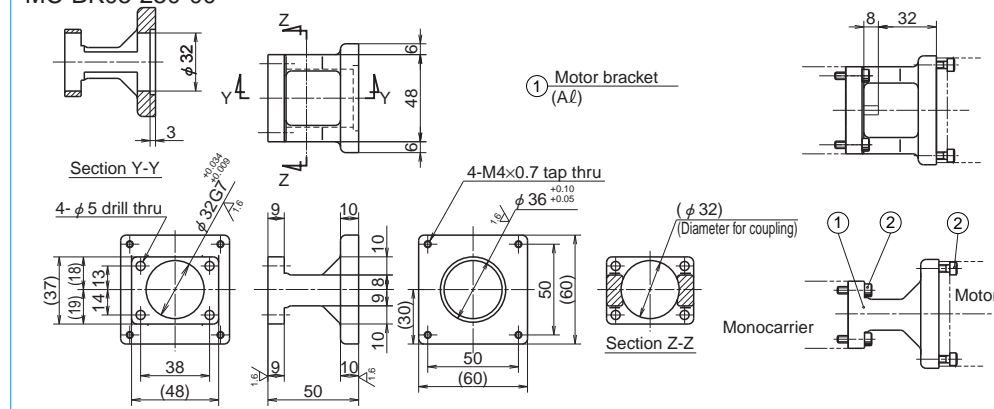
Notes: 1. Be sure to align the centerlines when installing the motor.  
2. Be careful for the assembly orientation of bracket.  
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	P50B05005(50W), P50B05010(100W), P50B05020(200W)

Motor Bracket for MCM05

Standard stock

Reference number  
MC-BK05-250-00



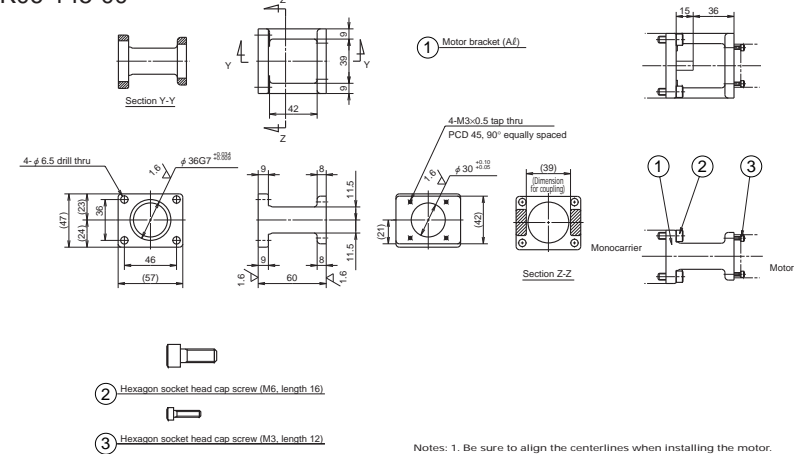
Notes: 1. Be sure to align the centerlines when installing the motor.  
2. Be careful for the assembly orientation of bracket.  
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	PBM603xxx, PBM604xxx, 103F78xx
Oriental Motor Co., Ltd.	AS66, ASC66, UPK56x, UFK56x, PK56x, CSK56x, CFK56x

Standard stock

Motor Bracket for MCM06

Reference number  
MC-BK06-145-00



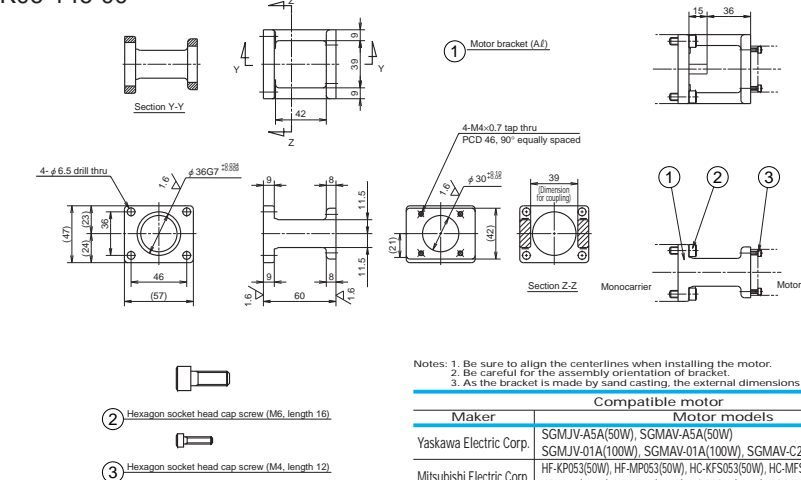
Notes: 1. Be sure to align the centerlines when installing the motor.  
2. Be careful for the assembly orientation of bracket.  
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor	
Maker	Motor models
Mabushita Electric Industrial Co. Ltd.	MSMD5A(50W), MSMD01(100W)

Motor Bracket for MCM06

Standard stock

Reference number  
MC-BK06-146-00



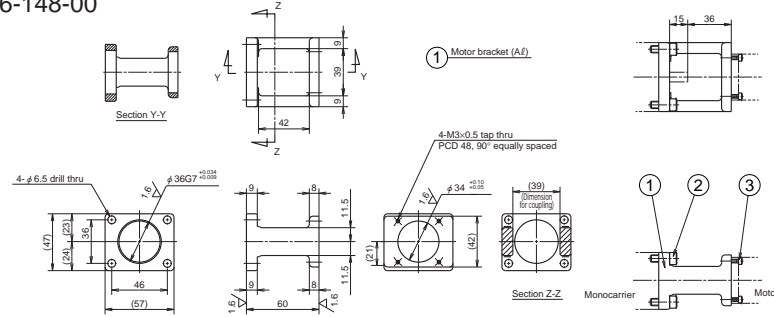
Notes: 1. Be sure to align the centerlines when installing the motor.  
2. Be careful for the assembly orientation of bracket.  
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor	
Maker	Motor models
Yaskawa Electric Corp.	SGMJV-A5A(50W), SGMJV-A5A(50W), SGMJV-01A(100W), SGMJV-01A(100W), SGMJV-C2A(150W)
Mitsubishi Electric Corp.	HF-KP053(50W), HF-MP053(50W), HC-KFS053(50W), HC-MFS053(50W), HF-KP13(100W), HF-MP13(100W), HC-KFS13(100W), HC-MFS13(100W)
OMRON Corp.	R88M-W03(30W), R88M-W05(50W), R88M-W10(100W)
Sanyo Denki Co., Ltd.	P30B4003(30W), P30B4005(50W), P30B4006(60W), P30B4010(100W)



Motor Bracket for MCM06

Reference number  
MC-BK06-148-00



- ① Motor bracket (A1)
- ② Hexagon socket head cap screw (M6, length 16)
- ③ Hexagon socket head cap screw (M3, length 12)

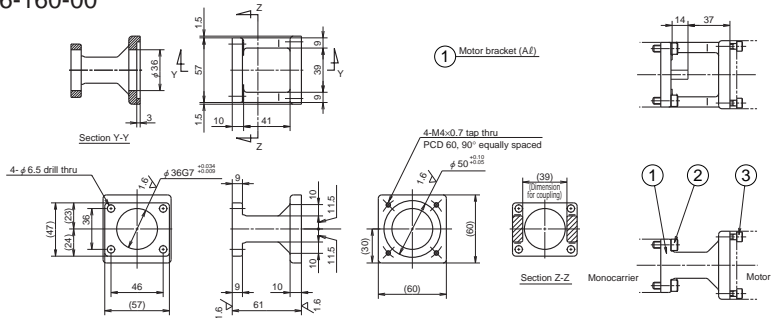
Notes: 1. Be sure to align the centerlines when installing the motor.  
2. Be careful for the assembly orientation of bracket.  
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor	
Maker	Motor models
Mitsubishi Electric Co., Ltd.	MAMA01(100W)
Sanyo Denki Co., Ltd.	P50B04040(60W), P50B04010(100W)



Motor Bracket for MCM06

Reference number  
MC-BK06-160-00



- ① Motor bracket (A1)
- ② Hexagon socket head cap screw (M6, length 16)
- ③ Hexagon socket head cap screw (M4, length 14)

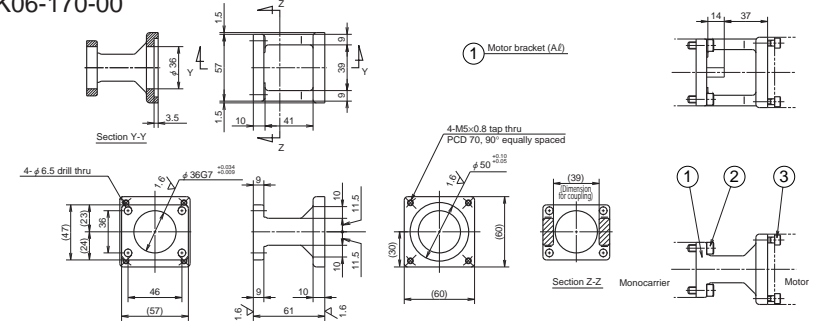
Notes: 1. Be sure to align the centerlines when installing the motor.  
2. Be careful for the assembly orientation of bracket.  
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	P50B05005(50W), P50B05010(100W), P50B05020(200W)



Motor Bracket for MCM06

Reference number  
MC-BK06-170-00



- ① Motor bracket (A1)
- ② Hexagon socket head cap screw (M6, length 16)
- ③ Hexagon socket head cap screw (M5, length 14)

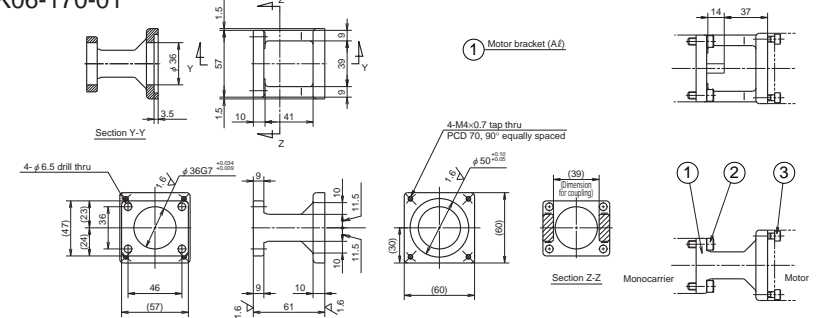
Notes: 1. Be sure to align the centerlines when installing the motor.  
2. Be careful for the assembly orientation of bracket.  
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor	
Maker	Motor models
Yaskawa Electric Corp.	SGMJV02A(200W), SGMJV02A(200W), SGMJV04A(400W), SGMJV04A(400W)
Mitsubishi Electric Corp.	HF-KP23(200W), HF-MP23(200W), HC-KP43(400W), HC-MP43(400W), HC-KFS23(200W), HC-MFS23(200W), HC-KFS43(400W), HC-MFS43(400W)
OMRON Corp.	R88M-W20(200W), R88M-W40(400W)
Sanyo Denki Co., Ltd.	P30B06020(200W), P30B06040(400W)



Motor Bracket for MCM06

Reference number  
MC-BK06-170-01



- ① Motor bracket (A1)
- ② Hexagon socket head cap screw (M6, length 16)
- ③ Hexagon socket head cap screw (M4, length 14)

Notes: 1. Be sure to align the centerlines when installing the motor.  
2. Be careful for the assembly orientation of bracket.  
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor	
Maker	Motor models
Mitsubishi Electric Industrial Co., Ltd.	MSMD02(200W), MAMA02(200W), MSMD04(400W), MAMA04(400W)

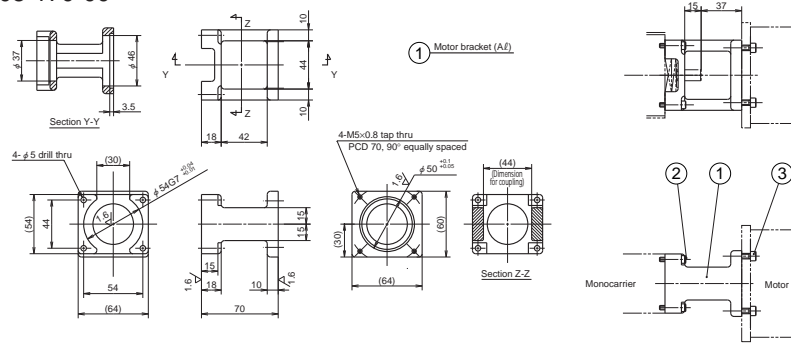






Motor Bracket for MCM08

Reference number  
MC-BK08-170-00



Notes: 1. Be sure to align the centerlines when installing the motor.  
2. Be careful for the assembly orientation of bracket.  
3. As the bracket is made by sand casting, the external dimensions are reference only.

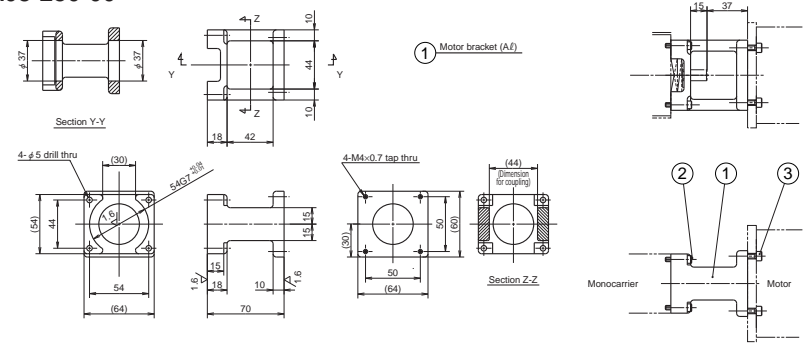
Compatible motor	
Maker	Motor models
Yaskawa Electric Corp.	SGMJV-02A(200W), SGMAM-02A(200W), SGMJV-04A(400W), SGMAM-04A(400W)
Mitsubishi Electric Corp.	HF-KP23(200W), HF-MP23(200W), HF-KP43(400W), HF-MP43(400W) HC-KFS23(200W), HC-MFS23(200W), HC-KFS43(400W), HC-MFS43(400W)
OMRON Corp.	R88M-W20(200W), R88M-W40(400W)
Sanyo Denki Co., Ltd.	P30B06020(200W), P30B06040(400W)

- ② Hexagon socket head cap screw (M4, length 20)
- ③ Hexagon socket head cap screw (M5, length 14)



Motor Bracket for MCM08

Reference number  
MC-BK08-250-00



Notes: 1. Be sure to align the centerlines when installing the motor.  
2. Be careful for the assembly orientation of bracket.  
3. As the bracket is made by sand casting, the external dimensions are reference only.

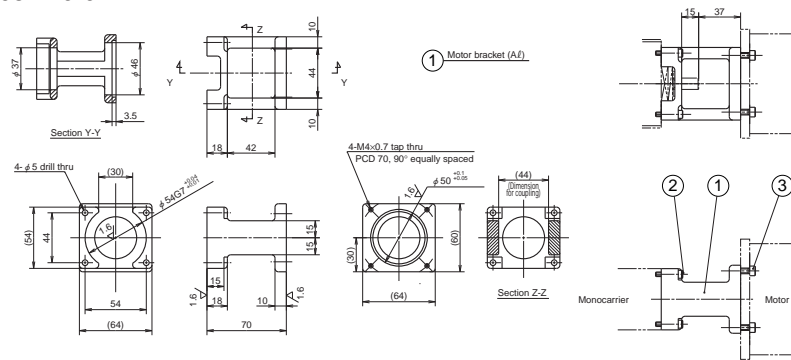
Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	PBM603xxx, PBM604xxx, 103F78xx
Oriental Motor Co., Ltd.	AS66, ASC66, UPK56xx, PK56xx, CSK56x CFK56x, UMK56x, UFK56x

- ② Hexagon socket head cap screw (M4, length 20)
- ③ Hexagon socket head cap screw (M4, length 14)



Motor Bracket for MCM08

Reference number  
MC-BK08-170-01



Notes: 1. Be sure to align the centerlines when installing the motor.  
2. Be careful for the assembly orientation of bracket.  
3. As the bracket is made by sand casting, the external dimensions are reference only.

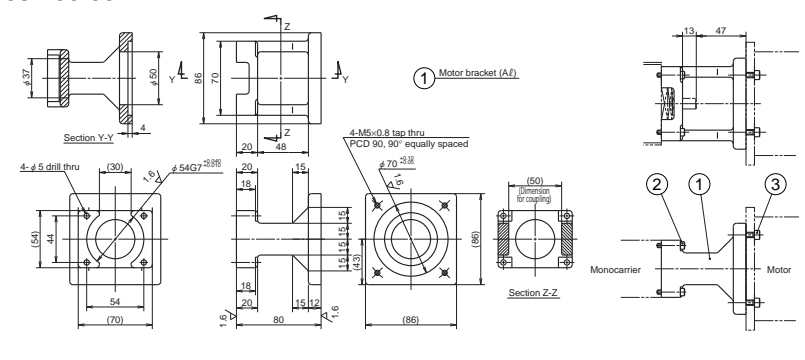
Compatible motor	
Maker	Motor models
Matsushita Electric Industrial Co. Ltd.	MSMD02(200W), MAMA02(200W), NSMD04(400W), MAMA04(400W)

- ② Hexagon socket head cap screw (M4, length 20)
- ③ Hexagon socket head cap screw (M4, length 14)



Motor Bracket for MCM08

Reference number  
MC-BK08-190-00



Notes: 1. Be sure to align the centerlines when installing the motor.  
2. Be careful for the assembly orientation of bracket.  
3. As the bracket is made by sand casting, the external dimensions are reference only.

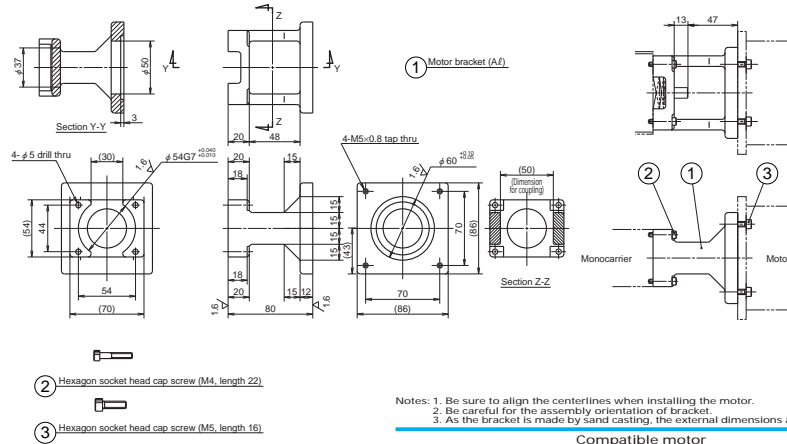
Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	P50B07020(200W), P50B07030(300W), P50B07040(400W)

- ② Hexagon socket head cap screw (M4, length 22)
- ③ Hexagon socket head cap screw (M5, length 16)



Motor Bracket for MCM08

Reference number  
MC-BK08-270-00

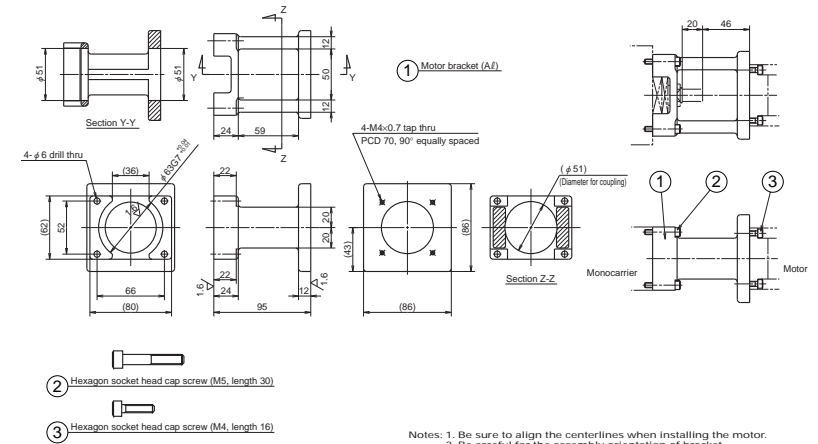


Notes: 1. Be sure to align the centerlines when installing the motor.  
2. Be careful for the assembly orientation of bracket.  
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor	
Maker	Motor models
Oriental Motor Co., Ltd.	AS98, ASC98, UPK59x, PK59x
Sanyo Denki Co., Ltd.	CSK59x, CFK59x, UMK59x, UFK59x
Sanyo Denki Co., Ltd.	103F85xx

Motor Bracket for MCM10

Reference number  
MC-BK10-170-01

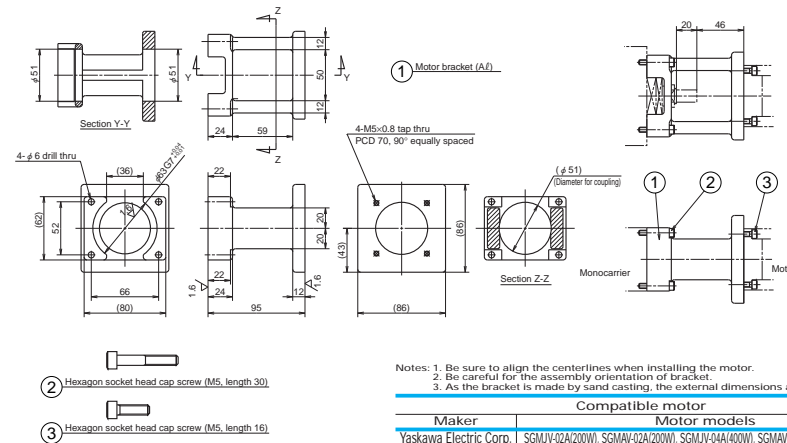


Notes: 1. Be sure to align the centerlines when installing the motor.  
2. Be careful for the assembly orientation of bracket.  
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor	
Maker	Motor models
Matsumita Electric Industrial Co., Ltd.	MSMD02(200W), MAMA02(200W), MSMD04(400W), MAMA04(400W)

Motor Bracket for MCM10

Reference number  
MC-BK10-170-00

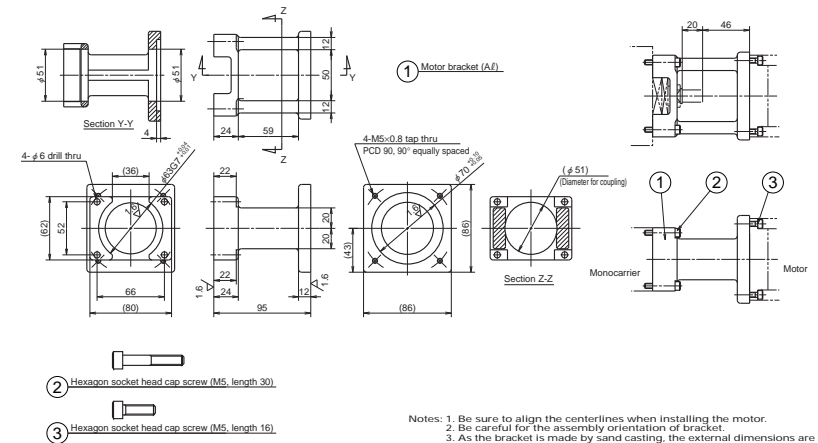


Notes: 1. Be sure to align the centerlines when installing the motor.  
2. Be careful for the assembly orientation of bracket.  
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor	
Maker	Motor models
Yaskawa Electric Corp.	SGMJV-02A(200W), SGMAM-02A(200W), SGMJV-04A(400W), SGMAM-04A(400W)
Mitsubishi Electric Corp.	HF-KP23(200W), HF-MP23(200W), HF-KP43(400W), HF-MP43(400W)
	HC-KFS23(200W), HC-MFS23(200W), HC-KFS43(400W), HC-MFS43(400W)
OMRON Corp.	R88M-W20(200W), R88M-W40(400W)
Sanyo Denki Co., Ltd.	P30B06020(200W), P30B06040(400W)

Motor Bracket for MCM10

Reference number  
MC-BK10-190-00



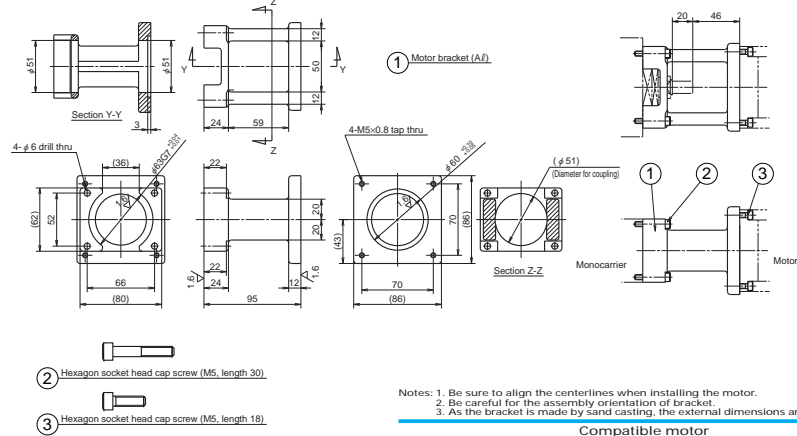
Notes: 1. Be sure to align the centerlines when installing the motor.  
2. Be careful for the assembly orientation of bracket.  
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor	
Maker	Motor models
Matsumita Electric Industrial Co., Ltd.	MSMD08(750W), MAMA08(750W)
Sanyo Denki Co., Ltd.	P50B07020(200W), P50B07030(300W), P50B07040(400W)



Motor Bracket for MCM10

Reference number  
MC-BK10-270-00



Notes: 1. Be sure to align the centerlines when installing the motor.  
2. Be careful for the assembly orientation of bracket.  
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	103F85xx
Oriental Motor Co., Ltd.	AS98, ASC98, UPK59x, PK59x, CSK59x, CFK59x, UMK59x, UFK59x

Availability Motor Table of Motor Bracket for MCM Series  
Table 5

Nominal size	Reference number code	Motor bracket reference number	Motor manufacturer	Stepping motor model number	Wattage of AC servo motor												
					10	20	30	50	60	100	150	200	300	400	750		
MCM02	1	MC-BK02-128-00	Yaskawa Electric Corp.		SGMM-A1	SGMM-A2											
	2	MC-BK02-133-00	Mitsubishi Electric Corp.		HC-AQ013	HC-AQ023											
	3	MC-BK02-223-00	Oriental Motor Co., Ltd.	PMU3335 (5-phase) PMC3335 (5-phase)													
MCM03	1	MC-BK03-146-00	Yaskawa Electric Corp.				SGMAH-A3	SGMJV-A5A SGMAV-A5A			SGMJV-01A SGMAV-01A	SGMAV-C2A					
			Mitsubishi Electric Corp.					HF-KP053 HF-MP053 HC-KFS053 HC-MFS053			HF-KP13 HF-MP13 HC-KFS13 HC-MFS13						
			OMRON Corp.					R88M-W03	R88M-W05								
MCM05	2	MC-BK05-146-00	Yaskawa Electric Corp.				SGMAH-A3	SGMJV-A5A SGMAV-A5A			SGMJV-01A SGMAV-01A	SGMAV-C2A					
			Mitsubishi Electric Corp.					HF-KP053 HF-MP053 HC-KFS053 HC-MFS053			HF-KP13 HF-MP13 HC-KFS13 HC-MFS13						
			OMRON Corp.					R88M-W03	R88M-W05								
MCM06	5	MC-BK06-170-00	Yaskawa Electric Corp.										SGMJV-02A SGMAV-02A			SGMJV-04A SGMAV-04A	
			Mitsubishi Electric Corp.								HF-KP23 HF-MP23 HC-KFS23 HC-MFS23			HF-KP43 HF-MP43 HC-KFS43 HC-MFS43			
			OMRON Corp.								R88M-W20			R88M-W40			

Nominal size	Reference number code	Motor bracket reference number	Motor manufacturer	Stepping motor model number	Wattage of AC servo motor														
					10	20	30	50	60	100	150	200	300	400	750				
MCM08	1	MC-BK08-145-00	Masuhita Electric Industrial Co., Ltd.								MSMD01								
			Yaskawa Electric Corp.								SGMJV-01A SGMAV-01A	SGMAV-C2A							
	2	MC-BK08-146-00	Mitsubishi Electric Corp.																
			Sanyo Denki Co., Ltd.				P30B04003	P30B04005	P30B04006	P30B04010									
			Yaskawa Electric Corp.										P50B05020						
	4	MC-BK08-170-00	Sanyo Denki Co., Ltd.																
			Yaskawa Electric Corp.										SGMJV-02A SGMAV-02A	SGMJV-04A SGMAV-04A					
			Mitsubishi Electric Corp.										HF-KP23 HF-MP23 HC-KFS23 HC-MFS23	HF-KP43 HF-MP43 HC-KFS43 HC-MFS43					
			OMRON Corp.										R88M-W20	R88M-W40					
	5	MC-BK08-170-01	Masuhita Electric Industrial Co., Ltd.																
			Sanyo Denki Co., Ltd.											P50B07020	P50B07030	P50B07040			
	7	MC-BK08-250-00	Sanyo Denki Co., Ltd.	PBM603xxx PBM604xxx															
Sanyo Denki Co., Ltd.			103F78xx																
Oriental Motor Co., Ltd.			AS66, ASC66 UPK56x, PK56x CSK56x, CFK56x UMK56x, UFK56x																
Sanyo Denki Co., Ltd.			103F85xx																
8	MC-BK08-270-00	Oriental Motor Co., Ltd.	AS98, ASC98 UPK59x, PK59x CSK59x, CFK59x UMK59x, UFK59x																
		Yaskawa Electric Corp.											SGMJV-02A SGMAV-02A	SGMJV-04A SGMAV-04A					
MCM10	1	MC-BK10-170-00	Mitsubishi Electric Corp.																
			Oriental Motor Co., Ltd.																
			OMRON Corp.																
			Sanyo Denki Co., Ltd.																
	2	MC-BK10-170-01	Masuhita Electric Industrial Co., Ltd.																
			Sanyo Denki Co., Ltd.																
	3	MC-BK10-190-00	Masuhita Electric Industrial Co., Ltd.																
			Sanyo Denki Co., Ltd.																
	4	MC-BK10-270-00	Sanyo Denki Co., Ltd.	103F85xx															
			Oriental Motor Co., Ltd.	AS98, ASC98 UPK59x, PK59x CSK59x, CFK59x UMK59x, UFK59x															
			Yaskawa Electric Corp.																
			Mitsubishi Electric Corp.																



1	MCH Series Reference Number Coding	C63
2	MCH Series Dimension Table of Standard Products	
	MCL06	C64
	MCH06	C65
	MCH09	C67
	MCH10	C69
3	MCH Series Option Part	
3.1	Sensor Unit	C71
3.2	Cover Unit	C73
3.3	Intermediate Plate For Motor	C77

# MCH Series

# C-3 MCH Series

## C-3-1 MCH Series Reference Number Coding

[Body] Reference number : **MC H 06 040 H 10 K (B0)** ※1

Monocarrier  
 H Type: MCH Series  
 L Type: MCH Series low profile rail (only for 06 size)  
 Nominal size (rail width, Unit: 10mm)  
 Stroke (Unit: 10mm)  
 Accuracy grade (H, High grade; P, Precision grade).

Special specification  
 Grease specification: B (LG2)(See page C19)  
 Slider specification K: Single slider  
 (See page C10) D: Double slider  
 Ball screw lead (mm)

※1 : These two code fields shall be added when non-standard grease is used. The coding of an MCH Monocarrier with standard grease shall have 12 characters as shown above.

[With Option part] Reference number : **MC S 06 040 H 10 K 0 0 K 0 0 0**

S : With MCH optional components  
 R : With MCL optional components

NSK management number  
 Sensor unit  
 Cover unit  
 Intermediate plate for motor bracket

Note : Optional components are available separately.

**Table 1 Sensor unit (See page C71)**

Reference number code	Specification	Reference number
0	N/A	—
1	Proximity switch (b-contact 3 pieces)	MC—SRHxx—10
2	Proximity switch (a-contact 3 pieces)	MC—SRHxx—11
3	Proximity switch (a-contact 1 piece, b-contact 2 pieces)	MC—SRHxx—12
4	Photo sensor 3 pieces	MC—SRHxx—13

xx: Reference number  
 Note: Sensor rail is not included in a sensor unit. If you require the rail, please request separately. (See page C71 to 72.)

**Table 2 Cover unit (See page C73 – 75)**

Reference number code	Specification	Reference number
0	N/A	—
1	For single slider For double slider	MC—HVxxxx—00 MC—HVxxxxD00

xxxxx: Reference number and stroke number

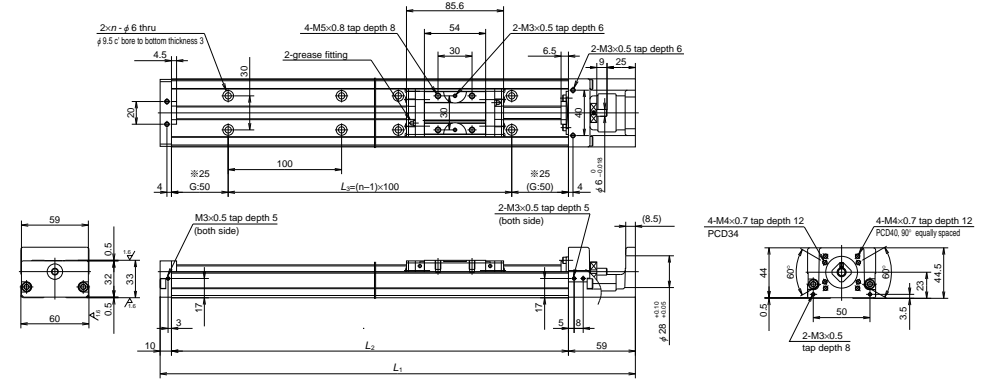
**Table 3 Intermediate plate for motor bracket (See page C77 – 80)**

Reference number code	Type		
	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

## C-3-2 MCH Series Dimension Table of Standard Products

### MCL06

Accuracy grade: High grade (H)



- The rail of MCL 06 is made lighter than that of MCH 06 by lowering the rail height. The weight ratio between the MCH 06 and MCL 06 is 5 to 4.
- Double slider specification is also available for the MCL 06.
- Combinations of stroke and ball screw lead of the MCL 06 are the same as those of the MCH 06.

Dimension of MCL06 (Single slider)

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm)				Inertia x 10 <sup>6</sup> (kg · m <sup>2</sup> )	Mass (kg)
				L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	n		
☆※MCL06005H05K	50	53 (65)	5	219	150	100	2	2.38	1.0
☆※MCL06005H10K		10	3.45						
☆ MCL06010H05K	100	103 (115)	5	269	200	100	2	3.17	1.3
☆ MCL06010H10K		10	4.12						
☆ MCL06020H05K	200	203 (215)	5	369	300	200	3	4.51	1.9
☆ MCL06020H10K		10	5.46						
☆ MCL06030H10K	300	303 (315)	10	469	400	300	4	6.80	2.6
☆ MCL06030H20K		20	10.6						
☆ MCL06040H10K	400	403 (415)	10	569	500	400	5	8.13	3.2
☆ MCL06040H20K		20	11.9						
☆ MCL06050H10K	500	503 (515)	10	669	600	500	6	9.47	3.9
☆ MCL06050H20K		20	13.3						

- Notes: 1. Items not marked are available from standard stock.  
 2. Items marked with ☆ are designated as "quick delivery item" upon request.  
 3. Dimension of G is 25 instead of 50 for those marked with ※.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	5	1.0 – 4.8
10	1.1 – 5.8	
20	1.6 – 7.9	

- Notes:  
 1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.  
 2. Grease is packed into ball screw, linear guide parts and support unit.  
 3. Consult NSK for life estimates under large moment loads.

Basic load rating

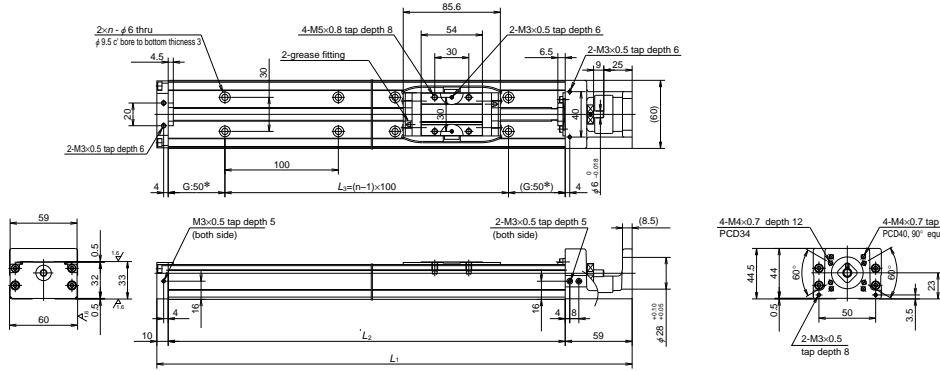
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
		Ball screw C <sub>a</sub>	Linear guides C	Support unit C <sub>a</sub>	Rated running distance L <sub>a</sub> (km)	Ball screw C <sub>0a</sub>	Linear guides C <sub>0</sub>	
5	φ 12	3000 (High grade) 3760 (Precision)	22800	4400	5	5410 (High grade) 6310 (Precision)	10900	1450
10		1930 (High grade) 2260 (Precision)				18100		
20		1930 (High grade) 2260 (Precision)	14400		20	3160 (High grade) 3780 (Precision)		

Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M <sub>RO</sub>	Pitching M <sub>PO</sub>	Yawing M <sub>YO</sub>
Single	335	133	133

MCH06

Accuracy grade: High grade (H)



Dimension of MCH06 (Single slider)

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm)				Inertia x 10 <sup>6</sup> (kg · m <sup>2</sup> )	Mass (kg)
				L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	n		
※ MCH06005H05K	50	53 (65)	5	219	150	100	2	2.38	1.8
※ MCH06005H10K			10					3.45	
☆ MCH06005H20K			20					7.25	
MCH06010H05K	100	103 (115)	5	269	200	100	2	3.17	2.2
MCH06010H10K			10					4.12	
MCH06010H20K			20					7.92	
MCH06020H05K	200	203 (215)	5	369	300	200	3	4.51	3.0
MCH06020H10K			10					5.46	
MCH06020H20K			20					9.26	
MCH06030H05K	300	303 (315)	5	469	400	300	4	5.85	3.7
MCH06030H10K			10					6.80	
MCH06030H20K			20					10.6	
MCH06040H05K	400	403 (415)	5	569	500	400	5	7.18	4.5
MCH06040H10K			10					8.13	
MCH06040H20K			20					11.9	
MCH06050H05K	500	503 (515)	5	669	600	500	6	8.52	5.2
MCH06050H10K			10					9.47	
MCH06050H20K			20					13.3	

Notes: 1. Items not marked are available from standard stock.  
 2. Items marked with ☆ are designated as "quick delivery item" upon request.  
 3. Dimension of G is 25 instead of 50 for those marked with ※.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	5	
	1.0 - 4.8	1.1 - 5.8
	1.6 - 7.9	

Notes:  
 1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.  
 2. Grease is packed into ball screw, linear guide parts and support unit.  
 3. Consult NSK for life estimates under large moment loads.

Basic load rating

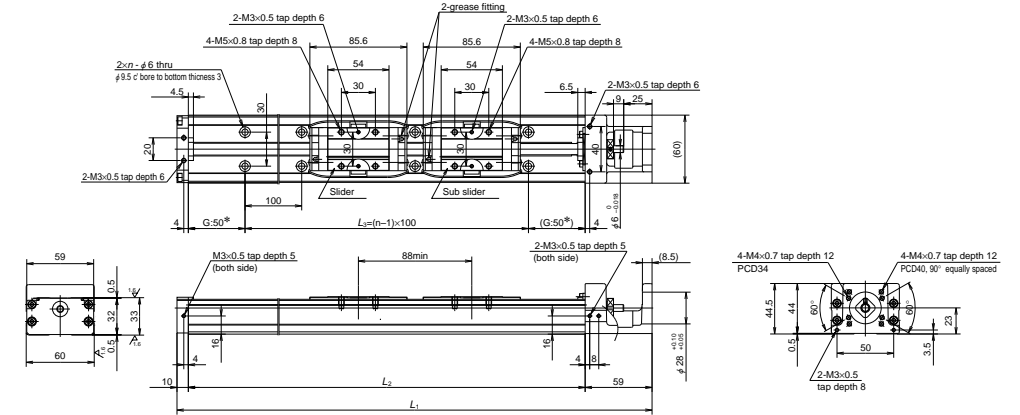
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
		Ball screw C <sub>a</sub>	Linear guides C	Support unit C <sub>a</sub>	Rated running distance L <sub>a</sub> (km)	Ball screw C <sub>0a</sub>	Linear guides C <sub>0</sub>	
5	φ 12	3000 (High grade)	22800	4400	5	5410 (High grade)	16300	1450
		3760 (Precision)				6310 (Precision)		
10	φ 12	1930 (High grade)	18100	4400	10	3160 (High grade)	16300	1450
		2260 (Precision)				3780 (Precision)		
20	φ 12	1930 (High grade)	14400	4400	20	3160 (High grade)	16300	1450
		2260 (Precision)				3780 (Precision)		

Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M <sub>RO</sub>	Pitching M <sub>PO</sub>	Yawing M <sub>VO</sub>
Single	335	133	133

MCH06 (Double slider)

Accuracy grade: High grade (H)



Dimension of MCH06 (Double slider)

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm)				Inertia x 10 <sup>6</sup> (kg · m <sup>2</sup> )	Mass (kg)
				L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	n		
☆ MCH06010H05D	100	115 (139)	5	369	300	200	3	4.82	3.5
☆ MCH06010H10D			10					6.72	
☆ MCH06020H05D	200	215 (239)	5	469	400	300	4	8.06	4.2
☆ MCH06020H10D			10					15.7	
☆ MCH06030H05D	300	315 (339)	5	569	500	400	5	9.40	5.0
☆ MCH06030H10D			10					17.0	
☆ MCH06040H10D	400	415 (439)	10	669	600	500	6	10.7	5.7
☆ MCH06040H20D			20					18.3	

Notes: 1. Items not marked are available from standard stock.  
 2. Items marked with ☆ are designated as "quick delivery item" upon request.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	5	
	1.2 - 5.2	1.5 - 9.6
	2.3 - 11.8	

Notes:  
 1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.  
 2. Grease is packed into ball screw, linear guide parts and support unit.  
 3. Consult NSK for life estimates under large moment loads.

Basic load rating

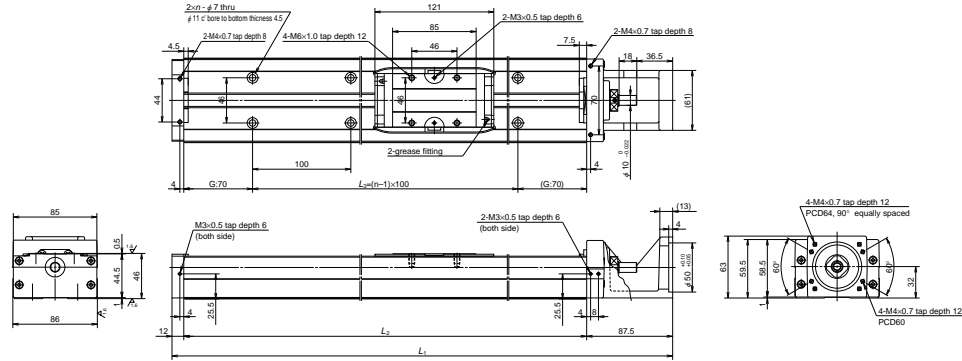
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
		Ball screw C <sub>a</sub>	Linear guides C	Support unit C <sub>a</sub>	Rated running distance L <sub>a</sub> (km)	Ball screw C <sub>0a</sub>	Linear guides C <sub>0</sub>	
5	φ 12	3000 (High grade)	22800	4400	5	5410 (High grade)	16300	1450
		3760 (Precision)				6310 (Precision)		
10	φ 12	1930 (High grade)	18100	4400	10	3160 (High grade)	16300	1450
		2260 (Precision)				3780 (Precision)		
20	φ 12	1930 (High grade)	14400	4400	20	3160 (High grade)	16300	1450
		2260 (Precision)				3780 (Precision)		

Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M <sub>RO</sub>	Pitching M <sub>PO</sub>	Yawing M <sub>VO</sub>
Double	770	730	730

MCH09

Accuracy grade: High grade (H)



Dimension of MCH09 (Single slider)

Reference number	Nominal stroke (mm)	Stroke limit (mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm)				Inertia $\times 10^{-6}(\text{kg} \cdot \text{m}^2)$	Mass (kg)
				L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	n		
☆MCH09010H05K	100	107 (121)	5	339.5	240	100	2	9.2	5.0
☆MCH09010H10K			10					10.7	
☆MCH09010H20K			20					16.8	
MCH09020H05K	200	207 (221)	5	439.5	340	200	3	12.4	6.5
MCH09020H10K			10					13.9	
☆MCH09020H20K			20					20.0	
MCH09030H05K	300	307 (321)	5	539.5	440	300	4	15.6	8.1
MCH09030H10K			10					17.1	
☆MCH09030H20K			20					23.2	
MCH09040H05K	400	407 (421)	5	639.5	540	400	5	18.8	9.7
MCH09040H10K			10					20.3	
☆MCH09040H20K			20					26.4	
☆MCH09050H05K	500	507 (521)	5	739.5	640	500	6	22.0	11
MCH09050H10K			10					23.5	
MCH09050H20K			20					29.6	
☆MCH09060H05K	600	607 (621)	5	839.5	740	600	7	25.2	13
MCH09060H10K			10					26.7	
MCH09060H20K			20					32.8	
☆MCH09070H05K	700	707 (721)	5	939.5	840	700	8	28.4	14.5
☆MCH09070H10K			10					30.0	
☆MCH09070H20K			20					36.0	
☆MCH09080H05K	800	807 (821)	5	1 039.5	940	800	9	31.6	16
MCH09080H10K			10					33.2	
MCH09080H20K			20					39.2	

Notes: 1. Items not marked are available from standard stock.  
2. Items marked with ☆ are designated as "quick delivery item" upon request.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	5	
	1.0 – 5.9	
	10	2.0 – 7.8
	20	2.0 – 10.8

Notes:  
1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.  
2. Grease is packed into ball screw, linear guide parts and support unit.  
3. Consult NSK for life estimates under large moment loads.

Basic load rating

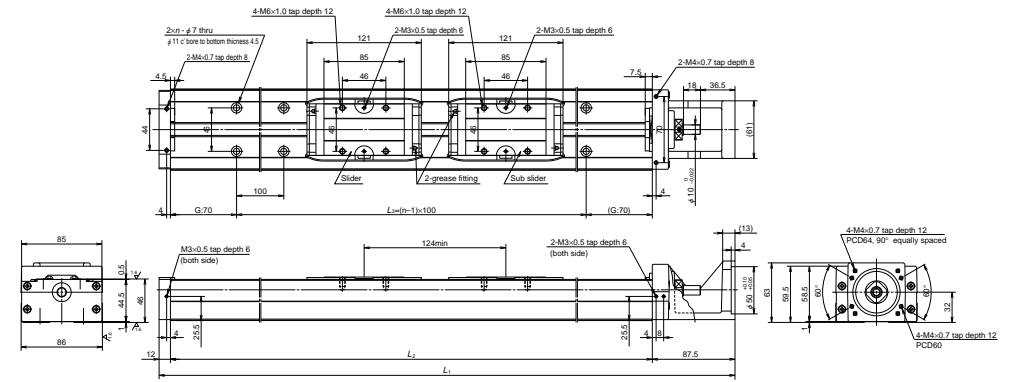
Lead $\ell$ (mm)	Shaft dia $d$ (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
		Ball screw $C_a$	Linear guides $C$	Support unit $C_a$	Rated running distance $L_a$ (km)	Ball screw $C_{0a}$	Linear guides $C_0$	
5	$\phi 15$	6820 (High grade)	40600	7100	5	13200 (High grade)	30500	3040
		7100 (Precision)				13000 (Precision)		
10	$\phi 15$	5110 (High grade)	32200	7100	10	9290 (High grade)	30500	3040
		7060 (Precision)				12700 (Precision)		
20	$\phi 15$	3290 (High grade)	25500	7100	20	5620 (High grade)	30500	3040
		4560 (Precision)				7750 (Precision)		

Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling $M_{RO}$	Pitching $M_{PO}$	Yawing $M_{VO}$
Single	890	385	385

MCH09 (Double slider)

Accuracy grade: High grade (H)



Dimension of MCH09 (Double slider)

Reference number	Nominal stroke (mm)	Stroke limit (mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm)				Inertia $\times 10^{-6}(\text{kg} \cdot \text{m}^2)$	Mass (kg)
				L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	n		
☆MCH09015H05D	150	183 (211)	5	539.5	440	300	4	16.1	8.9
☆MCH09015H10D			10					19.2	
☆MCH09025H05D	250	283 (311)	5	639.5	540	400	5	19.3	11
☆MCH09025H10D			10					22.4	
☆MCH09035H05D	350	383 (411)	5	739.5	640	500	6	22.5	12
☆MCH09035H10D			10					25.6	
☆MCH09045H10D	450	483 (511)	10	839.5	740	600	7	28.8	14
☆MCH09045H20D			20					40.9	
☆MCH09065H10D	650	683 (711)	10	1 039.5	940	800	9	35.2	17
☆MCH09065H20D			20					47.3	

Notes: 1. Items not marked are available from standard stock.  
2. Items marked with ☆ are designated as "quick delivery item" upon request.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	5	
	1.5 – 7.0	
	10	2.5 – 10.8
	20	4.0 – 17.2

Notes:  
1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.  
2. Grease is packed into ball screw, linear guide parts and support unit.  
3. Consult NSK for life estimates under large moment loads.

Basic load rating

Lead $\ell$ (mm)	Shaft dia $d$ (mm)	Basic dynamic load rating (N)				Basic static load rating (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	$\phi 15$	6820 (High grade)	40600	7100	5	13200 (High grade)	30500	3040
		7100 (Precision)				13000 (Precision)		
10	$\phi 15$	5110 (High grade)	32200	7100	10	9290 (High grade)	30500	3040
		7060 (Precision)				12700 (Precision)		
20	$\phi 15$	3290 (High grade)	25500	7100	20	5620 (High grade)	30500	3040
		4560 (Precision)				7750 (Precision)		

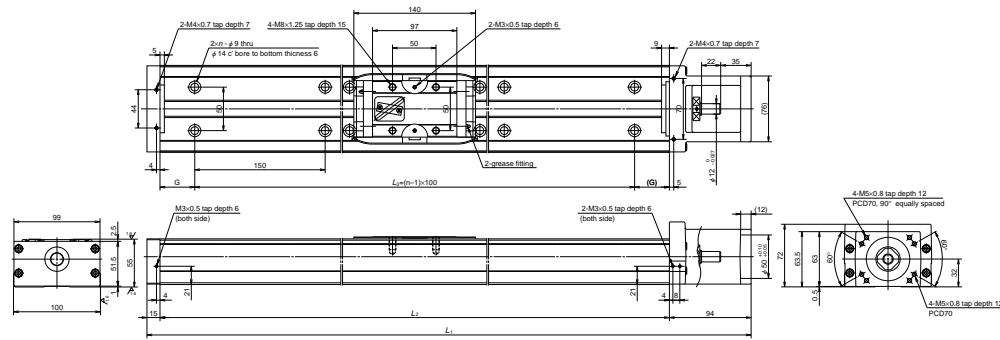
Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling $M_{RO}$	Pitching $M_{PO}$	Yawing $M_{VO}$
Double	1780	2070	2070



MCH10

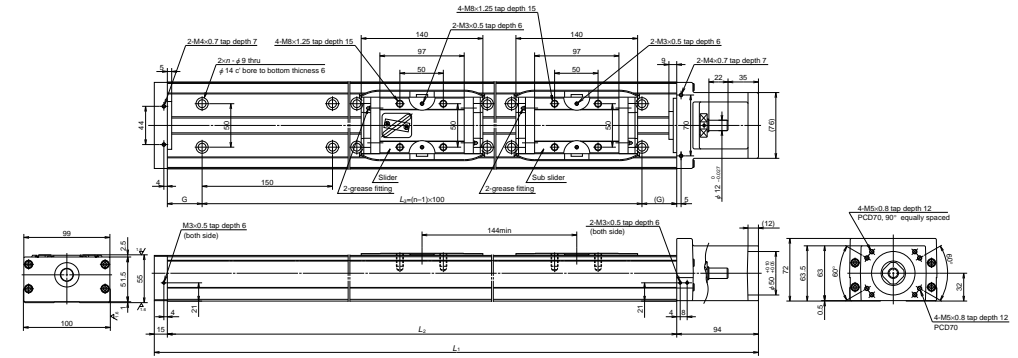
Accuracy grade: High grade (H)



MCH10

MCH10 (Double slider)

Accuracy grade: High grade (H)



Dimension of MCH10 (Single slider)

Reference number	Nominal stroke (mm)	Stroke limit (mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm)					Inertia x 10 <sup>-6</sup> (kg · m <sup>2</sup> )	Mass (kg)
				L <sub>1</sub>	L <sub>2</sub>	G	L <sub>3</sub>	n		
☆MCH10010H10K	100	126	10	389	280	65	150	2	33.2	7.3
☆MCH10010H20K		(142)	20						41.1	
☆MCH10020H10K	200	226	10	489	380	40	300	3	43.4	9.5
☆MCH10020H20K		(242)	20						51.3	
☆MCH10030H10K	300	326	10	589	480	15	450	4	53.7	12
☆MCH10030H20K		(342)	20						61.6	
MCH10040H10K	400	426	10	689	580	65	450	4	62.4	14
MCH10040H20K		(442)	20						71.8	
MCH10050H10K	500	526	10	789	680	40	600	5	74.7	16
MCH10050H20K		(542)	20						82.3	
MCH10060H10K	600	626	10	889	780	15	750	6	84.9	19
MCH10060H20K		(642)	20						92.5	
MCH10070H10K	700	726	10	989	880	65	750	6	95.1	21
MCH10070H20K		(742)	20						103	
MCH10080H10K	800	826	10	1 089	980	40	900	7	105	23
MCH10080H20K		(842)	20						113	
☆MCH10090H10K	900	926	10	1 189	1 080	15	1 050	8	116	25
☆MCH10090H20K		(942)	20						123	
☆MCH10100H10K	1 000	1 026	10	1 289	1 180	65	1 050	8	126	27
☆MCH10100H20K		(1 042)	20						133	
☆MCH10110H10K	1 100	1 126	10	1 389	1 280	40	1 200	9	136	29
☆MCH10110H20K		(1 142)	20						143	
☆MCH10120H10K	1 200	1 226	10	1 489	1 380	15	1 350	10	146	32
☆MCH10120H20K		(1 242)	20						154	

Notes: 1. Items not marked are available from standard stock.  
2. Items marked with ☆ are designated as "quick delivery item" upon request.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	10	2.7 - 10.8
	20	3.1 - 12.7

Notes:

- Frictional resistance of NSK K1 is included in the dynamic torque in the table.
- Grease is packed into ball screw, linear guide parts and support unit.
- Consult NSK for life estimates under large moment loads.

Basic load rating

Lead (mm)	Shaft dia (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
		Ball screw C <sub>a</sub>	Linear guides C	Support unit C <sub>a</sub>	Rated running distance L <sub>a</sub> (km)	Ball screw C <sub>0a</sub>	Linear guides C <sub>0</sub>	
10	φ 20	8230 (High grade)	44600	7600	10	17100 (High grade)	42000	3380
		10900 (Precision)				21700 (Precision)		
20	φ 20	5300 (High grade)	35400	7600	20	10300 (High grade)	42000	3380
		7060 (Precision)				12700 (Precision)		

Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M <sub>RO</sub>	Pitching M <sub>PO</sub>	Yawing M <sub>VO</sub>
Single	1460	610	610

Dimension of MCH10 (Double slider)

Reference number	Nominal stroke (mm)	Stroke limit (mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm)					Inertia x 10 <sup>-6</sup> (kg · m <sup>2</sup> )	Mass (kg)
				L <sub>1</sub>	L <sub>2</sub>	G	L <sub>3</sub>	n		
☆MCH10025H10D	250	282	10	689	580	65	450	4	67.1	15
☆MCH10025H20D		(314)	20						82.4	
☆MCH10035H10D	350	382	10	789	680	40	600	5	77.3	17
☆MCH10035H20D		(414)	20						92.5	
☆MCH10045H10D	450	482	10	889	780	15	750	6	87.5	20
☆MCH10045H20D		(514)	20						103	
☆MCH10055H10D	550	582	10	989	880	65	750	6	97.7	22
☆MCH10055H20D		(614)	20						113	
☆MCH10065H10D	650	682	10	1 089	980	40	900	7	108	24
☆MCH10065H20D		(714)	20						123	
☆MCH10075H20D	750	782(814)	20	1 189	1 080	15	1 050	8	133	26
☆MCH10085H20D	850	882(914)	20	1 289	1 180	65	1 050	8	143	28
☆MCH10095H20D	950	982(1 014)	20	1 389	1 280	40	1 200	9	154	30
☆MCH10105H20D	1 050	1 082(1 114)	20	1 489	1 380	15	1 350	10	164	33

Notes: 1. Items not marked are available from standard stock.  
2. Items marked with ☆ are designated as "quick delivery item" upon request.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	10	4.2 - 15.6
	20	5.0 - 19.6

Notes:

- Frictional resistance of NSK K1 is included in the dynamic torque in the table.
- Grease is packed into ball screw, linear guide parts and support unit.
- Consult NSK for life estimates under large moment loads.

Basic load rating

Lead (mm)	Shaft dia (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
		Ball screw C <sub>a</sub>	Linear guides C	Support unit C <sub>a</sub>	Rated running distance L <sub>a</sub> (km)	Ball screw C <sub>0a</sub>	Linear guides C <sub>0</sub>	
10	φ 20	8230 (High grade)	44600	7600	10	17100 (High grade)	42000	3380
		10900 (Precision)				21700 (Precision)		
20	φ 20	5300 (High grade)	35400	7600	20	10300 (High grade)	42000	3380
		7060 (Precision)				12700 (Precision)		

Basic static moment load of linear guide

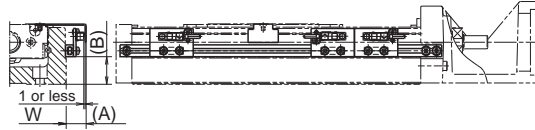
Slider	Basic static moment load (N · m)		
	Rolling M <sub>RO</sub>	Pitching M <sub>PO</sub>	Yawing M <sub>VO</sub>
Double	2920	3430	3430

### C-3-3 MCH Series Option Part

#### C-3-3. 1 Sensor Unit



##### ● Proximity switch

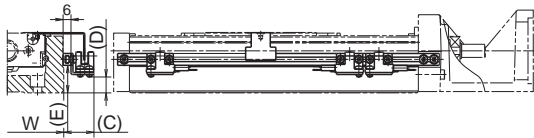


(Example of assembly)

Type	Reference number			Dimension(A) (mm)	Dimension(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 (a-contact)	—	3	1	E2S-W13 (OMRON Corp.)	
	Proximity switch (b-contact)	3	—	2	E2S-W14 (OMRON Corp.)	

Notes: 1. See page C21 for specification of proximity switch. 2. A sensor unit consists of sensors, a sensor dog and sensor mounting parts.

##### ● Photo sensor



(Example of assembly)

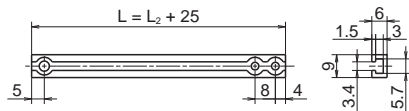
Type	Reference number	Dimension(C) (mm)	Dimension(D) (mm)	Dimension(E) (mm)	Body width W (mm)	Remarks
MCH06	MC-SRH06-13	24	2	11	60	EE-SX674 (OMRON Corp.) 3 sets (EE-1001 connector attachment)
MCH09	MC-SRH09-13	23	12	21	86	
MCH10	MC-SRH10-13	23	29	16	100	

Notes: 1. See page C22 for specification of photo sensor. 2. A sensor unit consists of sensors, a sensor dog and sensor mounting parts.

##### ● Sensor rail

Reference number : MC-SRL- \* \* \* \*

● \* \* \* \* is the same as rail dimension  $L_2$ .



### Body of MCH Series and Sensor Rail Combination Table

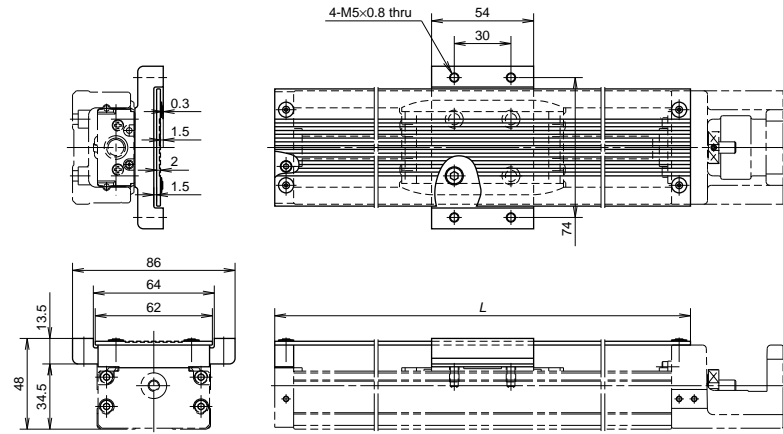
Table 4

Nominal size	Body length $L_2$ (mm)	Reference number	Sensor rail reference number
MCH06	150	MCH06005H05K MCH06005H10K MCH06005H20K	MC-SRL-0150
	200	MCH06010H05K MCH06010H10K MCH06010H20K	MC-SRL-0200
	300	MCH06020H05K MCH06020H10K MCH06020H20K	MC-SRL-0300
	400	MCH06030H05K MCH06030H10K MCH06030H20K MCH06020H05D MCH06020H10D MCH06020H10D	MC-SRL-0400
	500	MCH06040H05K MCH06040H10K MCH06040H20K MCH06030H05D MCH06030H10D	MC-SRL-0500
	600	MCH06050H05K MCH06050H10K MCH06050H20K MCH06040H10K MCH06040H20D	MC-SRL-0600
MCH06	150	MCL06005H05K MCL06005H10K	MC-SRL-0150
	200	MCL06010H05K MCL06010H10K	MC-SRL-0200
	300	MCL06020H05K MCL06020H10K	MC-SRL-0300
	400	MCL06030H10K MCL06030H20K	MC-SRL-0400
	500	MCL06040H10K MCL06040H20K	MC-SRL-0500
	600	MCL06050H10K MCL06050H20K	MC-SRL-0600
MCH09	240	MCH09010H05K MCH09010H10K MCH09010H20K	MC-SRL-0240
	340	MCH09020H05K MCH09020H10K MCH09020H20K	MC-SRL-0340
	440	MCH09030H05K MCH09030H10K MCH09030H20K MCH09015H05D MCH09015H10D	MC-SRL-0440
	540	MCH09040H05K MCH09040H10K MCH09040H20K MCH09025H05D MCH09025H10D	MC-SRL-0540
	640	MCH09050H05K MCH09050H10K MCH09050H20K MCH09035H05D MCH09035H10D	MC-SRL-0640
	740	MCH09060H05K MCH09060H10K MCH09060H20K MCH09045H10D MCH09045H20D	MC-SRL-0740

Nominal size	Body length $L_2$ (mm)	Reference number	Sensor rail reference number
MCH09	840	MCH09080H05K MCH09080H10K MCH09080H20K	MC-SRL-0840
	940	MCH09080H05K MCH09080H10K MCH09080H20K MCH09065H10D MCH09065H20D	MC-SRL-0940
	280	MCH10010H10K MCH10010H20K	MC-SRL-0280
MCH10	380	MCH10020H10K MCH10020H20K	MC-SRL-0380
	480	MCH10030H10K MCH10030H20K	MC-SRL-0480
	580	MCH10040H10K MCH10025H10D	MC-SRL-0580
	680	MCH10050H10K MCH10050H20K MCH10035H10D MCH10035H20D	MC-SRL-0680
	780	MCH10060H10K MCH10060H20K MCH10045H10D MCH10045H20D	MC-SRL-0780
	880	MCH10070H10K MCH10070H20K MCH10055H10D MCH10055H20D	MC-SRL-0880
	980	MCH10080H10K MCH10080H20K MCH10065H10D MCH10065H20D	MC-SRL-0980
	1080	MCH10090H10K MCH10090H20K MCH10075H20D	MC-SRL-1080
	1180	MCH10100H10K MCH10100H20K MCH10085H20D	MC-SRL-1180
	1280	MCH10110H10K MCH10110H20K MCH10095H20K	MC-SRL-1280
	1380	MCH10120H10K MCH10120H20K MCH10105H20D	MC-SRL-1380

C-3-3. 2 Cover Unit

Cover unit for MCH06  
Cover unit for MCL06

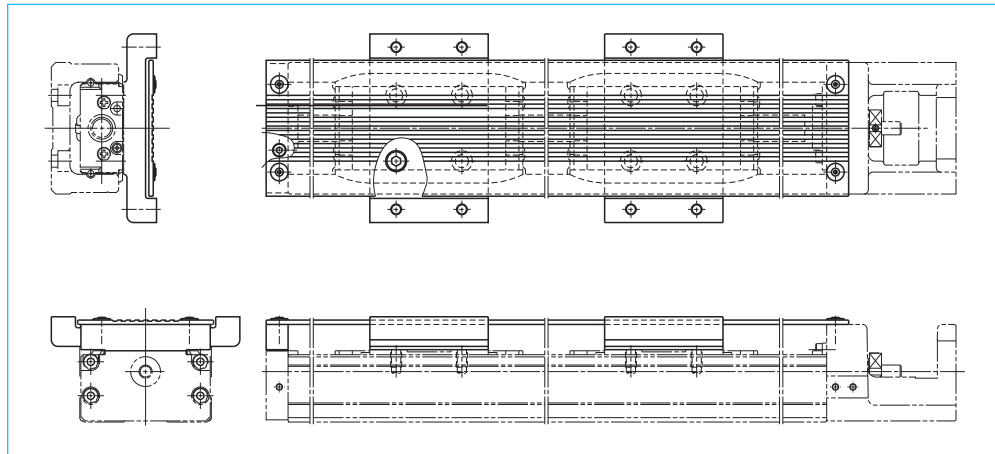


(Unit: mm)

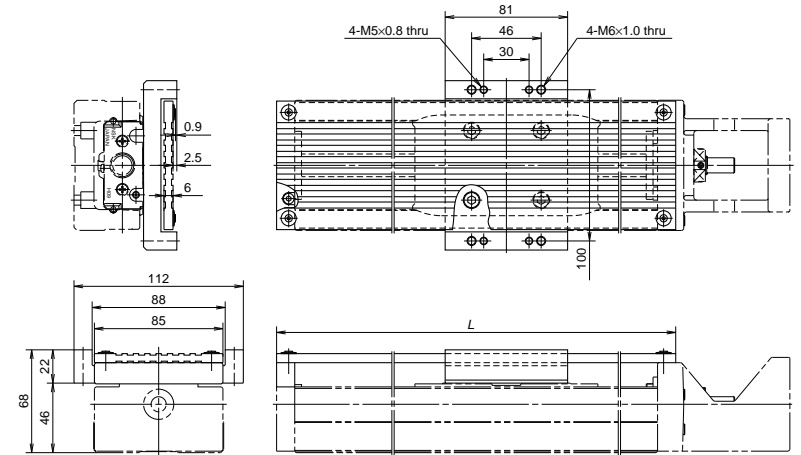
Single slider		Double slider		Top cover length L
Stroke	Reference number	Stroke	Reference number	
50	MC-HV06005-00	-	-	170
100	MC-HV06010-00	-	-	220
200	MC-HV06020-00	100	MC-HV06010D00	320
300	MC-HV06030-00	200	MC-HV06020D00	420
400	MC-HV06040-00	300	MC-HV06030D00	520
500	MC-HV06050-00	400	MC-HV06040D00	620

● Cover unit for double sliders (reference drawing)

Two spacers are attached for the double slider.



Cover unit for MCH09

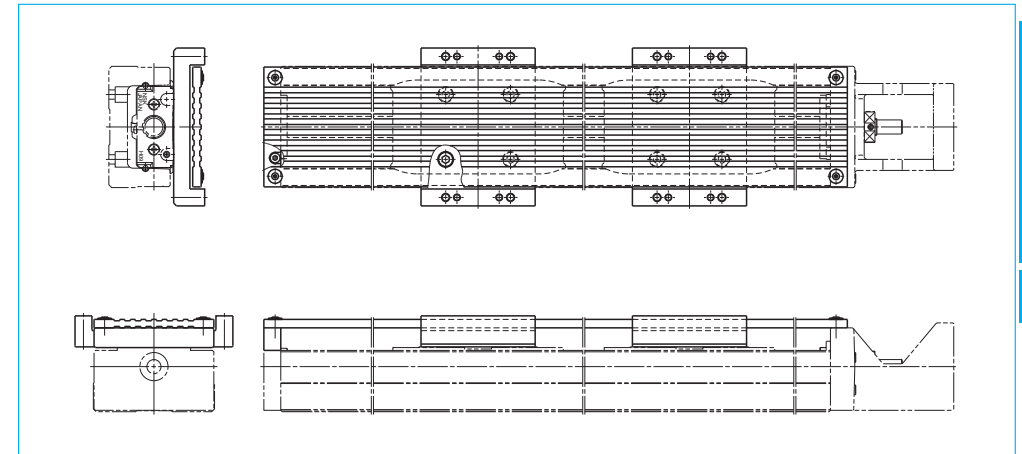


(Unit: mm)

Single slider		Double slider		Top cover length L
Stroke	Reference number	Stroke	Reference number	
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

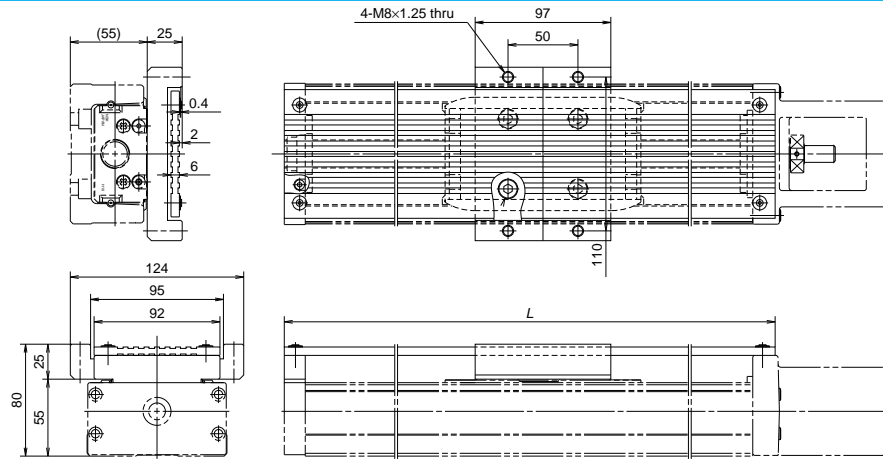
● Cover unit for double sliders (reference drawing)

Two spacers are attached for the double slider.





Cover unit for MCH10

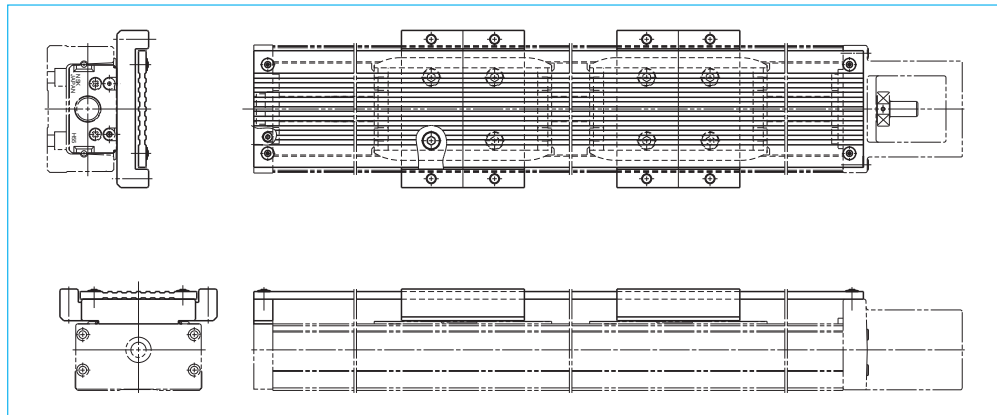


(Unit: mm)

Single slider		Double slider		Top cover length L
Stroke	Reference number	Stroke	Reference number	
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	1010
900	MC-HV10090-00	750	MC-HV10075D00	1110
1000	MC-HV10100-00	850	MC-HV10085D00	1210
1100	MC-HV10110-00	950	MC-HV10095D00	1310
1200	MC-HV10120-00	1050	MC-HV10105D00	1410

●Cover unit for double sliders (reference drawing)

Two spacers are attached for the double slider.



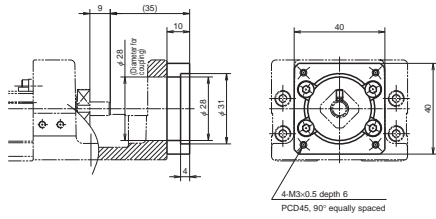
C-3-3. 3 Intermediate Plate for Motor

- Please ask NSK for a motor that is not listed in the compatible motor list.
- In case of motor indirect mount, please consult with NSK. ● Be sure to align the center lines when installing the motor.
- Motor models are subject to change at the motor manufacturers. For details, please contact the manufacture.

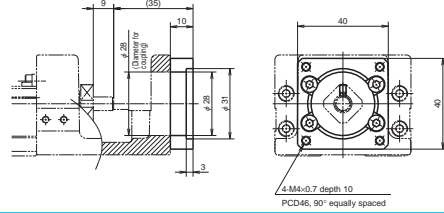
Motor Bracket for MCH06 and MCL06



Reference number : MC-BKH06-145-00



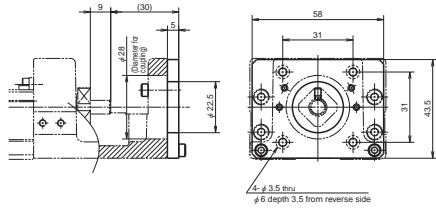
Reference number : MC-BKH06-146-00



Compatible motor	
Maker	Motor models
Matsushita Electric Industrial Co., Ltd.	MSMD5A(50W), MSMD01(100W)

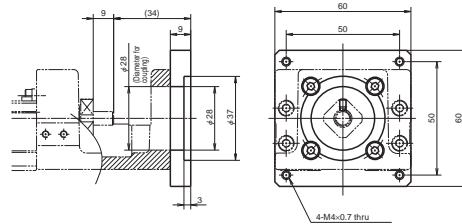
Compatible motor	
Maker	Motor models
Yaskawa Electric Corp.	SGMAH-A3(30W), SGMJV-A5A(50W), SGMVA-A5A(50W), SGMJV-01A(100W), SGMVA-01A(100W)
Mitsubishi Electric Corp.	HF-KP053(50W), HF-MP053(50W), HC-KFS053(50W), HC-MFS053(50W), HF-KP13(100W), HF-MP13(100W), HC-KFS13(100W), HC-MFS13(100W)
OMRON Corp.	R88M-W03(30W), R88M-W05(50W), R88M-W10(100W)
Sanyo Denki Co., Ltd.	P30B04xxx P Series

Reference number : MC-BKH06-231-00



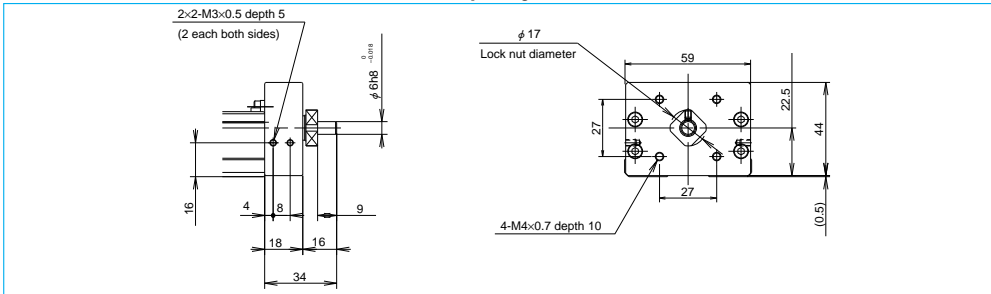
Compatible motor	
Maker	Motor models
Oriental Motor Co., Ltd.	AS46, ASC46, UPK54x, PK54x, CSK54x, CFK54x, UMK24x, CSK24x, PK24x
Sanyo Denki Co., Ltd.	PBM423xxx, 103F55xx

Reference number : MC-BKH06-250-00



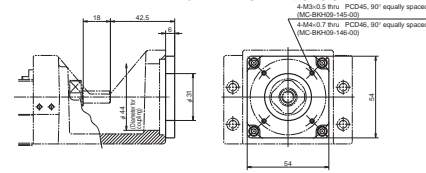
Compatible motor	
Maker	Motor models
Oriental Motor Co., Ltd.	AS66, ASC66, UPK56x, UFK56x, PK56x, CSK56x, CFK56x, MUMS02(200W), MUMS04(400W)
Sanyo Denki Co., Ltd.	PBM603xx, PBM604xx, 103F78xx

Diameter of ball screw shaft end to install a pulley for indirect motor mount of MCH06



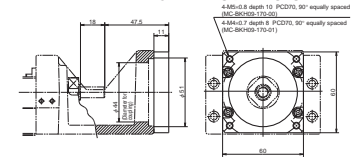
Motor Bracket for MCH09

Reference number : MC-BKH09-145-00  
MC-BKH09-146-00



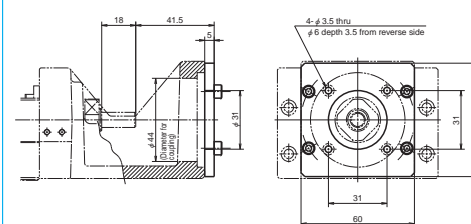
Reference number	Compatible motor	
	Maker	Motor models
MC-BKH09-145-00	Matsushita Electric Industrial Co., Ltd.	MSMD5A(50W), MSMD01(100W)
MC-BKH09-146-00	Yaskawa Electric Corp.	SGMJV-A5A(50W), SGMVA-A5A(50W), SGMJV-01A(100W), SGMVA-01A(100W)
	Mitsubishi Electric Corp.	HF-KP053(50W), HF-MP053(50W), HC-KFS053(50W), HC-MFS053(50W), HF-KP13(100W), HF-MP13(100W), HC-KFS13(100W), HC-MFS13(100W)
MC-BKH09-145-00	OMRON Corp.	R88M-W05(50W), R88M-W10(100W)
	Sanyo Denki Co., Ltd.	P30B04xxx P Series

Reference number : MC-BKH09-170-00  
MC-BKH09-170-01



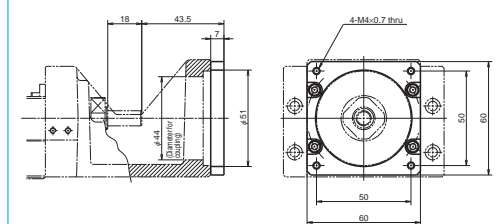
Reference number	Compatible motor	
	Maker	Motor models
MC-BKH09-170-00	Yaskawa Electric Corp.	SGMJV-02A(200W), SGMVA-02A(200W), SGMJV-04A(400W), SGMVA-04A(400W)
	Mitsubishi Electric Corp.	HF-KP23(200W), HF-MP23(200W), HF-KP43(400W), HF-MP43(400W), HC-KFS23(200W), HC-MFS23(200W), HC-KFS43(400W), HC-MFS43(400W)
	OMRON Corp.	R88M-W20(200W), R88M-W40(400W)
MC-BKH09-170-01	Sanyo Denki Co., Ltd.	P30B06xxx P Series
	Matsushita Electric Industrial Co., Ltd.	MSMD02(200W), MSMA02(200W), MSMA04(400W), MSMD04(400W)

Reference number : MC-BKH09-231-00



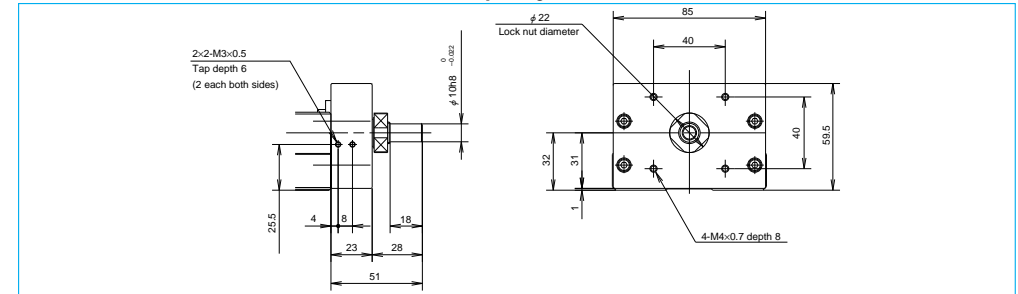
Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	PBM423xxx, 103F55xx
Oriental Motor Co., Ltd.	AS46, ASC46, UPK54x, PK54x, CSK54x, CFK54x, UMK24x, CSK24x, PK24x

Reference number : MC-BKH09-250-00



Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	PBM603xx, PBM604xx, 103F78xx
Oriental Motor Co., Ltd.	AS66, ASC66, UPK56x, UFK56x, PK56x, CSK56x, CFK56x

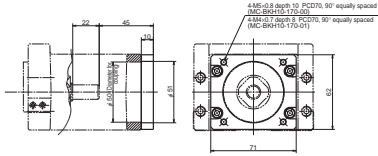
Diameter of ball screw shaft end to install a pulley for indirect motor mount of MCH09



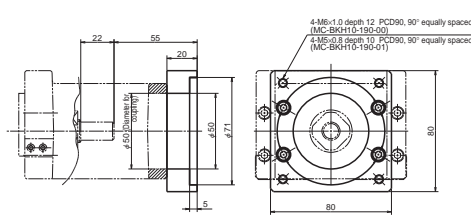


Motor Bracket for MCH10

Reference number : MC-BKH10-170-00  
MC-BKH10-170-01



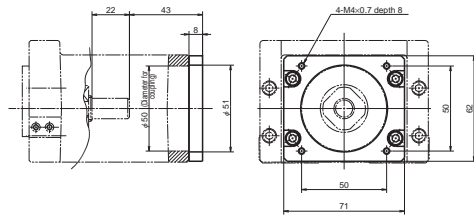
Reference number : MC-BKH10-190-00  
MC-BKH10-190-01



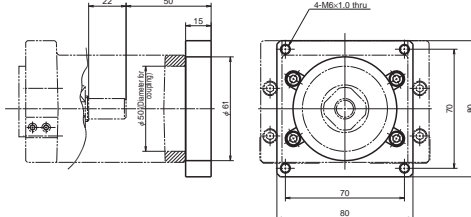
Reference number	Compatible motor	
	Maker	Motor models
MC-BKH10-170-00	Yaskawa Electric Corp.	SGMJV-02A(200W), SGMJV-02A(200W) SGMAV-04A(400W), SGMV-04A(400W)
	Mitsubishi Electric Corp.	HF-KP23(200W), HF-MP23(200W), HF-KP43(400W) HF-MP43(400W), HC-KFS23(200W), HC-MFS23(200W) HC-KFS43(400W), HC-MFS43(400W)
	OMRON Corp.	R88M-W20(200W), R88M-W40(400W)
	Sanyo Denki Co., Ltd.	P30B06xxx P Series
MC-BKH10-170-01	Matsushita Electric Industrial Co., Ltd.	MSMD02(200W), MSMA02(200W) MSMD04(400W), MSMA04(400W)

Reference number	Compatible motor	
	Maker	Motor models
MC-BKH10-190-00	Mitsubishi Electric Corp.	HC-KFS73(750W), HC-MFS73(750W) HF-KP73(750W), HF-MP73(750W)
MC-BKH10-190-01	Sanyo Denki Co., Ltd.	P50B07xxx P Series

Reference number : MC-BKH10-250-00



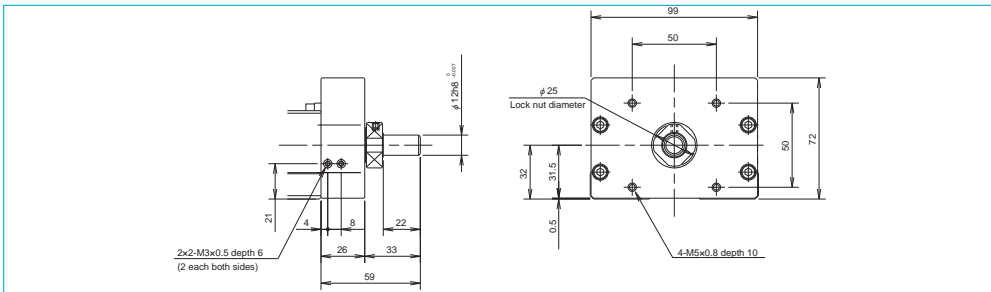
Reference number : MC-BKH10-270-00



Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	PBM603xx, PBM604xx, 103F78xx
Oriental Motor Co., Ltd.	AS66, ASC66, UPK56x, PK56x, CSK56x, CFK56x UMK56x, UFK56x

Compatible motor	
Maker	Motor models
Oriental Motor Co., Ltd.	AS98, ASC98, UPK59x, PK59x, CSK59x, CFK59x UMK59x, UFK59x

Diameter of ball screw shaft end to install a pulley for indirect motor mount of MCH10



Availability Motor Table of Intermediate Plate for MCH Series  
Table 5

Nominal size	Reference number code	Motor bracket reference number	Motor manufacturer	Stepping motor model number	Wattage of AC servo motor						
					30	50	100	200	400	750	
MCH06 MCL06	1	MC-BKH06-145-00	Matsushita Electric Industrial Co., Ltd.			MSMD5A	MSMD01				
			Yaskawa Electric Corp.		SGMAH-A3	SGMJV-A5A SGMAV-A5A	SGMJV-01A SGMAV-01A				
			Mitsubishi Electric Corp.			HF-KP053 HF-MP053 HC-KFS053 HC-MFS053	HF-KP13 HF-MP13 HC-KFS13 HC-MFS13				
			OMRON Corp. Sanyo Denki Co., Ltd.		R88M-W03	R88M-W05	R88M-W10				
MCH06 MCL06	2	MC-BKH06-146-00	Sanyo Denki Co., Ltd.	P30B04xxx (P Series)							
			Sanyo Denki Co., Ltd.		PBM423xxx 103F55xx						
			Oriental Motor Co., Ltd.		AS46, ASC46 UPK54x, PK54x CSK54x, CFK54x UMK24x, CSK24x PK24x						
			Sanyo Denki Co., Ltd. Oriental Motor Co., Ltd.		PBM603xx PBM604xx 103F78xx					MUMS02	MUMS04
MCH06 MCL06	3	MC-BKH06-231-00	Oriental Motor Co., Ltd.								
			Sanyo Denki Co., Ltd.		PBM603xx PBM604xx 103F78xx						
			Oriental Motor Co., Ltd.		AS66, ASC66 UPK56x, UFK56x PK56x, CSK56x CFK56x						
			Sanyo Denki Co., Ltd.		P30B04xxx (P Series)						
MCH09	1	MC-BKH09-145-00	Matsushita Electric Industrial Co., Ltd.			MSMD5A	MSMD01				
			Yaskawa Electric Corp.		SGMJV-A5A SGMAV-A5A	SGMJV-01A SGMAV-01A					
			Mitsubishi Electric Corp.		HF-KP053 HF-MP053 HC-KFS053 HC-MFS053	HF-KP13 HF-MP13 HC-KFS13 HC-MFS13					
			OMRON Corp. Sanyo Denki Co., Ltd.		R88M-W05	R88M-W10					
MCH09	2	MC-BKH09-146-00	Mitsubishi Electric Corp.								
			Sanyo Denki Co., Ltd.		P30B04xxx (P Series)						
			Oriental Motor Co., Ltd.		AS46, ASC46 UPK54x, PK54x CSK54x, CFK54x UMK24x, CSK24x PK24x						
			Sanyo Denki Co., Ltd.		PBM603xx PBM604xx 103F78xx						
MCH09	3	MC-BKH09-170-00	Yaskawa Electric Corp.					SGMJV-02A SGMAV-02A	SGMJV-04A SGMAV-04A		
			Mitsubishi Electric Corp.				HF-KP23 HF-MP23 HC-KFS23 HC-MFS23	HF-KP43 HF-MP43 HC-KFS43 HC-MFS43			
			OMRON Corp. Sanyo Denki Co., Ltd.		R88M-W20	R88M-W40					
			Sanyo Denki Co., Ltd.		P30B06xxx (P Series)						
MCH09	4	MC-BKH09-170-01	Matsushita Electric Industrial Co., Ltd.					MSMD02 MSMA02	MSMD04 MSMA04		
			Sanyo Denki Co., Ltd.		PBM423xxx 103F55xx						
			Oriental Motor Co., Ltd.		AS46, ASC46 UPK54x, PK54x CSK54x, CFK54x UMK24x, CSK24x PK24x						
			Sanyo Denki Co., Ltd.		PBM603xx PBM604xx 103F78xx						
MCH09	5	MC-BKH09-231-00	Oriental Motor Co., Ltd.								
			Sanyo Denki Co., Ltd.		PBM603xx PBM604xx 103F78xx						
			Oriental Motor Co., Ltd.		AS66, ASC66 UPK56x, UFK56x PK56x, CSK56x CFK56x						
			Sanyo Denki Co., Ltd.		P30B06xxx (P Series)						
MCH10	1	MC-BKH10-170-00	Yaskawa Electric Corp.					SGMJV-02A SGMAV-02A	SGMJV-04A SGMAV-04A		
			Mitsubishi Electric Corp.				HF-KP23 HF-MP23 HC-KFS23 HC-MFS23	HF-KP43 HF-MP43 HC-KFS43 HC-MFS43			
			OMRON Corp. Sanyo Denki Co., Ltd.		R88M-W20	R88M-W40					
			Sanyo Denki Co., Ltd.		P30B06xxx (P Series)						
MCH10	2	MC-BKH10-170-01	Matsushita Electric Industrial Co., Ltd.					MSMD02 MSMA02	MSMD04 MSMA04		
			Sanyo Denki Co., Ltd.		PBM603xx PBM604xx 103F78xx						
			Oriental Motor Co., Ltd.		AS66, ASC66 UPK56x, PK56x CSK56x, CFK56x UMK56x, UFK56x						
			Sanyo Denki Co., Ltd.		P50B07xxx (P Series)						
MCH10	3	MC-BKH10-190-00	Mitsubishi Electric Corp.								
			Sanyo Denki Co., Ltd.		PBM603xx PBM604xx 103F78xx						
			Oriental Motor Co., Ltd.		AS66, ASC66 UPK56x, PK56x CSK56x, CFK56x UMK56x, UFK56x						
			Sanyo Denki Co., Ltd.		P50B07xxx (P Series)						
MCH10	4	MC-BKH10-190-01	Sanyo Denki Co., Ltd.								
			Sanyo Denki Co., Ltd.		PBM603xx PBM604xx 103F78xx						
			Oriental Motor Co., Ltd.		AS66, ASC66 UPK56x, PK56x CSK56x, CFK56x UMK56x, UFK56x						
			Sanyo Denki Co., Ltd.		P50B07xxx (P Series)						
MCH10	5	MC-BKH10-250-00	Oriental Motor Co., Ltd.								
			Oriental Motor Co., Ltd.		AS98, ASC98 UPK59x, PK59x CSK59x, CFK59x UMK59x, UFK59x						
			Oriental Motor Co., Ltd.		AS98, ASC98 UPK59x, PK59x CSK59x, CFK59x UMK59x, UFK59x						
			Oriental Motor Co., Ltd.		P50B07xxx (P Series)						
MCH10	6	MC-BKH10-270-00	Oriental Motor Co., Ltd.								
			Oriental Motor Co., Ltd.		AS98, ASC98 UPK59x, PK59x CSK59x, CFK59x UMK59x, UFK59x						
			Oriental Motor Co., Ltd.		AS98, ASC98 UPK59x, PK59x CSK59x, CFK59x UMK59x, UFK59x						
			Oriental Motor Co., Ltd.		P50B07xxx (P Series)						



# Other

## Other

- 1. Special Environments ..... D1
- 2. Lubrication ..... D13
- 3. RoHS Compliant ..... D24



# 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	
Clean	Atmosphere, normal temperature	Standard material	Standard material	Standard material	LG2 Grease	D8
					NSK K1 lubrication unit	D10
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	LG2 Grease	D8
					NSK K1 lubrication unit	D10
Fluoride low temperature chrome plating	D5					
Fluoride grease						
Vacuum	Atmosphere-Vacuum, normal temperature Atmosphere-Vacuum up to 200°C Atmosphere-Vacuum up to 300°C High vacuum up to 500°C	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Fluoride grease	
					Molybdenum disulfide	
					Special silver film	D7
Corrosion resistance	Vapor, steam	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		D5
	Acid, alkali	Standard material	Standard material	Standard material	Fluoride low temperature chrome plating	D5
					D5	
	Acid, alkali, clean	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Fluoride low temperature chrome plating	D5
					LG2 Grease	D8
					Fluoride low temperature chrome plating	D5
Strong acid, strong alkali				Fluoride grease		
Organic solvent				Fluoride grease		
High temperature	Atmosphere up to 150°C	Standard material	Standard material	Austenitic stainless steel	ET150 Grease	
					Fluoride grease	
	Atmosphere Up to 200°C	Martensitic stainless steel	Martensitic stainless steel		Fluoride grease	
Low temperature	-273°C –	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Solid lubricant	
Radiation resistance	Atmosphere	Standard material	Standard material	Standard material	Radiation resistant grease	
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		
Foreign matters	Fine particles, wooden chips	Standard material	Standard material	Standard material	NSK K1 lubrication unit	D10
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		D10
	Water, under water	Martensitic stainless steel	Standard material	Standard material		D10
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		D10

### 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	
Clean	Atmosphere, normal temperature	Standard material	Standard material	Standard material	LG2 Grease	D8
					NSK K1 lubrication unit	D10
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	LG2 Grease	D8
					NSK K1 lubrication unit	D10
Fluoride low temperature chrome plating	D5					
Fluoride grease						
Vacuum	Atmosphere-Vacuum, normal temperature Atmosphere-Vacuum up to 200°C Atmosphere up to 200°C, Corrosion resistant Atmosphere-Vacuum, normal temperature Atmosphere-Vacuum up to 200°C Atmosphere-Vacuum up to 300°C High vacuum up to 500°C	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Fluoride grease	
					Molybdenum disulfide	
					Special silver film	D7
Corrosion resistance	Acid, alkali, clean	Standard material	Standard material	Austenitic stainless steel	Fluoride low temperature chrome plating	D5
		Martensitic stainless steel	Martensitic stainless steel		Fluoride grease	D5
		Precipitation hardening stainless steel	Precipitation hardening stainless steel			
Nonmagnetic	Strong acid, strong alkali, clean, nonmagnetic	Ceramic	Ceramic	Austenitic stainless steel	Fluoride grease	
		Special austenitic stainless steel	Ceramic		Fluoroplastic	
High temperature	Atmosphere Up to 200°C	Standard material	Standard material	Austenitic stainless steel	Fluoride grease	
		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 –	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Solid lubricant	
Radiation resistance	Atmosphere	Standard material	Standard material	Standard material	Radiation resistant grease	
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		
Foreign matters	Fine particles, wooden chips	Standard material	Standard material	Standard material	NSK K1 lubrication unit	D10
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		D10
	Water, under water					D10

## 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

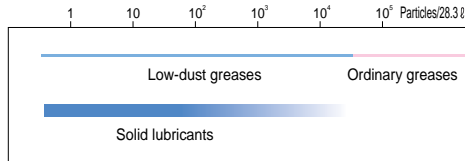


Fig. 2.2 Lubrication in vacuum

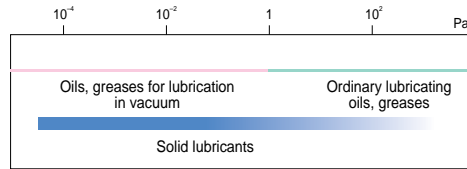


Fig. 2.3 Lubrication in corrosive environment

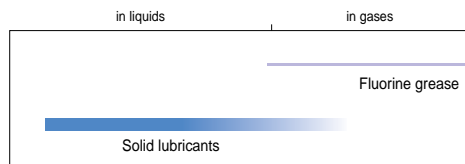


Fig. 2.4 Lubrication in high temperature

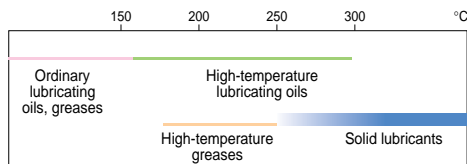


Fig. 2.5 Lubrication in low temperature

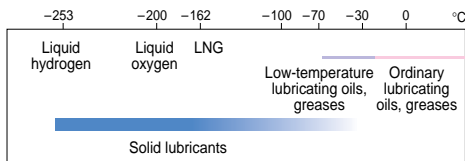


Fig. 2.6 Lubrication in radioactive environment

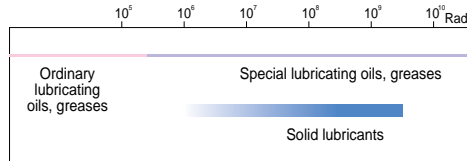
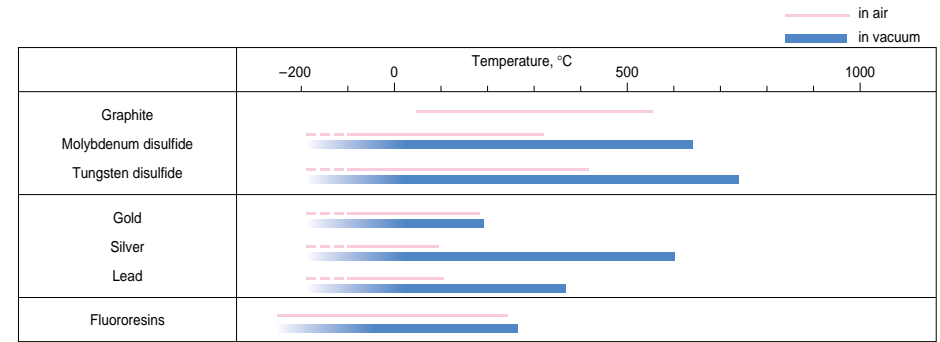


Fig. 2.7 Temperature range for using solid lubricants



### 2. Materials

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

Table 2.1 Characteristics of metal materials

Application	Type of steel	Linear expansivity ×10 <sup>-4</sup> /°C	Young's modulus GPa	Hardness <sup>(1)</sup> 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

Note (1) 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

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

Among all measures to cope with environment, rust prevention is the most challenging. Such environment includes: Moisture for washers and other equipment; Chemicals used in the wet processing of semiconductor and liquid crystal display manufacturing equipment.

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

#### ● What is "Fluoride low temperature chrome plating?"

This is a type of black chrome plating which forms a black film (1 to 2 μm) 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 an 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 by other surface treatment and stainless steel products.

Do not use organic solvent because it adversely affects antirust property of the plating.

#### ● Humidity cabinet corrosion resistance test

Table 3.1 Results of the humidity cabinet test

Test sample		Fluoride low temperature chrome plating (recommended)	Hard chrome plating (reference)	Electroless nickel plating (reference)	Equivalent to SUS440C material	Standard steel
Characteristic	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
Rust prevention ability	Test conditions	● Testing cabinet: High temperature, highly moist cabinet (made by DABAI ESPEC) ● Temperature: 70°C ● Relative humidity: 95% ● Testing time: 96 h Time to "reach to" and "falling from" the temperature/humidity conditions Reaching: 5 h Falling: 2 h				
	Film thickness	5 μm	0.5 - 7 μm	10 μm	—	—

Rusting A: No rust B: Not rust, but some discoloration  
C: Spotty rust D: Light rusted E: Completely rusted

#### ● Corrosion resistance test against chemicals

Table 3.2 Result of the corrosion resistance test

Test conditions		Rail base material: Equivalent to SUS440C Chemical density: 1 mol/l	
Fluoride low temperature chrome plating	Immersed in solution for 24 hrs Nitric acid Immersed in solution for 24 hrs Fluoride Exposed to vapor for 72 hrs Hydrochloric acid type washing solution HCℓ : H <sub>2</sub> O <sub>2</sub> : H <sub>2</sub> O = 1 : 1 : 8	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

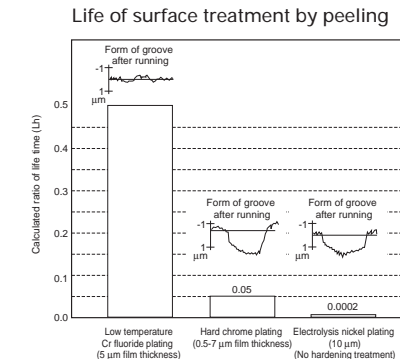


Fig. 3.1 Result of durability test

#### ● 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 very suitable in 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. Figure 4.1 is a schematic of the testing system in vacuum chamber. Table 4.2 shows testing conditions.



Photo 4.1 Vacuum testing system

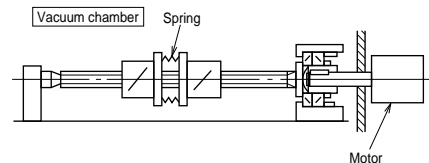


Fig. 4.1 Schematic of the testing system

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 Pa	
Material	Shaft	SUS630
	Nut	SUS440C
	Ball return tube	SUS304
	Steel balls	SUS440C
Solid lubricant	Special silver film	

Table 4.2 Testing conditions	
Rotational speed	300 min <sup>-1</sup>
Vacuum chamber pressure	1.3×10 <sup>-5</sup> – 1.3×10 <sup>-6</sup> 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.

#### Test results of the ball screw ①

The torque tendency was stable until about 1 x 10<sup>7</sup> rev. Then the torque characteristics slightly deteriorated. At about 1.35 x 10<sup>7</sup> 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 ②

Torque value is a little higher in the test ①. The value is also little unstable. The torque momentarily soared several times during the test (some 10N · 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 x 10<sup>7</sup> rev., it was determined that the ball screw reached the end of its life.

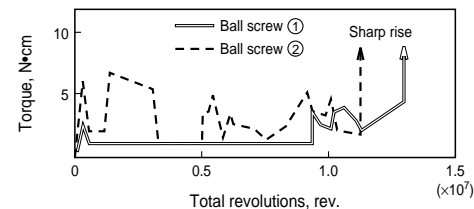


Fig. 4.2 Torque variation

Table 4.3 Ball screw durability

Classification	Ball screw ①	Ball screw ②	
Life	Total revolutions (rev.)	1.35×10 <sup>7</sup>	1.13×10 <sup>7</sup>
	Total traveling distance (km)	54.0	45.2
	Total traveling hours <sup>(1)</sup> (h)	750	628

Note: (1) Total traveling hours when operated constantly at 300 min<sup>-1</sup>

#### 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 x 10<sup>7</sup> 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, LGU

NSK Clean Grease LG2 is used in clean room for NSK linear guides, ball screws, Monocarriers, Robot Modules, Megathrust motors, XY tables, etc. with low-dust emitting specifications. For its low dust emission and high durability, LG2 earns trust and high reputation of semiconductor equipment manufacturers.

LG2 is superior in many areas to fluorine greases which are commonly used in clean room.

#### 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

Name	Thickener	Base oil	Base oil kinematic viscosity mm <sup>2</sup> /s (40°C)	Consistency	Dropping point °C
Clean Grease LG2	Lithium soap	Synthetic hydrocarbon oil + mineral oil	30	207	200
Clean Grease LGU	Diurea	Synthetic hydrocarbon oil	100	209	260

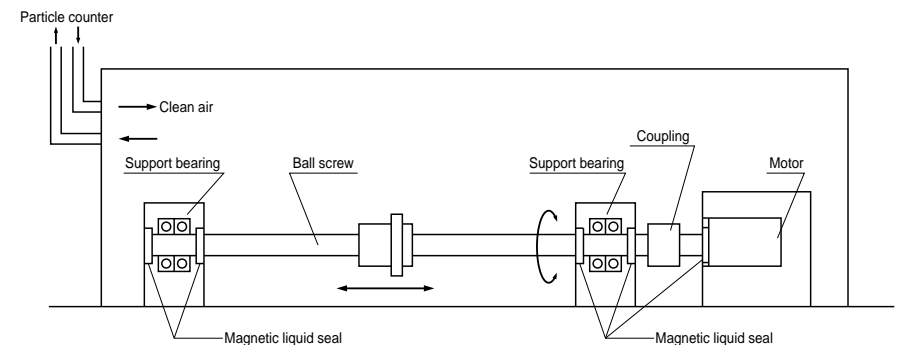


Fig. 4.3 Setting to measure dust generated by ball screw

● Feature 1: Remarkably low dust emission

Compared with fluoride greases, dust emission by LG2 is low and stable for long period of time.

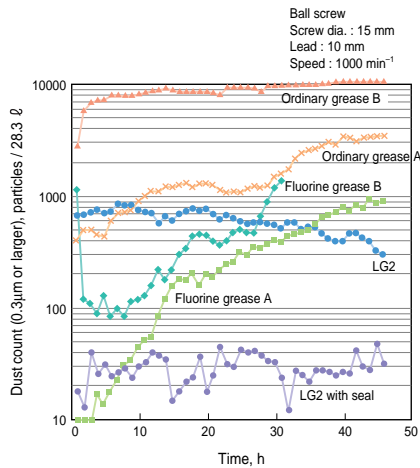


Fig. 4.4 Comparison in dust emission characteristics

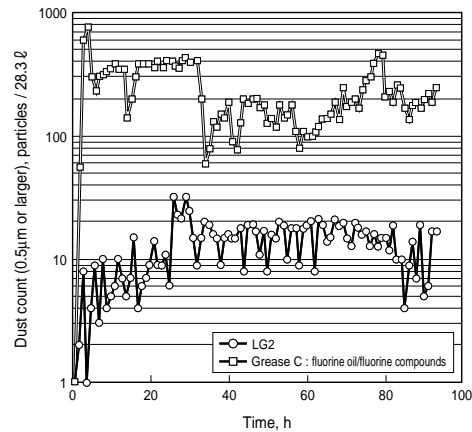


Fig. 4.5 Dust emission from linear guide (Linear guide: LU09)

● Feature 2 : Long life

Life is ten times or longer than fluorine greases, and equivalent to ordinary greases. This stretches maintenance intervals.

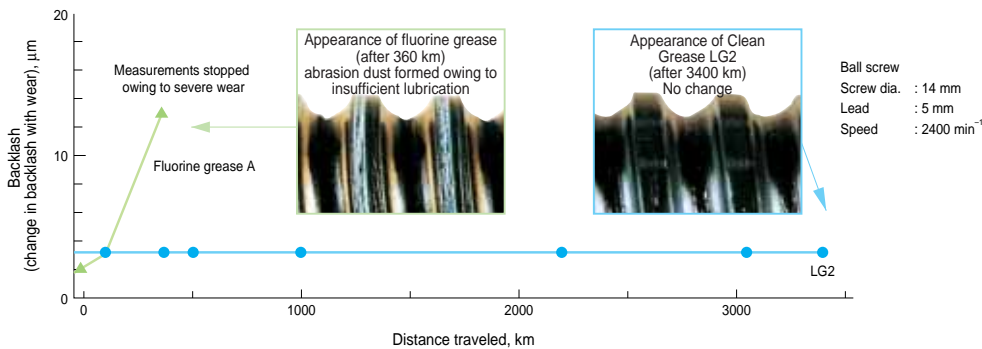


Fig. 4.6 Results of ball screw durability test

● Feature 3 : Excellent rust prevention capacity

The rust prevention capacity is significantly higher than fluoride type greases. Handling and preparation for operation are easy.

Ball screw rust prevention test (test conditions : 96 hr at humidity 95%, temperature 70°C)

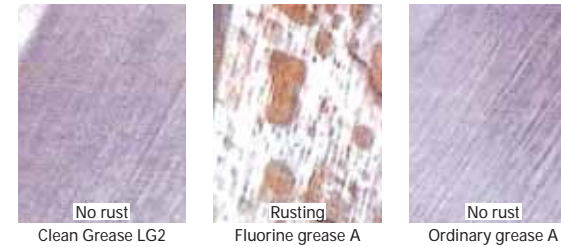


Photo 4.2

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.

Ball screw  
Screw dia. : 25 mm  
Lead : 5 mm  
Preload : 294 N

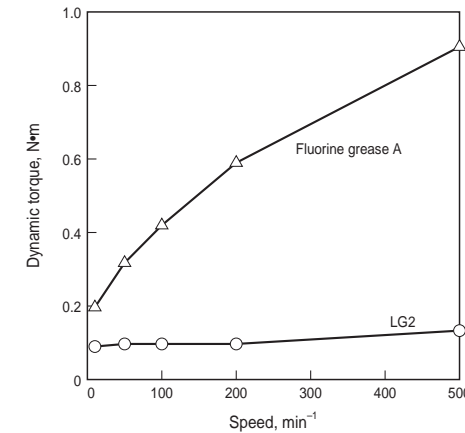


Fig. 4.7 Comparison of torque characteristics

● 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 K1 lubrication unit (linear guide and ball screw)

Molded oil is made of a lubrication oil and polyolefin which has affinity with the lubrication oil. More than 70% of the mass is lubrication oil.

Molded oil which is formed into NSK K1 lubrication unit effectively seals linear guides, continually supplying lubrication oil. NSK K1 lubrication unit has made it possible to use linear guides in water or powder dust.

NSK K1 lubrication unit is available for ball screws.

Features

- Extend maintenance-free intervals
- No contamination of surrounding environment
- Prolong life of the products exposed to water

Refer to Page A38 and B209 for details of NSK K1 lubrication unit.

## 1.5 Table to Cope With Special Environments

### 1. Linear guides

Series	Model No.	Special environment which linear guide can tolerate					
		Clean	Vacuum	Corrosion	High temp.	Hygienic	High dust proofing
SH	SH15	○		○			
	SH20	○					
	SH25	○		○			
	SH30	○		○			
	SH35	○		○			
SS	SH45	○		○			
	SH55	○		○			
	SS15	○		○			
	SS20	○		○			
LH	SS25	○		○			
	SS30	○		○			
	SS35	○		○			
	LH08	○		○			
	LH10	○		○			
LH	LH12	○		○		○	
	LH15	○	○	○	○	○	
	LH20	○	○	○	○	○	
	LH25	○	○	○	○	○	
	LH30	○	○	○	○	○	
	LH35	○	○	○	○	○	
	LH45	○		○			
	LH55	○		○			
	LH65	○		○			
	LS15	○	○	○	○	○	
LS	LS20	○	○	○	○	○	
	LS25	○	○	○	○	○	
	LS30	○	○	○	○	○	
	LS35	○	○	○	○	○	
VH	VH15	○		○	○		○
	VH20	○		○	○		○
	VH25	○		○	○		○
	VH30	○		○	○		○
	VH35	○		○	○		○
	VH45	○		○	○		○
LW	VH55	○		○	○		○
	LW17	○		○		○	
	LW21	○		○		○	
	LW27	○		○		○	
TS	LW35	○		○		○	
	LW50	○		○			
	TS15	○		○			
RA	TS20	○		○			
	TS25	○		○			
	TS30	○		○			
	TS35	○		○			
RA	RA15	○		○			
	RA20	○		○			

Series	Model No.	Special environment which linear guide can tolerate					
		Clean	Vacuum	Corrosion	High temp.	Hygienic	High dust proofing
RA	RA25	○		○			
	RA30	○		○			
	RA35	○		○			
	RA45	○		○			
	RA55	○		○			
	RA65	○		○			
LA	LA25	○		○			
	LA30	○		○			
	LA35	○		○			
	LA45	○		○			
	LA55	○		○			
	LA65	○		○			
PU	PU05	○		○			
	PU07	○		○			
	PU09	○		○		○	
	PU12	○		○		○	
	PU15	○		○		○	
PE	PE05	○		○			
	PE07	○		○			
	PE09	○		○		○	
	PE12	○		○		○	
	PE15	○		○		○	
LU	LU05	○		○			
	LU07	○		○			
	LU09_L	○	○	○	○	○	
	LU09_R	○	○	○	○	○	
	LU12_L	○	○	○	○	○	
	LU12_R	○	○	○	○	○	
	LU15	○	○	○	○	○	
	LE05	○		○			
	LE07	○		○			
	LE09_L	○	○	○	○	○	
LE	LE09_R	○		○		○	
	LE12_L	○	○	○	○	○	
	LE12_R	○		○		○	
	LE15_L	○	○	○	○	○	
	LE15AR	○		○		○	
HA	HA25	○		○			
	HA30	○		○			
	HA35	○		○			
	HA45	○		○			
	HA55	○		○			
HS	HS15	○		○			
	HS20	○		○			
	HS25	○		○			
	HS30	○		○			
HS	HS35	○		○			

### 2. Ball screws

Series	Special environment				
	Clean	Vacuum	Rust prevention	High temp.	Foreign matters
KA Series	○	○	○		
For Contaminated environments VSS Type					○
Made-to-order ball screw	○*	○*	○*	○*	○*

\*Available in the made-to-order ball screw.

Please consult NSK.

## 1.6 Precautions for Handling

Please observe the following precautions to maintain high functions of ball screws and linear motion guide bearings in special environment 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 type linear guide) and ball nut (rolled 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 agent.
- Wear plastic gloves and handle product in clean place.

## 2. Lubrication

There are two types of lubricating method -- grease and oil -- for ball screws and linear guides.

Use a lubricant agent and method most suitable to condition requirements and purpose to optimize functions of the ball screws and linear guides.

In general, lubricants with low base oil kinematic viscosity are used for high speed operation, in which thermal expansion has large impact, and in low temperatures.

Lubrication with high base oil kinematic viscosity is used for oscillating operations, low speed and high temperature.

The following are lubrication methods by grease and by oil.

### 2.1 Grease Lubrication

Grease lubrication is widely used because it does not require special oil supply system or piping. Grease lubricants made by NSK are:

- Various types of grease in bellowed container which can be instantly attached to the grease pump;
- NSK Grease Unit which comprise 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 and ball screws, in specific uses, conditions and purposes.

Table 1.1 Grease lubricant for linear guides and ball screws

Type	Thickener	Base oil	Base oil kinematic viscosity mm <sup>2</sup> /s (40°C)	Range of use temperature (°C)	Purpose
AS2	Lithium type	Mineral oil	130	- 10 - 110	For ball screws and linear guides for general use at high load.
PS2	Lithium type	Synthetic oil + mineral oil	15	- 50 - 110	For ball screws and linear guides for low temperature and high frequency operation.
LR3	Lithium type	Synthetic oil	30	- 30 - 130	For ball screws at high speed, medium load.
LG2	Lithium type	Synthetic oil + synthetic hydrocarbon oil	30	- 20 - 70	For ball screws and linear guides for clean environment.
LGU	Diurea	Synthetic hydrocarbon oil	100	- 30 - 120	For ball screws and linear guides for clean environment.
NF2	Urea composite type	Synthetic oil + mineral oil	27	- 40 - 100	For fretting resistant ball screws and linear guides.

#### (1) NSK Grease AS2

##### • Features

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

##### • Application

It is a standard grease for general NSK linear guides and ball screws. It is prevalently used in many applications because of its high base oil viscosity, high load resistance, and stability in oxidation. The

#### (2) NSK Grease PS2

##### • Features

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

##### • Application

It 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.

(Previous reference number is NSK Grease No.2)

#### (3) NSK Grease LR3

##### • Features

It contains a special synthetic oil for high temperature 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, medium load. Lubrication life exceeded 2000 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

It is a standard grease for NSK standard linear guides and ball screws in finished shaft end FA Type. It is ideal for operation with medium load, at high speed such as positioning in high tact material handling

AS2 has replaced the AV2 grease as the standard grease.

##### • Nature

Thickener	Lithium soap base
Base oil	Mineral oil
Consistency	275
Dropping point	185°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 <sup>2</sup> /s (40°C)

##### • Nature

Thickener	Lithium soap base
Base oil	Synthetic oil + mineral 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 mm <sup>2</sup> /s (40°C)

equipment.

(Previous reference number is NSK Grease No.1)

##### • Nature

Thickener	Lithium soap base
Base oil	Mineral oil
Consistency	227
Dropping point	208°C
Volume of evaporation	0.30% (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 <sup>2</sup> /s (40°C)

**(4) NSK Grease LG2**

**• Features**

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

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

In dust generation, LG2 is more than equal to 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 and ball screws for semiconductor and liquid crystal display (LCD) processing equipment which require a highly clean environment. Because LG2 is exclusively for a clean environment at normal temperatures, however, it cannot be used in a vacuum environment.

Refer to "Special environment" in Page D8 for detailed data on superb characteristics of NSK Grease LG2.

**• Nature**

Thickener	Lithium soap base
Base oil	Mineral oil + Synthetic hydrocarbon oil
Consistency	207
Dropping point	200°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	30 mm <sup>2</sup> /s (40°C)

**(5) NSK Grease LGU**

**• Features**

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

In comparison with fluorine base grease, which has been used commonly in clean rooms, LGU has better

lubricating property, longer duration of lubricant, better torque variation, much better anti-rust property, and equivalent or better dust emission. In addition, this grease can be handled in the same way as the other common grease because high-grade synthetic oil is used as the base oil.

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

**• Application**

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

This cannot be used in vacuum.

**• Nature**

Thickener	Diurea
Base oil	Synthetic hydrocarbon oil
Consistency	209
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	100 mm <sup>2</sup> /s (40°C)

**(6) NSK Grease NF2**

**• Features**

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

**• Application**

This grease is suitable for ball screws and linear guides of which application include oscillating operations. Allowable temperature range is -40° to 130°C.

**• Nature**

Thickener	Diurea
Base oil	Synthetic hydrocarbon oil
Consistency	288
Dropping point	269°C
Volume of evaporation	7.9% (177°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	27 mm <sup>2</sup> /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 clean environments at normal temperatures.

**2. How to replenish grease**

Use grease fitting to linear guide ball slide or to ball screw nut if exclusive grease supply component is not used. Supply required amount to grease fitting by a grease gun (pump).

Wipe off old grease and accumulated dust before supplying new grease. If grease fitting is not used, apply grease directly to the rail or to the ball groove of the screw shaft. Remove the seal if possible, and move a ball slide or ball nut few strokes so the grease permeates into the ball slide and inside the nut. A hand grease pump, an exclusive and easy lubrication device to linear guides and ball screws, is available at NSK.

**3. Volume of grease to be replenished**

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

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

- All at once, replenish the amount which 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 and 1.3 show internal spaces of ball slide and ball nut for reference.

\* When replenishing using a grease gun:

Use a grease gun and fill the inside of ball slide and the ball nut with grease. Supply grease until it comes out from the ball slide or ball nut area. Move the ball slide or ball nut 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 from inside. Trial operations are necessary because the resistance to sliding force of linear guide and the ball screw torque greatly increase immediately after replenishment (full-pack state) and may cause problems. Grease's agitating resistance is accountable for this phenomenon. Wipe off excess grease that accumulates at the end of the rail and screw shaft after trial runs, so the grease does not scatter to other areas.



Table 1.2 Inside space of the ball slide of linear guide

SH, SS Series Unit: cm <sup>3</sup>					LH, LS Series Unit: cm <sup>3</sup>				
Series Model No.	SH		SS		Series Model No.	LH		LS	
	High-load type	Super-high-load type	Medium-load type	High-load type		High-load type	Super-high-load type	Medium-load type	High-load type
15	2	3	1.5	2	08	0.2	-	-	-
20	5	7	3	4	10	0.4	-	-	-
25	9	12	5	7	12	1.2	-	-	-
30	11	17	7	11	15	3	4	2	3
35	20	27	11	17	20	6	8	3	4
45	42	53	-	-	25	9	13	5	8
55	73	93	-	-	30	13	20	8	12
					35	22	30	12	19
					45	47	59	-	-
					55	80	100	-	-
					65	139	186	-	-
					85	-	336	-	-

VH Series Unit: cm <sup>3</sup>		
Series Model No.	VH	
	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

RA Series Unit: cm <sup>3</sup>		
Series 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 Series Unit: cm <sup>3</sup>		
Series 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

HA, HS Series Unit: cm <sup>3</sup>		
Series Model No.	HA	HS
	15	-
20	-	9
25	16	16
30	27	25
35	42	40
45	67	-
55	122	-

PE, PU Series Unit: cm <sup>3</sup>				
Series Model No.	PE		PU	
	Standard type	High-load type	Standard type	High-load type
05	0.1	-	0.1	-
07	0.2	-	0.1	-
09	0.4	0.5	0.2	0.3
12	0.5	0.7	0.3	0.4
15	1.2	1.6	0.8	1.1

LW Series Unit: cm <sup>3</sup>	
Series Model No.	LW
17	3
21	3
27	7
35	24
50	52

LE, LU Series Unit: cm <sup>3</sup>					
Series Model No.	LE			LU	
	Medium-load type	Standard type	High-load type	Standard type	High-load type
05	0.1	0.1	-	0.1	-
07	0.1	0.2	0.3	0.1	-
09	0.2	0.4	0.5	0.2	0.3
12	0.3	0.5	0.7	0.3	0.4
15	0.8	1.2	1.6	0.8	1.1

TS Series Unit: cm <sup>3</sup>	
Series Model No.	TS
15	2
20	3
25	6
30	9
35	15

Table 1.3 Inside space of ball nut

Return tube type (single nut) Unit: cm <sup>3</sup>							
Nut model		Nut model		Nut model		Nut model	
Inside space	Inside space	Inside space	Inside space	Inside space	Inside space	Inside space	Inside space
1004 - 2.5	0.8	2005 - 5	4.3	2525 - 1.5	7.5	4005 - 10	14
1205 - 2.5	1.2	2010 - 2.5	4.7	2805 - 5	6	4010 - 5	30
1210 - 2.5	1.4	2020 - 1.5	4.2	3205 - 5	7	4012 - 5	34
1405 - 2.5	2.2	2504 - 5	3.2	3206 - 5	9.5	4510 - 5	34
1510 - 2.5	2.3	2505 - 5	5	3210 - 5	22	5010 - 5	37
1605 - 2.5	2.6	2506 - 5	7	3225 - 2.5	17	5010 - 10	59
1616 - 1.5	2.1	2510 - 3	9.5	3232 - 1.5	15		
2004 - 5	2.7	2520 - 2.5	12	3610 - 5	32		

Deflector type (single nut) Unit: cm <sup>3</sup>	
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 type Unit: cm <sup>3</sup>	
Nut model	Inside space
1520 - 1.5	1.9
2040 - 1	2.8
2550 - 1	4.2

Remarks: Nut model: shaft diameter, lead, total number of turns of balls  
Please consult NSK for other specifications.

4. Intervals of checks and replenishments

Although the grease is of high quality, it gradually deteriorates and its lubrication function diminishes. Also, the grease in the ball slide and ball nut is gradually removed by stroke movement. In some environments, the grease becomes dirty, and foreign

objects may enter. New grease should be replenished depending on frequency of use. The following is a guide of intervals of grease replenishments to linear guides and ball screws.

Intervals of checks	Items to check	Intervals of replenishments
3-6 months	Dirt, foreign matters such as cutting chip	Usually once per year. Every 3000 km for material handling system which travels more than 3000 km per year. Replenish if checking results warrant it necessary.

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

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

### 5. NSK Grease Unit

Supply grease to NSK linear guides and ball screws by a manual type hand grease pump. Install the

grease in bellows tube to the pump. Several types of grease (80 g) are available.



Grease in a bellows tube



#### (1) Composition of NSK Grease Unit

Components and grease types are shown below.

NSK Grease Unit		Name	(tube type)	Reference number
NSK Grease (80 g in a bellows tube)	NSK Grease AS2	NSK Grease AS2	(Brown)	NSK GRS AS2
	NSK Grease PS2	NSK Grease PS2	(Orange)	NSK GRS PS2
	NSK Grease LR3	NSK Grease LR3	(Green)	NSK GRS LR3
	NSK Grease LG2	NSK Grease LG2	(Blue)	NSK GRS LG2
	NSK Grease LGU	NSK Grease LGU	(Yellow)	NSK GRS LGU
NSK Hand Grease Pump Unit	NSK Hand Grease Pump (Straight nozzle NSK HGP NZ1 -- One nozzle is provided with the hand pump.)	NSK Hand Grease Pump		NSK HGP
	Grease nozzle (used with the hand grease pump)	NSK straight nozzle		NSK HGP NZ1
		NSK chuck nozzle		NSK HGP NZ2
		NSK drive fitting nozzle		NSK HGP NZ3
		NSK point nozzle		NSK HGP NZ4
		NSK flexible nozzle		NSK HGP NZ5
		NSK flexible extension pipe		NSK HGP NZ6
		NSK straight extension pipe		NSK HGP NZ7

#### (2) NSK Greases (80 g in a bellows tube)

Refer to Page D14 for their natures and details.

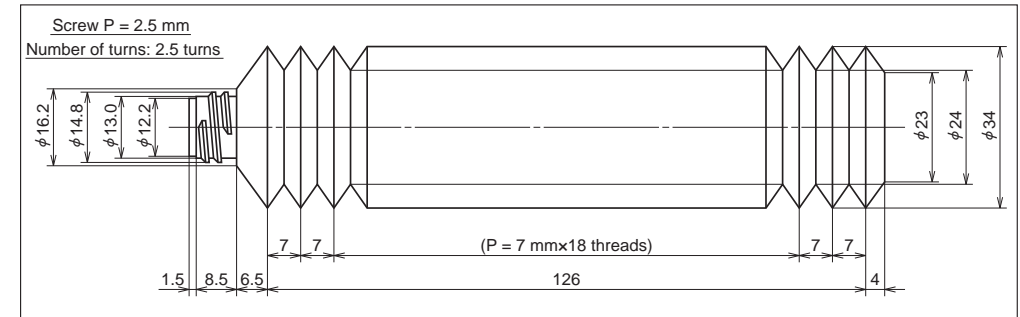


Fig. 3.1 Bellows tube

#### (3) NSK manual Grease Pump Unit

##### ① NSK Hand Grease Pump Unit (Reference number: NSK HGP)

###### ● Features

- Light-weight ..... Can be operated by one hand, yet there is no worry to making 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 the grease in bellows tube.
- Remaining grease ..... Can be confirmed through slit on the tube.
- Several nozzles ..... Five types of nozzles to choose from.

###### ● Specifications

- Discharge pressure .. 15 Mpa
- Spout volume ..... 0.35 g/stroke
- Mass of main body ... 393 g
- Overall length ..... About 200 mm
- Overall width ..... About 200 mm
- Grease tube outer diameter .. φ 38.1
- Accessory..... Several nozzles for a unique application can be attached

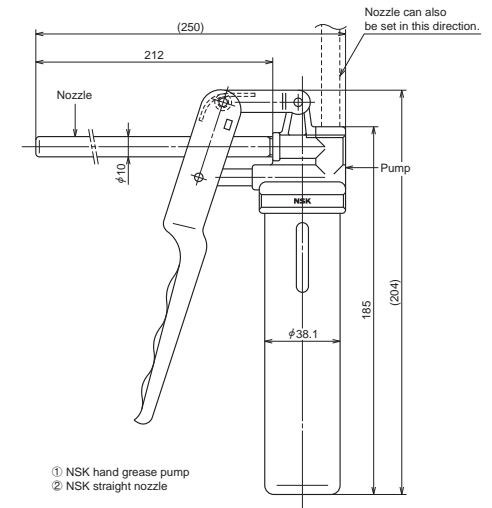


Fig. 3.2 NSK Hand Grease Pump with NSK straight nozzle

2 Nozzles

Table 3.1 Nozzles that can be attached to NSK Hand Grease Pump

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

Table 3.2 Grease fittings used for NSK linear guide

Series	Model number	Tap hole for grease fitting	Standard grease fitting	Straight nozzle NZ1	Chuck nozzles NZ2	Drive-in nipple nozzle NZ3	Point nozzle NZ4	Flexible nozzle NZ5
SH Series	SH15	φ3	Drive-in type			○		
	SH20, 25, 30, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○
	SH45, 55	Rc1/8	B type	○	○			○
SS Series	SS15	φ3	Drive-in type			○		
	SS20, 25, 30, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○
LH Series	LH08, 10	—	—				○	
	LH12, 15	φ3	Drive-in type			○		
	LH20, 25, 30, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○
LH Series	LH45, 55, 65, 85	Rc1/8	B type	○	○			○
	LS Series	LS15	φ3	Drive-in type			○	
LS20, 25, 30, 35 <sup>*)</sup>		M6×0.75	B type	○	○			○
VH Series	VH15	φ3	Drive-in type			○		
	LH20, 25, 30, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○
	VH45, 55	Rc1/8	B type	○	○			○
LW Series	LW17	φ3	Drive-in type			○		
	LW21, 27, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○
LW Series	LW50	Rc1/8	B type	○	○			○
	TS Series	TS15	φ3	Drive-in type			○	
TS20, 25, 30, 35 <sup>*)</sup>		M6×0.75	B type	○	○			○
RA Series	RA15, 20	φ3	Drive-in type			○		
	RA25, 30, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○
	RA45, 55, 65	Rc1/8	B type	○	○			○
LA Series	LA25, 30, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○
	LA45, 55, 65	Rc1/8	B type	○	○			○
PU Series	PU05, 07, 09, 12	—	—				○	
	PU15	φ3	Drive-in type			○		
PE Series	PE05, 07, 09, 12	—	—				○	
	PE15	φ3	Drive-in type			○		
LU Series	LU05, 07, 09, 12, 15	—	—				○	
LE Series	LE05, 07, 09, 12, 15	—	—				○	
HA Series	HA25, 30, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○
	HA45, 55	Rc1/8	B type	○	○			○
HS Series	HS15	φ3	Drive-in type			○		
	HS20, 25, 30, 35 <sup>*)</sup>	M6×0.75	B type	○	○			○

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

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

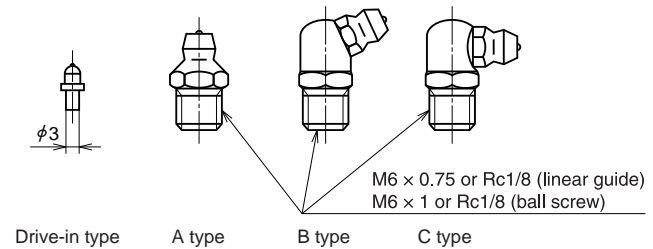


Fig. 3.3 Grease fittings

A long threaded grease fitting is required for NSK linear guides because of dust proof parts. Please refer to the sections pertaining to the lubrication and dust proof parts of each series. Normally, grease fitting is not provided to NSK ball screw. However, ball nut has a tap hole to install a grease fitting. The user should install a grease fitting if necessary. If there is no tap hole, apply grease directly to the screw shaft and ball grooves.

## 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.

*In case of ball type linear guides except the LA Series*

$$Q = n/150 \text{ (cm}^3\text{/hr)}$$

*In case of LA Series, RA Series*

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

*n: Linear guide code*

*e.g. When LH45 is used,*

$$n = 45$$

*Therefore,*

$$Q = 45/150 = 0.3 \text{ cm}^3\text{/hr}$$

Similarly, approximate oil supply volume  $Q$  to ball screw can be obtained by the following formula.

$$Q = d/15 \text{ (cm}^3\text{/hr)}$$

*d: Nominal shaft diameter of the ball screw*

*e.g. When the shaft diameter is 50,*

$$d = 50$$

*Therefore,*

$$Q = 50/15 = 3.3 \text{ cm}^3\text{/hr}$$

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

Note: 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 system, please confirm an oil supply amount at the each outlet part.

## 3. RoHS Compliant

### 1. Linear Guides

- Linear Guides listed in the catalog except the products for special environments, are compliant with RoHS.
- Please consult NSK for RoHS of special parts and lubricant provided by customer, and customer-supplied product.

### 2. Ball Screws

- Ball screws listed in the catalog except the products for special environments, are compliant with RoHS.

### 3. Monocarriers

- Monocarriers listed in the catalog are compliant with RoHS.

### 4. Ball Screw Support Bearings

- Ball screw support bearings listed in the catalog are compliant with RoHS.

\*For details of country-specific RoHS, contact NSK.

# APPENDICES: TABLES



## Appendices: Tables

1. Conversion from International Systems of Units (SI) ..... E1
2. Conversion table between N and kgf .....E3
3. Conversion table between kg and lb ..... E4
4. Hardness conversion table .. E5
5. Variations of shaft used in common fits ..... E7
6. Variations of housing holes in common fits ..... E9

### 1. Conversion from international system of units (SI)

Comparisons of SI, CGS, and engineering systems of units

Items System of units	Length	Mass	Time	Temperature	Acceleration	Force	Stress	Pressure	Energy	Power
	SI	m	kg	s	K, °C	m/s <sup>2</sup>	N	Pa	Pa	J
CGS system	cm	g	s	°C	Gal	dyn	dyn/cm <sup>2</sup>	dyn/cm <sup>2</sup>	erg	erg/s
Engineering system	m	kgf • s <sup>2</sup> /m	s	°C	m/s <sup>2</sup>	kgf	kgf/m <sup>2</sup>	kgf/m <sup>2</sup>	kgf • m	kgf • m/s

Prefixes for SI units

Powers of 10	Prefix Name	Code	Powers of 10	Prefix Name	Code
10 <sup>18</sup>	exa	E	10 <sup>-1</sup>	deci	d
10 <sup>15</sup>	peta	P	10 <sup>-2</sup>	centi	c
10 <sup>12</sup>	tera	T	10 <sup>-3</sup>	milli	m
10 <sup>9</sup>	giga	G	10 <sup>-6</sup>	micro	μ
10 <sup>6</sup>	mega	M	10 <sup>-9</sup>	nano	n
10 <sup>3</sup>	kilo	k	10 <sup>-12</sup>	pico	p
10 <sup>2</sup>	hecto	h	10 <sup>-15</sup>	femto	f
10 <sup>1</sup>	deca	da	10 <sup>-18</sup>	atto	a

Conversion rates from SI system of units

Item	SI unit		Units other than SI units		Conversion rate 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 <sup>6</sup>
			Angstrom	Å	10 <sup>10</sup>
Area	Square meter	m <sup>2</sup>	Are	a	10 <sup>-2</sup>
			Hectare	ha	10 <sup>-4</sup>
Volume	Cubic meter	m <sup>3</sup>	Liter	l, L	10 <sup>3</sup>
			Deciliter	dl, dL	10 <sup>4</sup>
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
Rotational speed	Times per second	s <sup>-1</sup>	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/s <sup>2</sup>	Gal	Gal	10 <sup>2</sup>
			G	G	1/9.806 65
Mass	Kilogram	kg	Ton	t	10 <sup>-3</sup>
Force	Newton	N	Weight kilogram	kgf	1/9.806 65
			Weight ton	tf	1/(9.806 65×10 <sup>3</sup> )
			Dyne	dyn	10 <sup>5</sup>
Torque and moment of force	Newton meter	N • m	Weight kilogram meter	kgf • m	1/9.806 65
Stress	Pascal (Newtons per square meter)	Pa (N/m <sup>2</sup> )	Weight kilogram per square centimeter	kgf/cm <sup>2</sup>	1/(9.806 65×10 <sup>4</sup> )
			Weight kilogram per square millimeter	kgf/mm <sup>2</sup>	1/(9.806 65×10 <sup>6</sup> )

Conversion rates from SI units (continued from previous page)

Item	SI unit		Units other than SI units		Conversion rate from SI unit
	Name of unit	Abbreviation	Name of unit	Abbreviation	
Pressure	Pascal (newton per square meter)	Pa (N/m <sup>2</sup> )	Weight kilogram per square meter	kgf/m <sup>2</sup>	1/9.806 65
			Water column meter	mH <sub>2</sub> O	1/(9.806 65×10 <sup>3</sup> )
			Mercurial column millimeter	mmHg	760/(1.013 25×10 <sup>5</sup> )
			Torr	Torr	760/(1.013 25×10 <sup>5</sup> )
			Bar	bar	10 <sup>-5</sup>
	Atmosphere	atm		1/(1.013 25×10 <sup>5</sup> )	
Energy	Joule (newton meter)	J (N • m)	Erg	erg	10 <sup>7</sup>
			Calorie (international)	cal <sub>IT</sub>	1/4.186 8
			Weight kilogram meter	kgf • m	1/9.806 65
			Kilowatt hour	kW • h	1/(3.6×10 <sup>6</sup> )
	Metric horsepower/hour	PS • h		≈3.776 72×10 <sup>-7</sup>	
Electric power, power	Watt (joules per second)	W (J/s)	Weight kilogram meter per second	kgf • m/s	1/9.806 65
			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	m <sup>2</sup> /s	Stokes	St	10 <sup>4</sup>
			Centistokes	cSt	10 <sup>6</sup>
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/10 <sup>3</sup>
Magnetic flux density	Tesla	T	Gauss	Gs	10 <sup>4</sup>
			Gamma	γ	10 <sup>9</sup>
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:  $\Delta T = \Delta\theta$ .  $\Delta T$  and  $\Delta\theta$  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. Conversion table between N and kgf

[How to read the table]

To convert 10 N to kgf, locate 10 in the center column in the first block. Locate a corresponding kgf figure in the right side column. You will find 10 N is 1.0197 kgf. To convert 10 kgf to N, locate a figure in N column to its left. You will find 10 kgf is 98.006 N.

$$1 \text{ N} = 0.1019716 \text{ kgf}$$

$$1 \text{ kgf} = 9.80665 \text{ N}$$

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. Conversion table between kg and lb

[How to read the table]

To convert 10 kg to lb, locate 10 in the center column in the first block. Locate a corresponding lb figure in right column. You will find 10 kg is 22.046 lb. To convert 10 lb to kg, locate the figure in the kg column to the left. You will find 10 lb is 4.536 kg.

$$1 \text{ kg} = 2.2046226 \text{ lb}$$

$$1 \text{ lb} = 0.45359237 \text{ kg}$$

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. Conversion table of hardness

Rockwell C Scale hardness (1 471 N)	Vickers hardness	Brinell hardness		Rockwell hardness		Shore hardness
		Standard ball	Tungsten carbide ball	A Scale	B Scale	
				Load 588.4 N brale penetrator	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

Rockwell C Scale hardness (1 471 N)	Vickers hardness	Brinell hardness		Rockwell hardness		Shore hardness
		Standard ball	Tungsten carbide ball	A Scale	B Scale	
				Load 588.4 N brale penetrator	Load 980.7 N Diameter 1.5888 mm {1/16 in} sphere	
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. Deviations of shafts used in common fits

Unit: μm

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	1000	-320 -376	-170 -226	-86 -142	—	-26 -82	—	0 -56	0 -90	0 -140	0 -230	0 -360	—	± 28
1000	1250	-350 -416	-195 -261	-98 -164	—	-28 -94	—	0 -66	0 -105	0 -165	0 -260	0 -420	—	± 33
1250	1600	-390 -468	-220 -298	-110 -188	—	-30 -108	—	0 -78	0 -125	0 -195	0 -310	0 -500	—	± 39
1600	2000	-430 -522	-240 -332	-120 -212	—	-32 -124	—	0 -92	0 -150	0 -230	0 -370	0 -600	—	± 46

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	+ 12 - 7	+ 18 - 12	+ 15 + 2	+ 21 + 2	+ 32 + 2	+ 24 + 11	+ 30 + 11	+ 39 + 20	+ 51 + 32	+ 60 + 41	+ 71 + 41	50	65
+ 6	+ 13 - 9	+ 20 - 15	+ 18 + 3	+ 25 + 3	+ 38 + 3	+ 28 + 13	+ 35 + 13	+ 45 + 23	+ 59 + 37	+ 73 + 51	+ 86 + 51	80	100
+ 7	+ 14 - 11	+ 22 - 18	+ 21 + 3	+ 28 + 3	+ 43 + 3	+ 33 + 15	+ 40 + 15	+ 52 + 27	+ 68 + 43	+ 86 + 65	+ 105 + 65	140	160
+ 7	+ 16 - 13	+ 25 - 21	+ 24 + 4	+ 33 + 4	+ 50 + 4	+ 37 + 17	+ 46 + 17	+ 60 + 31	+ 79 + 50	+ 106 + 80	+ 123 + 80	180	200
+ 7	+ 16 - 16	+ 25 ± 16	+ 27 + 4	+ 36 + 4	+ 56 + 4	+ 43 + 20	+ 52 + 20	+ 66 + 34	+ 88 + 56	+ 113 + 84	+ 130 + 84	225	250
+ 7	+ 18 - 18	+ 29 - 28	+ 29 + 4	+ 40 + 4	+ 61 + 4	+ 46 + 21	+ 57 + 21	+ 73 + 37	+ 98 + 62	+ 126 + 108	+ 146 + 108	315	355
+ 7	+ 20 - 20	+ 31 - 32	+ 32 + 5	+ 45 + 5	+ 68 + 5	+ 50 + 23	+ 63 + 23	+ 80 + 40	+ 108 + 68	+ 139 + 126	+ 189 + 126	400	450
—	—	—	—	+ 44 0	+ 70 0	—	+ 70 + 26	+ 88 + 44	+ 122 + 78	+ 194 + 150	+ 220 + 150	500	560
—	—	—	—	+ 50 0	+ 80 0	—	+ 80 + 30	+ 100 + 50	+ 138 + 88	+ 225 + 175	+ 255 + 175	630	710
—	—	—	—	+ 56 0	+ 90 0	—	+ 90 + 34	+ 112 + 56	+ 156 + 100	+ 266 + 210	+ 300 + 210	800	900
—	—	—	—	+ 66 0	+ 105 0	—	+ 106 + 40	+ 132 + 66	+ 186 + 120	+ 316 + 250	+ 355 + 250	1000	1120
—	—	—	—	+ 78 0	+ 125 0	—	+ 126 + 48	+ 156 + 78	+ 218 + 140	+ 378 + 300	+ 425 + 300	1250	1400
—	—	—	—	+ 92 0	+ 150 0	—	+ 150 + 58	+ 184 + 92	+ 262 + 170	+ 408 + 330	+ 455 + 330	1400	1600
—	—	—	—	+ 92 0	+ 150 0	—	+ 150 + 58	+ 184 + 92	+ 262 + 170	+ 462 + 370	+ 520 + 370	1600	1800
—	—	—	—	+ 92 0	+ 150 0	—	+ 150 + 58	+ 184 + 92	+ 262 + 170	+ 492 + 400	+ 550 + 400	1800	2000

6. Deviations of holes used in common fits

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	1000	+226 +170	+142 +86	+176 +86	+82 +26	+116 +26	+56 0	+90 0	+140 0	—	—	±28	±45
1000	1250	+261 +195	+164 +98	+203 +98	+94 +28	+133 +28	+66 0	+105 0	+165 0	—	—	±33	±52.5
1250	1600	+298 +220	+188 +110	+235 +110	+108 +30	+155 +30	+78 0	+125 0	+195 0	—	—	±39	±62.5
1600	2000	+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	1000
—	0 -66	0 -105	—	-40 -106	-40 -145	—	-66 -132	-66 -171	-120 -186	-120 -225	1000	1250
—	0 -78	0 -125	—	-48 -126	-48 -173	—	-78 -156	-78 -203	-140 -218	-140 -265	1250	1600
—	0 -92	0 -150	—	-58 -150	-58 -208	—	-92 -184	-92 -242	-170 -262	-170 -320	1600	2000

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JOHOR BAHRU	88 Jalan Ros Merah 217, Taman Johor Jaya, 81100 Johor Bahru, Johor, Malaysia P: 07-3546290	F: 07-3546291	C: 60
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TAINAN	No.8 Daye 1st Rd., Southern Taiwan Science Park, Tainan County 741, Taiwan R.O.C. P: 06-505-5861	F: 06-505-5061	C: 86
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<b>NSK BEARINGS MANUFACTURING (THAILAND) CO., LTD.</b> OFFICE/PLANT	700/430 Moo 7, Amata Nakorn Industrial Estate, T.Donhuaior, A.Muangchonburi, Chonburi 20000, Thailand P: 038-454-010	F: 038-454-017	C: 66
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<b>Europe</b> <b>NSK EUROPE LTD. (EUROPEAN HEADQUARTERS)</b> <b>www.eu.nsk.com</b> MAIDENHEAD	Belmont Place, Belmont Road, Maidenhead, Berkshire SL6 6TB, U.K. P: 01628-509-800	F: 01628-509-808	C: 44
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WOLFSBURG	Heinrich-Nordhoff-Strasse 101, D-38440 Wolfsburg, Germany P: 05361-27647-10	F: 05361-27647-70	C: 49
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<b>NSK POLSKA SP. ZO. O.</b> KIELCE	Ul. Karcz
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