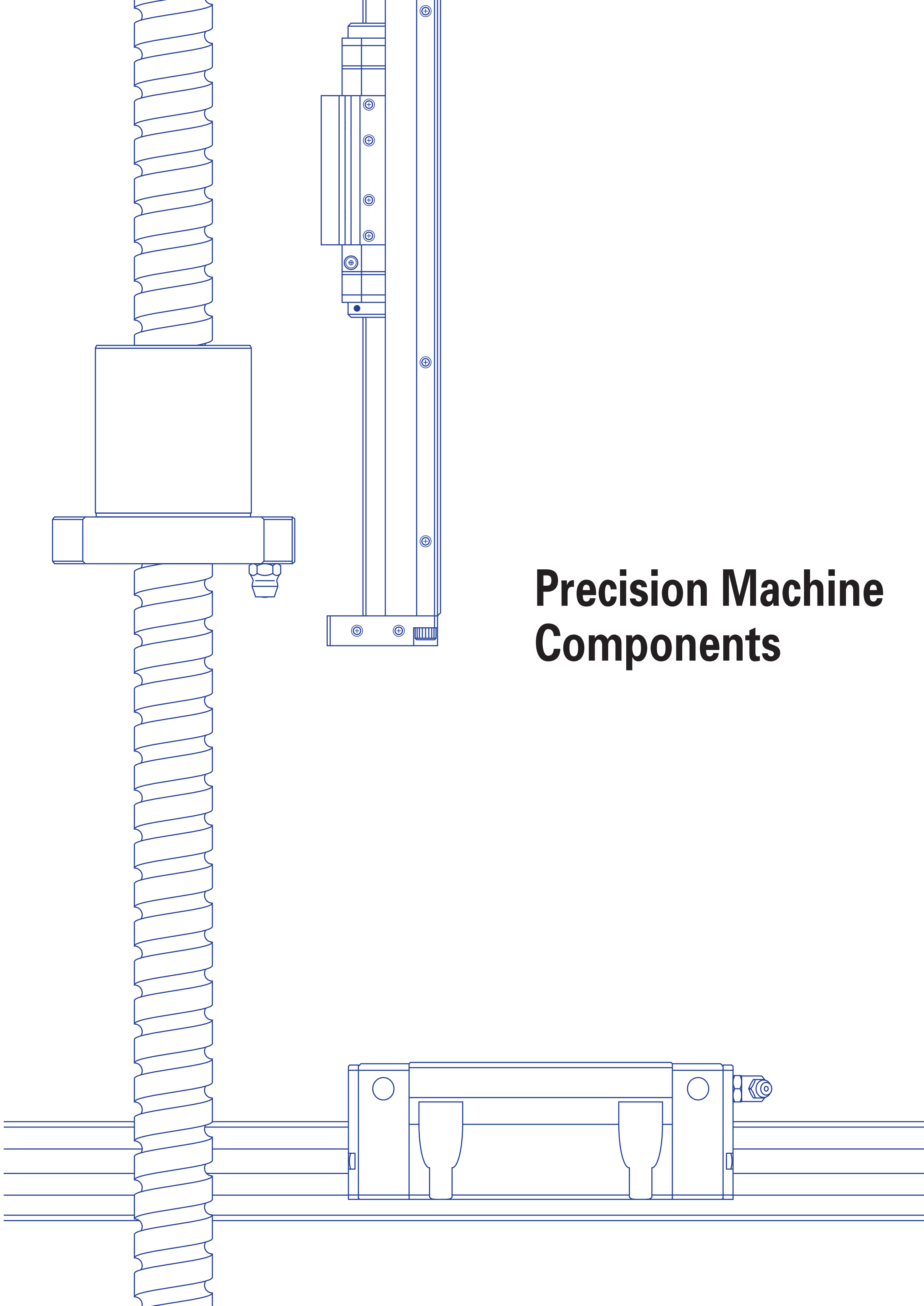
MOTION & CONTROL™
NSK

Precision Machine Components

NSK Linear Guides™
Ball Screws
Monocarriers™

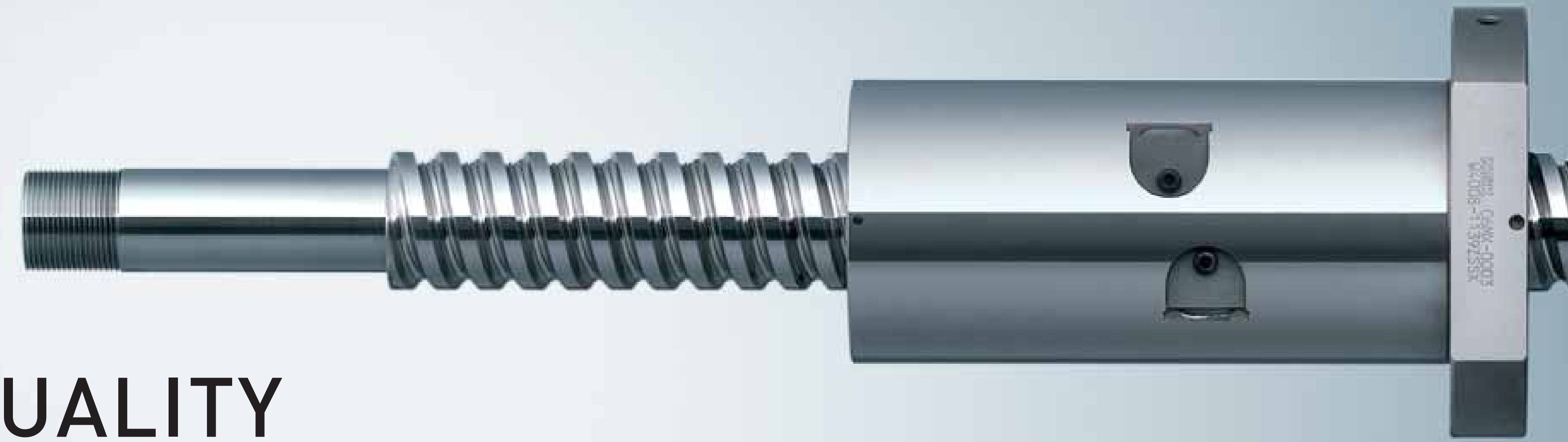


Precision Machine Components

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 more than 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

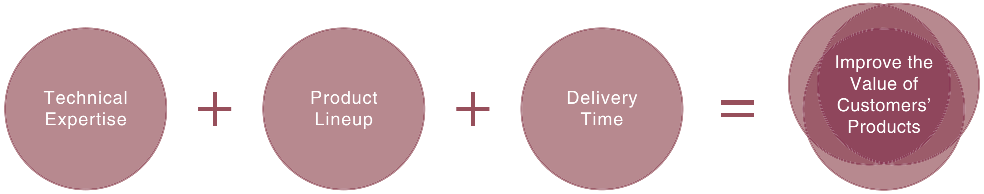
Focus on customers' total quality

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.

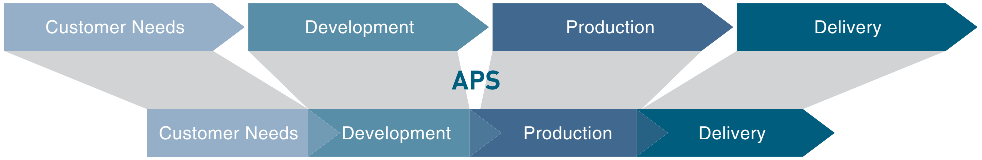


With its Technology Center as the cornerstone, NSK is able to provide technical support worldwide and quickly offer innovative solutions. We are able to more rapidly deliver the required products by combining a global production system with a broad lineup that includes precision products and bearings. 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.

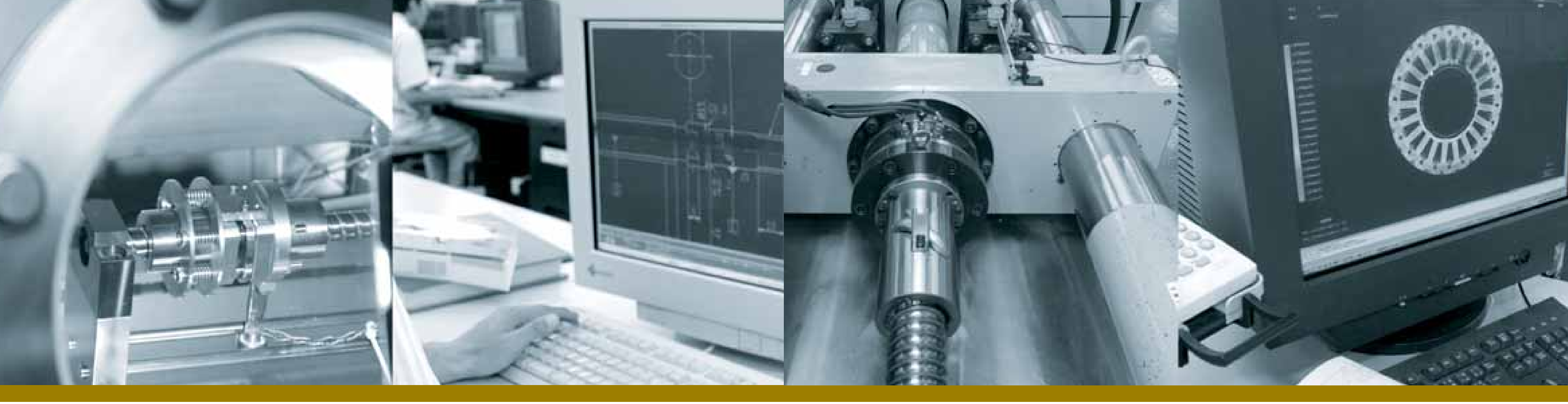
APS

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

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



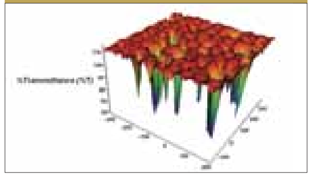
To more effectively respond to customer needs, NSK implemented APS (Advanced Production System) encompassing sales, development, design, manufacturing and distribution. Under our APS, we established a project for streamlining operations to shorten lead times. As a result, the system has boosted supply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



TECHNOLOGY

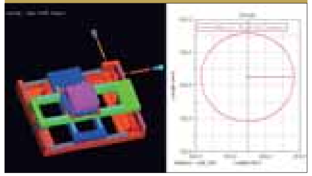
Developing innovative technologies and products by our four core technologies

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

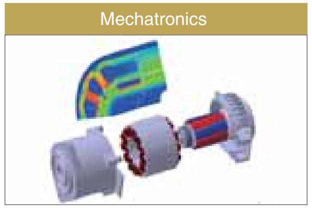


NSK utilizes computer simulations to conduct virtual experiments that require high precision or are difficult to run under actual machine operating conditions. Further improvements in analysis technology have accelerated product development.

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.

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.

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.

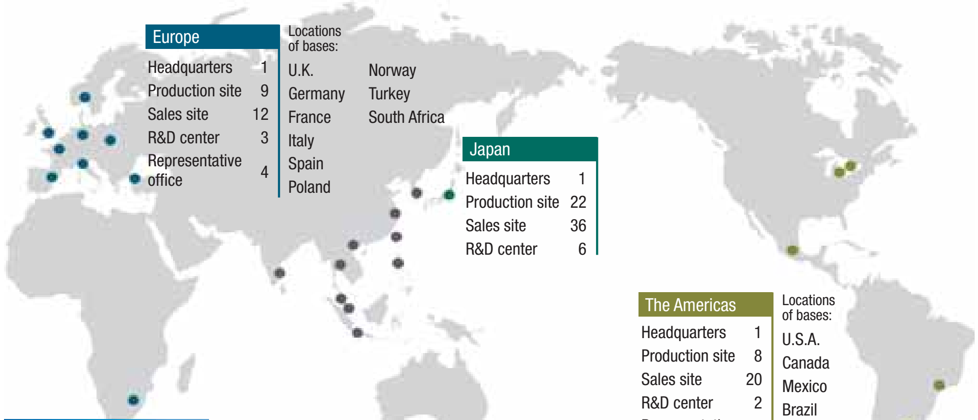
Green Procurement Standards

The NSK Group must deliver products that ensure satisfaction and meet the European and each country's 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.

Conference for Green Procurement

NSK Global Network

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



Europe

Headquarters	1	
Production site	9	
Sales site	12	
R&D center	3	
Representative office	4	

Locations of bases:
- U.K.
- Germany
- France
- Italy
- Spain
- Poland
- Norway
- Turkey
- South Africa

Japan

Headquarters	1
Production site	22
Sales site	36
R&D center	6

The Americas

Headquarters	1
Production site	8
Sales site	20
R&D center	2
Representative office	1

Locations of bases:
- U.S.A.
- Canada
- Mexico
- Brazil
- Peru
- Argentina

NSK Ltd. Headquarters (Shinagawa, Tokyo)

Asia and Oceania

Headquarters	3
Production site	23
Sales site	50
R&D center	3
Representative office	3

Locations of bases:
- China
- Taiwan
- South Korea
- Thailand
- Singapore
- Indonesia
- Malaysia
- Philippines
- Vietnam
- India
- Australia
- New Zealand

As of May 2012
For the latest information, please refer to the NSK website.

Research & Development

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

Linear Technology Center

Kirihara, Kanagawa

The Linear Technology Center plays a vital role in developing next-generation precision products in cooperation with NSK Technology 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.

NSK Technology Development Center

Fujisawa, Kanagawa

The 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 Linear 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 Kyushu Co., Ltd.

Ukiha, Fukuoka

As the world's No. 1 production base for 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

Maebashi Precision Machinery Plant

Maebashi, Gunma

As a production base for precision machinery components, the Maebashi Precision Machinery 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

Saitama Precision Machinery Plant

Hanyu, Saitama

The Saitama Precision Machinery 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 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

Shenyang NSK Precision Co., Ltd. Shenyang Plant

Shenyang, China

Shenyang NSK Precision Co., Ltd. was established in 2009 as a precision ball screw production base to meet the market needs of the emerging countries such as China, where demand is expected to grow.
By adopting NSK's own production technology developed in a Japanese plant and performing meticulous quality control, Shenyang NSK Precision Co., Ltd. endeavors to shorten delivery time.
Products: Ball Screws

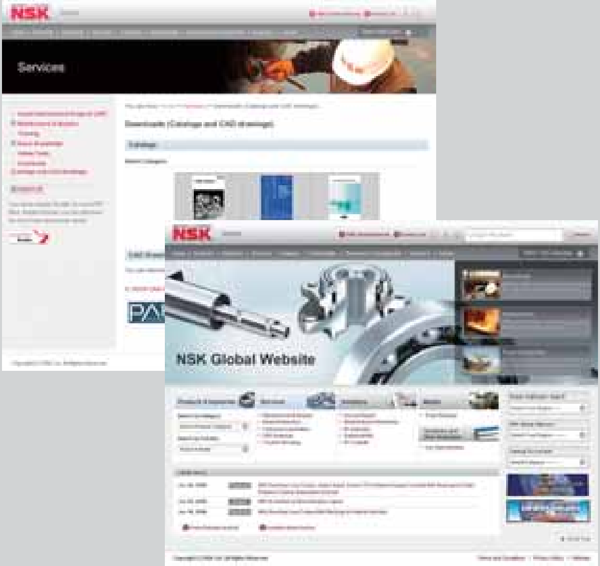
NSK Korea Co., Ltd. Changwon Plant

Changwon, Korea

The Changwon Plant was established in 2010 as a production base for the supply of linear guides to the growing Korean market and its key industries: automotive, IT and machining tools. The plant is answering to the needs of the Korean market and plays an important role in NSK's global sourcing strategy.
Products: Linear Guides

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

http://www.nsk.com



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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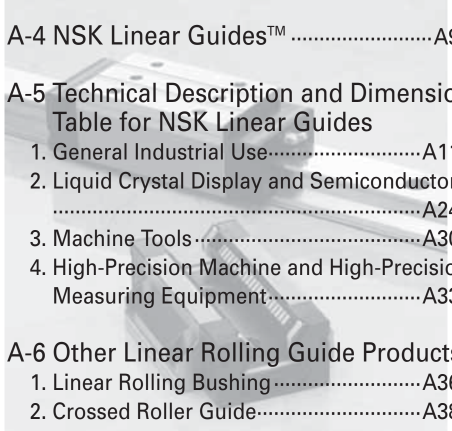
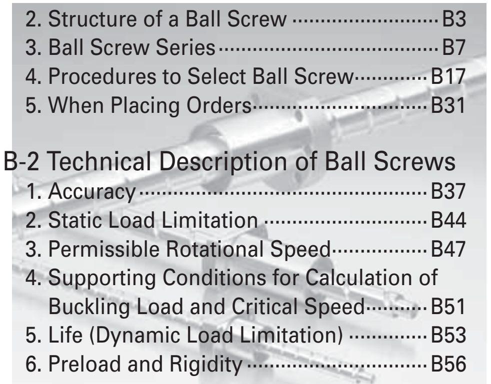
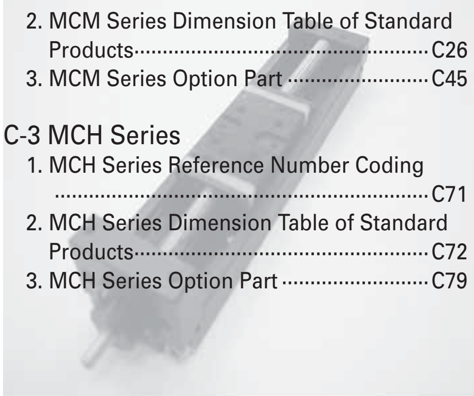
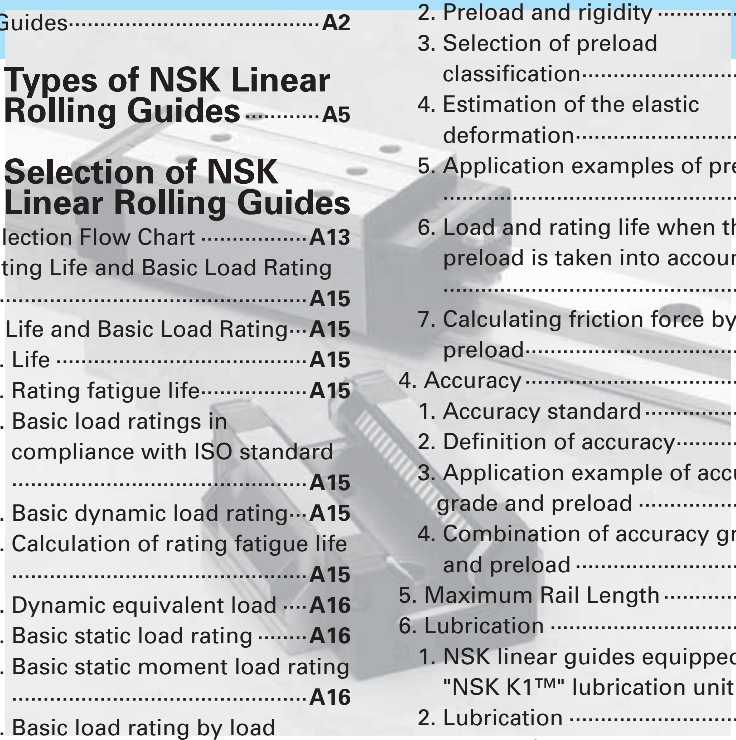






A BLOCK NSK Linear Rolling Guide Product



A-1 Characteristics of NSK Linear Rolling Guides

A-2 Types of NSK Linear Rolling Guides A5

A-3 Selection of NSK Linear Rolling Guides

A-4 NSK Linear Guides™

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

A-6 Other Linear Rolling Guide Products

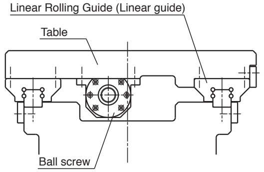
A-1 Characteristics of NSK Linear Rolling Guides

Characteristics of the NSK linear rolling guides are:

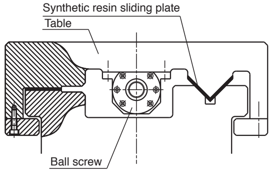
- Designs are simple and economic. This contributes to a highly accurate and low cost guide way system.
- Low friction coefficient facilitates a compact and low cost driving mechanism.
- Ultra-high purity of materials and superb processing technology ensure a long-term reliable operation.
- Prompt delivery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

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

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



Example of rolling guide



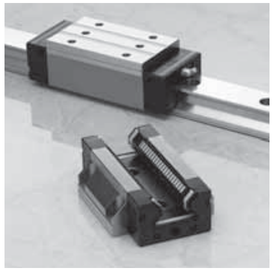
Example of sliding guide

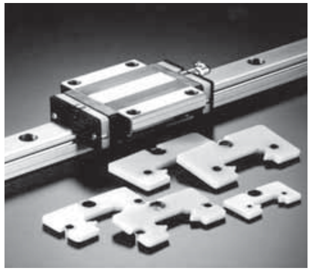
Comparative characteristics of rolling and sliding guide ways

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

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

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





1. Structure of NSK Linear Guides

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

2. Characteristics of NSK Linear Guides

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

(1) High precision and quality

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

(2) High reliability and durability

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

(3) Abundant in type for any purpose

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

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

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

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

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

(6) Lineup of extremely high-load capacity series

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

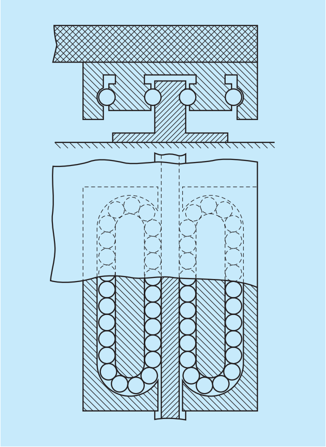


Fig. 1
- **French Patent in 1932.**
- **Inventor: Gretsh (German)**

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

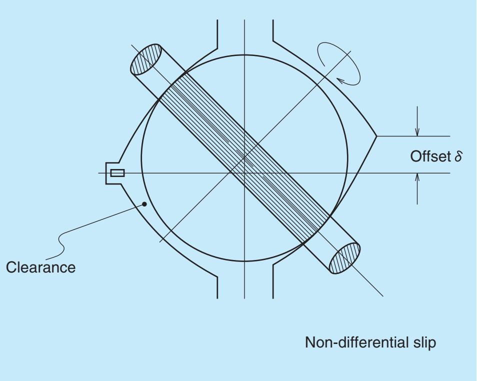


Fig. 3 Two point contacts of the offset Gothic arch groove

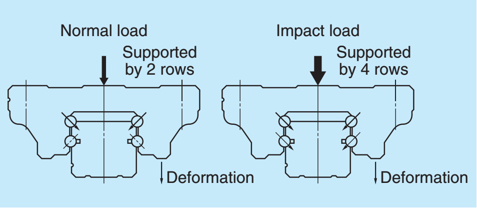


Fig. 5 Shock-resistance

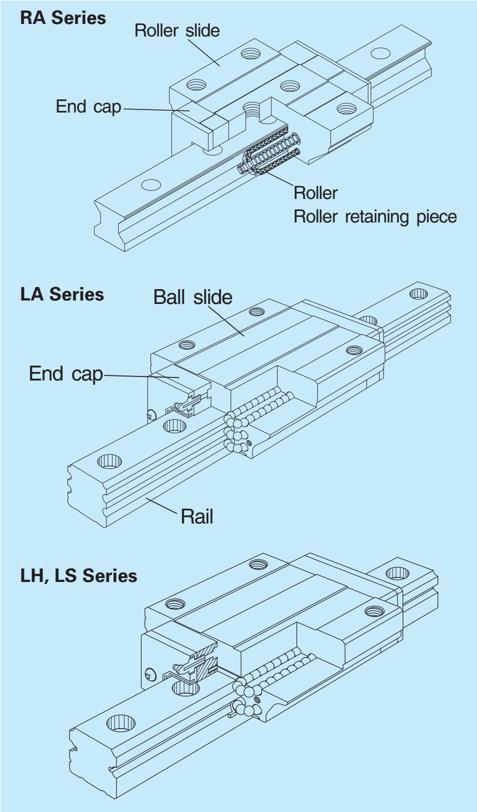


Fig. 2 Structure of NSK linear guides

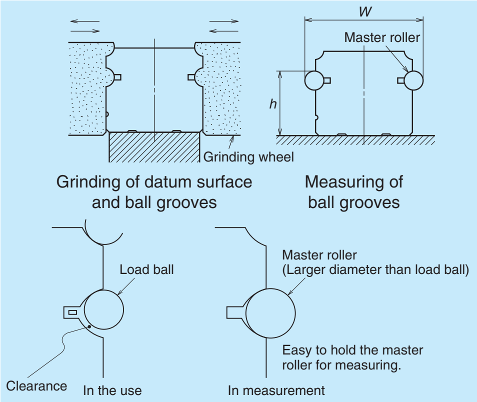
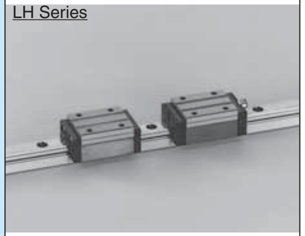
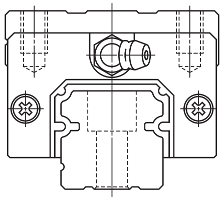
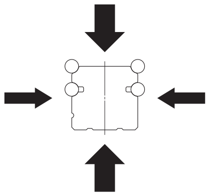
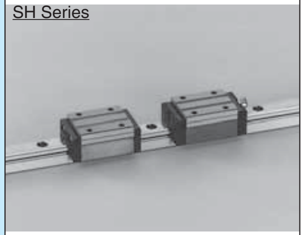
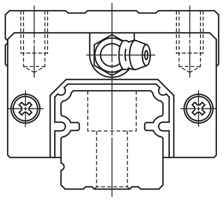
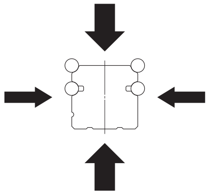
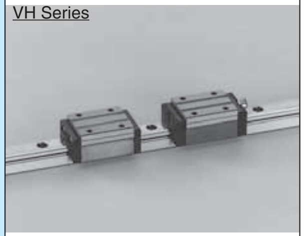
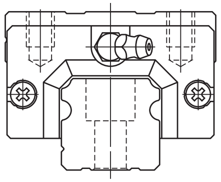
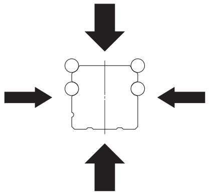
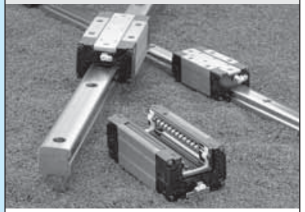
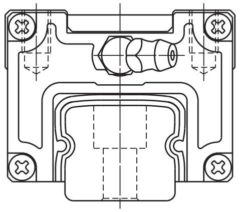
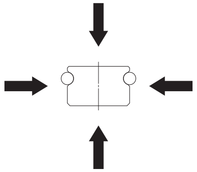


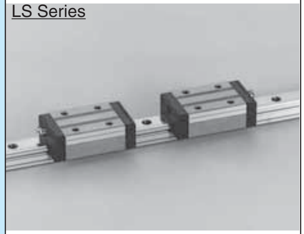
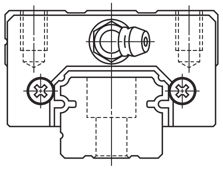
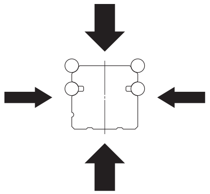
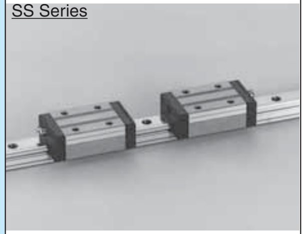
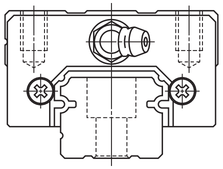
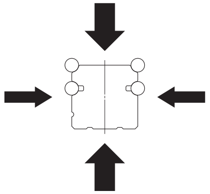
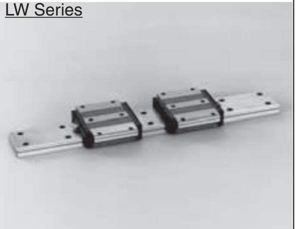
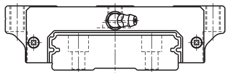
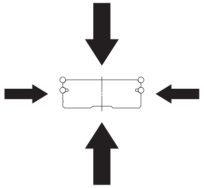
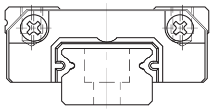
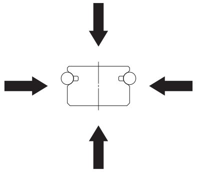
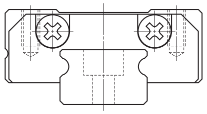
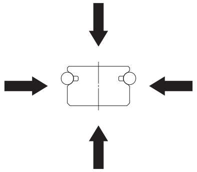
Fig. 4 Processing and measuring grooves

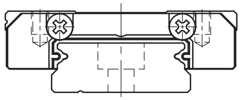
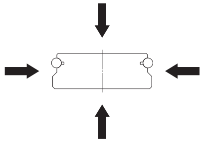
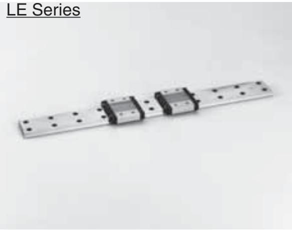
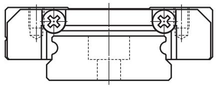
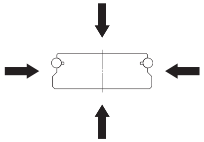
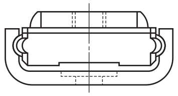
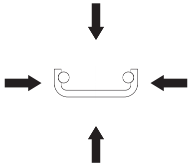
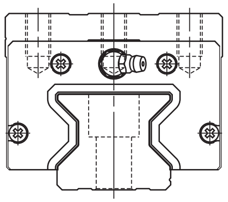
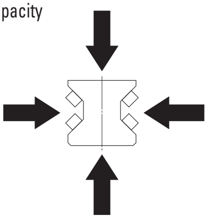
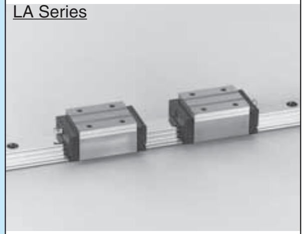
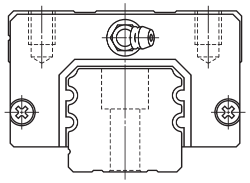
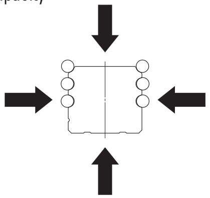
Measuring grooves is easy: you can obtain highly accurate results for all types of NSK series. This is why you can purchase rails and slides separately for random matching.

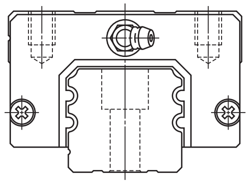
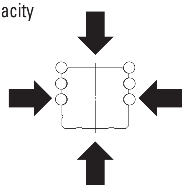
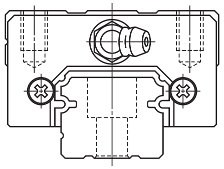
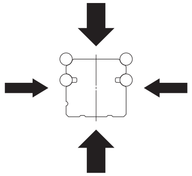
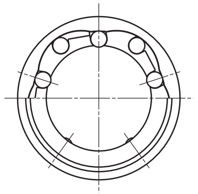
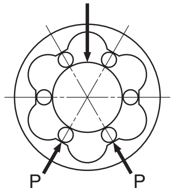
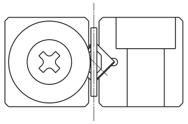
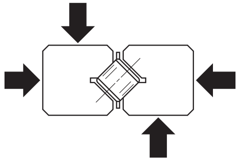
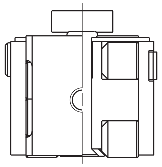
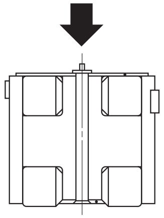
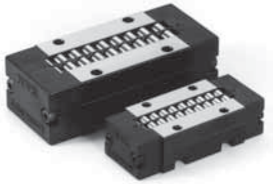
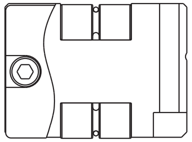
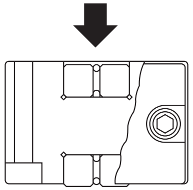
A-2 Types of NSK Linear Rolling Guides

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

Product	Appearance	Shape	Rolling element	Load carrying characteristics	Rigidity	Friction characteristic	Assembly workability	Major applications	Page
NSK Linear Guides	LH Series 		Ball	High vertical load carrying capacity 	◎	◎	◎	• Industrial robots • Materials handling equipment • Semiconductor manufacturing equipment • Laser cutting machines • Electric discharge machines • Packaging/packing machines	A115
	SH Series 		Ball	High vertical load carrying capacity 	◎	◎	◎	• Industrial robots • Materials handling equipment • Semiconductor manufacturing equipment • Laser cutting machines • Electric discharge machines • Packaging/packing machines	A139
	VH Series 		Ball	High vertical load carrying capacity 	◎	◎	◎	• Industrial robots • Materials handling equipment • Woodworking machines • Laser cutting machines • Electric discharge machines • Packaging/packing machines	A163
	TS Series 		Ball	Four-way equal load carrying capacity 	◎	◎	◎	• Industrial robots • Materials handling equipment • Woodworking machines • Laser cutting machines • Electric discharge machines • Packaging/packing machines	A185

Product	Appearance	Shape	Rolling element	Load carrying characteristics	Rigidity	Friction characteristic	Assembly workability	Major applications	Page
NSK Linear Guides	LS Series 		Ball	High vertical load carrying capacity 	◎	◎	◎	• Industrial robots • Materials handling equipment • Electric discharge machines • Woodworking machines • Semiconductor manufacturing equipment • Packaging/packing machines • Pneumatic equipment	A191
	SS Series 		Ball	High vertical load carrying capacity 	◎	◎	◎	• Industrial robots • Materials handling equipment • Electric discharge machines • Semiconductor manufacturing equipment • Packaging/packing machines • Pneumatic equipment	A213
	LW Series 		Ball	High vertical load carrying capacity 	◎	◎	◎	• Industrial robots • Materials handling equipment • Electric discharge machines • Woodworking machines • Semiconductor manufacturing equipment • Packaging/packing machines • Pneumatic equipment	A235
	PU Series 		Ball	Four-way equal load carrying capacity 	○	◎	◎	• Semiconductor manufacturing equipment • LCD manufacturing equipment • Medical equipment • Optical stages • Microscope XY stages • Miniature robots • Pneumatic equipment • Computer peripherals	A251
	LU Series 		Ball	Four-way equal load carrying capacity 	○	◎	◎	• Semiconductor manufacturing equipment • LCD manufacturing equipment • Medical equipment • Optical stages • XY stage of microscope • Miniature robots • Pneumatic equipment • Computer peripherals	A261

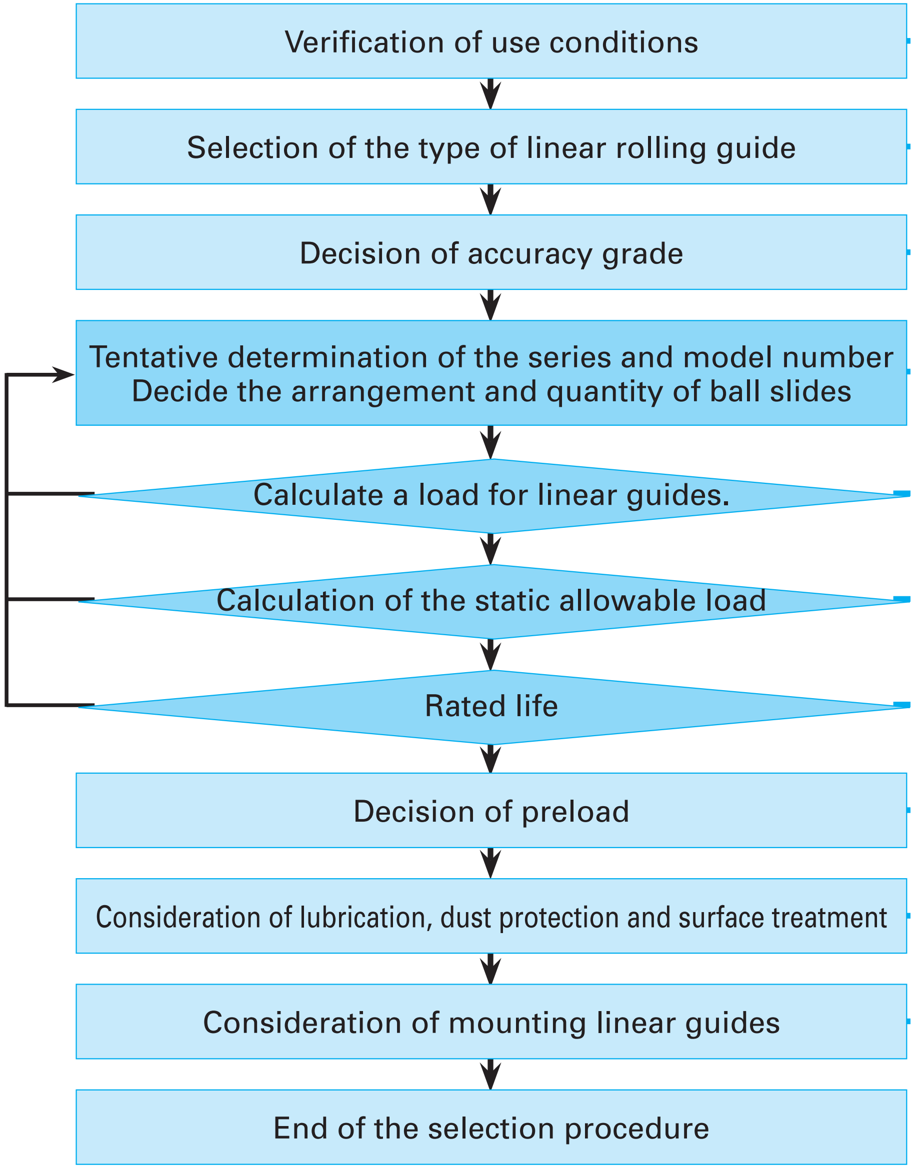
Product	Appearance	Shape	Rolling element	Load carrying characteristics	Rigidity	Friction characteristic	Assembly workability	Major applications	Page
NSK Linear Guides	PE Series 		Ball	Four-way equal load carrying capacity 	○	◎	◎	• Semiconductor manufacturing equipment • LCD manufacturing equipment • Medical equipment • Optical stages • Microscope XY stages • Miniature robots • Pneumatic equipment • Computer peripherals	A273
	LE Series 		Ball	Four-way equal load carrying capacity 	○	◎	◎	• Semiconductor manufacturing equipment • LCD manufacturing equipment • Medical equipment • Optical stages • XY stages of microscope • Miniature robots • Pneumatic equipment • Computer peripherals	A283
	LL Series 		Ball	Four-way equal load carrying capacity 	○	◎	◎	• Knitting machines • Computer peripherals • Pneumatic equipment • Office equipment	A297
	RA Series 		Roller	Four-way equal load carrying capacity 	☆	◎	◎	• Machining centers • NC lathes • Heavy cutting machine tools • Various types of NC grinders • Gear-cutting machines • Press machines • Electric discharge machines	A303
	LA Series 		Ball	Four-way equal load carrying capacity 	⊚	○	◎	• Machining centers • NC lathes • Heavy cutting machine tools • Various types of NC grinders • Gear-cutting machines • Press machines • Electric discharge machines	A321

Product	Appearance	Shape	Rolling element	Load carrying characteristics	Rigidity	Friction characteristic	Assembly workability	Major applications	Page
NSK Linear Guides	HA Series 		Ball	Four-way equal load carrying capacity 	⊚	○	◎	• Machining centers • Precision lathes • Various types of NC grinders • Electric discharge machines • Optical stages • LCD manufacturing equipment • Die molding machines • High-precision measuring equipment	A341
	HS Series 		Ball	High vertical load carrying capacity 	⊚	◎	◎	• Machining centers • Precision lathes • Various types of grinders • Electric discharge machines • Optical stages • LCD manufacturing equipment • High-precision measuring equipment	A355
Linear rolling bushing			Ball		○	◎	○	• Materials handling equipment • Packaging/packing machines • Medical equipment • Pneumatic equipment • Office equipment • Assembling machines	A369
Crossed roller guide			Roller		◎	◎	○	• Precision stages • Measuring equipment • Test equipment • Printed circuit assembly machines	A380
Roller pack			Roller		⊚	◎	○	• Large machine tools • Conveyor system for heavy objects (guide ways for heavy loads)	A386
Linear roller bearing			Roller		⊚	◎	○	• Large machine tools • Conveyor system for heavy objects (guide ways for heavy loads)	A393

A-3 Selection of NSK Linear Rolling Guides

A-3-1 Selection Flow Chart

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



	Page
• Machine structure, installation space and position of the linear guides • Functional requirements (required life, rigidity and accuracy) and use environment	A15 Description of the rated life A28 Description of the preload A32 Description of the accuracy A57 Description of rust prevention and surface treatment A67 Description of arrangement and mounting A113 Technical descriotion and dimension table for NSK Linear Guides
• Consider the load, rigidity, friction and installation position, and select the model and size of linear guide most suitable to the condition requirements.	
• Decide by the required running accuracy of the machine.	A32 Description of the accuracy
• Select a model based on the installation space. • Select a model temporarily based on the mutual balance between the machine, its ancillaries and the size of ball screws, making use of your experience and actual results.	A15 Description of the rated life A113 Technical descriotion and dimension table for NSK Linear Guides
• Calculate loads in the direction of up/down and right/left, and moment loads of the linear guide. • Consider loads caused by acceleration/deceleration and the fluctuation of load.	A15 Description of the rated life
• Calculate the static allowable load, and confirm that the total static load is within the permissible range. • Confirm the strength of fastening parts of linear guides such as bolts and their material.	A16 Description of the static load rating
• Estimate the life and confirm it is within the scope of the use conditions.	A15 Description of the rated life
• Select a preload and clearance most suitable to the requirements.	A28 Description of the preload
• Select lubricant, grease or oil, and the lubrication method according to the use conditions. • Select suitable dust protection means (seals, bellows or surface treatment) for the use environment.	A38 Description of lubrication A52 Description of dust protection
• Decision of an installation position, the shoulder height and corner radius R of mounting surface of a machine base • Confirm installation procedures.	A67 Description of arrangement and mounting Special supplement, Description of the mounting of linear guides

A-3-2 Rating Life and Basic Load Rating

A-3-2.1 Life and Basic Load Rating

1. Life

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

2. Rating fatigue life

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

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

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

3. Basic load ratings in compliance with ISO standard

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

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

ISO: International Organization for
Standardization

[Basic dynamic load rating]
ISO 14728-1; Rolling bearings — Linear motion rolling bearings
Part 1: Dynamic load ratings and rating life

[Basic static load rating]
ISO 14728-2; Rolling bearings — Linear motion rolling bearings
Part 2: Static load ratings

4. Basic dynamic load rating

- The basic dynamic load rating, which indicates load carrying capacity of the linear guide, is a load whose direction and volume do not change, and which furnishes 50 km of rating fatigue life.
- In case of the linear guides, it is a constant load applied to downward direction to the center of the slide.
- Value of the basic dynamic load rating C is shown in "**A-5 Technical Description and Dimension Table for NSK Linear Guides.**"
- NSK defines the basic dynamic load rating as the load that furnishes 50 km of rated fatigue life for the balls as rolling element. 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 for 50 km (C_{50}) into the dynamic load rating for 100 km (C_{100}).
  : $C_{100} = C_{50}/1.26$ (N)

- For rollers as rolling element, NSK defines the basic dynamic load rating as the load that furnishes 100 km of rated fatigue life. However, some linear guide manufacturers in Japan define the load for the basic fatigue life of 50 km as the basic dynamic load ratings.
- The following formula may be used to convert the basic dynamic load rating for 100 km (C_{100}) into the dynamic load rating for 50 km (C_{50}) rated fatigue life.
  : $C_{50} = 1.23 \times C_{100}$ (N)

5. Calculation of rating fatigue life

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

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

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

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

L : Rating fatigue life (km)
C : Dynamic load rating (N) (100 km)
F : Load to a slide (N) (dynamic equivalent load)

6. Dynamic equivalent load

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

7. Basic static load rating

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

8. Basic static moment load rating

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

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

9. Basic load rating by load direction

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

Table 2.1 Basic load ratings by load direction

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

A-3-2.2 How to Calculate the Life

1. Setting operating condition of linear guide

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

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

2. Calculating load to a slide

- **Table 2.2** shows a formula to calculate loads that are going to be applied to each assembled slide into a machine.

  The Table shows six typical patterns of linear guide installing structure.
- In the Tables, directions indicated by arrows denote "plus" for the applied loads (F_x, F_y, F_z) and the loads which are applied to the slides. (F_r, F_s, M_r, M_p, M_y)
- Codes in the Tables are as follows:

  F_r : Vertical loads to the slide (N)

  F_s : Lateral loads to the slide (N)

  M_r : Rolling moment to the slide (N · mm)

  M_p : Pitching moment to the slide (N · mm)

  M_y : Yawing moment to the slide (N · mm)

  Suffixes (1, 2, ...) to the above F_r – M_y : Slide number

  F_{xi} : Load applied in X direction (i = 1 to n; n is the number of loads applied in X direction) (N)

  F_{yj} : Load applied in Y direction (j = 1 to n; n is the number of loads applied in Y direction) (N)

  F_{zk} : Load applied in Z direction (k = 1 to n; n is the number of loads applied in Z direction) (N)

  Coordinates (X_{xi}, Y_{xi}, Z_{xi}): Point where load F_{xi} (mm) is applied.

  Coordinates (X_{yj}, Y_{yj}, Z_{yj}): Point where load F_{yj} (mm) is applied.

  Coordinates (X_{zk}, Y_{zk}, Z_{zk}): Point where load F_{zk} (mm) is applied.

  l: Slide span (mm)

  L: Rail span (mm)

  Coordinates (X_b, Y_b, Z_b): Center of driving mechanism

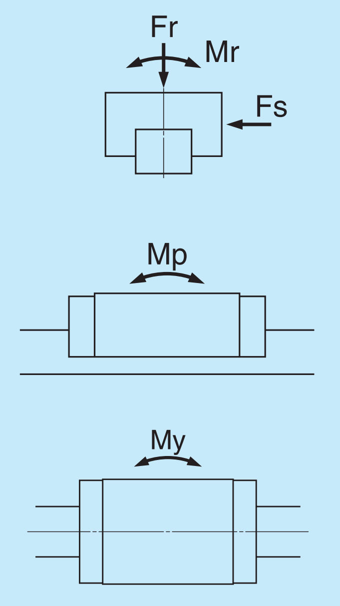
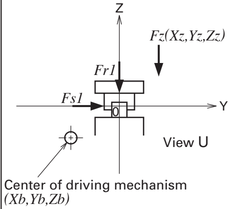
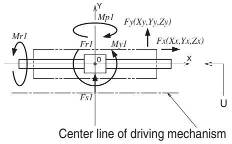
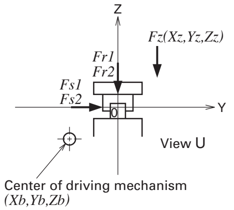
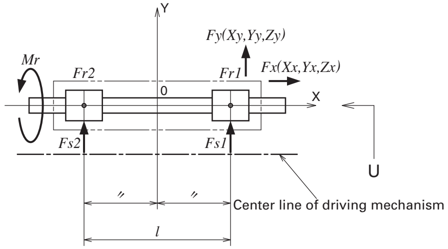
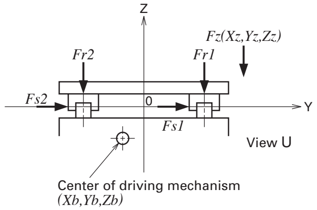
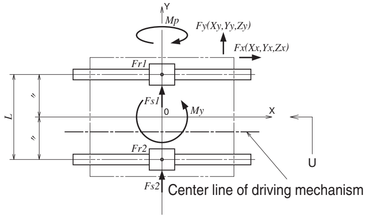
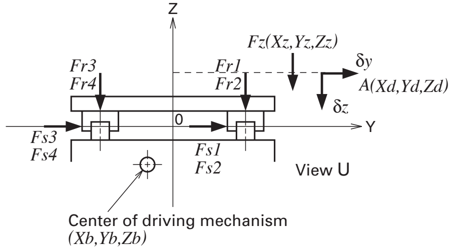
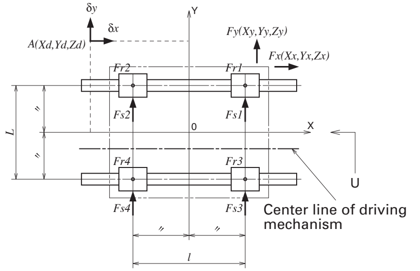
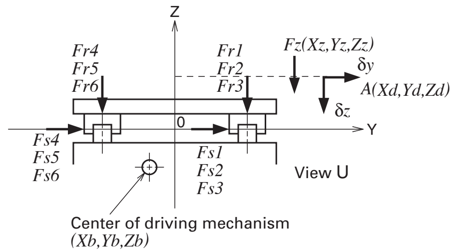
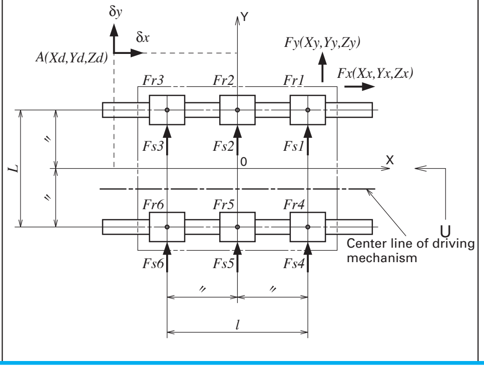
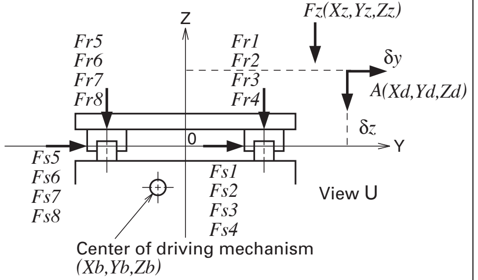
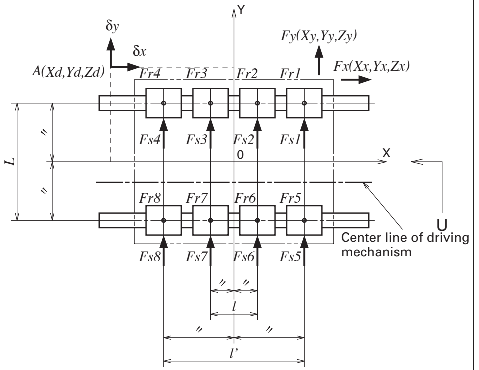


Fig. 2.1

Table 2.2 Loads applied to the slides

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

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

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

3. Calculation of dynamic equivalent load

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

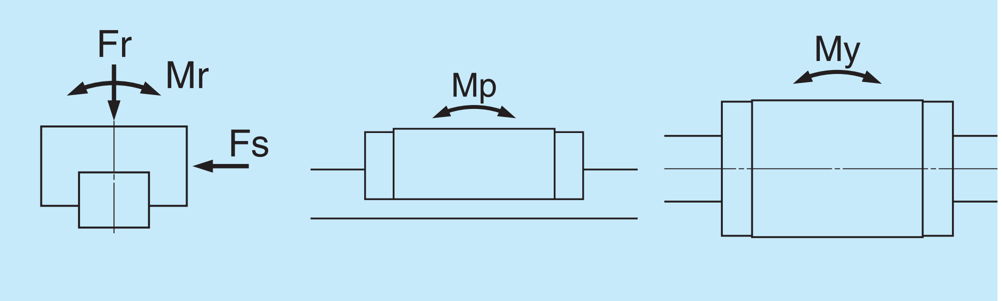
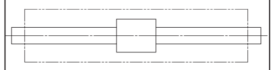
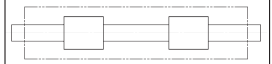
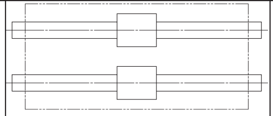
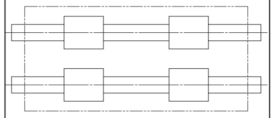


Fig. 2.2

Table 2.3 Loads in the arrangement of linear guides

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

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

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

Table 2.4 Dynamic equivalent coefficients

Unit: 1/m

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

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 ; LH45__
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 (only LU and LE)

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

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

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

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

4. Calculation of mean effective load

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

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

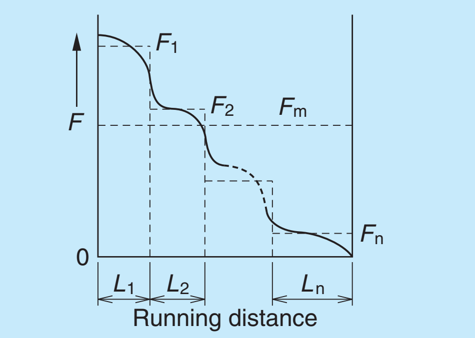


Fig. 2.3 Stepwise load change

Running distance while dynamic equivalent load F_1 is applied: L_1

Running distance while dynamic equivalent load F_2 is applied: L_2

Running distance while dynamic equivalent load F_3 is applied: L_3

• • • • • • • • • • • • • • • • • •

Running distance while dynamic equivalent load F_n is applied: L_n

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

In case of ball

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

In case of roller

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

*F*m : Mean effective load of the deviating load (N)

L : Running distance (ΣLn)

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

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

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

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

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

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

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

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

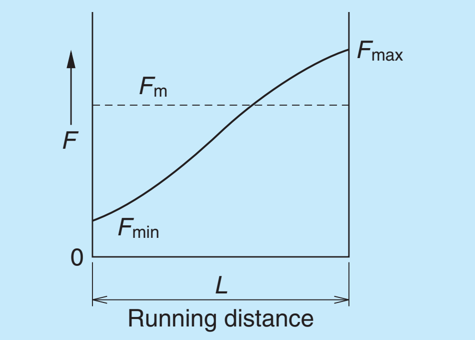
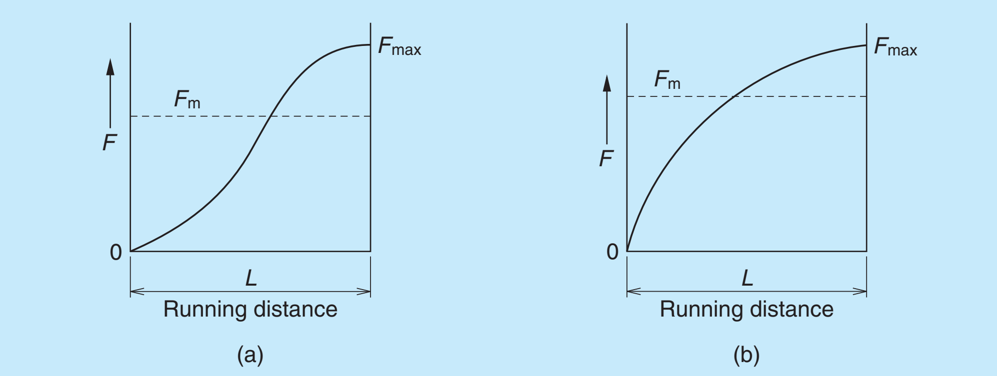


Fig. 2.4 Linear load change



(a) (b)

Fig. 2.5 Load that changes in sinusoidal pattern

5. Various coefficients

(1) Load factors

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

Table 2.5 Load factor fw

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

(2) Hardness coefficient

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

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

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

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

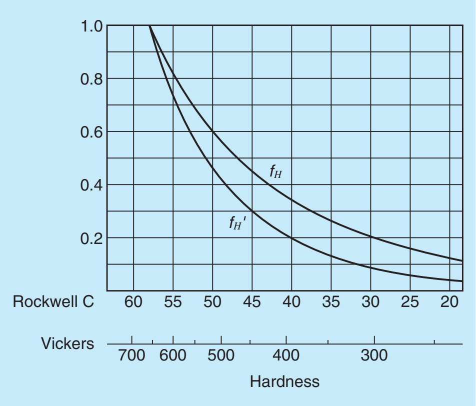


Fig. 2.6 Hardness coefficient

(3) Reliability coefficient

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

6. Calculation of rating life

Life Calculating Formula

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

For balls as rolling element

$$\boldsymbol{L = 50 \times \left(\frac{f_H \cdot C}{f_W \cdot F_m} \right)^3 \text{(km)}}$$

C : Basic dynamic load rating (N) (50 km)
f_H : Hardness coefficient
f_W : Load factor
F_m : Mean effective load

For rollers as rolling element

$$\boldsymbol{L = 100 \times \left(\frac{f_H \cdot C}{f_W \cdot F_m} \right)^{\frac{10}{3}} \text{(km)}}$$

C : Basic dynamic load rating (N) (100 km)
f_H : Hardness coefficient
f_W : Load factor
F_m : Mean effective load

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

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

Life as an entire guide way system

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

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

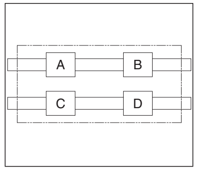


Fig. 2.7 Life of a system

7. Examination of the basic static load rating

(1) Examine from the basic static load rating

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

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

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

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

If compressed load and lateral load are combined

$$\boldsymbol{P_0 = Fr + 1.54Fs}$$

If tensile load and lateral load are combined

$$\boldsymbol{P_0 = 1.28Fr + 1.54Fs}$$

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

$$\boldsymbol{P_0 = Fr + Fs}$$

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

Table 2.6

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

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

(2) Examining from static moment load rating

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

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

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

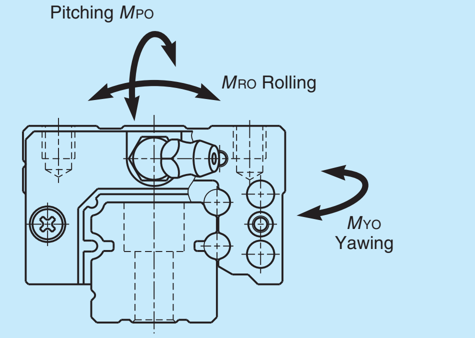


Fig. 2.8 Moment load directions

8. Precautions for the design in examining the life

The following points must be heeded in examining the life.

In case of oscillating motion

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

When applying pitching or yawing moment

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

When an extraordinary high load is applied during stroke

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

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

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

Application at high speed

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

A-3-3 Preload

1. Objective of preload

- An elimination of clearance between the raceways and rolling elements vanishes the mechanical play of the linear guide system.
- When a preload is applied, the deformation of linear guides by external vertical load is further improved thus increasing the system stiffness.
- Preloading method

  The preload is applied by inserting rolling elements slightly bigger than the space of two raceways as shown in **Fig. 3.1**.

2. Preload and rigidity

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

(1) Radial rigidity: Rigidity of vertical and lateral directions, up/down and right/left (**Fig. 3.4**).

(2) Moment rigidity: Three moment directions, pitching, rolling, and yawing (**Fig. 3.5**).

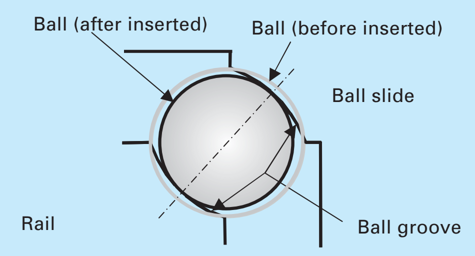


Fig. 3.1 Preloading method

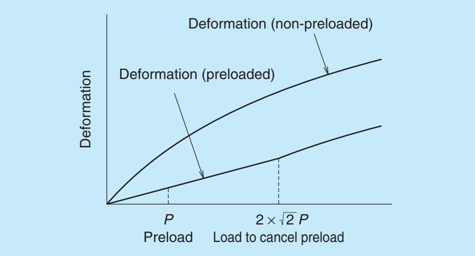


Fig. 3.2 Elastic deformation

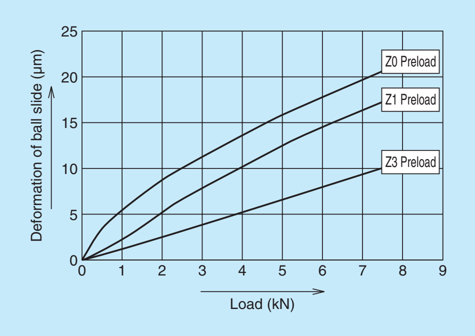


Fig. 3.3 Rigidity of SH35, downward direction load (example)

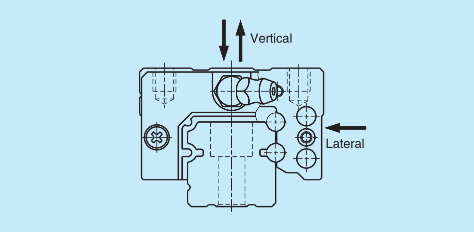


Fig. 3.4 Radial rigidity

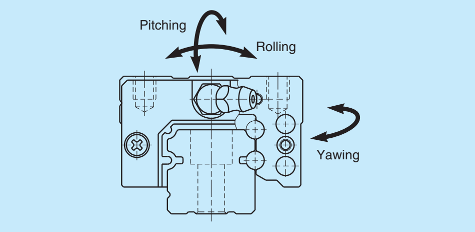


Fig. 3.5 Moment rigidity

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

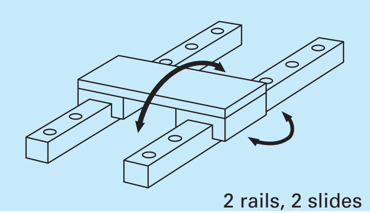


Fig. 3.6 Pitching and yawing direction

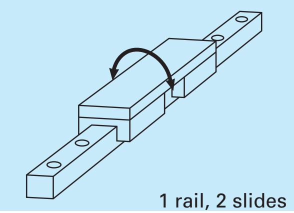


Fig. 3.7 Rolling direction

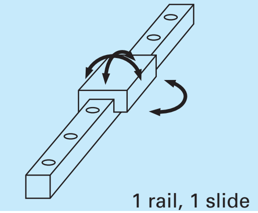


Fig. 3.8 All directions

3. Selection of preload classification

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

Table 3.1 Classification of preload in each series

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

Table 3.2 Selection criterion of the preload

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

4. Estimation of the elastic deformation

The followings are the relation between load and deformation.

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

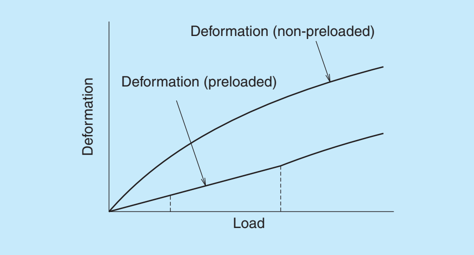


Fig. 3.9 Elastic deformation

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

<Required conditions to calculate deformation>

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

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

5. Application examples of preload

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

Table 3.3 Application examples of preload

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

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

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

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

For balls as rolling element

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

P: Preload (N)

However, when the full dynamic equivalent load taking account of preload is larger than the load at which preload is removed, $Fe_P = Fe$.

For this case, preload is lost at $F_{PO} = 2^{\frac{3}{2}}P$

For rollers as rolling element

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

P: Preload (N)

However, when the full dynamic equivalent load taking preload into account is larger than the load at which preload is removed, $Fe_P = Fe$.

For this case, preload is lost at $F_{PO} = 2^{\frac{10}{9}}P$

7. Calculating friction force by preload

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

$$F = iP$$

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

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

LH, SH, VH, LS, SS, LW and HS Series	: 0.004
LA and HA Series	: 0.010
PU, LU, PE and LE Series	: 0.026

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

Calculation example

In case of LH35AN - Z3

$i = 0.004$

$P = 2\ 350$ (N) (refer to LH series preload)

$F = \mathrm{i}P$

$= 0.004 \times 2\ 350 = 9.4$ (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. The NSK linear guides can deal with these factors and provide the best suited model for your specific application.

2. Definition of accuracy

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

Table 4.1 Definition of accuracy

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

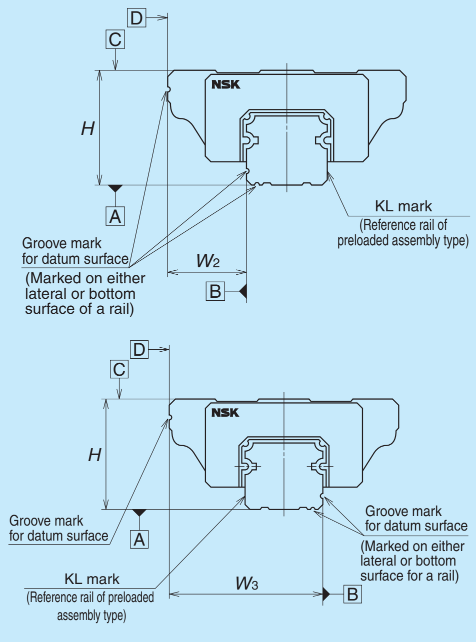


Fig. 4.1 Assembled dimensions

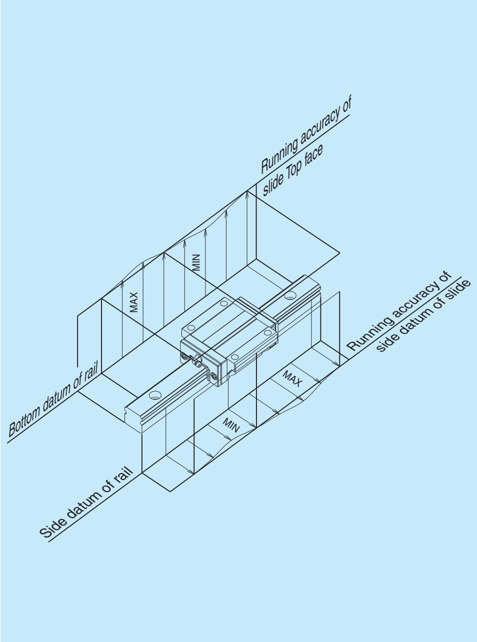


Fig. 4.2 Running parallelism of slide

Mounting width: W_2, and W_3

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

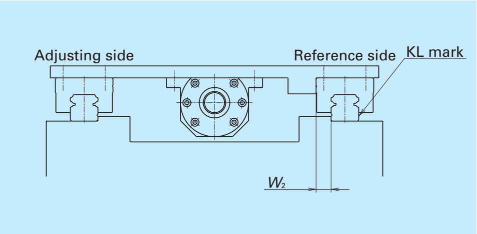


Fig. 4.3 Mounting width W_2

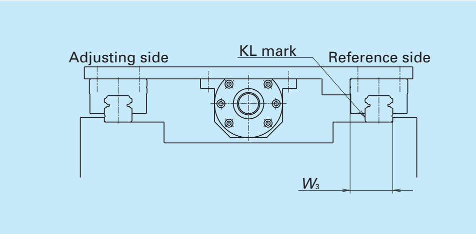


Fig. 4.4 Mounting width W_3

Running Parallelism of Ball Slide

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

Table 4.2 Running parallelism of slide

Unit: µm

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

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

3. Application examples of accuracy grade and preload

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

Table 4.3 Application examples of accuracy grade and preload

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

Note: Only Z1 and Z0 are available for PN grade.
For random-matching type, preload "ZH" and "ZZ" are available for PH grade. For PC grade, "ZH", "ZZ" and "ZT" are available.
For random-matching RA Series, only accuracy grade "P6" and preload "Z3" are avialable.

4. Combination of accuracy grade and preload

(1) Accuracy grades

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

Table 4.4 Accuracy grades and applicable series

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

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

(2) Preload

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

Table 4.5 Classification of preload

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

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

(3) Combinations of accuracy grade and preload

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

Table 4.6 Combinations of accuracy grade and preload type

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

[*1] The random-matching type is available for the models of RA25 to RA65. P6 is set for the accuracy and Z3 is set for the preload. (Preload code is ZZ.)

[*2] ZH and ZZ preload are available for the PH accuracy grade.

A-3-5 Maximum Rail Length

General Industrial Use Unit: mm

Series	Size / Material	08	10	12	15	20	25	30	35	45	55	65
LH	Special high carbon steel				2 000	3 960	3 960	4 000	4 000	3 990	3 960	3 900
	Stainless steel	375	600	800	1 800	3 500	3 500	3 500				
SH	Special high carbon steel				2 000	3 960	3 960	4 000	4 000	3 990	3 960	
	Stainless steel				1 800	3 500	3 500	3 500				
VH	Special high carbon steel				2 000	3 960	3 960	4 000	4 000	3 990	3 960	
	Stainless steel				1 800	3 500	3 500	3 500				
TS	Special high carbon steel				1 960	2 920	4 000	4 040	4 040			
LS	Special high carbon steel				2 000	3 960	3 960	4 000	4 000			
	Stainless steel				1 700	3 500	3 500	3 500	3 500			
SS	Special high carbon steel				2 000	3 960	3 960	4 000	4 000			
	Stainless steel				1 700	3 500	3 500	3 500	3 500			

Unit: mm

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

Liquid Crystal Display and Semiconductor Unit: mm

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

Machine Tools Unit: mm

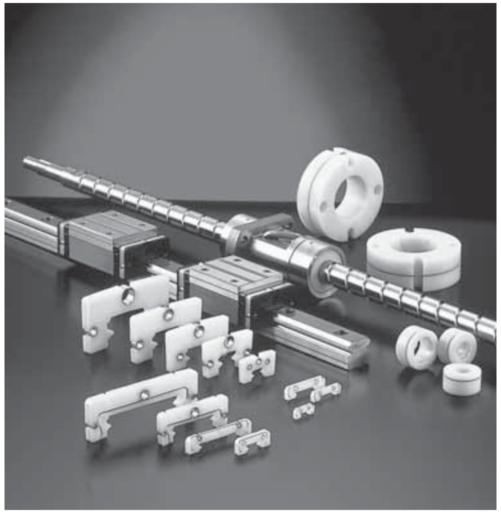
Series	Size / Material	15	20	25	30	35	45	55	65
RA	Special high carbon steel	2 000	3 000	3 000	3 500	3 500	3 500	3 500	3 500
LA	Special high carbon steel			3 960	4 000	4 000	3 990	3 960	3 900

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

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

A-3-6 Lubrication

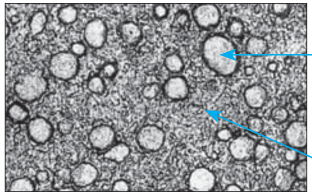
1. NSK linear guides equipped with "NSK K1™" lubrication unit



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

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

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



Enlarged surface of NSK K1 Lubrication Unit

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

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

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

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

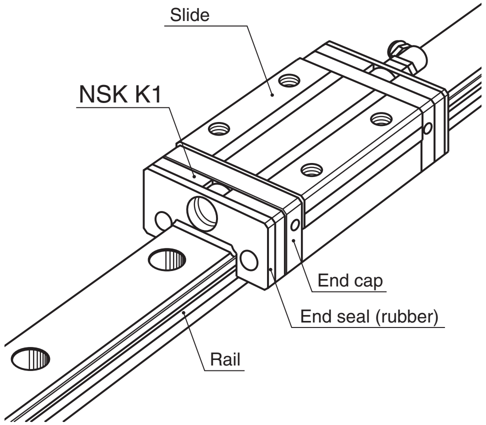


Fig. 6.1

(1) Features

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

1) Maintenance is required only infrequently

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

▼

For automotive component processing lines, etc.

2) Does not pollute the environment

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

▼

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

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

(2) Functions

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

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

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

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

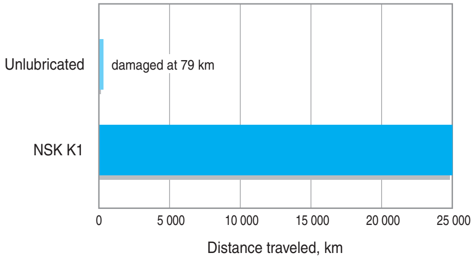


Fig. 6.2 Durability test at high speed, with no lubrication (lubricated by NSK K1 only)

3) Good for applications where lubricant is washed away

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

▼

Food processing equipment, housing/construction machines, etc.

4) Maintains efficiency in dusty environments

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

▼

Woodworking machines, etc.

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

2) Immersion test

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

Conditions: Sample ; LS30 Stainless steel (preload Z1)
Travel speed ; 24 m/min
Stroke ; 400 mm
Load ; 4 700 N/Slide
Lubricant ; Fully packed with grease (*) exclusive use for food proccesing machines
Immersing condition:
Immersed and traveled once per week for 24 hours at a time.
* Grease made in U.S.A.
Characteristic
Consistency: 280
Base oil viscosity: 580 (cSt)

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

Unit: μm

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

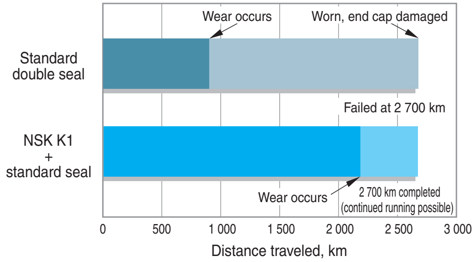


Fig. 6.3 Durability test immersed in water

4) Dust generation

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

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

3) Durability test with wood chips

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

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

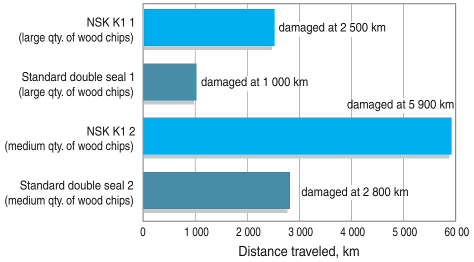


Fig. 6.4 Durability test with wood chips

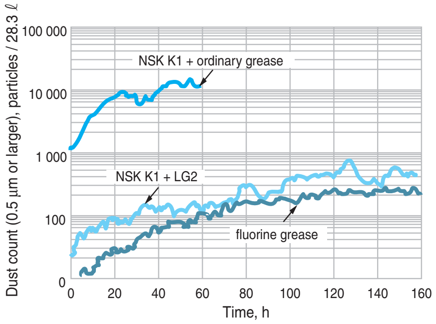


Fig. 6.5 Comparison of dust emission

(3) Specifications

1) Applicable series and sizes

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

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

2) Standard specifications

a) NSK K1 is installed between the end seal and end cap.

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

b) NSK standard grease is packed inside the slide.

(You may specify the type of grease and its volume if required.)

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

3) Number of installed NSK K1

Normally, one NSK K1 should be installed on both ends of slides. (two K1s for one slide)

However, more NSK K1 may be required under more stringent operating conditions and environment. Please consult NSK for details in such a case.

Precautions for handling

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

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

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

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

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2. Lubrication

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

(1) Grease Lubrication

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

- Various types of grease in bellows tube which can be instantly attached to the hand grease pump;
- NSK Grease Unit that consists of a hand grease pump and various nozzles. These are compact and easy to use.

1) NSK grease lubricants

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

Table 6.2 Grease lubricant for linear guides

Type	Thickener	Base oil	Base oil kinematic viscosity mm^2/s (40°C)	Range of use temperature (°C)	Purpose
AS2[*1]	Lithium type	Mineral oil	130	–10 – 110	For general use at high load
PS2[*2]	Lithium type	Synthetic oil + 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 hydrocarbon oil	27	–40 – 100	For fretting resistant

∗1) Standard grease of LH, SH, VH, TS, LS, SS, LW, RA, LA, HA, and HS Series.
∗2) Standard grease of PU, LU, PE, and LE Series.

[1] NSK Grease AS2

● Features

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

● Application

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

● Nature

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

[2] NSK Grease PS2

● Features

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

● Application

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

● Nature

Thickener	Lithium soap base
Base oil	Synthetic oil + mineral oil
Consistency	275
Dropping point	190°C
Volume of evaporation	0.60% (99°C, 22 hr)
Copper corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	3.6% (100°C, 24 hr)
Base oil kinematic viscosity	15 mm^2/s (40°C)

[3] NSK Grease LG2

● Features

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

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

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

● Application

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

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

● Nature

Thickener	Lithium soap base
Base oil	Mineral oil + Synthetic hydrocarbon oil
Consistency	207
Dropping point	200°C
Volume of evaporation	1.40% (99°C, 22 hr)
Copper corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.8% (100°C, 24 hr)
Base oil kinematic viscosity	30 mm^2/s (40°C)

[4] NSK Grease LGU

● Features

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

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

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

● Application

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

This grease cannot be used in vacuum.

● Nature

Thickener	Diurea
Base oil	Synthetic hydrocarbon oil
Consistency	209
Dropping point	260°C
Volume of evaporation	0.09% (99°C, 22 hr)
Copper corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.6% (100°C, 24 hr)
Base oil kinematic viscosity	100 mm^2/s (40°C)

[5] NSK Grease NF2

● Features

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

● Application

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

● Nature

Thickener	Diurea
Base oil	Synthetic hydrocarbon oil
Consistency	288
Dropping point	269°C
Volume of evaporation	7.9% (177°C, 22 hr)
Copper corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.6% (100°C, 24 hr)
Base oil kinematic viscosity	27 mm^2/s (40°C)

● Precautions for handling

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

2) How to replenish grease

Use the grease fitting of a slide if an exclusive grease supply system is not used. Supply the required amount of grease by a grease pump.

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

3) Volume of grease to be replenished

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

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

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

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

• When replenishing grease using a grease gump:

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

4) Intervals of checks and replenishments

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

Table 6.3 Intervals of checks and replenishments for grease lubrication

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

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

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

Table 6.4 Inside space of the slide

LH, SH Series

Unit: cm^3

Series	LH		SH	
Model No.	High-load type	Ultra-high-load type	High-load type	Ultra-high-load type
08	0.2	–	–	–
10	0.4	–	–	–
12	1.2	–	–	–
15	3	4	2	3
20	6	8	5	7
25	9	13	9	12
30	13	20	11	17
35	22	30	20	27
45	47	59	42	53
55	80	100	73	93
65	139	186	–	–

LW Series

Unit: cm^3

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

VH Series

Unit: cm^3

Series	VH	
Model No.	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

PU, LU Series

Unit: cm^3

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

TS Series

Unit: cm^3

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

PE, LE Series

Unit: cm^3

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

LS, SS Series

Unit: cm^3

Series	LS		SS	
Model No.	Medium-load type	High-load type	Medium-load type	High-load type
15	2	3	1.5	2
20	3	4	3	4
25	5	8	5	7
30	8	12	7	11
35	12	19	11	17

RA Series

Unit: cm^3

Series	RA	
Model No.	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

Unit: cm^3

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

HA, HS Series

Unit: cm^3

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

5) NSK grease unit

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

Grease in a bellows tube

[1] Composition of NSK grease unit

Components and grease types are shown below.

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

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

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

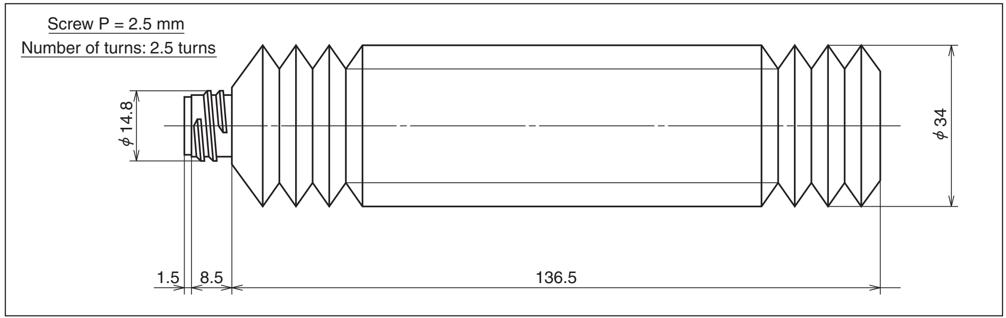


Fig. 6.6 Bellows tube

[3] NSK hand grease pump unit

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

●Features

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

●Specifications

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

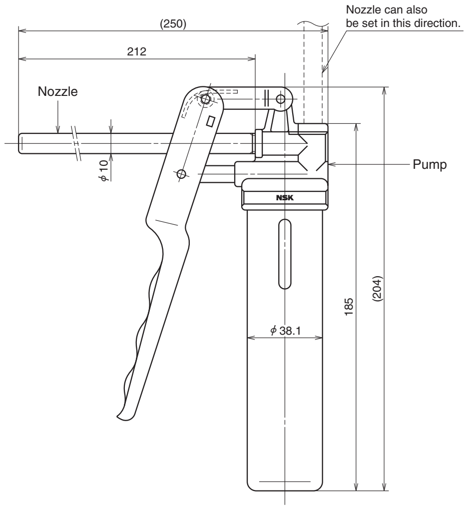


Fig. 6.7 NSK Hand Grease Pump with NSK straight nozzle

b) Nozzles

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

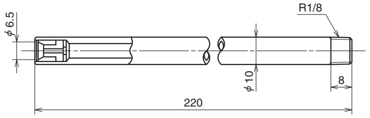
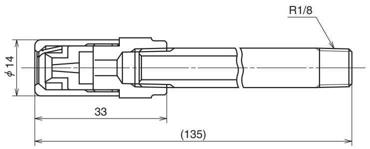
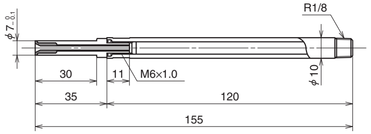
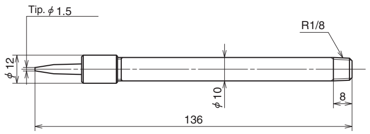
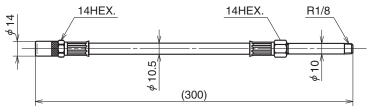
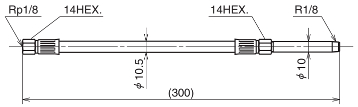
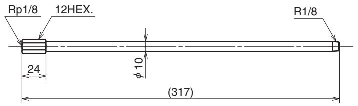
Name	Designation code	Use	Dimensions
NSK straight nozzle	NSK HGP NZ1	Can be used with grease fitting A, B, and C under JIS B1575 standard.	
NSK chuck nozzle	NSK HGP NZ2	Same as above. However, there is no need to press the hand pump because the grease fitting and the nozzle come into contact due to the chucking mechanism at the tip.	
NSK fitting nozzle	NSK HGP NZ3	Dedicated for the -ϕ3 drive-in grease fitting.	
NSK point nozzle	NSK HGP NZ4	Used for linear guides that do not have grease fitting. Supplies grease directly to the ball grooves, or through the opening of slide or slide to inside.	
NSK flexible nozzle	NSK HGP NZ5	The tip of the flexible nozzle is a chuck nozzle. 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 6.6 Grease fittings used for NSK linear guide

Series	Model No.	Tap hole for grease fitting	Standard grease fitting	Straight nozzle NZ1	Chuck nozzle NZ2	Drive-in fitting nozzle NZ3	Point nozzle NZ4	Flexible nozzle NZ5
LH Series	LH08, 10	–	–				○	
	LH12, 15	ϕ3	Drive-in type			○		
	LH20, 25, 30, 35*	M6×0.75	B type	○	○			○
	LH45, 55, 65	Rc1/8	B type	○	○			○
SH Series	SH15	ϕ3	Drive-in type			○		
	SH20, 25, 30, 35*	M6×0.75	B type	○	○			○
	SH45, 55	Rc1/8	B type	○	○			○
VH Series	VH15	ϕ3	Drive-in type			○		
	LH20, 25, 30, 35*	M6×0.75	B type	○	○			○
	VH45, 55	Rc1/8	B type	○	○			○
TS Series	TS15	ϕ3	Drive-in type			○		
	TS20, 25, 30, 35*	M6×0.75	B type	○	○			○
LS Series	LS15	ϕ3	Drive-in type			○		
	LS20, 25, 30, 35*	M6×0.75	B type	○	○			○
SS Series	SS15	ϕ3	Drive-in type			○		
	SS20, 25, 30, 35*	M6×0.75	B type	○	○			○
LW Series	LW17	ϕ3	Drive-in type			○		
	LW21, 27, 35*	M6×0.75	B type	○	○			○
	LW50	Rc1/8	B type	○	○			○
PU Series	PU05, 07, 09, 12	–	–				○	
	PU15	ϕ3	Drive-in type			○		
LU Series	LU05, 07, 09, 12, 15	–	–				○	
PE Series	PE05, 07, 09, 12	–	–				○	
	PE15	ϕ3	Drive-in type			○		
LE Series	LE05, 07, 09, 12, 15	–	–				○	
RA Series	RA15, 20	ϕ3	Drive-in type			○		
	RA25, 30, 35*	M6×0.75	B type	○	○			○
	RA45, 55, 65	Rc1/8	B type	○	○			○
LA Series	LA25, 30, 35*	M6×0.75	B type	○	○			○
	LA45, 55, 65	Rc1/8	B type	○	○			○
HA Series	HA25, 30, 35*	M6×0.75	B type	○	○			○
	HA45, 55	Rc1/8	B type	○	○			○
HS Series	HS15	ϕ3	Drive-in type			○		
	HS20, 25, 30, 35*	M6×0.75	B type	○	○			○

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

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

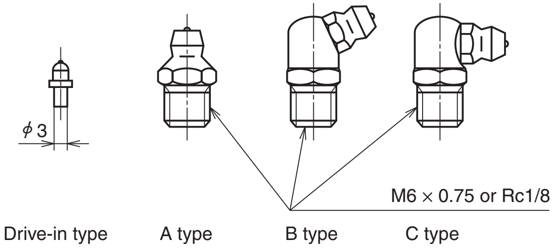


Fig. 6.8 Grease fittings

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

(2) Oil lubrication

Required amount of new oil is regularly supplied by:

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

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

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

In case of all ball type linear guides except LA series

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

In case of LA and RA series

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

n: Linear guide size code

e.g. When LH45 is used,

$n = 45$,

Therefore,

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

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

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

Table 6.7 Intervals of checks and replenishments

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

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

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

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

A-3-7 Dust Proof

1. Standard specification parts

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

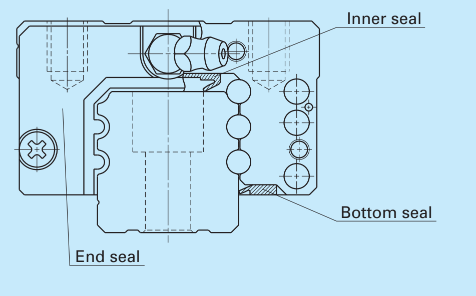


Fig. 7.1

Table 7.1 Standard seals

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

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

2. Dust-proof parts

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

Table 7.2 Optional dust-proof parts

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

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

(1) Double seal

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

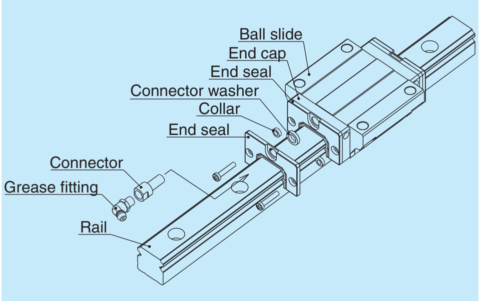


Fig. 7.2 Double seal

(2) Protector

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

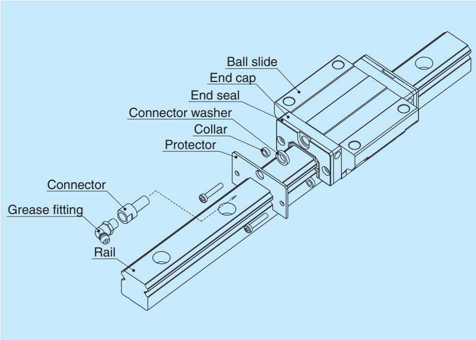


Fig. 7.3 Protector

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

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

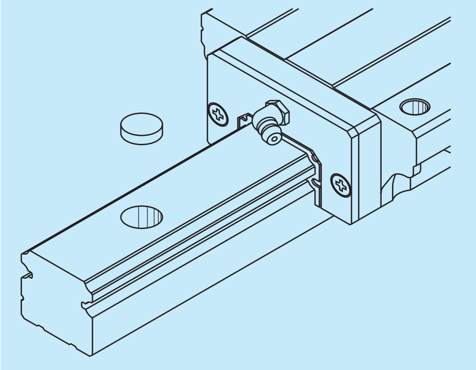


Fig. 7.4

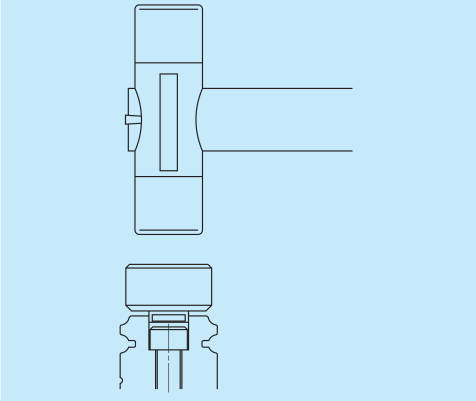


Fig. 7.5

(4) Inner seal

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

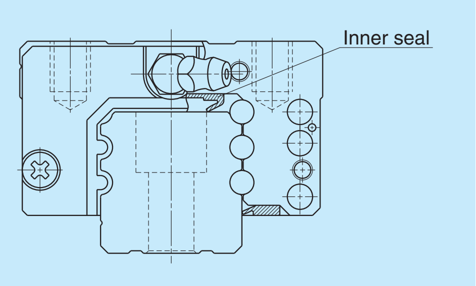


Fig. 7.6 Inner seal when installed

[1] Installation of bellows LH and LS Series

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

- Remove two machine screws (M_2) which secure the end seals to the end of the slide (**Fig. 7.7**). For 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 insert a spacer to the hole for securing the end seal. Fasten the mounting plate at the end of the bellows to the slide with a slightly longer machine screw (provided with the bellows).

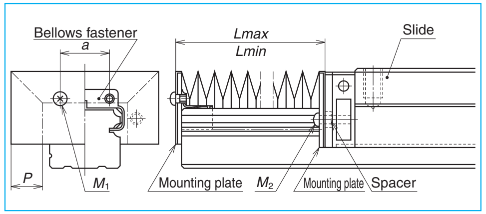


Fig. 7.7

(5) Bellows

- A bellows covers entire linear guide. It has been used widely as a way of protection in an environment where foreign matters are prevalent.
- NSK has bellows exclusively for LH, SH, LS, SS, LW and LA 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 EM, FL, EL, GM, GL, HL, AL and BL types. The top of the high type bellows is slightly lower than the top surface of the slide.
- When a high type bellows is installed to the slide with the height code L (such as 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 than the low type.
- Special bellows are required when installing the linear guide vertically, or hanging it from a ceiling. Please consult NSK in such a case.
- When a bellows is used, please be advised that we cannot put a grease fitting on the end of slide to which the bellows is attached. If you require the grease fitting, it shall be put on the side of end cap or slide body. Consult NSK for details.
- For the dimension of bellows, please refer to the section of dust proof parts of each series.

*** Fixing to the rail**

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

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

[2] LW and LA Series

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

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

*** Fixing to the rail**

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

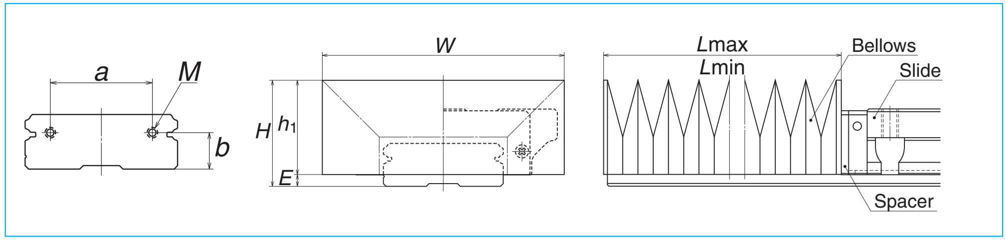


Fig. 7.8

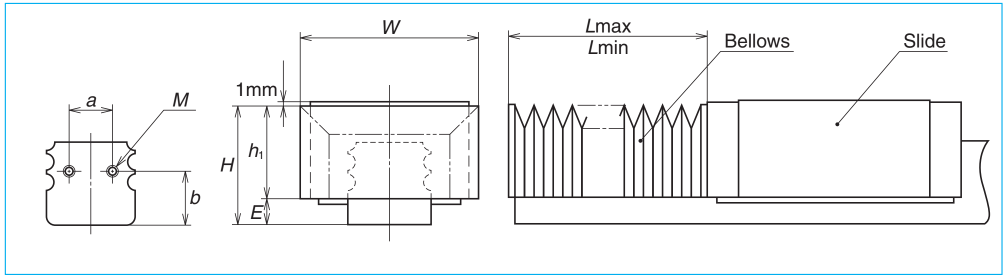


Fig. 7.9

Calculating length of bellows

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

Lmax = 7 × P × Number of BL

- Length when contracted to the minimum length :

Lmin = 17 × Number of BL

- Stroke : **_St_ = _Lmax_ – _Lmin_**
- The dimension of P and the number of BL are shown in the bellows dimension table of each series.

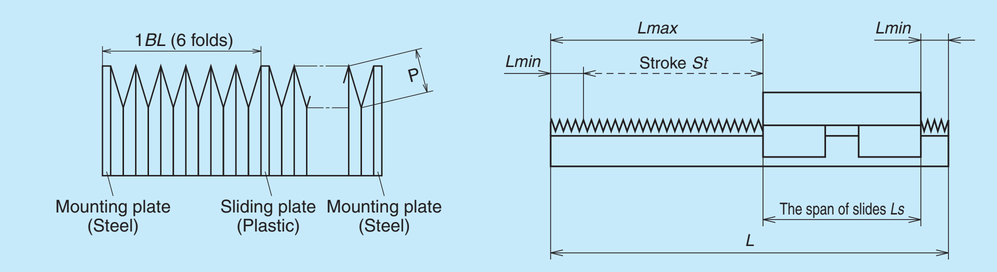


Fig. 7.10

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

1. Stainless steel

NSK linear guide is available in stainless steel.

○Stainless steel standard series

PU Series	**PE Series**
LE Series	**LL Series**

○Available in stainless steel

LH Series	**SH Series**
LS Series	**SS Series**
LU Series	

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

2. Surface treatment

(1) Recommended surface treatment

We recommend "low temperature chrome plating" and "fluoride low temperature chrome plating" for rust prevention because of the result of the humidity chamber test for antirust characteristics and their cost-effectiveness.
However, never apply any organic solvent to those treatments for degreasing because it has adverse effect on antirust characteristics.
Refer to the next page for the results of humidity chamber test.
Please consult NSK for other surface treatment.

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

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

○Fluoride low temperature chrome plating

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

(2) Rust prevention of fluoride low temperature chrome plating

The use environment of NSK linear guides is expanding from general industrial machines, semiconductor and liquid crystal manufacturing systems to aerospace equipment.
Among all measures to cope with environment, rust prevention is the most challenging. Such environment includes:

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

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

● What is "Fluoride low temperature chrome plating?"

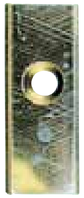
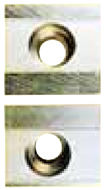
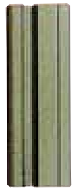
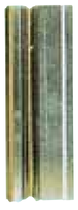
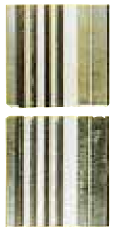
This is a type of black chrome plating which forms a black film (1 to 2 µm in thicness) on the metal surface. Fluoroplastic coating is added to the film to increase corrosion resistance.

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

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

● Humidity chamber test

Table 8.1 Results of the humidity test

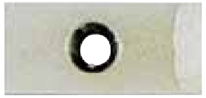
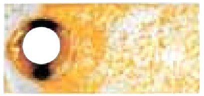
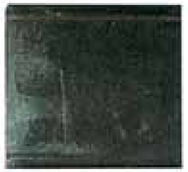
Characteristic		Test sample	Fluoride low temperature chrome plating (Recommended)	Hard chrome plating (Reference)	Electroless nickel plating (Reference)	Equivalent to SUS440C material	Standard steel
Corrosion-resistant property	Rusting	Top	(Ground) B	(Ground) B	(Ground) A	(Ground) C	(Ground) D
		Side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

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

● Chemical corrosion resistance test

Table 8.2 Results of the corrosion resistance test

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

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

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

● Surface treatment durability test

Peeling resistance of surface treatment

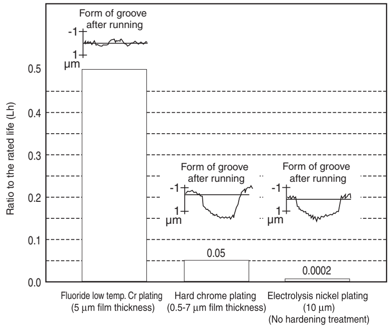


Fig. 8.1 Results of durability test

● Total evaluation

Table 8.3 Evaluation

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

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

A-3-9 Special Environment

1. Heat-resistant specifications

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

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

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

Heat resistant linear guides

LH Series	**LS Series**
LW Series	**LU Series**
LE Series	

See page A66 for the availability.

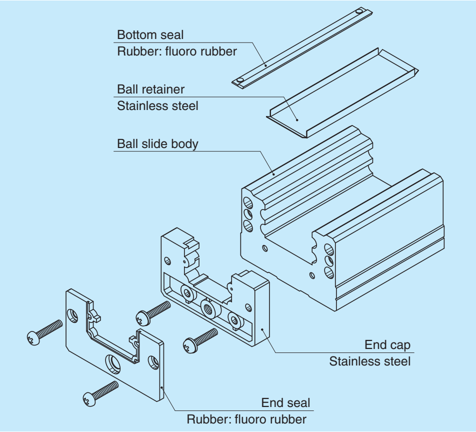


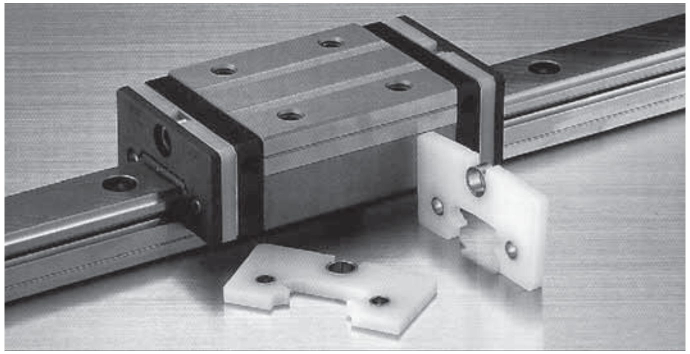
Fig. 9.1

2. Vacuum and clean specifications

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

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

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



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

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

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

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

(1) Features

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

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

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

<Features of grease for food processing machines>

- This grease is approved by USDA H1. (National Science Foundation [NSF] carries out certification for USDA.)
- Superb water resistance and antirust capability
- Superb wear resistance
- Applicable for a centralized oiling system

2) Appropriate volume of grease

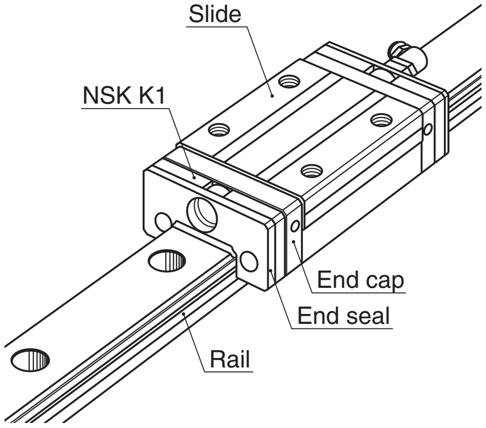
A supply of appropriate volume of grease reduces grease draining and scattering, and maintains a clean environment.

(2) Available models

Table 9.2 shows available models.

Table 9.2

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



Precautions for use

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

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

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

4. Specifications for special environments

Table 9.3 Linear guide specifications

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

5. Lubrication and materials

(1) Lubrication

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

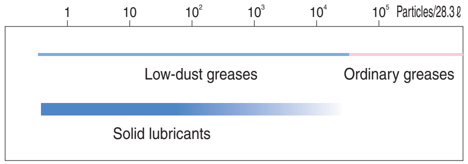


Fig. 9.2 Lubrication in clean environment

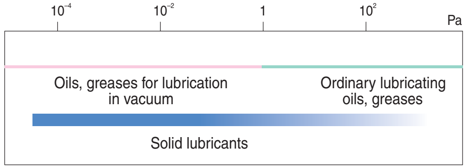


Fig. 9.3 Lubrication in vacuum

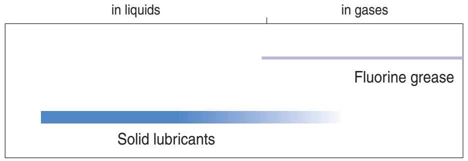


Fig. 9.4 Lubrication in corrosive environment

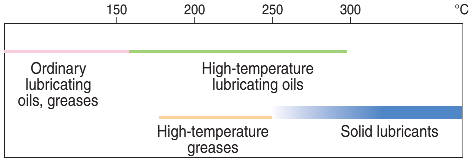


Fig. 9.5 Lubrication in high temperature

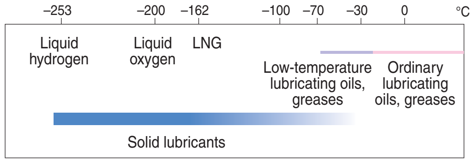


Fig. 9.6 Lubrication in low temperature

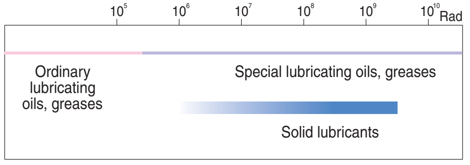


Fig. 9.7 Lubrication in radioactive environment

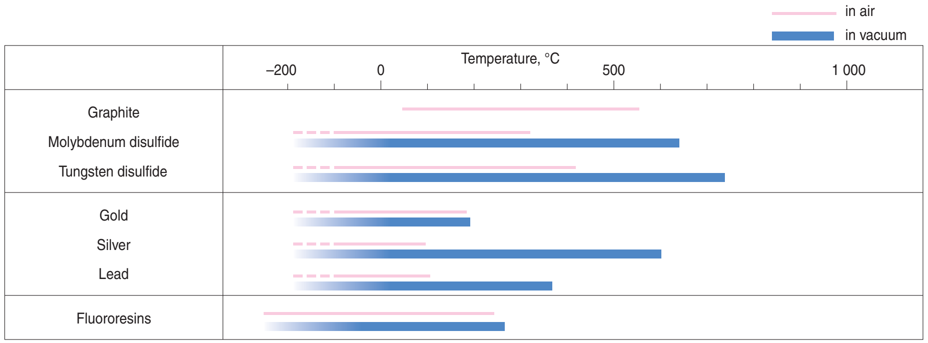


Fig. 9.8 Temperature range for using solid lubricants

(2) Materials

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

Table 9.4 Characteristics of metal materials

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

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

6. Responsiveness of NSK linear guides for special environments

Series	Model No.	Special environment which linear guide can tolerate					
		Clean	Vacuum	Corrosion	High temp.	Hygienic	High dust proofing
LH	LH08	○		○			
	LH10	○		○			
	LH12	○		○		○	
	LH15	○		○		○	
	LH20	○	○	○	○	○	
	LH25	○	○	○	○	○	
	LH30	○	○	○	○	○	
	LH35	○		○	○	○	
	LH45	○		○	○		
	LH55	○		○			
	LH65	○		○			
SH	SH15	○		○			
	SH20	○		○			
	SH25	○		○			
	SH30	○		○			
	SH35	○		○			
	SH45	○		○			
	SH55	○		○			
VH	VH15	○		○			○
	VH20	○		○			○
	VH25	○		○			○
	VH30	○		○			○
	VH35	○		○			○
	VH45	○		○			○
	VH55	○		○			○
TS	TS15	○		○			
	TS20	○		○			
	TS25	○		○			
	TS30	○		○			
	TS35	○		○			
LS	LS15	○	○	○	○	○	
	LS20	○	○	○	○	○	
	LS25	○	○	○	○	○	
	LS30	○	○	○	○∗	○	
	LS35	○		○		○	
SS	SS15	○		○			
	SS20	○		○			
	SS25	○		○			
	SS30	○		○			
	SS35	○		○			
LW	LW17	○		○	○∗	○	
	LW21	○		○	○∗	○	
	LW27	○		○	○	○	
	LW35	○		○		○	
	LW50	○		○			
PU	PU05	○		○			
	PU07	○		○			
PU	PU09	○		○		○	
	PU12	○		○		○	
	PU15	○		○		○	
LU	LU05	○		○			
	LU07	○		○			
	LU09_L	○	○	○	○	○	
	LU09_R	○		○		○	
	LU12_L	○	○	○	○	○	
	LU12_R	○		○		○	
	LU15	○	○	○	○∗	○	
PE	PE05	○		○			
	PE07	○		○			
	PE09	○		○		○	
	PE12	○		○		○	
	PE15	○		○		○	
LE	LE05	○		○			
	LE07	○	○	○	○∗		
	LE09_L	○	○	○	○∗	○	
	LE09_R	○		○		○	
	LE12_L	○	○	○	○	○	
	LE12_R	○		○		○	
	LE15_L	○	○	○	○	○	
	LE15AR	○		○		○	
RA	RA15	○		○			
	RA20	○		○			
	RA25	○		○			
	RA30	○		○			
	RA35	○		○			
	RA45	○		○			
	RA55	○		○			
	RA65	○		○			
LA	LA25	○		○			
	LA30	○		○			
	LA35	○		○			
	LA45	○		○			
	LA55	○		○			
	LA65	○		○			
HA	HA25	○		○			
	HA30	○		○			
	HA35	○		○			
	HA45	○		○			
	HA55	○		○			
HS	HS15	○		○			
	HS20	○		○			
	HS25	○		○			
	HS30	○		○			
	HS35	○		○			

∗) Applicable except for the dust-proofing parts.

7. Precautions for handling

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

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

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

A-3-10 Arrangement and Mounting of Linear Guide

1. Arrangement

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

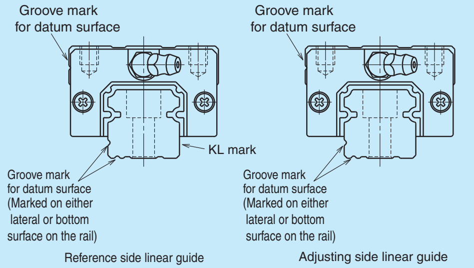


Fig. 10.1 Datum surface

Example of arrangement

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

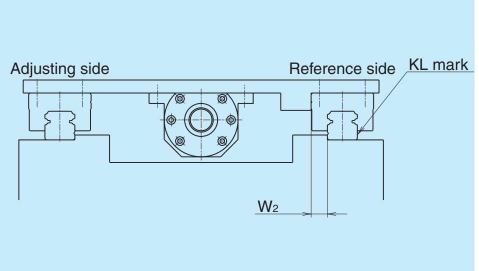


Fig. 10.2 Most common setting of the reference side rail

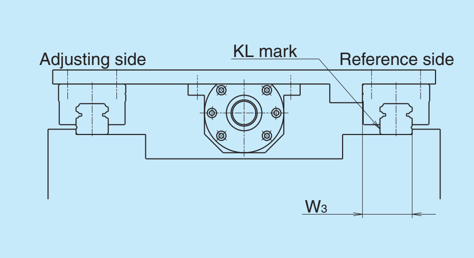


Fig. 10.3 Setting of the reference side rail in certain occasions

Table 10.1 Marks on the rail datum surfaces in each series

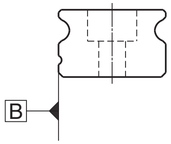
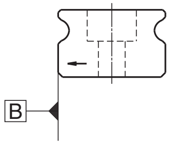
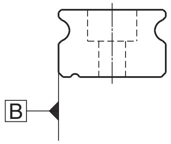
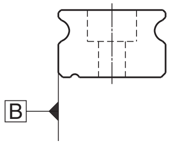
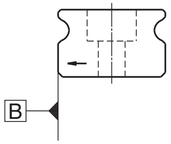
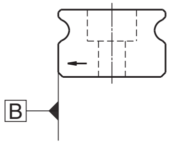
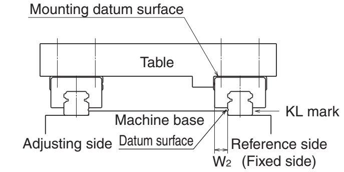
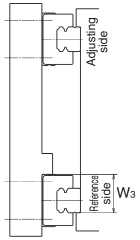
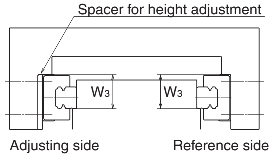
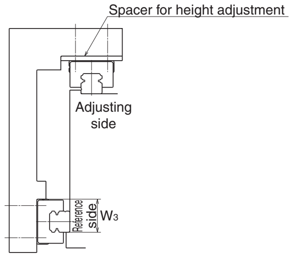
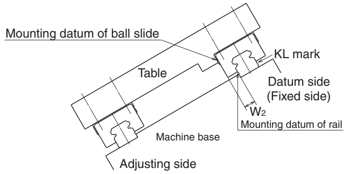
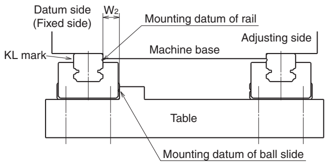
Model No. / Material	Standard	LU05, 07, 09 PU05, 09, 12, 15 LE07, 09, 12	LU12, 15, LH15	PU07 LE05, 15 LE09, 12 (with a ball retainer) PE series LH08, 10, 12 LW17, 21 RA15
Special high carbon steel				
Stainless steel				

Table 10.2 Arrangement example

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

2. Mounting accuracy

(1) Accuracy of the mounting base of machine

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

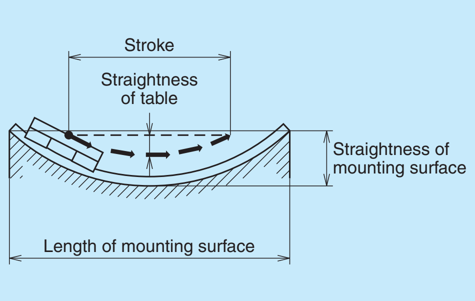
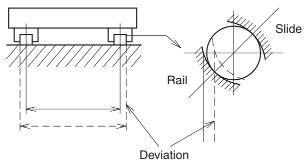
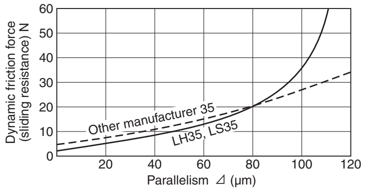
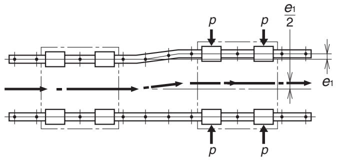


Fig. 10.4

(2) Installation error

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

Table 10.3 Influence of mounting error

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

(3) Permissible values of mounting error

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

For ball linear guides

- The permissible load per ball slide due to the mounting error is 10% of the basic dynamic load rating C.
- The rated life is 5 000 km.
- The rigidity of the machine base is infinite.

For roller linear guide

- The permissible load per roller slide due to the mounting error is 10% of the basic dynamic load rating C.
- The rated life is 10 000 km.
- The rigidity of the machine base is infinite.

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

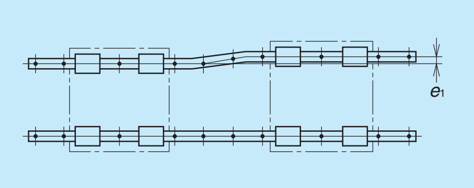


Fig. 10.5

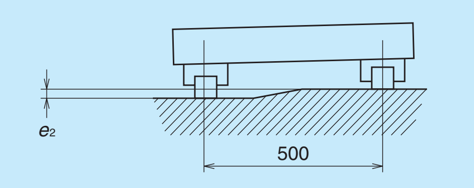


Fig. 10.6

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

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

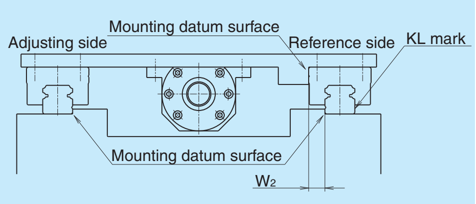


Fig. 10.7

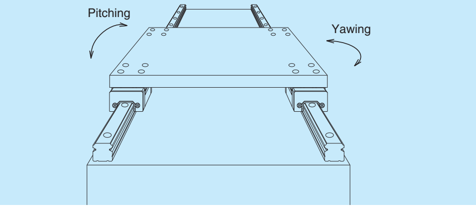


Fig. 10.8

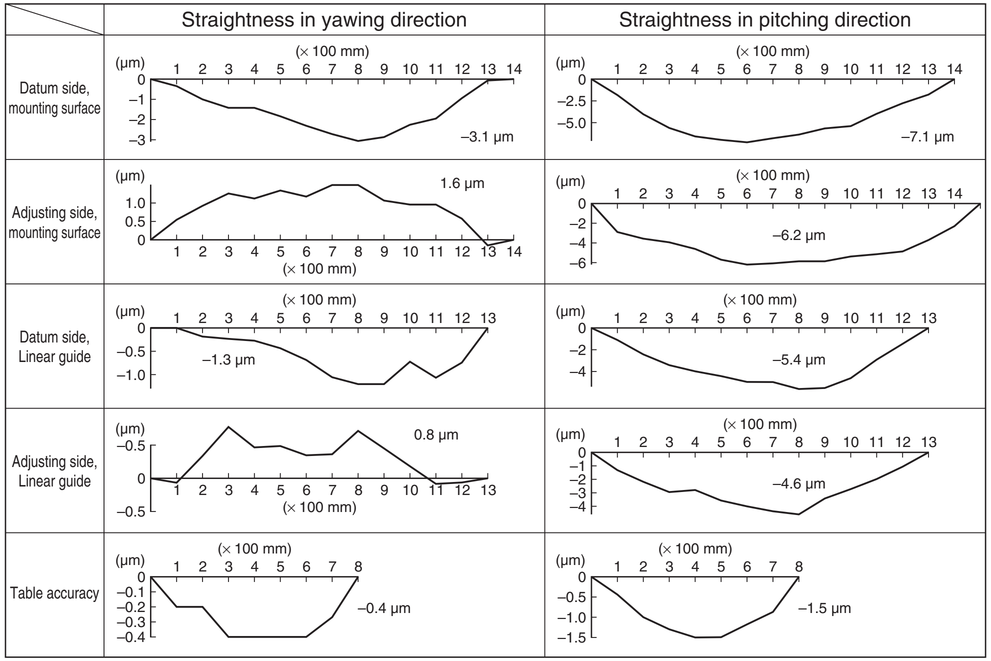


Fig. 10.9 Straightness of the table equipped with linear guide

3. Installation

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

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

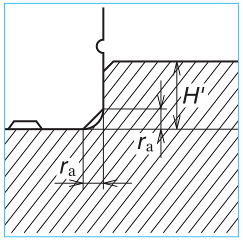


Fig. 10.10 Shoulder for the rail datum surface

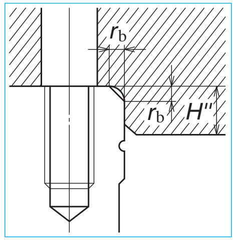


Fig. 10.11 Shoulder for the slide datum surface

(2) Tightening torque of the bolt

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

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

Unit: N·m

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

(3) Installation procedures

- There are two installation ways depending on the accuracy requirement.
  - a. Installation with high accuracy
  - b. Accuracy is not high, but easy to install
- For both methods, wipe off the rust preventive oil applied to the linear guide. Remove burrs and small bumps on the machine base and table mounting surface with an oilstone (**Fig. 10.12**).

  Apply machine oil or similar oil with low viscosity to the mounting surface to increase the rust preventive effect.
- Linear guides are precision products. Handle them with care.

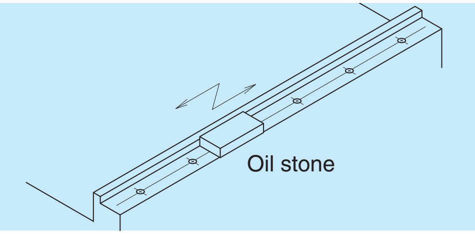


Fig. 10.12

1) Highly accurate installation

A) Rail installation procedures

a) When the machine base has a shoulder for the reference side rail.

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

At this time, press the rail from sideways to make the rail tightly contact to the shoulder of the machine base. When using a shoulder plate, refer to **Table 10.4** for the bolt tightening torque (**Fig. 10.13**).

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

[2] For final tightening of the bolts to secure the rail, tighten the bolt on either end of the rail, then proceed to other end.

If the datum surface is on the left side as shown in **Fig. 10.14**, tighten the bolt at the farthest end first, then proceed to the near end.

This way, creates a bolt rotating force that presses the rail against the shoulder. (Therefore, the rail is pressed sufficiently tight against the shoulder by merely pressing the rail by hand. However, if there is a possibility applying a lateral impact load, it is necessary to use a shoulder plate to prevent the rail from slipping.)

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

[4] If there is no shoulder on the mounting surface of the machine base for the adjusting side rail: Secure a measuring table to the slides of the reference side rail (**Fig. 10.15**). Use this to adjust the parallelism of the adjusting side rail. Check parallelism of the adjusting side rail with a dial indicator from one end of the rail, tightening the bolts one by one.

The measuring table is more stable if secured to two slides, but one slides is sufficient.

Parallelism between two rails can also be checked by the same method in **Fig. 10.15** when there is a shoulder on the surface where the adjusting side rail is installed.

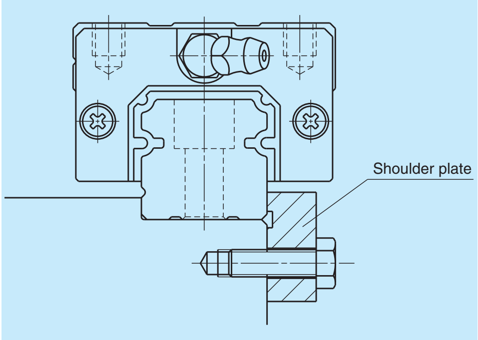


Fig. 10.13 Pressing the rail from sideways

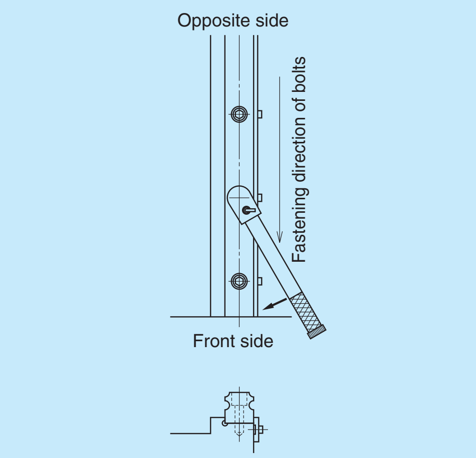


Fig. 10.14 Rail installation

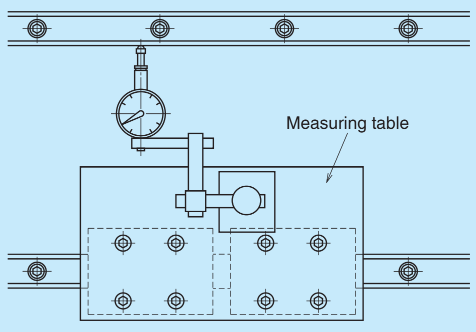


Fig. 10.15 Measuring parallelism

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

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

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

[3] Once the position of the straight edge is determined, use it as the reference. With a dial indicator, check parallelism with the rail, and adjust the rail if necessary. Then tighten the bolts.

Ensure that the straight edge does not move while the bolts are being tightened.

This procedure should be carried out starting from one end of the rail to the other end (**Fig. 10.16**).

[4] Finally tighten all bolts with specified torque.

[5] There are two ways for installation of adjusting side rail:

1. Based on the straight edge which is used for reference side rail installation
2. Based on the reference side rail which is installed prior to the adjusting side rail.

In both cases, use a dial indicator to measure parallelism.

Other procedures are the same as [1] - [4] above, and the [4] for the case where there is a shoulder on the machine base.

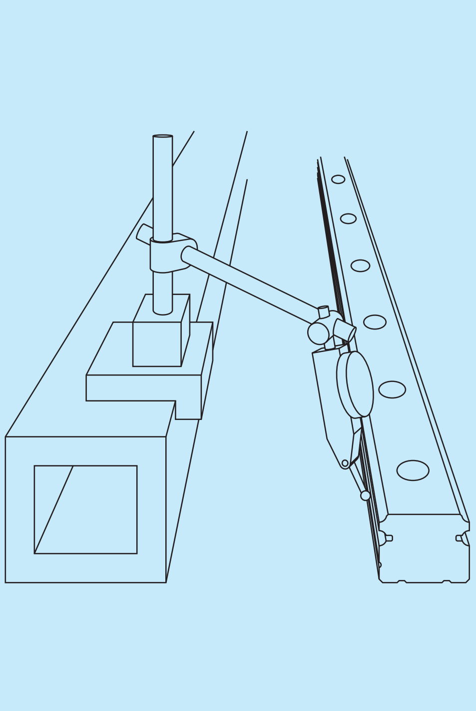


Fig. 10.16

B) Procedures for slide installation

a) When the table has a shoulder

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

[2] While pressing the table from sideways, further tighten the bolts which secure the slides on the reference side, so the table shoulder and the slide's mounting datum surface are sufficiently tightly pressed.

If a shoulder plate is provided, first tighten the bolts of the plate, then further tighten the bolts to the slides (**Fig. 10.17**).

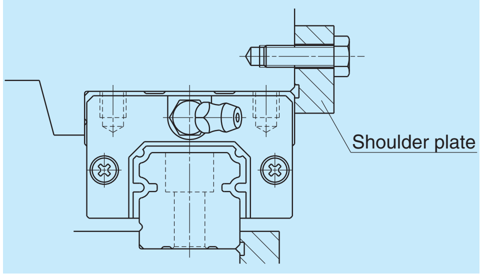


Fig. 10.17 Pressing slide from sideways

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

[4] Finally, tighten all bolts with standard torque.

b) When table does not have a shoulder

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

[2] Since the table does not have a shoulder, immediately tighten the bolts further to secure slides.

[3] Move the table by hand to confirm that there is no abnormality. Finally, tighten all bolts with the specified torque.

2) Easy installation

[1] Carefully place the reference side rail on the machine base. Then tighten the bolts to the specified torque.

[2] Loosely tighten the bolts on the adjusting side rail.

[3] Tighten the slides on the reference side rail and one slide on the adjustment side rail with the specified torque. Leave the rest of the slide on the adjusting side rail loosely tightened (**Fig. 10.18**).

[4] While moving the table with each pitch of the bolt for rail: With the specified torque, tighten the rail mounting bolt which is located immediately adjacent to the slide on the adjusting side rail that had been firmly tightened.
Take this procedure from one end to the other.

[5] Return the table to the original position once. Then, tighten the rest of the slides on the adjusting side to the specified torque. By the same procedure as in [4], tighten the rest of the rail mounting bolts to the specified torque. Move the table to check any abnormality such as large friction force.

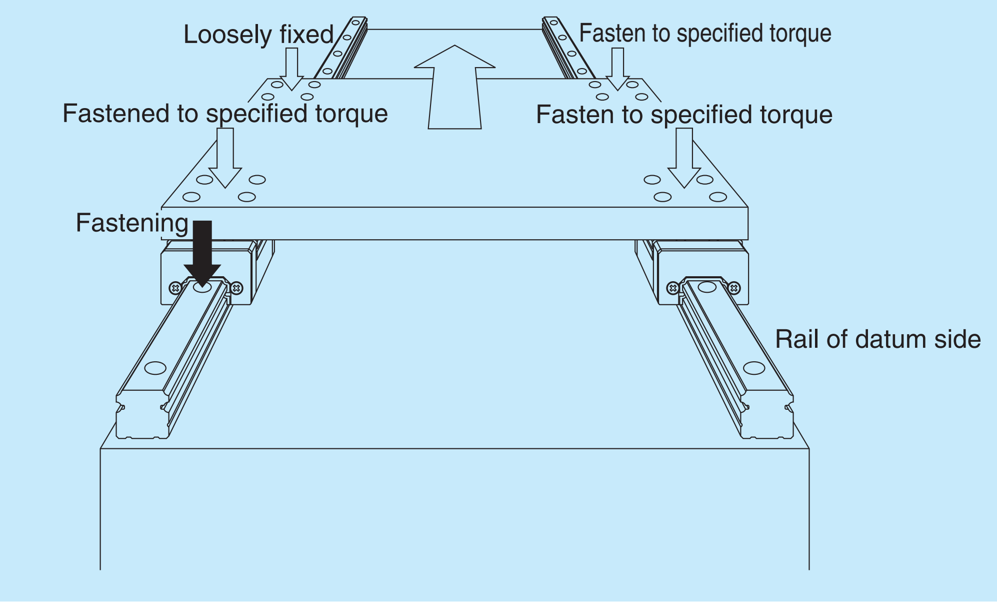


Fig. 10.18 Easy installation

(4) Various methods to press linear guide sideways

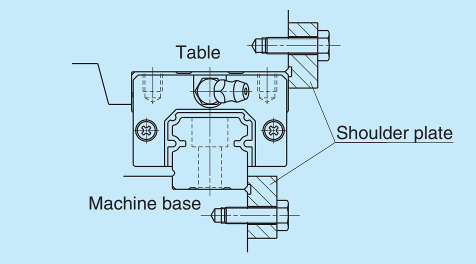


Fig. 10.19 Recommended method

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

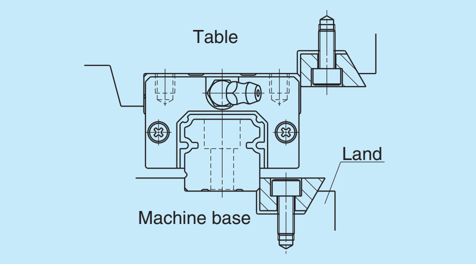


Fig. 10.20 Installation that requires caution

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

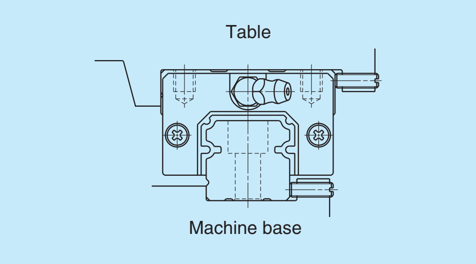


Fig. 10.21

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

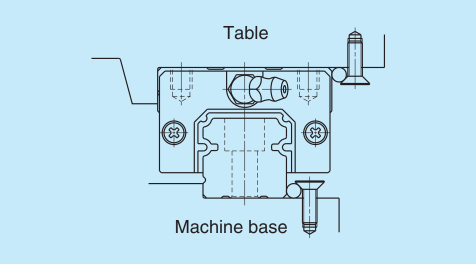


Fig. 10.22

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

4. Assembly random-matching type linear guide

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

Assembly procedures of a random-matching type linear guide

Follow steps as described below.

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

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

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

5. Butting rail specification

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

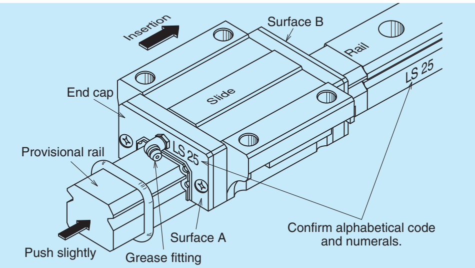


Fig. 10.23 Inserting slide into the rail

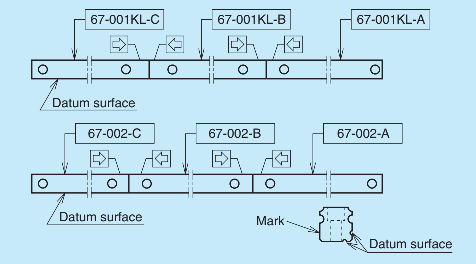


Fig. 10.25

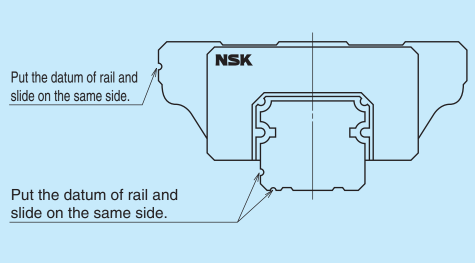


Fig. 10.24

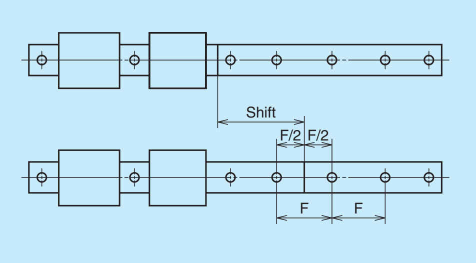


Fig. 10.26

6. Handling preloaded assembly

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

Mark for assembling ball slide and rail

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

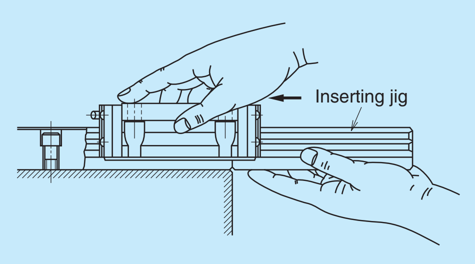


Fig. 10.27

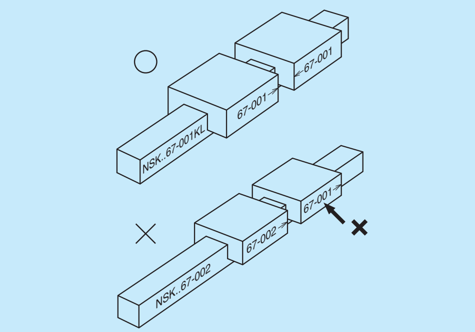


Fig. 10.28

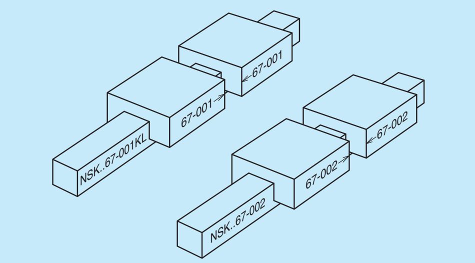


Fig. 10.29 When two rails have the same reference number

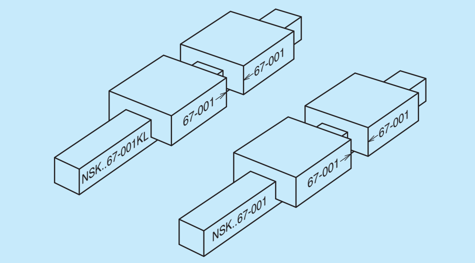


Fig. 10.30 When two rails have different reference number

A-3-11 Drills to Select Linear Guide

1. Single axis material handling system

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

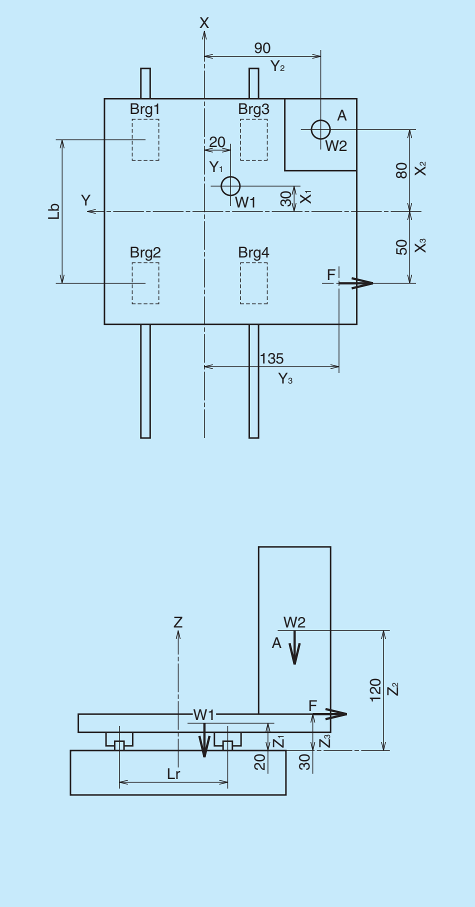


Fig. 11.1 Single axis material handling system

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

Specification of the single axis material handling system

Table weight W1 : 150 (N)
Weight of the work W2 : 200 (N)
Acting load F : 200 (N)

Ball slide span L_b : 100 (mm)
Rail span L_r : 90 (mm)

Load point coordinates from the table center (mm)

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

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

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

(1) Selection of linear guide model

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

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

(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 : 5 550 (N)
Basic static load rating : 6 600 (N)

Load conditions of the linear guide

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

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

Calculation of the load applied to ball slide

Calculate two occasions:

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

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

When a work is mounted on the table

Vertical loads

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

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

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

Similarly

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

Lateral loads

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

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

Similarly

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

No work mounted on the table

Vertical load

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

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

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

Similarly

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

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

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

Lateral loads

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

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

Similarly

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

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

Calculation of dynamic equivalent load

Use **"A-3-2.2 3. Calculation of dynamic equivalent load."**

It matches Position 4 in **"Table 2.3 Loads in the arrangement of linear guides."** Ball slide loads that must be considered are vertical and lateral direction loads.

In case of LU15AL,

Vertical direction dynamic equivalent load

$F_r = F_r$

Lateral direction dynamic equivalent load

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

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

Results are shown in the table below.

Unit: N

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

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

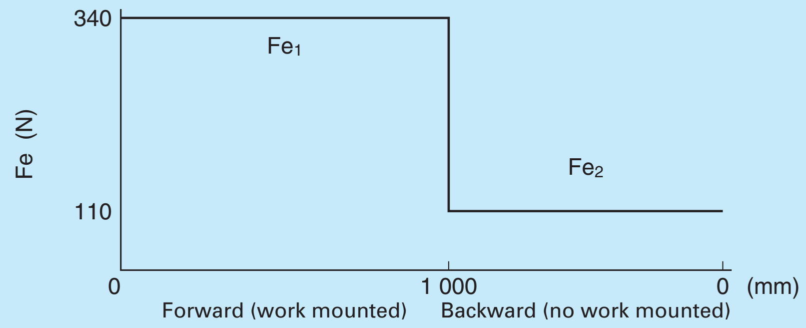
Therefore;

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

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

Calculation of mean effective load

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



Cycle patterns of full dynamic equivalent load

From the cycle pattern, the mean effective load matches the case **"(1) When load and running distance vary stepwise."** Therefore, use the following formula.

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

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

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

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

Determine various coefficients

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

Load factors

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

Hardness coefficient

The hardness of NSK linear guides is HRC58 to 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 basic rating life."**

The basic dynamic load rating (C) of linear guide LU15AL : 5 550 (N)

Mean effective load F_m : 273 (N)

Load factor f_w : 1.2

Hardness coefficient f_H : 1

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

$$= 50 \times \left(\frac{1 \times 5\,550}{1.2 \times 273}\right)^3$$

$$= \text{approximately } 243\,110\ (\mathrm{km})$$

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

Convert the above rating fatigue life into hours:

$$\frac{243\,110 \times 1\,000}{12 \times 60 \times 16} = \text{approximately } 21\,100\ (\text{days})$$

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: 6 600 (N)

Ball slide No. 3 bears the largest load.

P_0 at this time:

$P_0 = F_r + F_s = 340$

Therefore, static permissible load coefficient fs is:

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

There is no problem at this value.

(3) Selection of accuracy grade and preload

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

(4) Calculation of deformation

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

$K_s = K_r$ = 45 (N/μm) = 45 000 (N/mm)

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

From Pattern 4 in Table 2.2 (page A19)

Work mounted:

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

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

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

Similarly, δ_{y1} = – 0.0082 (mm) = – 8.2 (μm)

δ_{z1} = 0.0123 (mm) = 12.3 (μm)

No work mounted:

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

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

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

Similarly, δ_{y2} = –0.0023 (mm) = –2.3 (μm)

δ_{z2} = 0.0039 (mm) = 3.9 (μm)

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

$\delta_x = \delta_{x1} - \delta_{x2}$ = 7.5 –3.2 = 4.3 (μm)

$\delta_y = \delta_{y1} - \delta_{y2}$ = –8.2 – (–2.3) = –5.9 (μm)

$\delta_z = \delta_{z1} - \delta_{z2}$ = 12.3 –3.9 = 8.4 (μm)

2. Machining center

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

Operating conditions

Dimensions and load conditions are:

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

X axis stroke : 400 (mm)

Y axis stroke : 350 (mm)

Z axis stroke : 500 (mm)

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

Cutting load

Milling process	*Fx* = *Fy* = 1 000 (N)
Drilling process	*Fz* = 3 000 (N)

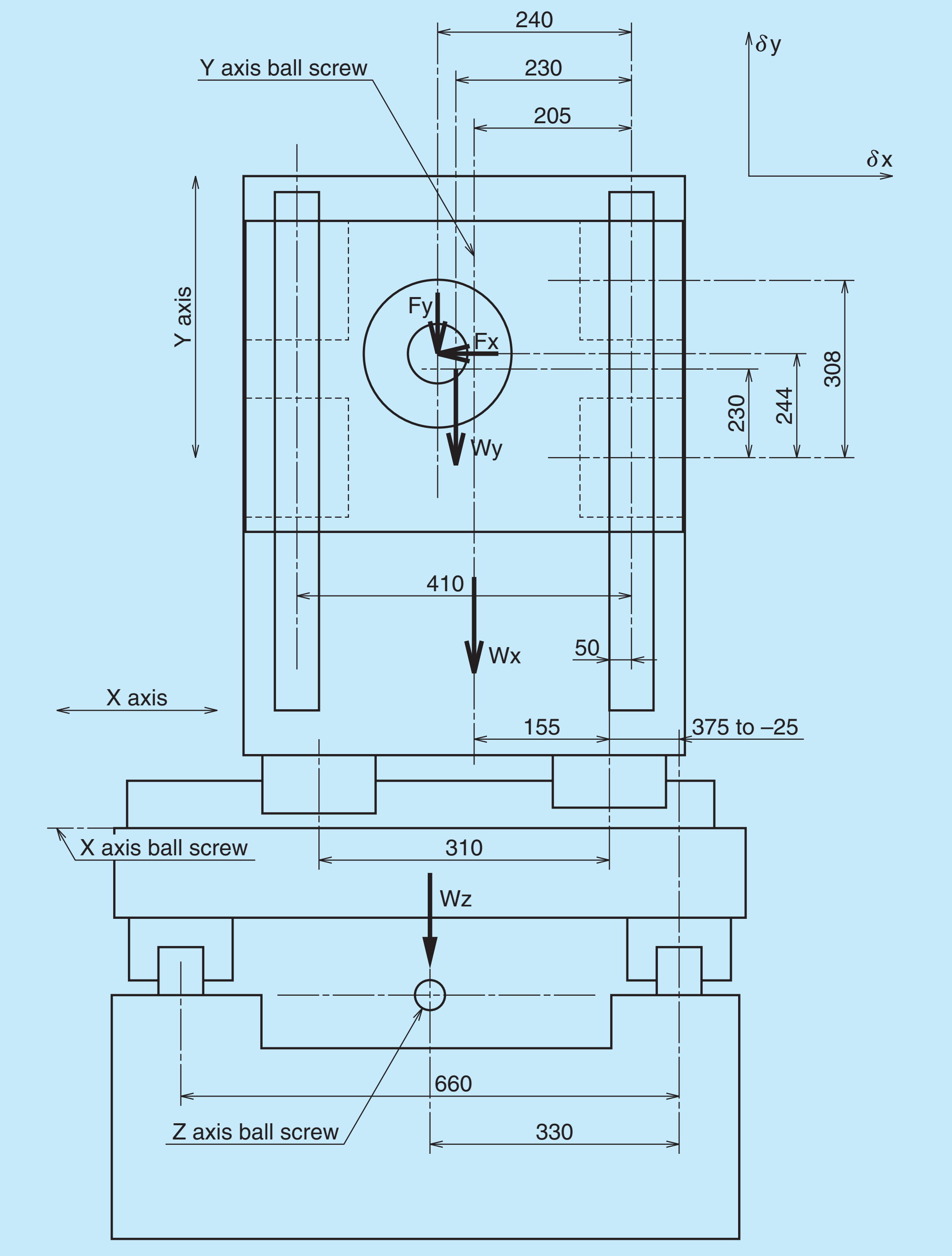


Fig. 11.2 Machining center (front view)

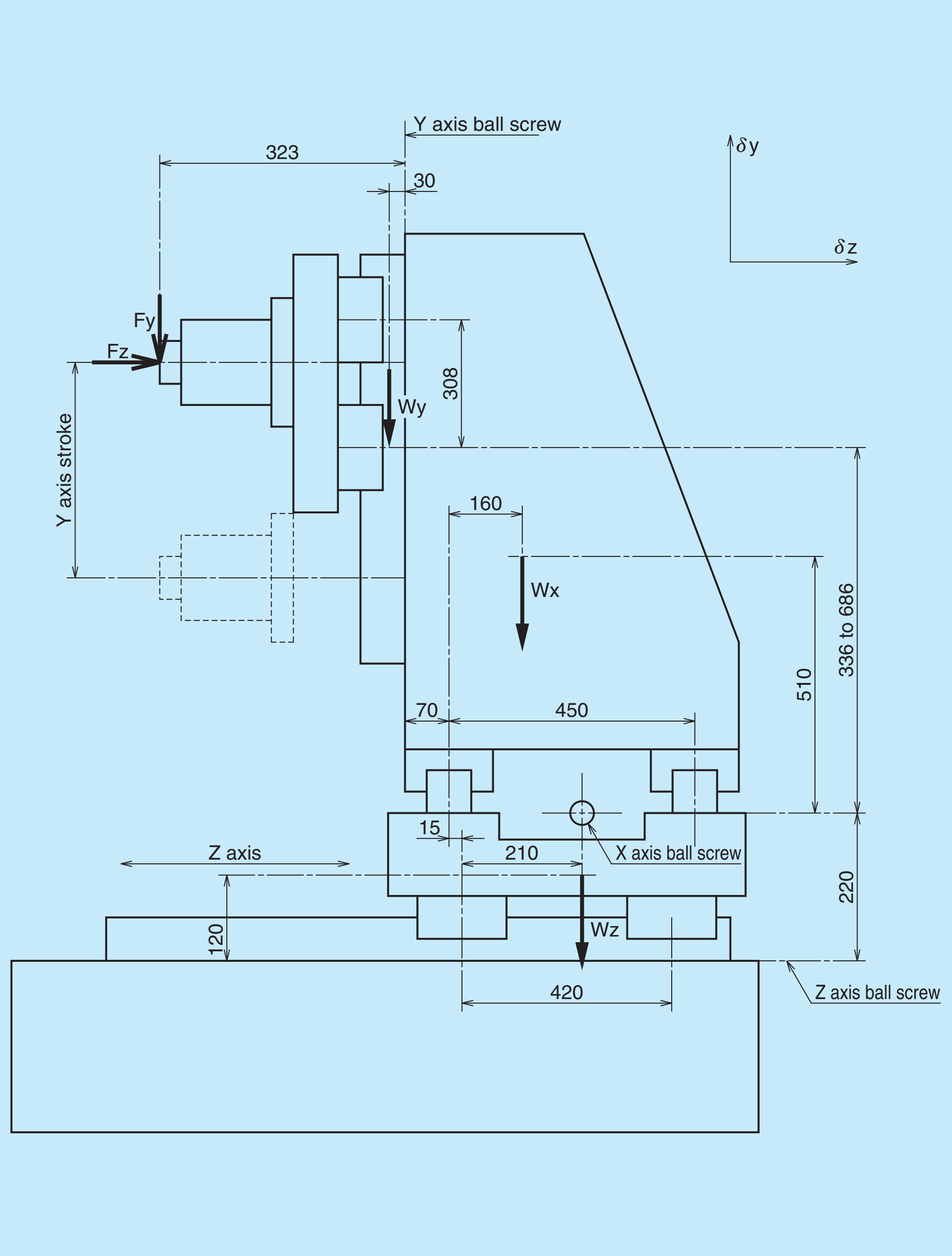


Fig. 11.3 Machining center (side view)

(1) Selection of linear guide model

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

Select below temporarily from shaft diameter of ball screw:

X axis LA55
Y axis LA35
Z axis LA65

(2) Selection of accuracy grade and preload

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

(3) Calculation of life expectancy

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

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

Calculation of the loads that apply to the ball slide

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

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

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

Unit: N

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

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

Similarly,

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

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

Unit: N

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

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

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

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

Unit: N

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

Calculation of dynamic equivalent load

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

Vertical dynamic equivalent load

$Fr = Fr$

Lateral dynamic equivalent load

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

From the above, calculate *Fe* using formulas for full dynamic equivalent loads shown in page A23.

From calculation, the largest full dynamic equivalent loads are as follows.

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

Calculation of full dynamic equivalent load taking account of preload

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

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

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

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

Calculation of mean effective load

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

Therefore,

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

Determine various coefficients

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

For this case the factors are following.

Load coefficient f_W : 1.5

Hardness coefficient f_H : 1

Calculation of rating life

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

Basic dynamic load rating C

(X axis linear guide LA55): 139 000 (N)

Basic dynamic load rating C

(Y axis linear guide LA35): 61 500 (N)

Basic dynamic load rating C

(Z axis linear guide LA65): 260 000 (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 $Lx =$ 65 410 (km)

In case of Y axis $Ly =$ 138 440 (km)

In case of Z axis $Lz =$ 108 300 (km)

In case of roller linear guides, refer to **"A-3-2.2 6. Calculation of rating life"** (page A26).

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

Basic static load rating C_0

(X axis linear guide LA55): 215 000 (N)

Basic static load rating C_0

(Y axis linear guide LA35): 98 000 (N)

Basic static load rating C_0

(Z axis linear guide LA65): 420 000 (N)

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

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

Similarly,

Y axis fs = 61.5

Z axis fs = 42.0

Therefore, there is no problem.

(3) Calculation of deformation

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

Rigidity of X axis linear guide LA55Z3: 1 400 (N/μm)

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

Rigidity of Z axis linear guide LA65Z3: 1 730 (N/μm)

Calculate using Pattern 4 in Table 2.2.

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

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

δx = –17.9 – (–3.4) = –14.5 (μm)

δy = –13.3 – (–9.1) = –4.2 (μm)

δz = –14.2 – (–9.3) = –4.9 (μm)

Deformation at processing points at time of drilling is:

δx = –5.8 – (–3.4) = –2.4 (μm)

δy = 5.0 – (–9.1) = 14.1 (μm)

δz = 14.3 – (–9.3) = 23.6 (μm)

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

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

A-3-12 Reference

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

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

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

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

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

A-4 NSK Linear Guides™

1. Structure of NSK Linear Guides

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

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

2. Characteristics of NSK Linear Guides

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

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

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

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

(1) High precision and quality

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

(2) High reliability and durability

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

(3) Abundant in type for any purpose

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

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

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

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

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

(6) Lineup of extremely high-load capacity series

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

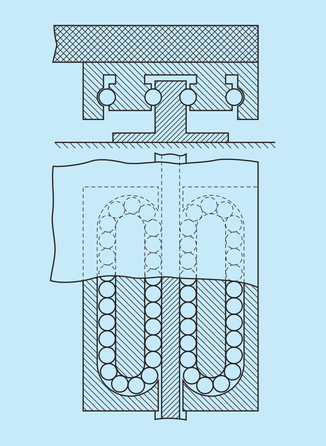


Fig. 1 • **French Patent in 1932.**
• **Inventor: Gretsh (German)**

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

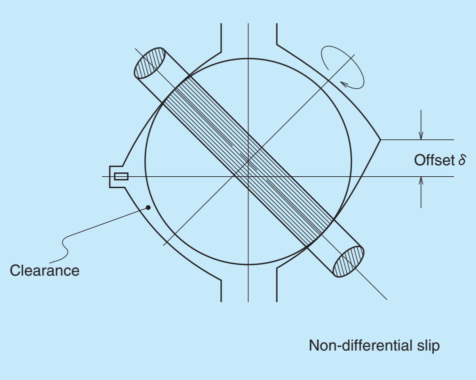


Fig. 3 Two contact point at offset Gothic arch groove

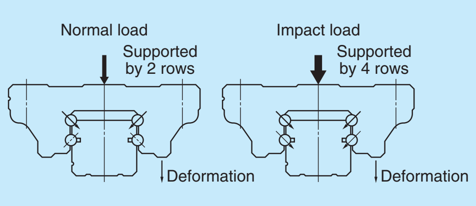


Fig. 5 Shock-resistance

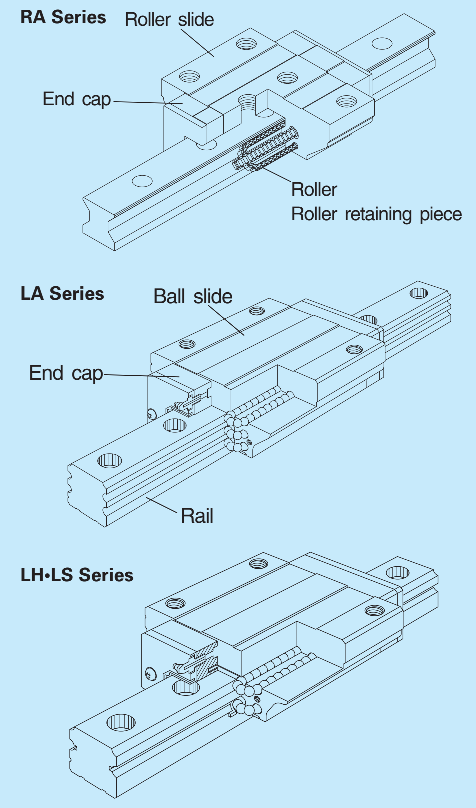


Fig. 2 Structure of NSK linear guides

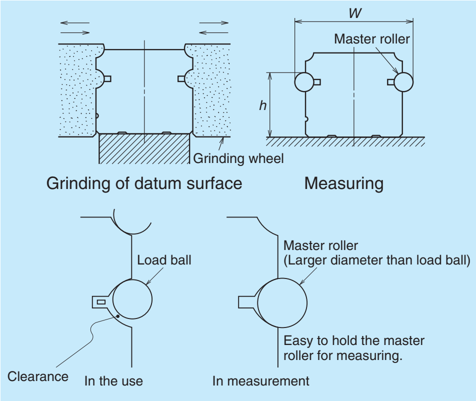
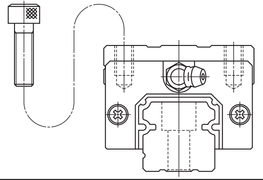
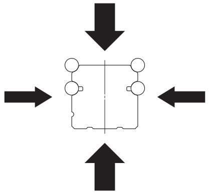
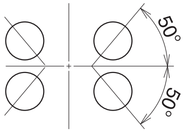
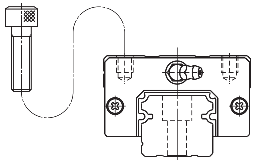
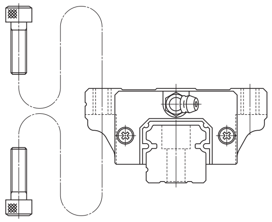
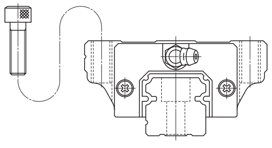
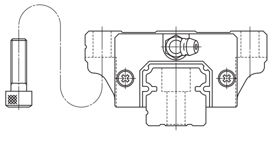


Fig. 4 Processing and measuring grooves

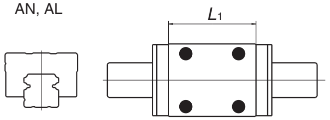
Measuring grooves accuracy is easy. You can obtain highly accurate results for all types of NSK series. This is why you can purchase rails and slides separately for random matching.

3. Types and Characteristics of NSK Linear Guides

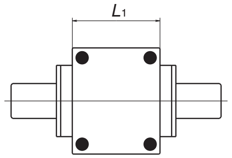
Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	Characteristics	Applications	Page
High vertical load carrying capacity type	Self-aligning type	LH	AN BN				The LH series is applicable to a wide range of uses from general industrial use to high-accuracy application. Random-matching of rails and ball slides is available as a standard. ● The contact angle between the ball and ball groove is set at 50 degrees. This design increases the load carrying capacity against the vertical directions, which is the main load acting direction in most operations. ● The DF contact structure greatly absorbs the installation error in the perpendicular direction to the rail. ● Balls make contact at two points thanks to the offset Gothic arch groove. This keeps friction to a minimum. ● High resistance against shock load due to the unique load-carrying structure. ● Gothic arch groove renders measuring of ball grooves accurate and easy. ● Standardized random-matching type allows separate purchase of rails and ball slides. ● Stainless steel standard type is also available for small sizes (LH15 to LH30). ● Stainless steel type is standard for LH08 to 12.	• Cartesian type robots • Robots that remove plastic molds from injection machine • Material handling equipment • Food processing machines • Packaging/packing machines • Printing machines • Woodworking machines • Paper manufacturing machines • Measuring equipment • Inspecting equipment • Semiconductor manufacturing equipment • LCD manufacturing equipment • Medical equipment • Electric discharge machines • Laser cutting machines • Press machines • Tool grinders • Flat surface grinders • NC lathes • Machining centers • Automatic tool changers	A115
			AL BL						
			EM GM						
			EL GL						
			FL HL						

High-load type

AN, AL

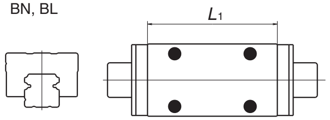


EM, EL, FL

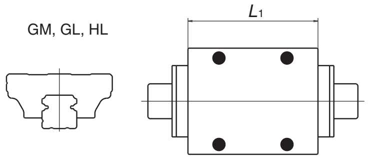


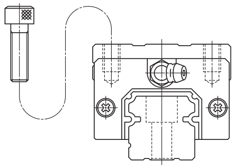
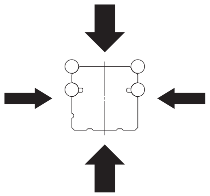
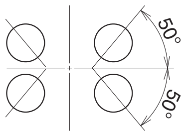
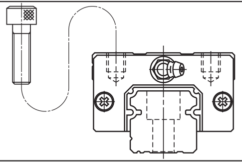
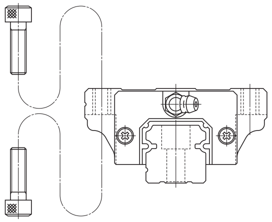
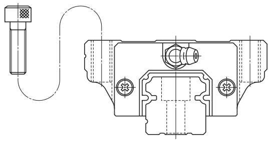
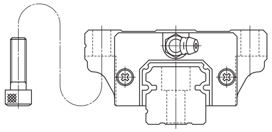
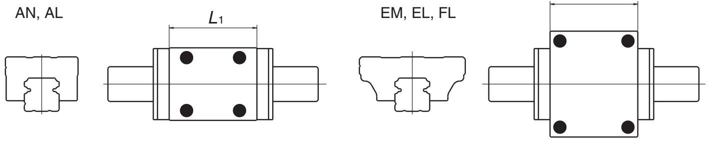
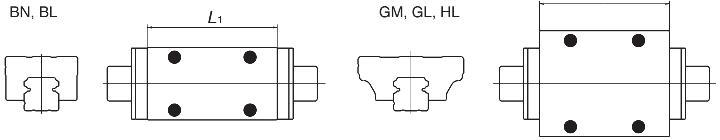
Super-high-load type

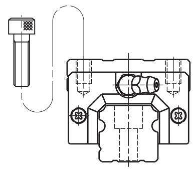
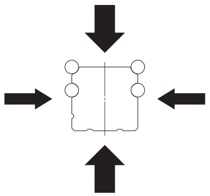
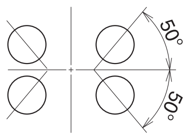
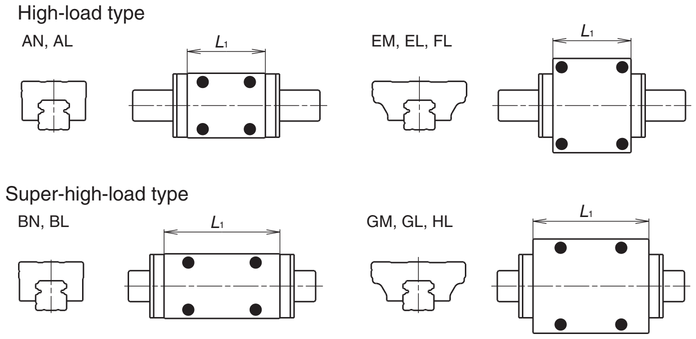
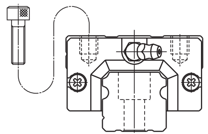
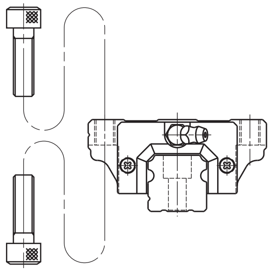
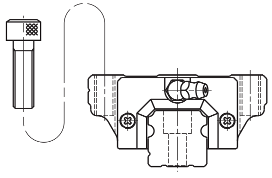
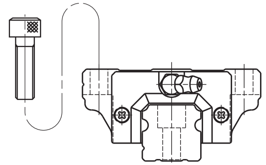
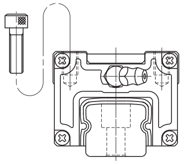
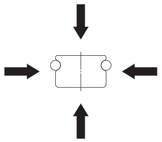
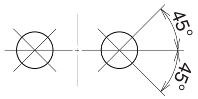
BN, BL

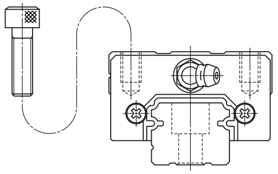
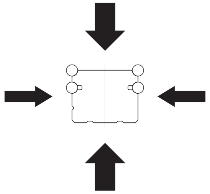
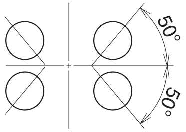
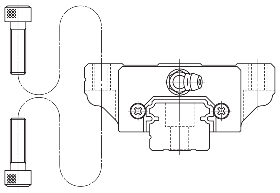
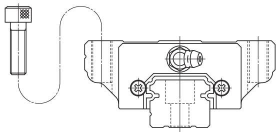
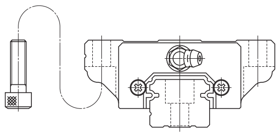


GM, GL, HL



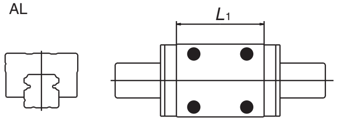
Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	Characteristics	Applications	Page
High vertical load carrying capacity type	Self-aligning type	SH	AN BN				The SH series has achieved lower noise, gentler tone, and smoother motion. Random-matching of rails and ball slides is available as a standard. ● Lower noise and gentler tone. ● The contact angle between the ball and ball groove is set at 50 degrees. This design increases the load carrying capacity against the vertical directions, which is the main load acting direction in most operations. ● The DF contact structure greatly absorbs the installation error in the perpendicular direction to the rail. ● Balls make contacts at two points thanks to the offset Gothic arch groove. This keeps friction to a minimum. ● Unique load-carrying structure contributes to high resistance against shock load. ● Gothic arch groove renders measuring of ball grooves accurate and easy. ● Standardized random-matching type allows separate purchase of rails and ball slides. ● Stainless steel standard type is also available for small sizes (SH15 to SH30).	• Semiconductor manufacturing equipment • LCD manufacturing equipment • Cartesian type robots • Robots that remove plastic molds from injection machine • Material handling equipment • Packaging/packing machines • Printing machines • Paper manufacturing machines • Measuring equipment • Inspecting equipment • Medical equipment • Electric discharge machines • Laser cutting machines • Press machines • Tool grinders • Flat surface grinders • NC lathes • Machining centers • Automatic tool changers	A139
			AL BL						
			EM GM						
			EL GL						
			FL HL						
				High-load type 			Super-high-load type 		

Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	Characteristics	Applications	Page
High vertical load carrying capacity type	Self-aligning type	VH	AN BN				The VH series delivers outstanding dust-proof functionality and thus ensures long operating life under contaminated environments. Random-matching of rails and ball slides is available as a standard. ● The contact angle between the ball and the raceway is set at 50 degrees. This design increases the load carrying capacity against vertical directions, which is the main load acting direction in most operations. ● The DF contact structure greatly absorbs the installation error in the perpendicular direction to the rail. ● Thanks to the offset Gothic arch groove, balls make contacts at two points. This keeps friction to a minimum. ● High resistance against shock load due to the unique load carrying structure. ● Gothic arch groove renders measuring groove accurate and easy. ● Standardized random-matching type allows separate purchase of rails and ball slides. ● Penetration of fine contaminants is less than 1/10 of the existing products. ● Operating life under contaminated environments is more than 5 times longer.  High-load type Super-high-load type	• Automotive manufacturing equipment • Press machines • Machine tools loader/un-loader • Tire molding machines • Woodworking machines • Automatic doors	A163
			AL BL						
			EM GM						
			EL GL						
			FL HL						
Four-way equal load carrying capacity type	Standard type	TS	AN				The TS series is suitable for transfer equipment. ● The newly developed manufacturing processes contribute to low cost. ● Standardized random-matching type allows separate purchase of rails and ball slides.	• Automotive manufacturing equipment • Press machines • Loader/unloader of machine tools • Tire molding machines • Woodworking machines • Automatic doors	A185

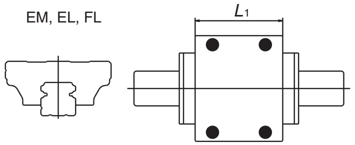
Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	Characteristics	Applications	Page
High vertical load carrying capacity type	Self-aligning type	LS	CL AL				The LS series is low in height, and is applicable to a wide range of uses from general industrial use to high-accuracy application. Random-matching of rails and ball slides is available as a standard. ● Compact and low profile. ● The contact angle between the ball and the groove is set at 50 degrees. This design increases the load carrying capacity against vertical directions, which is the main load direction prevalent in most operations. ● The DF contact structure greatly absorbs the installation error in the perpendicular direction of the rail. ● Thanks to the offset Gothic arch groove, balls make contacts at two points. This keeps friction to a minimum. ● High resistance against shock load due to the unique load carrying structure. ● Gothic arch groove renders measuring groove accurate and easy. ● Standardized random-matching type allows separate purchase of rails and ball slides. ● Stainless steel type is also available.	• Cartesian type robots • Robots that remove plastic molds from injection machine • Material handling equipment • Food processing machines • Packaging/packing machines • Printing machines • Woodworking machines • Paper manufacturing machines • Measuring equipment • Inspection equipment • Semiconductor manufacturing equipment • LCD manufacturing equipment • Medical equipment • Electric discharge machines • Laser cutting machines • Press machines	A191
			JM EM						
			JL EL						
			KL FL						

High-load type

AL

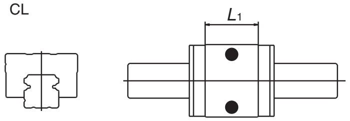


EM, EL, FL

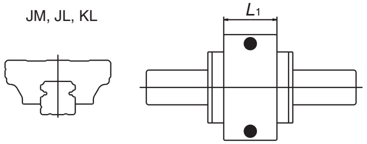


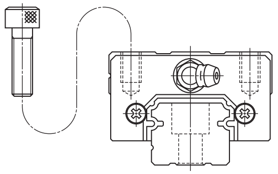
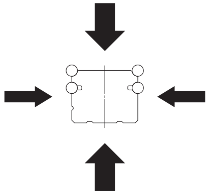
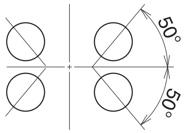
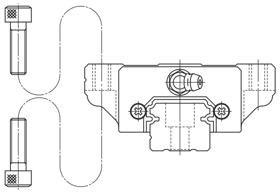
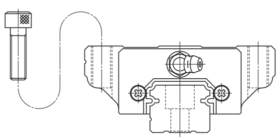
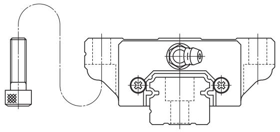
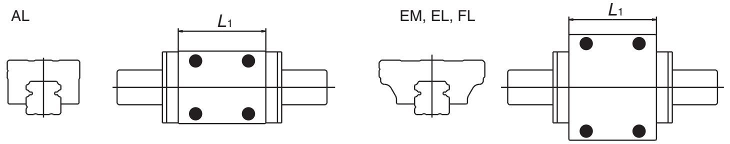
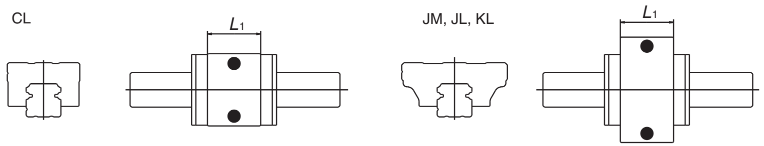
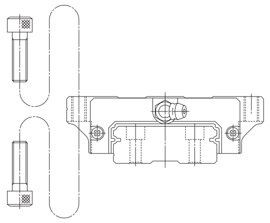
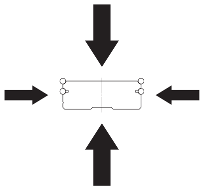
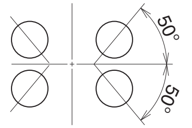
Medium-load type

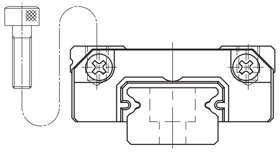
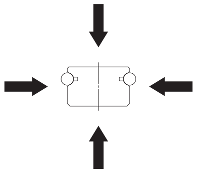
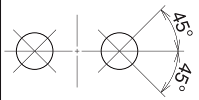
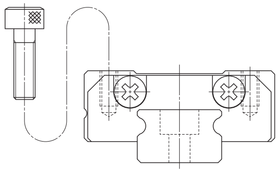
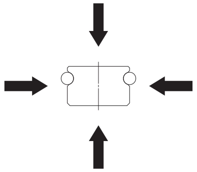
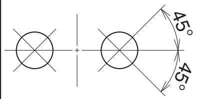
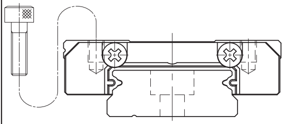
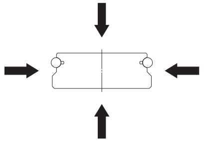
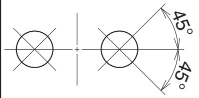
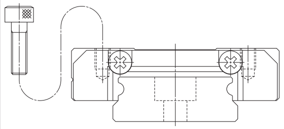
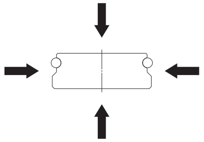
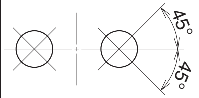
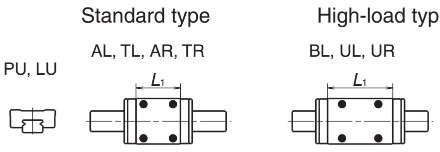
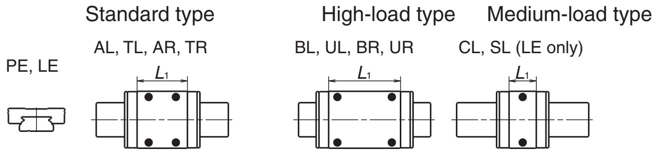
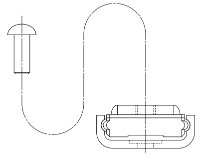
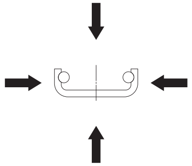
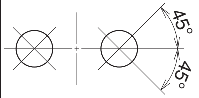
CL

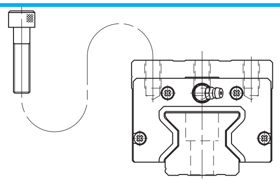
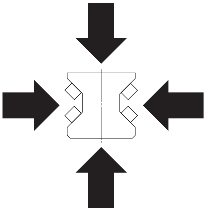
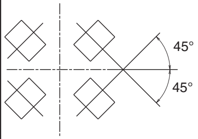
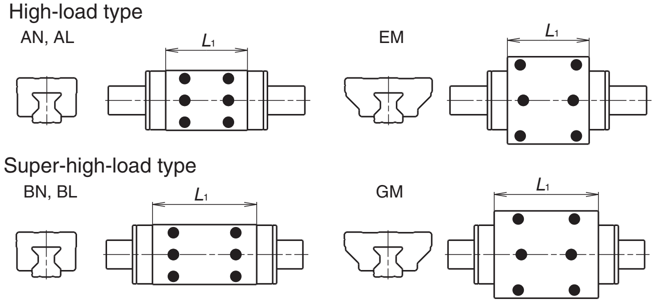
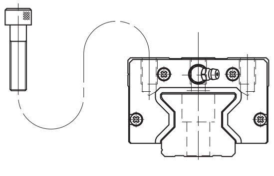
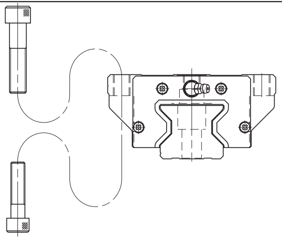
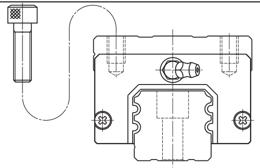
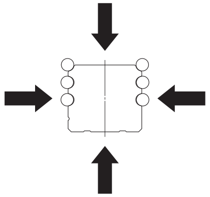
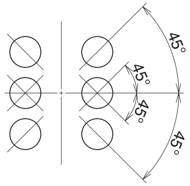
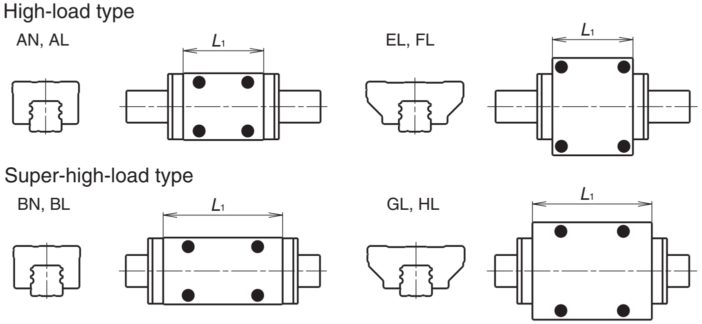
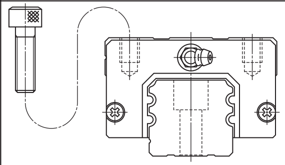
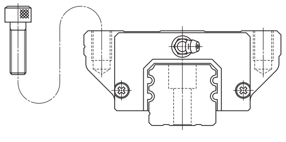
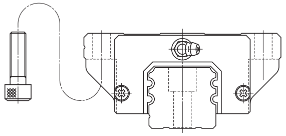


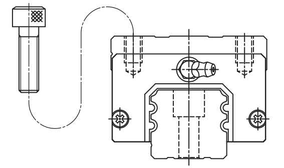
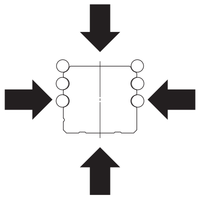
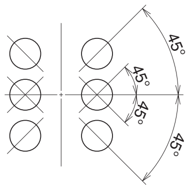
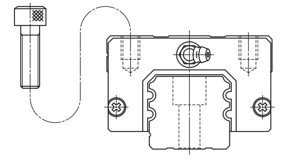
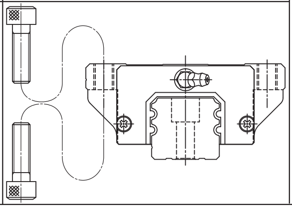
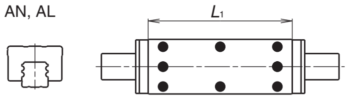
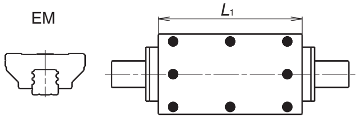
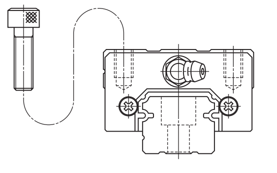
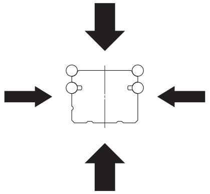
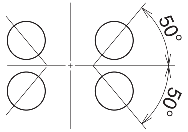
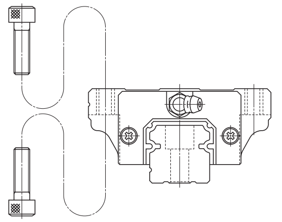
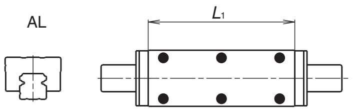
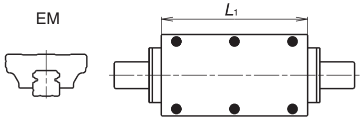
JM, JL, KL



Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	Characteristics	Applications	Page
High vertical load carrying capacity type	Self-aligning type	SS	CL AL				The SS series has achieved lower noise, gentler tone, and smoother motion, and has a low and compact design. Random-matching of rails and ball slides is available as a standard. ● Lower noise and gentler tone. ● Compact and low profile. ● The contact angle between the ball and the ball groove is set at 50 degrees. This design increases the load carrying capacity against vertical directions, which is the main load acting direction in most operations. ● The DF contact structure greatly absorbs the installation error in the perpendicular direction to the rail. ● Thanks to the offset Gothic arch groove, balls make contacts at two points. This keeps friction to a minimum. ● Great resistance against shock load due to the unique load carrying structure. ● Gothic arch groove renders measuring ball grooves accurate and easy. ● Standardized random-matching type allows separate purchase of rails and ball slides. ● Stainless steel type is also available.	• Semiconductor manufacturing equipment • LCD manufacturing equipment • Cartesian type robots • Robots that remove plastic molds from injection machine • Material handling equipment • Packaging/packing machines • Printing machines • Paper manufacturing machines • Measuring equipment • Inspection equipment • Medical equipment • Electric discharge machines • Laser cutting machines • Press machines	A213
			JM EM						
			JL EL						
			KL FL						
				High-load type 			Medium-load type 		
	High moment capacity type	LW	EL				High-moment rigidity and low profile products are most suited for a single rail linear guideway system. Random-matching of rails and ball slides is available as a standard. ● The wide rail contributes to a high rolling moment carrying capacity and to great moment rigidity of a single rail linear guideway system. ● Balls contact at two points in the Gothic arch groove, thus keeping friction to a minimum. ● High resistance against shock load ● Standardized random-matching type allows separate purchase of rails and ball slides.	• Semiconductor manufacturing equipment • LCD manufacturing equipment • Conveyor systems • Medical equipment • Microscope XY stages	A235

Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	Characteristics	Applications	Page
Miniature type	Standard type	PU	AL AR TR UR BL				Low inertia and low dust generation miniature series. ● Low dust generation and highly smooth operation ● Super-compact size ● Stainless steel is the standard material. ● A ball retainer is a standard equipment. ● Standardized random-matching type allows separate purchase of rails and ball slides.	• Semiconductor manufacturing equipment • LCD manufacturing equipment • Medical equipment • Optical stages • Microscope XY stages • Conveying system of optical fibers • Miniature robots • Computer peripherals • Pneumatic equipment	A251
		LU	AL TL AR TR BL UL				Miniature series ● Extremely compact size ● Stainless steel is the standard material. ● A ball retainer is a standard equipment. ● Standardized random-matching type allows separate purchase of rails and ball slides.		A261
	High moment capacity type	PE	AR TR UR BR				Wide rail miniature with low inertia and low dust generation. ● Low dust generation and highly smooth operation ● Super-compact size ● Stainless steel is the standard material. ● A ball retainer is a standard equipment. ● Standardized random-matching type allows separate purchase of rails and ball slides.	• Semiconductor manufacturing equipment • LCD manufacturing equipment • Medical equipment • Optical stages • Microscope XY stages • Conveying optical fibers • Miniature robots • Computer peripherals • Pneumatic equipment	A273
		LE	AL TL AR TR BL UL CL SL				Miniature wide series ● Super-small size in wide rail type ● Stainless steel is the standard material. ● A ball retainer is a standard equipment. ● Standardized random-matching type allows separate purchase of rails and ball slides.		A283
									
	Lightweight type	LL	PL				The LL series is a compact and lightweight miniature linear guide for press molding. ● Rails and ball slides are made of thin steel plate, and thus making them very light. ● Stainless steel is the standard material.	• Platter pen heads • Robot hands • Pneumatic equipment	A297

Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	Characteristics	Applications	Page
Four-way equal load carrying capacity type	Super-rigid type	RA	AN BN				The RA series roller guides have realized the world highest load capacity. Super-high rigidity and smooth motion contribute to higher performance of machine tools. ● Unique and optimum design of rollers and other component facilitate the high-load capacity and high rigidity. ● High-performance seals, a standard feature in the roller guides, maintain the initial performance for a prolonged time. ● The installation of retaining piece achieves smooth motion. ● Standardized random-matching type allows separate purchase of rails and roller slides. 	• Machining centers • NC lathes • Heavy cutting machine tools • Gear cutters • Electric discharge machines • Press machines • Various types of grinders	A303
			AL BL						
			EM GM						
Four-way equal load carrying capacity type	Super-rigid type	LA	AN BN				As well as providing a low friction operation, the LA series provides a top class high-load capacity for the ball linear guides. The series is most suited for machine tools. ● The contact angle between the ball and the raceway is set at 45 degrees. This makes load carrying capacity and rigidity equal in vertical and lateral directions. ● Six-row ball grooves support the load from vertical and lateral directions, enhancing rigidity and increasing load carrying capacity. ● Appropriate friction ● Best suited for machine tools. 	• Machining centers • NC lathes • Heavy cutting machine tools • Gear cutters • Electric discharge machines • Press machines • Various types of grinders	A321
			AL BL						
			EL GL						
			FL HL						

Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure	Characteristics	Applications	Page
Four-way equal load carrying capacity type	Super rigidity, high-precision type	HA	AN				The HA Series ball guide with high-precision and high-load carrying capacity, featuring high-motion accuracy equivalent to hydrostatic linear bearings. ● Ball passage vibration has been reduced to one-third of conventional models by ultra-long ball slides and specification of new design. ● The contact angle between the ball and the raceway is set at 45 degrees. This makes load carrying capacity and rigidity equal in vertical and lateral directions. ● High motion accuracy is realized by the feature of super-finished ball groove (optional). ● End seals, bottom seals, and inner seals of high dust-proof specification are the standard equipment. ● Best suited for high-grade machine tools.	• Die molding machines • High precision processing machine • Heavy cutting machine tools • Gear cutters • Press machines • Various types of NC grinders	A341
			AL						
			EM						
									
High vertical load carrying capacity type	Self-aligning, super-precision type	HS	AL				The HS Series ball guide with high-precision featuring high-motion accuracy equivalent to hydrostatic linear bearings. ● Ball passage vibration has been reduced to one-third of conventional models by ultra-long ball slides and specification of new design. ● The contact angle between the ball and the raceway is set at 50 degrees. The load carrying capacity against vertical directions, which is the main load acting direction in most operations, increases by this design. ● The DF contact structure greatly absorbs the installation error in the perpendicular direction of rail. ● Thanks to the offset Gothic arch groove, balls make contacts at two points, thus keeping friction low.	• High precision processing machines • Electric discharge machines • Various types of NC grinders • LCD manufacturing equipment	A355
			EM						
									

4. Guide to Technical Services

(1) CAD drawing data

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

NSK website

http://www.nsk.com

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

Data offered by CAD

NSK linear guides

LH Series
SH Series
VH Series
TS Series
LS Series
SS Series
LW Series
PU Series
LU Series
PE Series
LE Series
RA Series
LA Series
HA Series
HS Series

(2) Telephone consultation with NSK engineers

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

5. Linear Guides: Handling Precautions

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

(1) Lubrication

Confirm lubrication.

a. If your linear guide is rust prevention specification, thoroughly wipe the rust prevention oil, and put lubricant inside of slide before using.

b. 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.

a. Slides for random-matching are installed to the provisional rail when they leave the factory. Handle the slide with care during installation to the rail.

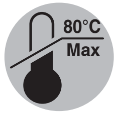
b. Do not disassemble the linear guide unless absolutely necessary. Not only does it allow dust to enter, but it lessens precision.

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

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

(3) Precautions in use

Do not contaminate.



Temperature limitation.

Do not hang upside down.

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

b. Please apply splash guard or bellows to the linear guide to prevent sticking resolvent or coolant when it contains corrosive material.

c. The temperature of the place where linear guides are used should not exceed 80°C (excluding heat-resistant type linear guides). A higher temperature may damage the plastic end cap.

d. If the user cuts the rail, thoroughly remove burrs and sharp edges on the cut surface.

e. When hanging upside-down (e.g. the rail is installed upside-down on the ceiling in which the slide faces downward), should the end cap be damaged, causing the balls or rollers to fall out, the slide may be detached from the rail and fall. For such use, take measures including installing a safety device.

(4) Storage

Store in the correct position.

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

6. Design Precautions

The following points must be heeded in examining the life.

In case of oscillating stroke

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

When applying pitching or yawing moment

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

When an extraordinary large load is applied during stroke

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

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

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

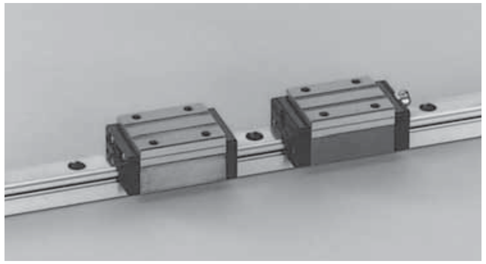
Application at high speed

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

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

A-5-1 General Industrial Use

A-5-1.1 LH Series



1. Features

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

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

This increases the capacity to absorb errors in installation.

(2) High load carrying capacity to vertical direction

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

(3) High resistance against impact load

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

(4) High accuracy

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

(5) 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 size of LH 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)

High precision grade and mediun preload types are also available in randam matching. (Special high-carbon steel products for LH15 to LH45)

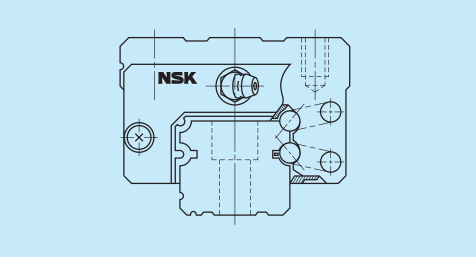


Fig. 1 LH Series

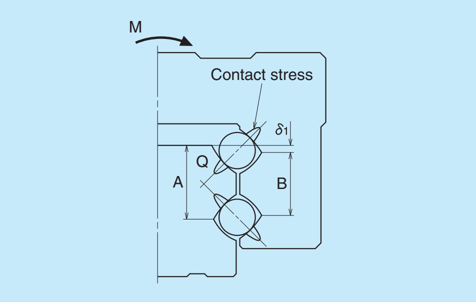


Fig. 2 Enlarged illustration of the offset Gothic arch groove

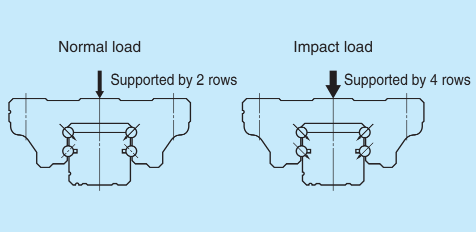
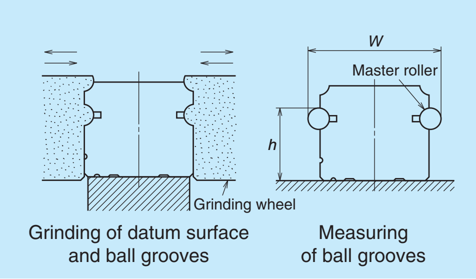


Fig. 3 When load is applied

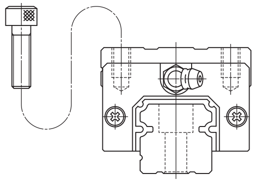
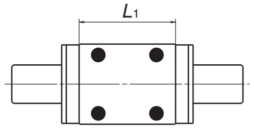
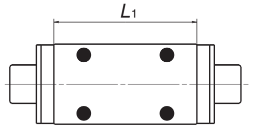
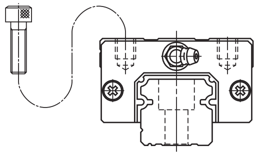
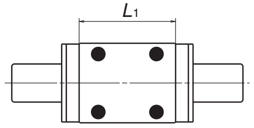
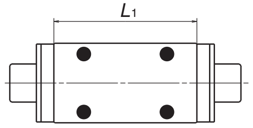
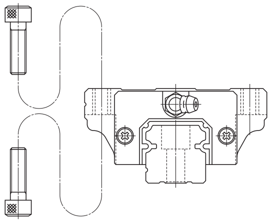
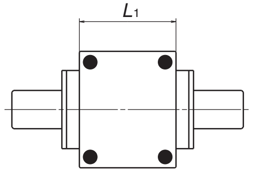
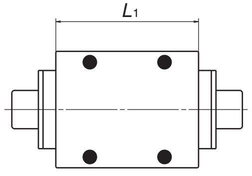
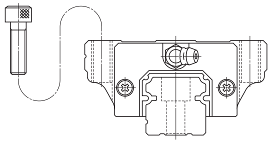
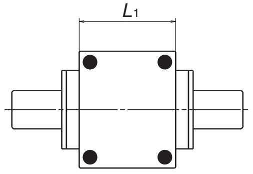
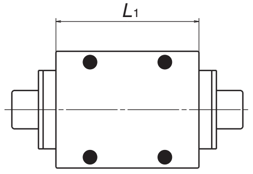
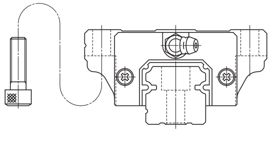
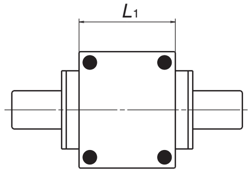
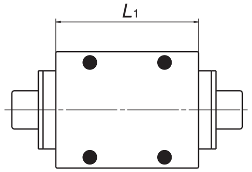


Grinding of datum surface and ball grooves

Measuring of ball grooves

Fig. 4 Rail grinding and measuring

2. Ball slide shape

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

Note: High-precision grade and medium preload of random-matching type are not applicable to EL, GL, FL, and HL models.

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

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

Notes: 1)High-precision grade of random-matching type is available in LH15 to LH45.
2)LH08, 10, and 12 are not available in random-matching type. For LH08,10, and 12, accuracy of 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 High precision PH and Normal PC grade.

- **Tolerance of preloaded assembly**

Table 2

Unit: μm

Characteristics \ Accuracy grade	Ultra precision P3	Super precision P4		High precision P5		Precision grade P6		Normal grade PN	
		LH08,10,12	LH15 –	LH08,10,12	LH15 –	LH08,10,12	LH15 –	LH08,10,12	LH15 –
Mounting height *H* Variation of *H* (All ball slides on a set of rails)	±10 3	±10 3	±10 5	±20 5	±20 7	±40 7	±40 15	±80 15	±80 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±15 3	±10 5	±15 7	±15 7	±25 10	±25 10	±50 20	±50 20	±100 30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in **Table 1**, **Fig. 5**, and **Fig. 6**								

Note: For LH08, 10, and 12, accuracy of P4, P5, P6, and PN grades are available.

- **Tolerance of random-matching type**

Table 3

Unit: μm

Accuracy grade	High precision grade PH		Normal grade PC	
Characteristics \ Model No.	LH15, 20, 25, 30, 35	LH45	LH15, 20, 25, 30, 35	LH45, 55, 65
Mounting height *H*	±20	±30	±20	±30
Variation of mounting height *H*	15① 30②	20① 35②	15① 30②	20① 35②
Mounting width W_2 or W_3	±30	±35	±30	±35
Variation of mounting width W_2 or W_3	20	30	25	30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	See **Table 1**, **Fig. 5** and **Fig. 6**			

Notes: 1) LH08, 10 and 12 are not available in the random-matching type.
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	High precision	Normal grade
Without NSK K1 lubrication unit		P3	P4	P5	P6	PN	PH	PC
With NSK K1 lubrication unit		K3	K4	K5	K6	KN	KH	KC
With NSK K1 for food and medical equipment		F3	F4	F5	F6	FN	FH	FC
Preload	Fine clearance Z0	○	○	○	○	○	—	—
	Slight preload Z1	○	○	○	○	○	—	—
	Medium preload Z3	○	○	○	○	—	—	—
	Random-matching type with fine clearance ZT	—	—	—	—	—	—	○
	Random-matching type with slight preload ZZ	—	—	—	—	—	○	○
	Random-matching type with slight preload ZH	—	—	—	—	—	○	○

Notes: 1)Medium preload of random-matching type is available in LH15 to LH45.
2)LH08, 10, and 12 are not available in random-matching type.

(4) Assembled accuracy

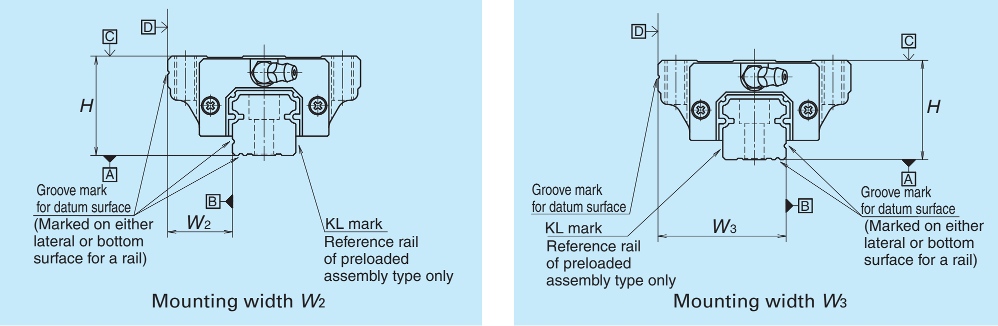


Fig. 5 Special high carbon steel

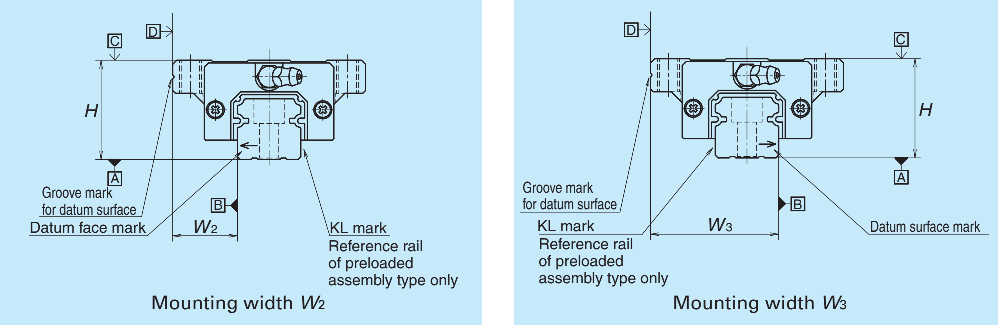


Fig. 6 Stainless steel

(5) Preload and rigidity

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

- **Preload and rigidity of preloaded assembly**

Table 5

	Model No.	Preload (N)		Rigidity (N/μm)			
				Vertical direction		Lateral direction	
		Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3
High-load type	LH08 AN	5	—	33	—	23	—
	LH10 AN	9	—	44	—	31	—
	LH12 AN	22	—	68	—	47	—
	LH15 AN, EM, EL, FL	78	490	137	226	98	186
	LH20 AN, EM, EL, FL	147	835	186	335	137	245
	LH25 AL, AN, EM, EL, FL	196	1 270	206	380	147	284
	LH30 AL, AN	245	1 570	216	400	157	294
	LH30 EM, EL, FL	294	1 770	265	480	186	355
	LH35 AL, AN, EM, EL, FL	390	2 350	305	560	216	390
	LH45 AN, AL, EM, EL, FL	635	3 900	400	745	284	540
	LH55 AN, EM, EL, FL	980	5 900	490	910	345	645
	LH65 AN, EM, EL, FL	1 470	8 900	580	1 070	400	755
Super-high-load type	LH15 BN, GM, GL, HL	98	685	196	345	137	284
	LH20 BN, GM, GL, HL	196	1 080	265	480	196	355
	LH25 BL, BN, GM, GL, HL	245	1 570	294	560	216	400
	LH30 BL, BN, GM, GL, HL	390	2 260	360	665	265	480
	LH35 BL, BN, GM, GL, HL	490	2 940	430	795	305	570
	LH45 BL, BN, GM, GL, HL	785	4 800	520	960	370	695
	LH55 BL, BN, GM, GL, HL	1 180	7 050	635	1 170	440	835
	LH65 BN, GM, GL, HL	1 860	11 300	805	1 480	550	1 040

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

- **Clearance and preload of random-matching type**

Table 6

Unit: μm

Model No.	Fine clearance ZT	Slight preload ZZ	Medium preload ZH
LH15	–4 — 15	–4 — 0	–8 — –3.5
LH20	–5 — 15	–5 — 0	–9 — –3.5
LH25		–5 — 0	–11 — –5.5
LH30		–7 — 0	–13 — –6
LH35		–7 — 0	–14 — –7
LH45		–7 — 0	–17 — –9
LH55		–9 — 0	
LH65		–9 — 0	

Notes: 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 type.

4. Maximum rail length

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

Table 7 Length limitations of rails

Unit: mm

Series	Size / Material	08	10	12	15	20	25	30	35	45	55	65
LH	Special high carbon steel				2 000	3 960	3 960	4 000	4 000	3 990	3 960	3 900
	Stainless steel	375	600	800	1 800	3 500	3 500	3 500				

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

5. Installation

(1) Permissible values of mounting error

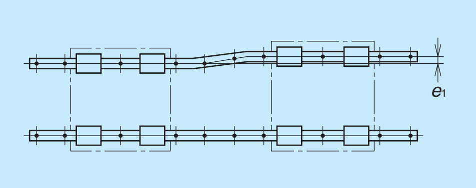


Fig. 7

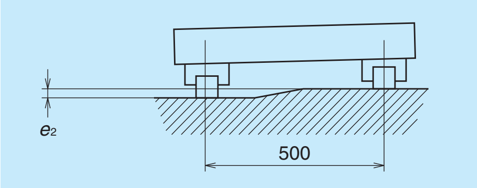


Fig. 8

Table 8

Unit: μm

Value	Preload	Model No.										
		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, ZH	–	–	–	13	15	20	25	30	40	45	60
Permissible values of parallelism (height) in two rails e_2	Z0, ZT	375 μm/500 mm										
	Z1, ZZ, Z3, ZH	330 μm/500 mm										

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

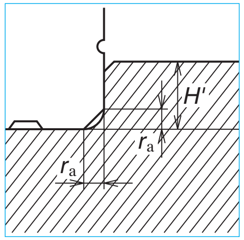


Fig. 9 Shoulder for the rail datum surface

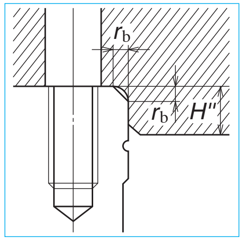


Fig. 10 Shoulder for the ball slide datum surface

Table 9

Unit: mm

Model No.	Corner radius (maximum)		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 pages A38 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 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.

When you require stainless lubrication accessories, please ask NSK.

(2) Mounting position of lubrication accessories

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

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

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

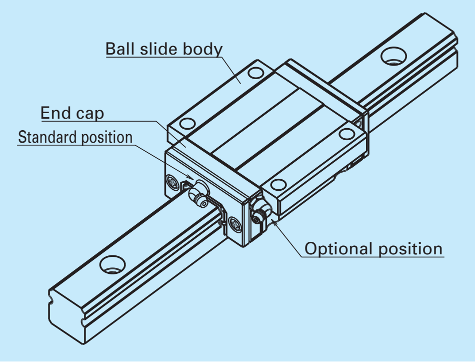


Fig. 12 Mounting position of lubrication accessories

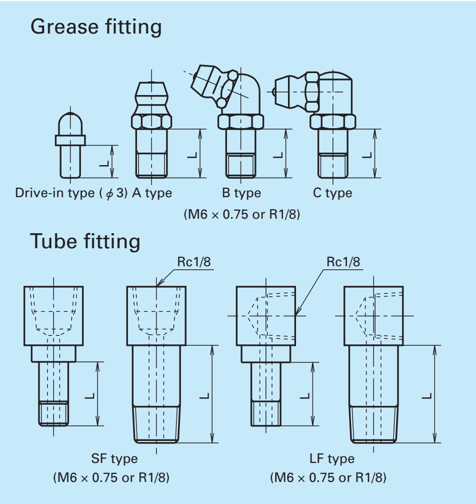


Fig. 11 Grease fitting and tube fitting

Table 10 Unit: mm

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	5
	With NSK K1	12	12
	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

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

7. Dust-proof components

(1) Standard specification

The LH Series can be readily used as they have a dust protection means for normal conditions. As the standard equipment, the ball slides have an end seal on both ends, and bottom seals at the bottom. However, the bottom seals are not used to LH08 and 10.

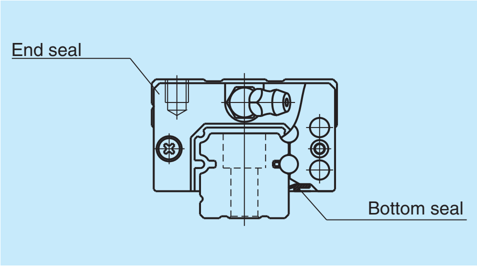


Fig. 13

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

Series \ Size	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^{TM} lubrication unit

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

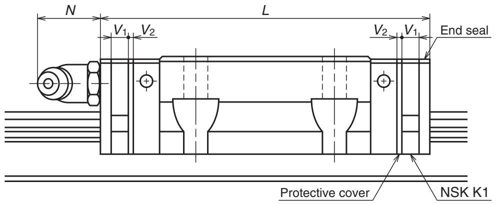


Table 12 Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_1	Protective cover thickness V_2	Protruding area of the grease fitting N
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, EM, EL, FL	55	65.6	4.5	0.8	(5)
	Long	BN, GM, GL, HL	74	84.6			
LH20	Standard	AN, EM, EL, FL	69.8	80.4	4.5	0.8	(14)
	Long	BN, GM, GL, HL	91.8	102.4			
LH25	Standard	AL, AN, EM, EL, FL	79.0	90.6	5.0	0.8	(14)
	Long	BL, BN, GM, GL, HL	107	118.6			
LH30	Standard	AL, AN	85.6	97.6	5.0	1.0	(14)
	Flange type	EM, EL, FL	98.6	110.6			
	Long	BL, BN, GM, GL, HL	124.6	136.6			
LH35	Standard	AL, AN, EM, EL, FL	109	122	5.5	1.0	(14)
	Long	BL, BN, GM, GL, HL	143	156			
LH45	Standard	AL, AN, EM, EL, FL	139	154	6.5	1.0	(15)
	Long	BL, BN, GM, GL, HL	171	186			
LH55	Standard	AL, AN, EM, EL, FL	163	178	6.5	1.0	(15)
	Long	BL, BN, GM, GL, HL	201	216			
LH65	Standard	AN, EM, EL, FL	193	211	8.0	1.0	(16)
	Long	BN, GM, GL, HL	253	271			

Notes: 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_1 × Number of NSK K1) + (Thickness of the protective cover, V_2 × 2)

(3) Double seal

Use a double seal set as showing in **Table 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 as showing in **Fig.14** is required.

(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 as showing in **Fig.15** is required.

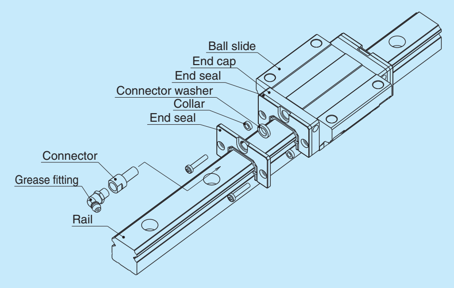


Fig. 14 Double seal

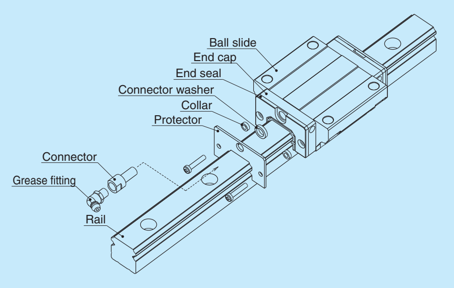


Fig. 15 Protector

Table 13 Double-seal set

Model No.	Reference No.		Increased thickness V_3 (mm)
	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_4 (mm)
	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.

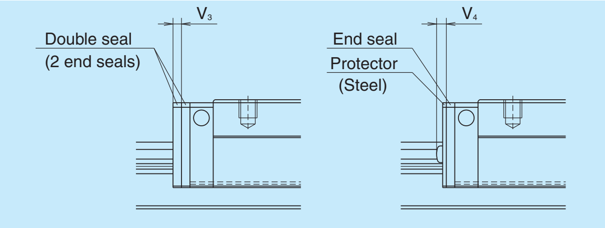


Fig. 16

(5) Cap to plug the rail mounting bolt hole

Table 15 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
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 as showing **Fig.7.7** on page A55.
- When NSK K1, double seals or protectors are used, the set screws of bellows fastener kit are unable to use.
  Please contact NSK for details.
- Bellows fastener is available only for the horizontal mounting positions. For other mounting positions, sliding plate is required (see **Fig. 7.10** on page A56).
  For fixing to the rail, make tap holes to the rail end surface. Fix the bellows mounting plate to the rail end surface through these tap holes by using a machine screw. NSK processes a tap hole to the rail end face when ordered with a linear guide.
- Please consult NSK for the bellows of LH08, 10, 12, and 15.

(6) Inner seal

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

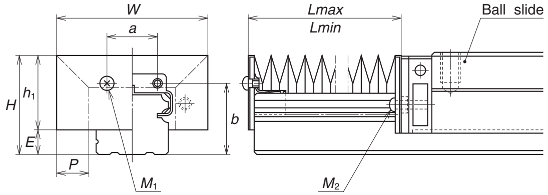
Table 16

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



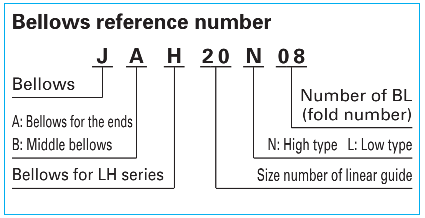

Bellows reference number

Fig. 17 Dimensions of bellows

Table 18 Dimensions of bellows

Unit: mm

Model No.	*H*	*h*$_1$	*E*	*W*	*P*	*a*	*b*	BL minimum length	*M*$_1$Tap x depth	*M*$_2$Tap x depth
JAH20N	29.5	24.5	5	48	10	13	22	17	M3 × 5	M2.5 × 16
JAH25L	35	28	7	51	10	16	26	17	M3 × 5	M3 × 18
JAH25N	39	32		61	15					
JAH30L	41	32	9	60	12	18	31	17	M4 × 6	M4 × 22
JAH30N	44	35		66	15					
JAH35L	47	37.5	9.5	72	15	24	34	17	M4 × 6	M4 × 23
JAH35N	54	44.5		82	20					
JAH45L	59	45	14	83	15	32	44.5	17	M5 × 8	M5 × 28
JAH45N	69	55		103	25					
JAH55L	69	54	15	101	20	40	50.5	17	M5 × 8	M5 × 30
JAH55N	79	64		121	30					
JAH65N	89	73	16	131	30	48	61	17	M6 × 8	M6 × 35

Table 19 Numbers of folds (BL) and lengths of bellows

Unit: mm

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

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

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 1200 AN C 2 - P5 3**

- LH: Series name
- 30: Size
- 1200: Rail length (mm)
- AN: Ball slide shape code (See page A116.)
- C: Material/surface treatment code (See Table 20.)
  C: Special high carbon steel (NSK standard), K: Stainless steel
- 2: Number of ball slides per rail
- -**: Design serial number
  Added to the reference number.
- P5: Accuracy code (See Table 21.)
- 3: Preload code (See page A118.)
  0: Z0, 1: Z1, 3: Z3

(2) Reference number for random-matching type

Ball slide **LAH 30 AN S Z -K**

- LAH: Random-matching ball slide series code
  LAH: LH Series random-matching ball slide
- 30: Size
- AN: Ball slide shape code (See page A116.)
- S: Material code
  No code: Special high carbon steel (NSK standard), S: Stainless steel
- Z: Preload code
  No code: Fine clearance, Z: Slight preload, H: Medium preload
- -K: Option code
  -K: Equipped with NSK K1
  -F: Fluoride low temperature chrome plating+AS2 grease
  -F50: Fluoride low temperature chrome plating+LG2 grease

Rail **L1H 30 1200 L C N -** PC Z**

- L1H: Random-matching rail series code
  L1H: LH Series random-matching rail
- 30: Size
- 1200: Rail length (mm)
- L: Rail shape code: L
  L: Standard
- C: Material/surface treatment code (See Table 20.)
- N: *Butting rail specification
  N: Non-butting. L: Butting specification
- -**: Design serial number
  Added to the reference number.
- PC: Accuracy code
  PH: High precision grade random-matching type
  PC: Normal grade random-matching type
- Z: Preload code (See page A118.)
  T: Fine clearance
  Z: Slight preload (common rail for slight or medium preload)

*Please consult with NSK for butting rail specification.

The reference number coding for the assembly of random-matching type is the same as that of the preloaded assembly. However, only preload codes of "fine clearance T", "slight preload Z" and "medium preload H" are available (refer to page A118).

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

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

Table 21 Accuracy code

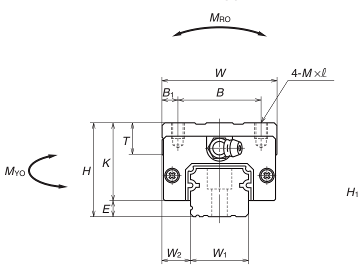
Accuracy	Standard (Without NSK K1)	With NSK K1	With NSK K1 for food and medical equipment
Ultra precision grade	P3	K3	F3
Super precision grade	P4	K4	F4
High precision grade	P5	K5	F5
Precision grade	P6	K6	F6
Normal grade	PN	KN	FN
High precision grade (random-matching type)	PH	KH	FH
Normal grade (random-matching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

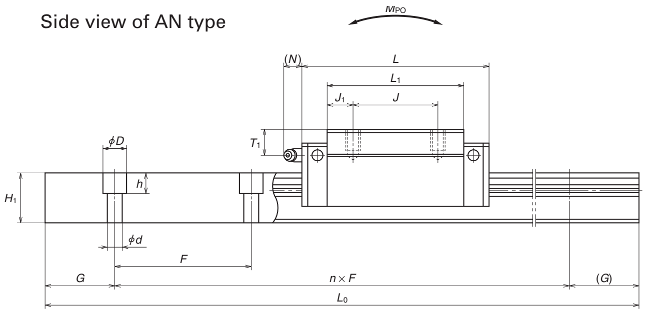
Note: Refer to pages A38 and A61 for NSK K1 lubrication unit.

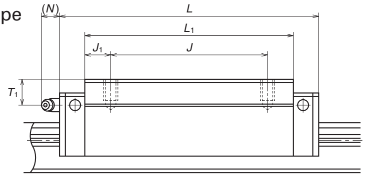
9. Dimensions
LH-AN (High-load type / Standard)
LH-BN (Super-high-load type / Long)

LH 30 1200 AN C 2 -** PC Z

Series name
Size
Rail length (mm)
Ball slide shape code (See page A116.)
Material/surface treatment code (See Table 20.)
C: Special high carbon steel (NSK standard), K: Stainless steel
Preload code (See page A118.)
0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ, H: ZH
Accuracy code (See Table 21.)
Design serial number
Added to the reference number.
Number of ball slides per rail


Front view of AN and BN types


Side view of AN type


Side view of BN type

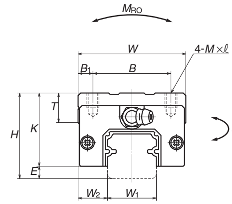
Model No.	Assembly			Ball slide												
	Height			Width	Length	Mounting hole								Grease fitting		
	H	E	W_2	W	L	B	J	M × pitch × ℓ	B_1	L_1	J_1	K	T	Hole size	T_1	N
LH08AN	11	2.1	4	16	24	10	10	M2×0.4×2.5	3	15	2.5	8.9	—	—	—	—
LH10AN	13	2.4	5	20	31	13	12	M2.6×0.45×3	3.5	20.2	4.1	10.6	6	—	—	—
LH12AN	20	3.2	7.5	27	45	15	15	M4×0.7×5	6	31	8	16.8	6	$\phi 3$	5	4
LH15AN	28	4.6	9.5	34	55	26	26	M4×0.7×6	4	39	6.5	23.4	8	$\phi 3$	8.5	3.3
LH15BN					74					58	16					
LH20AN	30	5	12	44	69.8	32	36	M5×0.8×6	6	50	7	25	12	M6×0.75	5	11
LH20BN					91.8		50			72	11					
LH25AN	40	7	12.5	48	79	35	35	M6×1×9	6.5	58	11.5	33	12	M6×0.75	10	11
LH25BN					107		50			86	18					
LH30AN	45	9	16	60	85.6	40	40	M8×1.25×10	10	59	9.5	36	14	M6×0.75	10	11
LH30BN					124.6		60			98	19					
LH35AN	55	9.5	18	70	109	50	50	M8×1.25×12	10	80	15	45.5	15	M6×0.75	15	11
LH35BN					143		72			114	21					
LH45AN	70	14	20.5	86	139	60	60	M10×1.5×17	13	105	22.5	56	17	Rc1/8	20	13
LH45BN					171		80			137	28.5					
LH55AN	80	15	23.5	100	163	75	75	M12×1.75×18	12.5	126	25.5	65	18	Rc1/8	21	13
LH55BN					201		95			164	34.5					
LH65AN	90	16	31.5	126	193	76	70	M16×2×20	25	147	38.5	74	23	Rc1/8	19	13
LH65BN					253		120			207	43.5					

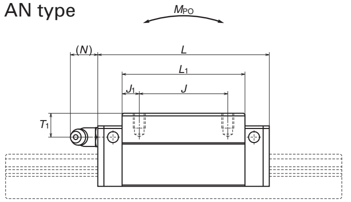
Notes: 1) LH08 does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.
2) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.
3) Only stainless steel models are available for LH08 to LH12.

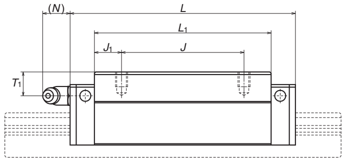
Reference number for ball slide of random-matching type

Ball slide LAH 30 AN S Z -K

Random-matching ball slide series code
LAH: LH Series random-matching ball slide
Size
Ball slide shape code (See page A116.)
Option code
-K: Equipped with NSK K1
-F: Fluoride low temperature chrome plating+AS2 grease
-F50: Fluoride low temperature chrome plating+LG2 grease
Preload code
No code: Fine clearance, Z: Slight preload, H: Medium preload
Material code
No code: Special high carbon steel (NSK standard), S: Stainless steel


AN and BN types

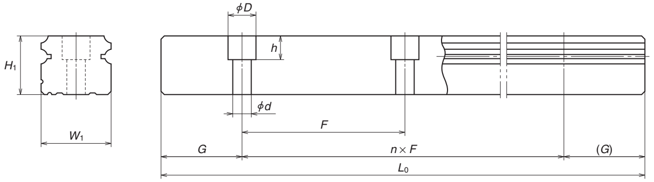

AN type


BN type

Reference number for rail of random-matching type

Rail L1H 30 1200 L C N -** PC Z

Random-matching rail series code
L1H: LH Series random-matching rail
Size
Rail length (mm)
Rail shape code: L
L: Standard
Material/surface treatment code (See Table 20.)
Preload code (See page A118.)
T: Fine clearance.
Z: Slight preload (common rail for medium preload)
Accuracy code
PH: High precision grade. PC: Normal grade
Design serial number
Added to the reference number.
*Butting rail specification
N: Non-butting. L: Butting specification
*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Rail						Basic load rating							Weight	
	Width	Height	Pitch	Mounting bolt hole	G	Max. length L_{0max}. ( ) for stainless	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
							C	C_0	M_{RO}	M_{PO}		M_{YO}			
	W_1	H_1	F	d × D × h	(reference)		(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
LH08AN	8	5.5	20	2.4×4.2×2.3	7.5	(375)	1 240	2 630	7.25	4.55	32.5	3.8	27.2	0.013	0.31
LH10AN	10	6.5	25	3.5×6×3.5	10	(600)	2 250	4 500	16.2	10.5	73.0	8.8	61.0	0.026	0.44
LH12AN	12	10.5	40	3.5×6×4.5	15	(800)	5 650	11 300	47.5	41.5	254	35	214	0.082	0.88
LH15AN	15	15	60	4.5×7.5×5.3	20	2 000	10 800	20 700	108	94.5	575	79.5	480	0.18	1.6
LH15BN						(1 800)	14 600	32 000	166	216	1 150	181	965	0.26	
LH20AN	20	18	60	6×9.5×8.5	20	3 960	17 400	32 500	219	185	1 140	155	955	0.33	2.6
LH20BN						(3 500)	23 500	50 500	340	420	2 230	355	1 870	0.48	
LH25AN	23	22	60	7×11×9	20	3 960	25 600	46 000	360	320	1 840	267	1 540	0.55	3.6
LH25BN						(3 500)	34 500	71 000	555	725	3 700	610	3 100	0.82	
LH30AN	28	26	80	9×14×12	20	4 000	31 000	51 500	490	350	2 290	292	1 920	0.77	5.2
LH30BN						(3 500)	46 000	91 500	870	1 030	5 600	865	4 700	1.3	
LH35AN	34	29	80	9×14×12	20	4 000	47 500	80 500	950	755	4 500	630	3 800	1.5	7.2
LH35BN							61 500	117 000	1 380	1 530	8 350	1 280	7 000	2.1	
LH45AN	45	38	105	14×20×17	22.5	3 990	81 000	140 000	2 140	1 740	9 750	1 460	8 150	3.0	12.3
LH45BN							99 000	187 000	2 860	3 000	15 600	2 520	13 100	3.9	
LH55AN	53	44	120	16×23×20	30	3 960	119 000	198 000	3 600	3 000	16 300	2 510	13 700	4.7	16.9
LH55BN							146 000	264 000	4 850	5 150	26 300	4 350	22 100	6.1	
LH65AN	63	53	150	18×26×22	35	3 900	181 000	281 000	6 150	4 950	27 900	4 150	23 400	7.7	24.3
LH65BN							235 000	410 000	8 950	10 100	51 500	8 450	43 500	10.8	

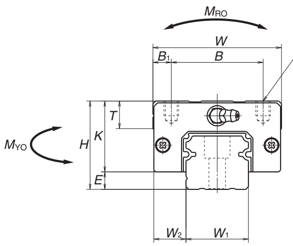
4) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.
5) Random matching is available for LH15 to LH65.
6) High-precision grade and medium preload of random-matching type are available for LH15 to LH45 of high-carbon steel products.

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

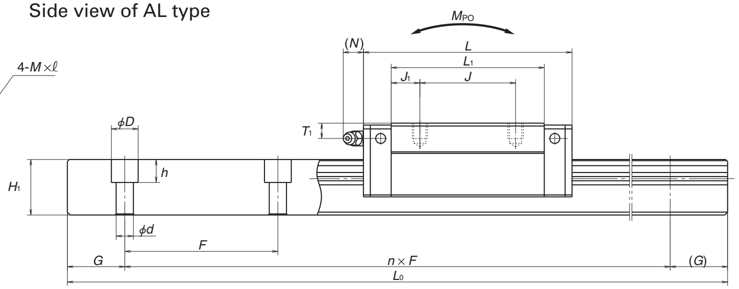
LH 30 1200 AL C 2 - PC Z**

- Series name: LH
- Size: 30
- Rail length (mm): 1200
- Ball slide shape code (See page A116.): AL
- Material/surface treatment code (See Table 20.): C
  - C: Special high carbon steel (NSK standard), K: Stainless steel
- Number of ball slides per rail: 2
- Design serial number: -**
  - Added to the reference number.
- Accuracy code (See Table 21.): PC
- Preload code (See page A118.): Z
  - 0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ, H: ZH

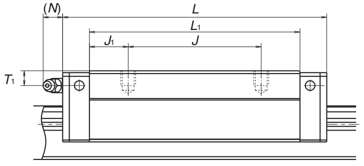
Front view of AL and BL types



Side view of AL type



Side view of BL type

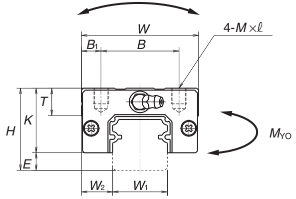


Reference number for ball slide of random-matching type

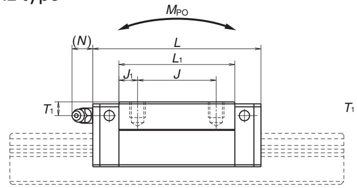
Ball slide **LAH 30 AL S Z -K**

- Random-matching ball slide series code: LAH
  - LAH: LH Series random-matching ball slide
- Size: 30
- Ball slide shape code (See page A116.): AL
- Material code: S
  - No code: Special high carbon steel (NSK standard), S: Stainless steel
- Preload code: Z
  - No code: Fine clearance, Z: Slight preload, H: Medium preload
- Option code: -K
  - -K: Equipped with NSK K1
  - -F: Fluoride low temperature chrome plating+AS2 grease
  - -F50: Fluoride low temperature chrome plating+LG2 grease

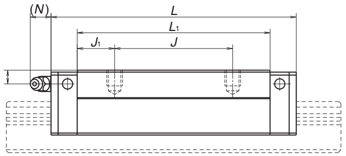
AL and BL types



AL type



BL type

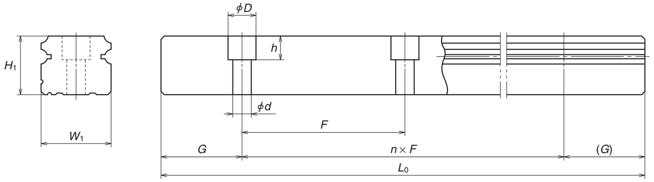


Reference number for rail of random-matching type

Rail **L1H 30 1200 L C N -** PC Z**

- Random-matching rail series code: L1H
  - L1H: LH Series random-matching rail
- Size: 30
- Rail length (mm): 1200
- Rail shape code: L
  - L: Standard
- Material/surface treatment code (See Table 20.): C
- *Butting rail specification: N
  - N: Non-butting. L: Butting specification
- Design serial number: -**
  - Added to the reference number.
- Accuracy code: PC
  - PH: High precision grade
  - PC: Normal grade
- Preload code (See page A118.): Z
  - T: Fine clearance.
  - Z: Slight preload (common rail for medium preload)

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide												
	Height			Width	Length	Mounting hole								Grease fitting		
	H	E	W_2	W	L	B	J	M × pitch × ℓ	B_1	L_1	J_1	K	T	Hole size	T_1	N
LH25AL	36	7	12.5	48	79	35	35	M6×1×6	6.5	58	11.5	29	12	M6×0.75	6	11
LH25BL					107		50			86	18					
LH30AL	42	9	16	60	85.6	40	40	M8×1.25×8	10	59	9.5	33	14	M6×0.75	7	11
LH30BL					124.6		60			98	19					
LH35AL	48	9.5	18	70	109	50	50	M8×1.25×8	10	80	15	38.5	15	M6×0.75	8	11
LH35BL					143		72			114	21					
LH45AL	60	14	20.5	86	139	60	60	M10×1.5×10	13	105	22.5	46	17	Rc1/8	10	13
LH45BL					171		80			137	28.5					
LH55AL	70	15	23.5	100	163	75	75	M12×1.75×13	12.5	126	25.5	55	15	Rc1/8	11	13
LH55BL					201		95			164	34.5					

Model No.	Rail						Basic load rating							Weight	
	Width	Height	Pitch	Mounting bolt hole	G	Max. length $L_{0max.}$ ( ) for stainless	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
	W_1	H_1	F	d × D × h	(reference)		C (N)	C_0 (N)	M_{RO}	M_{PO}		M_{YO}		(kg)	(kg/m)
										One slide	Two slides	One slide	Two slides		
LH25AL	23	22	60	7×11×9	20	3 960	25 600	46 000	360	320	1 840	267	1 540	0.46	3.6
LH25BL						(3 500)	34 500	71 000	555	725	3 700	610	3 100	0.69	
LH30AL	28	26	80	9×14×12	20	4 000	31 000	51 500	490	350	2 290	292	1 920	0.69	5.2
LH30BL						(3 500)	46 000	91 500	870	1 030	5 600	865	4 700	1.16	
LH35AL	34	29	80	9×14×12	20	4 000	47 500	80 500	950	755	4 500	630	3 800	1.2	7.2
LH35BL							61 500	117 000	1 380	1 530	8 350	1 280	7 000	1.7	
LH45AL	45	38	105	14×20×17	22.5	3 990	81 000	140 000	2 140	1 740	9 750	1 460	8 150	2.2	12.3
LH45BL							99 000	187 000	2 860	3 000	15 600	2 520	13 100	2.9	
LH55AL	53	44	120	16×23×20	30	3 960	119 000	198 000	3 600	3 000	16 300	2 510	13 700	3.7	16.9
LH55BL							146 000	264 000	4 850	5 150	26 300	4 350	22 100	4.7	

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

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

3) High-precision grade and medium preload of random-matching type are available for LH15 to LH45 of high-carbon steel products.

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

LH 30 1200 EM C 2 -✻✻ PC Z

Series name: LH

Size: 30

Rail length (mm): 1200

Ball slide shape code (See page A116.): EM

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

C: Special high carbon steel (NSK standard), K: Stainless steel

Number of ball slides per rail: 2

Design serial number: -✻✻

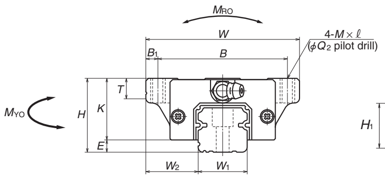
Added to the reference number.

Accuracy code (See Table 21.): PC

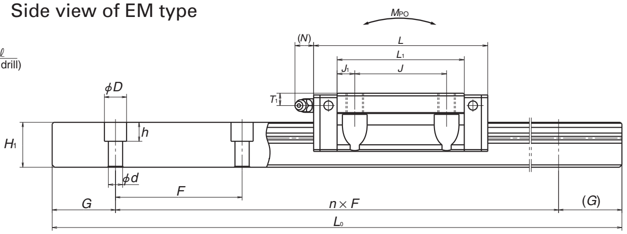
Preload code (See page A118.): Z

0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ, H: ZH

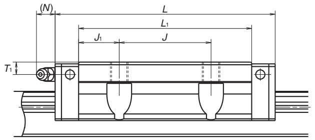
Front view of EM and GM types



Side view of EM type



Side view of GM type



Reference number for ball slide of random-matching type

Ball slide **LAH 30 EM S Z -K**

Random-matching ball slide series code: LAH

LAH: LH Series random-matching ball slide

Size: 30

Ball slide shape code (See page A116.): EM

Material code: S

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

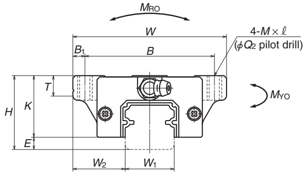
Preload code: Z

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

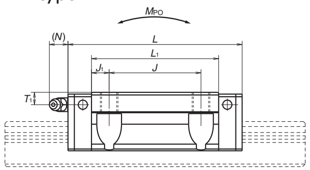
Option code: -K

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

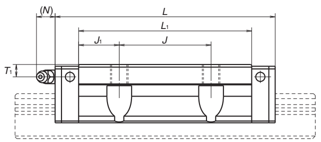
EM and GM types



EM type



GM type



Reference number for rail of random-matching type

Rail **L1H 30 1200 L C N -✻✻ PC Z**

Random-matching rail series code: L1H

L1H: LH Series random-matching rail

Size: 30

Rail length (mm): 1200

Rail shape code: L

L: Standard

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

*Butting rail specification: N

N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.

Design serial number: -✻✻

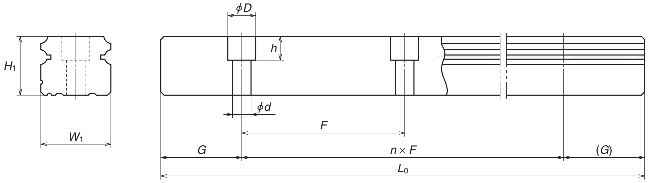
Added to the reference number.

Accuracy code: PC

PH: High precision grade
PC: Normal grade

Preload code (See page A118.): Z

T: Fine clearance.
Z: Slight preload (common rail for medium preload)



Model No.	Assembly			Ball slide													
	Height			Width	Length	Mounting hole									Grease fitting		
	H	E	W_2	W	L	B	J	M × pitch × ℓ	Q_2	B_1	L_1	J_1	K	T	Hole size	T_1	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	φ3	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

Unit: mm

Model No.	Rail						Basic load rating							Weight	
	Width	Height	Pitch	Mounting bolt hole	G	Max. length $L_{0max.}$ ( ) for stainless	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
							C	C_0	M_{RO}	M_{PO}		M_{YO}			
	W_1	H_1	F	d × D × h	(reference)		(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
LH15EM **LH15GM**	15	15	60	4.5×7.5×5.3	20	2 000 (1 800)	10 800 14 600	20 700 32 000	108 166	94.5 216	575 1 150	79.5 181	480 965	0.17 0.25	1.6
LH20EM **LH20GM**	20	18	60	6×9.5×8.5	20	3 960 (3 500)	17 400 23 500	32 500 50 500	219 340	185 420	1 140 2 230	155 355	955 1 870	0.45 0.65	2.6
LH25EM **LH25GM**	23	22	60	7×11×9	20	3 960 (3 500)	25 600 34 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.63 0.93	3.6
LH30EM **LH30GM**	28	26	80	9×14×12	20	4 000 (3 500)	35 500 46 000	63 000 91 500	600 870	505 1 030	3 150 5 600	425 865	2 650 4 700	1.2 1.6	5.2
LH35EM **LH35GM**	34	29	80	9×14×12	20	4 000	47 500 61 500	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.7 2.4	7.2
LH45EM **LH45GM**	45	38	105	14×20×17	22.5	3 990	81 000 99 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	3 3.9	12.3
LH55EM **LH55GM**	53	44	120	16×23×20	30	3 990	119 000 146 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	5 6.5	16.9
LH65EM **LH65GM**	63	53	150	18×26×22	35	3 900	181 000 235 000	281 000 410 000	6 150 8 950	4 950 10 100	27 900 51 500	4 150 8 450	23 400 43 500	10 14.1	24.3

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

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

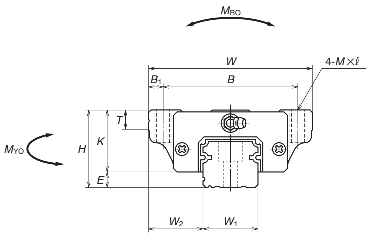
4) High-precision grade and medium preload of random-matching type are available for LH15 to LH45 of high-carbon steel products.

LH-EL (High-load type / Standard)
LH-GL (Super-high-load type / Long)

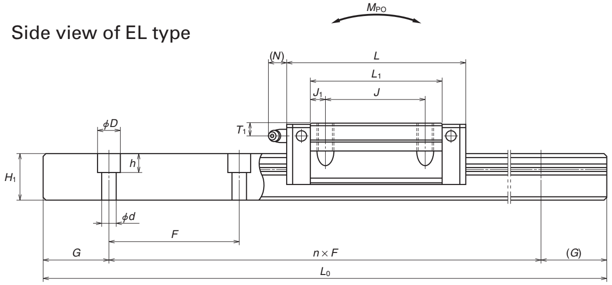
LH 30 1200 EL C 2 - PC Z**

- LH: Series name
- 30: Size
- 1200: Rail length (mm)
- EL: Ball slide shape code (See page A116.)
- C: Material/surface treatment code (See Table 20.)
  C: Special high carbon steel (NSK standard), K: Stainless steel
- 2: Number of ball slides per rail
- -**: Design serial number
  Added to the reference number.
- PC: Accuracy code (See Table 21.)
- Z: Preload code (See page A118.)
  0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ

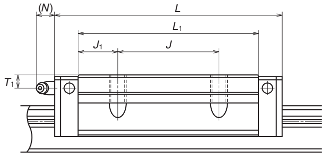
Front view of EL and GL types



Side view of EL type



Side view of GL type

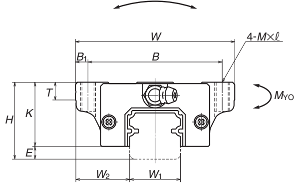


Reference number for ball slide of random-matching type

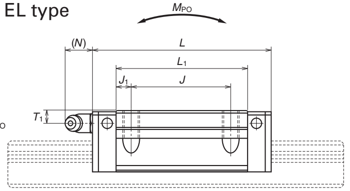
Ball slide **LAH 30 EL S Z -K**

- LAH: Random-matching ball slide series code
  LAH: LH Series random-matching ball slide
- 30: Size
- EL: Ball slide shape code (See page A116.)
- S: Material code
  No code: Special high carbon steel (NSK standard), S: Stainless steel
- Z: Preload code
  No code: Fine clearance, Z: Slight preload
- -K: Option code
  -K: Equipped with NSK K1
  -F: Fluoride low temperature chrome plating+AS2 grease
  -F50: Fluoride low temperature chrome plating+LG2 grease

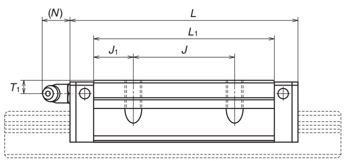
EL and GL types



EL type



GL type

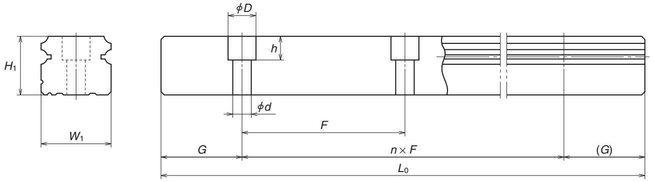


Reference number for rail of random-matching type

Rail **L1H 30 1200 L C N -** PC Z**

- L1H: Random-matching rail series code
  L1H: LH Series random-matching rail
- 30: Size
- 1200: Rail length (mm)
- L: Rail shape code: L
  L: Standard
- C: Material/surface treatment code (See Table 20.)
- N: *Butting rail specification
  N: Non-butting. L: Butting specification
- -**: Design serial number
  Added to the reference number.
- PC: Accuracy code: PC
  PC: Normal grade is only available
- Z: Preload code (See page A118.)
  T: Fine clearance. Z: Slight preload

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide												
	Height			Width	Length	Mounting hole								Grease fitting		
	H	E	W_2	W	L	B	J	M × pitch × ℓ	B_1	L_1	J_1	K	T	Hole size	T_1	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

Model No.	Rail						Basic load rating							Weight	
	Width	Height	Pitch	Mounting bolt hole	G	Max. length L_{0max}. ( ) for stainless	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
							C	C_0	M_{RO}	M_{PO}		M_{YO}			
	W_1	H_1	F	d × D × h	(reference)		(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
LH15EL **LH15GL**	15	15	60	4.5×7.5×5.3	20	2 000 (1 800)	10 800 14 600	20 700 32 000	108 166	94.5 216	575 1 150	79.5 181	480 965	0.17 0.25	1.6
LH20EL **LH20GL**	20	18	60	6×9.5×8.5	20	3 960 (3 500)	17 400 23 500	32 500 50 500	219 340	185 420	1 140 2 230	155 355	955 1 870	0.45 0.65	2.6
LH25EL **LH25GL**	23	22	60	7×11×9	20	3 960 (3 500)	25 600 34 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.63 0.93	3.6
LH30EL **LH30GL**	28	26	80	9×14×12	20	4 000 (3 500)	35 500 46 000	63 000 91 500	600 870	505 1 030	3 150 5 600	425 865	2 650 4 700	1.2 1.6	5.2
LH35EL **LH35GL**	34	29	80	9×14×12	20	4 000	47 500 61 500	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.7 2.4	7.2
LH45EL **LH45GL**	45	38	105	14×20×17	22.5	3 990	81 000 99 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	3.0 3.9	12.3
LH55EL **LH55GL**	53	44	120	16×23×20	30	3 960	119 000 146 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	5.0 6.5	16.9
LH65EL **LH65GL**	63	53	150	18×26×22	35	3 900	181 000 235 000	281 000 410 000	6 150 8 950	4 950 10 100	27 900 51 500	4 150 8 450	23 400 43 500	10.0 14.1	24.3

Notes: 1) Parenthesized dimensions are for items made of stainless steel.
2) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.
3) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.
4) High-precision grade and medium preload of random-matching type are not available for EL and GL models.

LH-FL (High-load type / Standard)
LH-HL (Super-high-load type / Long)

LH 30 1200 FL C 2 - PC Z**

Series name

Size

Rail length (mm)

Ball slide shape code (See page A116.)

Material/surface treatment code (See Table 20.)

C: Special high carbon steel (NSK standard), K: Stainless steel

Preload code (See page A118.)

0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ

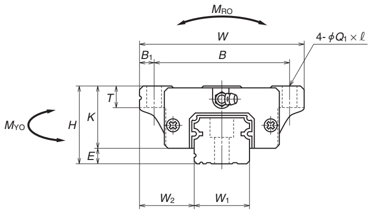
Accuracy code (See Table 21.)

Design serial number

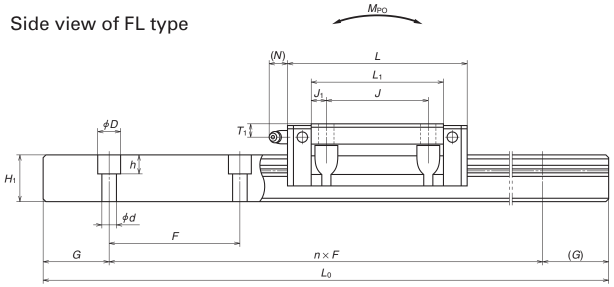
Added to the reference number.

Number of ball slides per rail

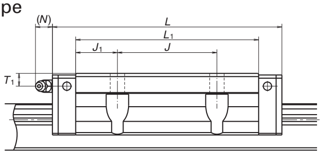
Front view of FL and HL types



Side view of FL type



Side view of HL type



Reference number for ball slide of random-matching type

Ball slide **LAH 30 FL S Z -K**

Random-matching ball slide series code

LAH: LH Series random-matching ball slide

Size

Ball slide shape code (See page A116.)

Option code

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

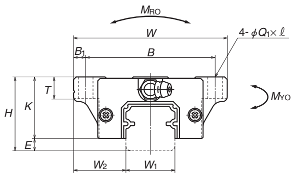
Preload code

No code: Fine clearance, Z: Slight preload

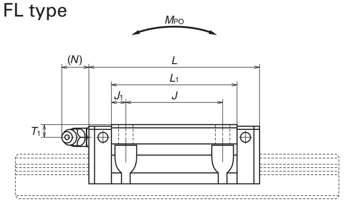
Material code

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

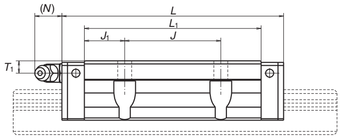
FL and HL types



FL type



HL type



Reference number for rail of random-matching type

Rail **L1H 30 1200 L C N -** PC Z**

Random-matching rail series code

L1H: LH Series random-matching rail

Size

Rail length (mm)

Rail shape code: L

L: Standard

Material/surface treatment code (See Table 20.)

Preload code (See page A118.)

T: Fine clearance. Z: Slight preload

Accuracy code: PC

PC: Normal grade is only available

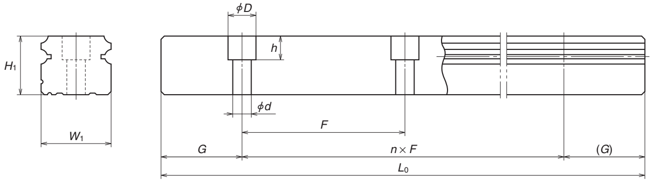
Design serial number

Added to the reference number.

*Butting rail specification

N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide													Rail						Basic load rating							Weight	
	Height			Width	Length	Mounting hole								Grease fitting			Width	Height	Pitch	Mounting bolt hole	G	Max. length $L_{0max.}$ ( ) for stainless	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
	H	E	W_2	W	L	B	J	$Q_1 \times \ell$	B_1	L_1	J_1	K	T	Hole size	T_1	N	W_1	H_1	F	$d \times D \times h$	(reference)		C (N)	C_0 (N)	M_{RO}	M_{PO}		M_{YO}		(kg)	(kg/m)
																										One slide	Two slides	One slide	Two slides		
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	15	15	60	4.5×7.5×5.3	20	2 000 (1 800)	10 800 14 600	20 700 32 000	108 166	94.5 216	575 1 150	79.5 181	480 965	0.17 0.25	1.6
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	20	18	60	6×9.5×8.5	20	3 960 (3 500)	17 400 23 500	32 500 50 500	219 340	185 420	1 140 2 230	155 355	955 1 870	0.45 0.65	2.6
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	23	22	60	7×11×9	20	3 960 (3 500)	25 600 34 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.63 0.93	3.6
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	28	26	80	9×14×12	20	4 000 (3 500)	35 500 46 000	63 000 91 500	600 870	505 1 030	3 150 5 600	425 865	2 650 4 700	1.2 1.6	5.2
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	34	29	80	9×14×12	20	4 000	47 500 61 500	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.7 2.4	7.2
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	45	38	105	14×20×17	22.5	3 990	81 000 99 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	3 3.9	12.3
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	53	44	120	16×23×20	30	3 990	119 000 146 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	5 6.5	16.9
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	63	53	150	18×26×22	35	3 900	181 000 235 000	281 000 410 000	6 150 8 950	4 950 10 100	27 900 51 500	4 150 8 450	23 400 43 500	10 14.1	24.3

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

3) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.
4) High-precision grade and medium preload of random-matching type are not available for FL and HL models.

A-5-1.2 SH Series

1. Features

(1) Lower noise and gentler tone

Incorporating a retaining piece and optimizing the circulation path enables steel ball circulation stability and the prevention of ball collision, and thus 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 the 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 to the ball grooves 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.
High-precision grade and medium preload types are also available in random matching (Special high-carbon steel products for SH15 to SH45)

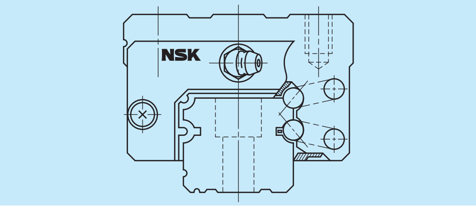


Fig. 1 SH Series

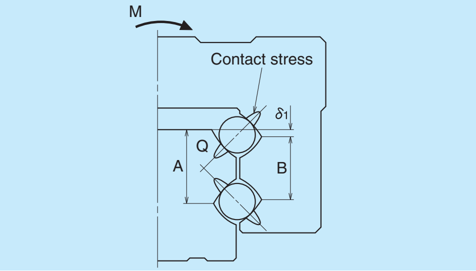


Fig. 2 Enlarged illustration of the offset Gothic arch groove

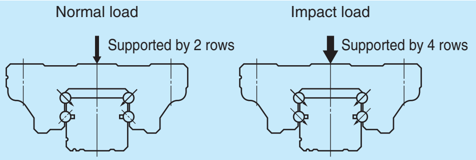
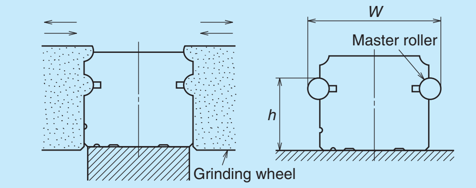


Fig. 3 When load is applied

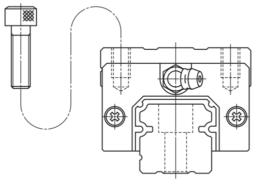
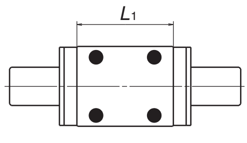
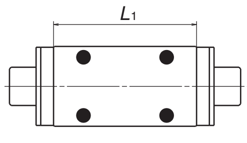
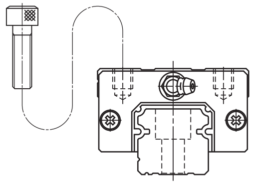
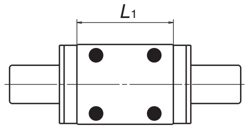
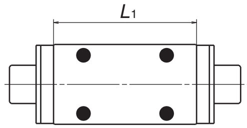
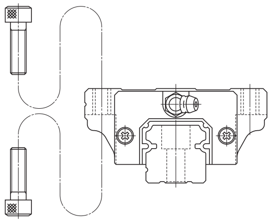
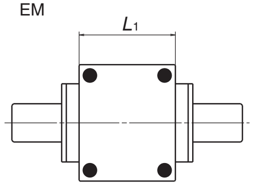
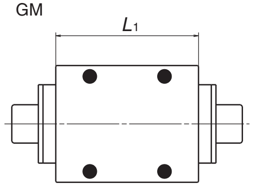
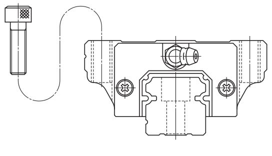
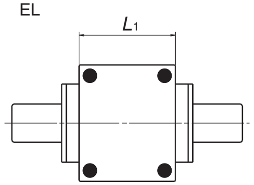
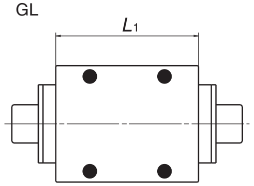
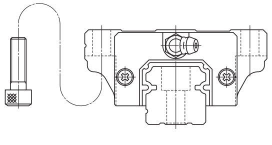
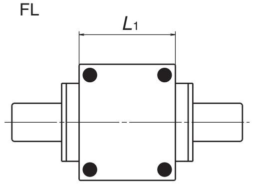
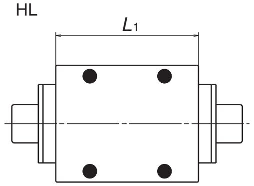


Grinding of datum surface and ball grooves

Measuring of ball grooves

Fig. 4 Rail grinding and measuring

2. Ball slide shape

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

Note: High-precision grade and medium preload of random-matching type are not applicable to EL, GL, FL, and HL models.

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: µm

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

Notes: High precision grade of random-matching type is available for SH15 to SH45.

(2) Accuracy standard

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

- **Tolerance of preloaded assembly**

Table 2

Unit: µm

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

- **Tolerance of random-matching type**

Table 3

Unit: µm

Accuracy grade	High precision grade PH		Normal grade PC	
Characteristics / Model No.	SH15, 20, 25, 30, 35	SH45	SH15, 20, 25, 30, 35	SH45, 55
Mounting height *H*	±20	±30	±20	±30
Variation of mounting height *H*	15① 30②	20① 35②	15① 30②	20① 35②
Mounting width W_2 or W_3	±30	±35	±30	±35
Variation of mounting width W_2 or W_3	20	20	25	30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	See **Table 1**, **Fig. 5** and **Fig. 6**			

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

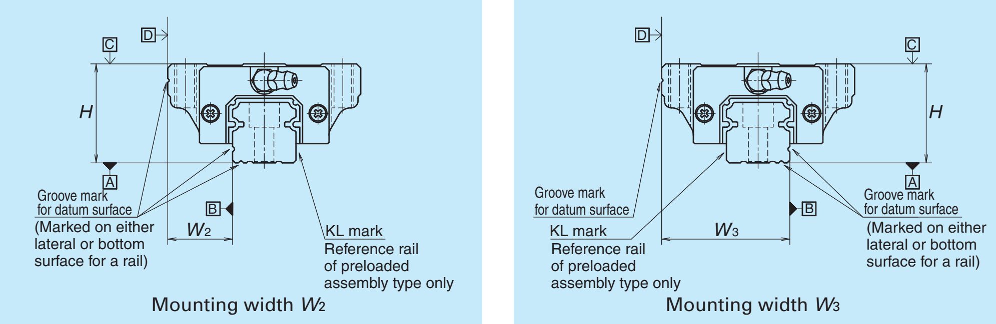
(3) Combinations of accuracy and preload

Table 4

		Accuracy grade						
		Ultra precision	Super precision	High precision	Precision grade	Normal grade	High precision	Normal grade
Without NSK K1 lubrication unit		P3	P4	P5	P6	PN	PH	PC
With NSK K1 lubrication unit		K3	K4	K5	K6	KN	KH	KC
Preload	Fine clearance Z0	○	○	○	○	○	—	—
	Slight preload Z1	○	○	○	○	○	—	—
	Medium preload Z3	○	○	○	○	—	—	—
	Random-matching type with slight preload ZZ	—	—	—	—	—	○	○
	Random-matching type with medium preload ZH	—	—	—	—	—	○	○

Note: Medium preload of random-matching type is available for SH15 to SH45.

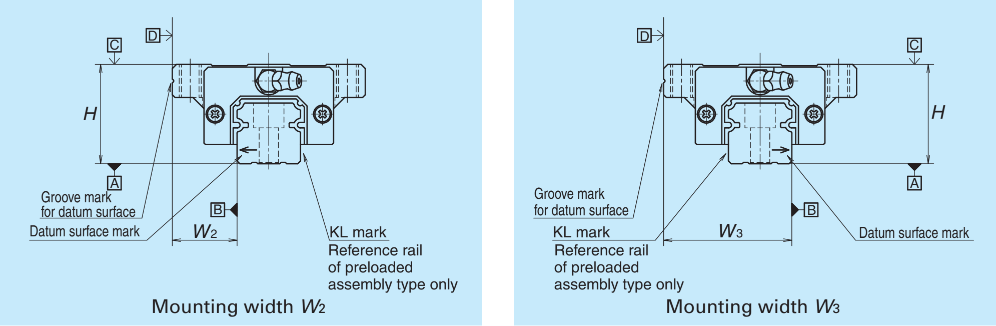
4. Assembled accuracy



Mounting width W_2

Mounting width W_3

Fig. 5 Special high carbon steel



Mounting width W_2

Mounting width W_3

Fig. 6 Stainless steel

(5) Preload and rigidity

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

- **Preload and rigidity of preloaded assembly**

Table 5

	Model No.	Preload (N)		Rigidity (N/μm)			
				Vertical direction		Lateral direction	
		Slight preload (Z1)	Medium preload (Z3)	Slight preload (Z1)	Medium preload (Z3)	Slight preload (Z1)	Medium preload (Z3)
High-load type	SH15 AN, EM, EL, FL	78	441	127	215	88	166
	SH20 AN, EM, EL, FL	147	784	157	274	127	225
	SH25 AN, EM, AL, EL, FL	196	1 180	186	343	137	255
	SH30 AN, AL	245	1 470	196	363	137	265
	SH30 EM, EL, FL	294	1 670	245	441	176	323
	SH35 AN, AL, EM, EL, FL	390	2 160	294	529	205	382
	SH45 AN, AL, EM, EL, FL	635	3 700	397	727	283	529
	SH55 AN, AL, EM, EL, FL	930	5 600	482	891	336	635
Super-high-load type	SH15 BN, GM, GL, HL	98	637	186	333	137	264
	SH20 BN, GM, GL, HL	196	1 080	235	421	186	343
	SH25 BN, GM, BL, GL, HL	245	1 570	284	529	196	382
	SH30 BN, GM, BL, GL, HL	343	2 160	333	627	235	451
	SH35 BN, GM, BL, GL, HL	490	2 840	411	755	284	529
	SH45 BN, GM, BL, GL, HL	785	4 600	515	944	367	686
	SH55 BN, GM, BL, GL, HL	1 180	6 750	631	1 148	440	817

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	Medium preload ZH
SH15	–4 — 0	–8 — –3.5
SH20	–5 — 0	–9 — –3.5
SH25	–5 — 0	–11 — –5.5
SH30	–7 — 0	–13 — –6
SH35	–7 — 0	–14 — –7
SH45	–7 — 0	–17 — –9
SH55	–9 — 0	

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

4. Maximum rail length

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

Table 7 Length limitation of rails

Unit: mm

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

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

5. Installation

(1) Permissible values of mounting error

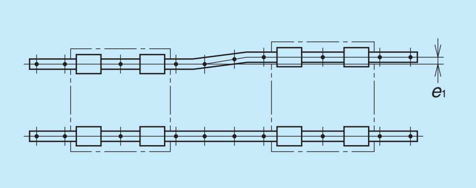


Fig. 7

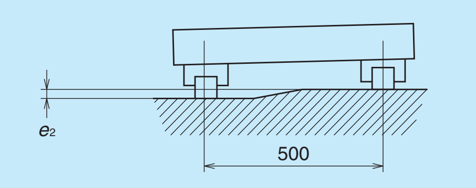


Fig. 8

Table 8

Unit: μm

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

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

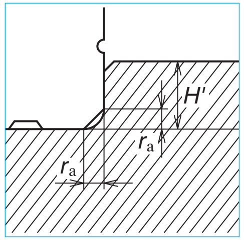


Fig. 9 Shoulder for the rail datum surface

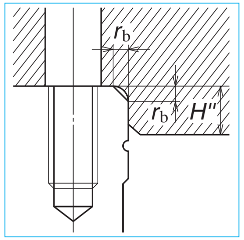


Fig. 10 Shoulder for the ball slide datum surface

Table 9

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
SH15	0.5	0.5	4	4
SH20	0.5	0.5	4.5	5
SH25	0.5	0.5	5	5
SH30	0.5	0.5	6	6
SH35	0.5	0.5	6	6
SH45	0.7	0.7	8	8
SH55	0.7	0.7	10	10

6. Lubrication components

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

(1) Types of lubrication accessories

Fig. 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.

When you require stainless lubrication accessories, please ask NSK.

(2) Mounting position of lubrication accessories

- The standard position of grease fittings is the end face of ball slide. We mount them on a side of end cap for an option. (**Fig. 12**)
  Please consult NSK for installation of grease or tube fittings to the ball slide body or side of end cap.
- When using a piping unit with thread of M6 × 1, you require a connector to connect to a grease fitting mounting hole with M6 × 0.75. The connector is available from NSK.

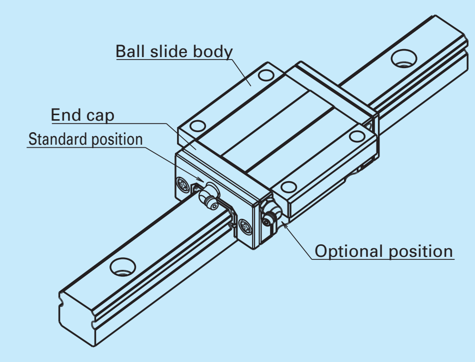


Fig. 12 Mounting position of lubrication accessories

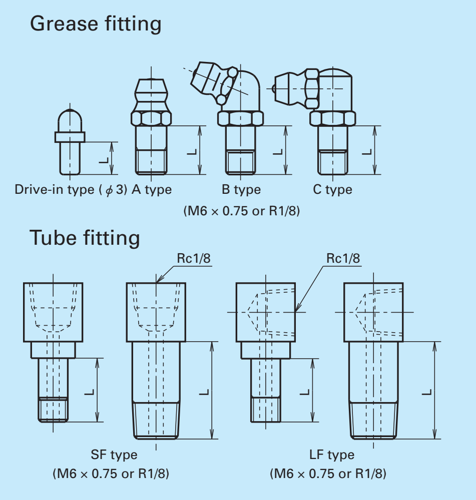


Fig. 11 Grease fitting and tube fitting

Table 10 Unit: mm

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	5
	With NSK K1	12	12
	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

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

7. Dust-proof components

(1) Standard specification

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

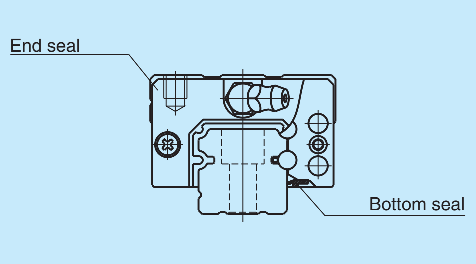


Fig. 13

Table 11 Seal friction per ball slide (maximum value)

Unit: N

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

(2) NSK K1™ lubrication unit

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

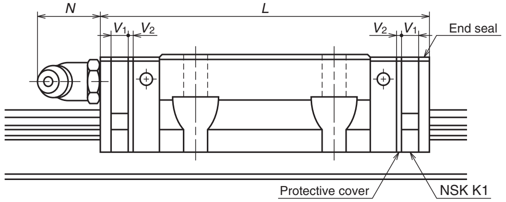


Table 12 Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_1	Protective cover thickness V_2	Protruding area of the grease fitting N
SH15	Standard	AN, EM, EL, FL	55	65.6	4.5	0.8	(5)
	Long	BN, GM, GL, HL	74	84.6			
SH20	Standard	AN, EM, EL, FL	69.8	80.4	4.5	0.8	(14)
	Long	BN, GM, GL, HL	91.8	102.4			
SH25	Standard	AN, AL, EM, EL, FL	79.0	90.6	5.0	0.8	(14)
	Long	BN, BL, GM, GL, HL	107	118.6			
SH30	Standard	AN, AL	85.6	97.6	5.0	1.0	(14)
	Flange type	EM, EL, FL	98.6	110.6			
	Long	BN, BL, GM, GL, HL	124.6	136.6			
SH35	Standard	AN, AL, EM, EL, FL	109	122	5.5	1.0	(14)
	Long	BN, BL, GM, GL, HL	143	156			
SH45	Standard	AN, AL, EM, EL, FL	139	154	6.5	1.0	(15)
	Long	BN, BL, GM, GL, HL	171	186			
SH55	Standard	AN, AL, EM, EL, FL	163	178	6.5	1.0	(15)
	Long	BN, BL, GM, GL, HL	201	216			

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

(3) Double seal

Use a double seal set as showing in **Table 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 as showing **Fig.14** is required.

(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 as showing **Fig.15** is required.

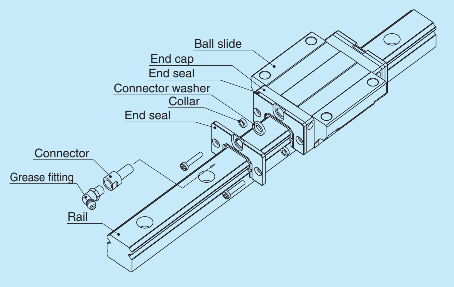


Fig. 14 Double seal

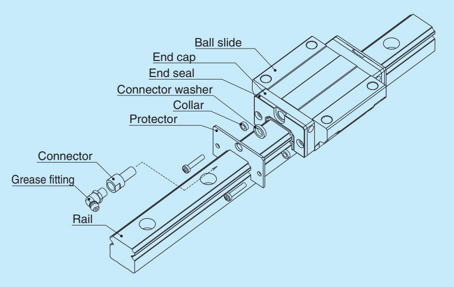


Fig. 15 Protector

Table 13 Double-seal set

Model No.	Reference No.		Increased thickness V_3 (mm)
	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

Table 14 Protector set

Model No.	Reference No.		Increased thickness V_4 (mm)
	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.

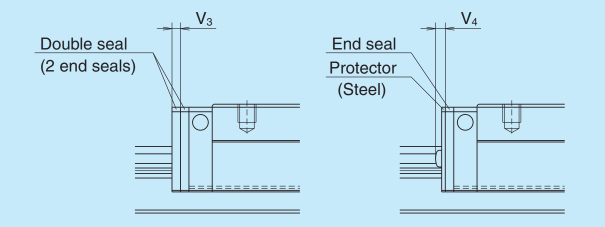


Fig. 16

(5) Cap to plug the rail mounting bolt hole

Table 15 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
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

(6) Inner seal

Inner seal is only available for the models shown below.

Table 16

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

(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 as showing **Fig.7.7** on page A55.

- When NSK K1, double seals or protectors are used, the set screws of bellows fastener kit are unable to use.
  Please contact NSK for details.
- Bellows fastener is available only for the horizontal mounting positions. For other mounting positions, sliding plate is required (see **Fig. 7.10** on page A56).
  For fixing to the rail, make tap holes to the rail end surface. Fix the bellows mounting plate to the rail end surface through these tap holes by using a machine screw. NSK processes a tap hole to the rail end face when ordered with a linear guide.

Table 17 Bellows fastner 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

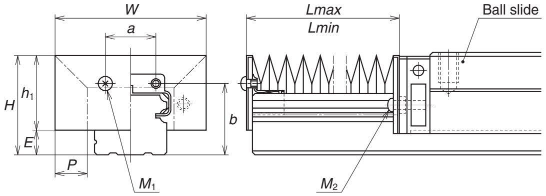


Fig. 17 Dimensions of bellows

Bellows reference number

J A H 20 N 08

Bellows — J

A: Bellows for the ends
B: Middle bellows — A

For SH and LH series — H

Size number of linear guide — 20

N: High type L: Low type — N

Number of BL (fold number) — 08

Table 18 Dimensions of bellows

Unit: mm

Model No.	H	h_1	E	W	P	a	b	BL minimum length	M_1 Tap x depth	M_2 Tap x depth
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*min	34	68	102	136	170	204	238	272	306	340
JAH20N	Stroke	106	212	318	424	530	636	742	848	954	1 060
	*L*max	140	280	420	560	700	840	980	1 120	1 260	1 400
JAH25L	Stroke	106	212	318	424	530	636	742	848	954	1 060
	*L*max	140	280	420	560	700	840	980	1 120	1 260	1 400
JAH25N	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	*L*max	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
JAH30L	Stroke	134	268	402	536	670	804	938	1 072	1 206	1 340
	*L*max	168	336	504	672	840	1 008	1 176	1 344	1 512	1 680
JAH30N	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	*L*max	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
JAH35L	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	*L*max	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
JAH35N	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
	*L*max	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
JAH45L	Stroke	176	352	528	704	880	1 058	1 232	1 408	1 584	1 760
	*L*max	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
JAH45N	Stroke	316	632	948	1 264	1 580	1 896	2 212	2 528	2 844	3 160
	*L*max	350	700	1 050	1 400	1 750	2 100	2 450	2 800	3 150	3 500
JAH55L	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
	*L*max	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
JAH55N	Stroke	386	772	1 158	1 544	1 930	2 316	2 702	3 088	3 474	3 860
	*L*max	420	840	1 260	1 680	2 100	2 520	2 940	3 360	3 780	4 200

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

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

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 1200 AN C 2 - P5 3**

Series name

Size

Rail length (mm)

Ball slide shape code (See page A140.)

Material/surface treatment code (See Table 21.)
C: Special high carbon steel (NSK standard), K: Stainless steel

Preload code (See page A142.)
0: Z0, 1: Z1, 3: Z3

Accuracy code (See Table 22.)

Design serial number
Added to the reference number.

Number of ball slides per rail

(2) Reference number for random-matching type

Ball slide

SAH 30 AN Z -K

Random-matching ball slide series code
SAH: SH Series random-matching ball slide

Size

Ball slide shape code (See page A140.)

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

Preload code
Z: Slight preload, H: Medium preload

Rail

L1H 30 1200 L C N - PC Z**

Random-matching rail series code
L1H: SH Series random-matching rail

Size

Rail length (mm)

Rail shape code: L
L: Standard

Material/surface treatment code (See Table 21.)

Preload code (See page A142.)
Z: Slight preload (common rail for slight or medium preload)

Accuracy code
PH: High precision grade random-matching type
PC: Normal grade random-matching type

Design serial number
Added to the reference number.

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

*Please consult with NSK for butting rail specification.

The reference number coding for the assembly of random-matching type is the same as that of the preloaded assembly. However, only preload code of "medium preload H" and "slight preload Z" are available (refer to page A142).

Table 21 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

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

Table 22 Accuracy code

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

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

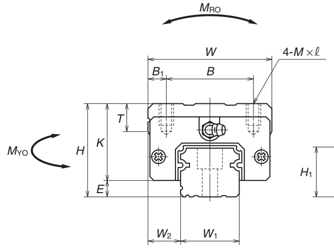
9. Dimensions

SH-AN (High-load type / Standard)
SH-BN (Super-high-load type / Long)

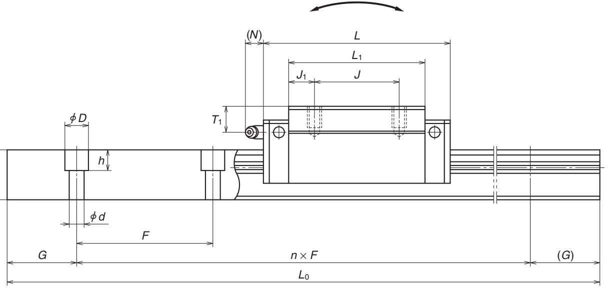
SH 30 1200 AN C 2 -＊＊ PC Z

Series name: SH
Size: 30
Rail length (mm): 1200
Ball slide shape code (See page A140.): AN
Material/surface treatment code (See Table 21.): C
C: Special high carbon steel (NSK standard), K: Stainless steel
Number of ball slides per rail: 2
Design serial number: -＊＊
Added to the reference number.
Accuracy code (See Table 22.): PC
Preload code (See page A142.): Z
0: Z0, 1: Z1, 3: Z3, Z: ZZ, H: ZH

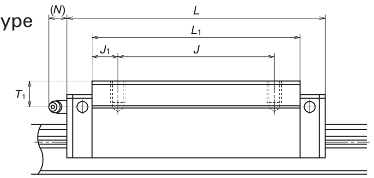
Front view of AN and BN types



Side view of AN type



Side view of BN type

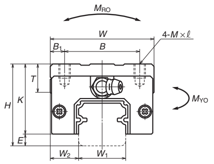


Reference number for ball slide of random-matching type

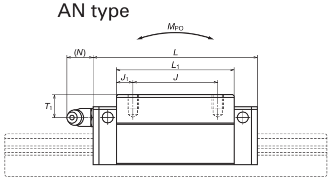
Ball slide **SAH 30 AN Z -K**

Random-matching ball slide series code: SAH
SAH: SH Series random-matching ball slide
Size: 30
Ball slide shape code (See page A140.): AN
Preload code: Z
Z: Slight preload, H: Medium preload
Option code: -K
-K: Equipped with NSK K1
-F: Fluoride low temperature chrome plating+AS2 grease

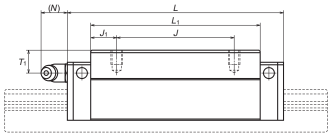
AN and BN types



AN type



BN type

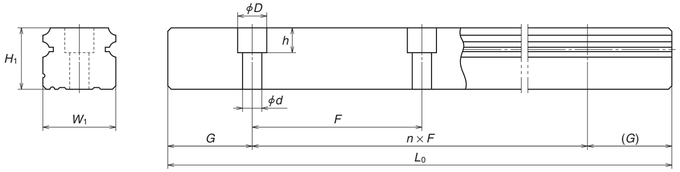


Reference number for rail of random-matching type

Rail **L1H 30 1200 L C N -＊＊ PC Z**

Random-matching rail series code: L1H
L1H: SH Series random-matching rail
Size: 30
Rail length (mm): 1200
Rail shape code: L
L: Standard
Material/surface treatment code (See Table 21.): C
*Butting rail specification: N
N: Non-butting. L: Butting specification
Design serial number: -＊＊
Added to the reference number.
Accuracy code: PC
PH: High precision grade
PC: Normal grade
Preload code (See page A142.): Z
Z: Slight preload (common rail for medium preload)

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide													Rail						Basic load rating							Weight	
	Height			Width	Length	Mounting hole								Grease fitting			Width	Height	Pitch	Mounting bolt hole	G	Max. length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
	H	E	W_2	W	L	B	J	M×pitch×ℓ	B_1	L_1	J_1	K	T	Hole size	T_1	N	W_1	H_1	F	d×D×h	(reference)	L_{0max} ( ) for stainless	C (N)	C_0 (N)	M_{RO}	M_{PO}		M_{YO}		(kg)	(kg/m)
																										One slide	Two slides	One slide	Two slides		
SH15AN **SH15BN**	28	4.6	9.5	34	55 74	26	26	M4×0.7×6	4	39 58	6.5 16	23.4	8	ϕ3	8.5	3.3	15	15	60	4.5×7.5×5.3	20	2 000 (1 800)	10 100 13 400	18 800 28 200	98 147	87 193	525 1 020	73 162	440 855	0.18 0.26	1.6
SH20AN **SH20BN**	30	5	12	44	69.8 91.8	32	36 50	M5×0.8×6	6	50 72	7 11	25	12	M6×0.75	5	11	20	18	60	6×9.5×8.5	20	3 960 (3 500)	16 300 21 600	29 600 44 500	199 298	167 360	1 050 1 990	141 305	875 1 670	0.33 0.48	2.6
SH25AN **SH25BN**	40	7	12.5	48	79 107	35	35 50	M6×1×9	6.5	58 86	11.5 18	33	12	M6×0.75	10	11	23	22	60	7×11×9	20	3 960 (3 500)	22 400 32 000	37 500 62 500	295 490	246 615	1 540 3 300	207 515	1 290 2 780	0.55 0.82	3.6
SH30AN **SH30BN**	45	9	16	60	85.6 124.6	40	40 60	M8×1.25×10	10	59 98	9.5 19	36	14	M6×0.75	10	11	28	26	80	9×14×12	20	4 000 (3 500)	31 000 46 000	51 500 91 500	490 870	365 1 060	2 270 5 600	305 885	1 910 4 700	0.77 1.3	5.2
SH35AN **SH35BN**	55	9.5	18	70	109 143	50	50 72	M8×1.25×12	10	80 114	15 21	45.5	15	M6×0.75	15	11	34	29	80	9×14×12	20	4 000	47 500 61 500	80 500 117 000	950 1 380	780 1 600	4 500 8 300	655 1 340	3 750 7 000	1.5 2.1	7.2
SH45AN **SH45BN**	70	14	20.5	86	139 171	60	60 80	M10×1.5×17	13	105 137	22.5 28.5	56	17	Rc1/8	20	13	45	38	105	14×20×17	22.5	3 990	76 500 94 500	128 000 175 000	1 970 2 680	1 550 2 760	9 000 14 700	1 300 2 320	7 550 12 400	3.0 3.9	12.3
SH55AN **SH55BN**	80	15	23.5	100	163 201	75	75 95	M12×1.75×18	12.5	126 164	25.5 34.5	65	18	Rc1/8	21	13	53	44	120	16×23×20	30	3 960	113 000 140 000	181 000 247 000	3 300 4 550	2 640 4 800	15 100 24 800	2 210 4 050	12 700 20 800	4.7 6.1	16.9

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

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

3) High-precision grade and medium preload of random-matching type are available for SH15 to SH45 of high-carbon steel products.

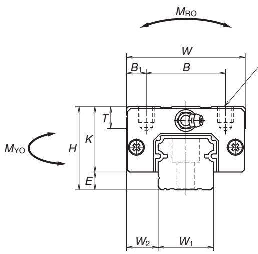
SH-AL (High-load type / Standard)
SH-BL (Super-high-load type / Long)

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

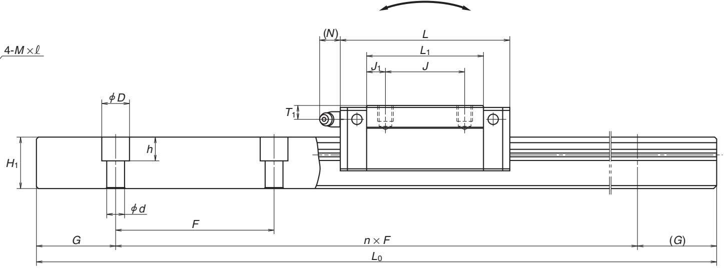
Series name
Size
Rail length (mm)
Ball slide shape code (See page A140.)
Material/surface treatment code (See Table 21.)
C: Special high carbon steel (NSK standard), K: Stainless steel

Preload code (See page A142.)
0: Z0, 1: Z1, 3: Z3, Z: ZZ, H: ZH
Accuracy code (See Table 22.)
Design serial number
Added to the reference number.
Number of ball slides per rail

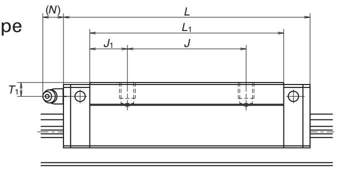
Front view of AL and BL types



Side view of AL type



Side view of BL type



Model No.	Assembly			Ball slide											Grease fitting		
	Height			Width	Length	Mounting hole											
	H	E	W_2	W	L	B	J	M×pitch×ℓ	B_1	L_1	J_1	K	T	Hole size	T_1	N
SH25AL	36	7	12.5	48	79	35	35	M6×1×6	6.5	58	11.5	29	12	M6×0.75	6	11
SH25BL					107		50			86	18					
SH30AL	42	9	16	60	85.6	40	40	M8×1.25×8	10	59	9.5	33	14	M6×0.75	7	11
SH30BL					124.6		60			98	19					
SH35AL	48	9.5	18	70	109	50	50	M8×1.25×8	10	80	15	38.5	15	M6×0.75	8	11
SH35BL					143		72			114	21					
SH45AL	60	14	20.5	86	139	60	60	M10×1.5×10	13	105	22.5	46	17	Rc1/8	10	13
SH45BL					171		80			137	28.5					
SH55AL	70	15	23.5	100	163	75	75	M12×1.75×13	12.5	126	25.5	55	15	Rc1/8	11	13
SH55BL					201		95			164	34.5					

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

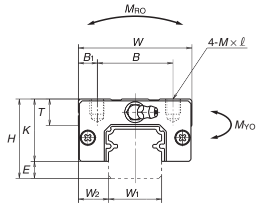
Reference number for ball slide of random-matching type

Ball slide **SAH 30 AL Z -K**

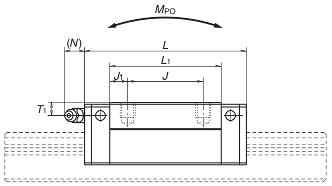
Random-matching ball slide series code
SAH: SH Series random-matching ball slide
Size
Ball slide shape code (See page A140.)

Option code
-K: Equipped with NSK K1
-F: Fluoride low temperature chrome plating+AS2 grease
Preload code
Z: Slight preload, H: Medium preload

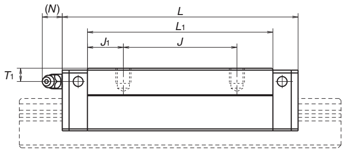
AL and BL types



AL type



BL type

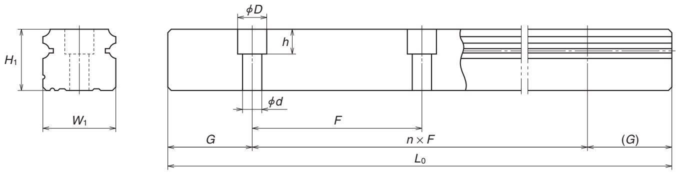


Reference number for rail of random-matching type

Rail **L1H 30 1200 L C N -** ** **PC Z**

Random-matching rail series code
L1H: SH Series random-matching rail
Size
Rail length (mm)
Rail shape code: L
L: Standard
Material/surface treatment code (See Table 21.)

Preload code (See page A142.)
Z: Slight preload (common rail for medium preload)
Accuracy code
PH: High precision grade
PC: Normal grade
Design serial number
Added to the reference number.
*Butting rail specification
N: Non-butting. L: Butting specification
*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Rail						Basic load rating							Weight	
	Width	Height	Pitch	Mounting bolt hole	G	Max. length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
						L_{0max}	C	C_0	M_{RO}	M_{PO}		M_{YO}			
	W_1	H_1	F	d×D×h	(reference)	( ) for stainless	(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
SH25AL	23	22	60	7×11×9	20	3 960	22 400	37 500	295	246	1 540	207	1 290	0.46	3.6
SH25BL						(3 500)	32 000	62 500	490	615	3 300	515	2 780	0.69	
SH30AL	28	26	80	9×14×12	20	4 000	31 000	51 500	490	365	2 270	305	1 910	0.69	5.2
SH30BL						(3 500)	46 000	91 500	870	1 060	5 600	885	4 700	1.16	
SH35AL	34	29	80	9×14×12	20	4 000	47 500	80 500	950	780	4 500	655	3 750	1.2	7.2
SH35BL							61 500	117 000	1 380	1 600	8 300	1 340	7 000	1.7	
SH45AL	45	38	105	14×20×17	22.5	3 990	76 500	128 000	1 970	1 550	9 000	1 300	7 550	3.0	12.3
SH45BL							94 500	175 000	2 680	2 760	14 700	2 320	12 400	3.9	
SH55AL	53	44	120	16×23×20	30	3 960	113 000	181 000	3 300	2 640	15 100	2 210	12 700	4.7	16.9
SH55BL							140 000	247 000	4 550	4 800	24 800	4 050	20 800	6.1	

2) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.
3) High-precision grade and medium preload of random-matching type are available for SH15 to SH45 of high-carbon steel products.

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

SH 30 1200 EM C 2 -✻✻ PC Z

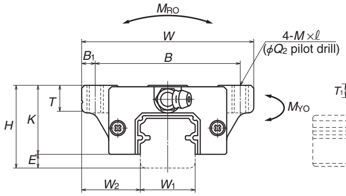
Series name
Size
Rail length (mm)
Ball slide shape code (See page A140.)
Material/surface treatment code (See Table 21.)
C: Special high carbon steel (NSK standard), K: Stainless steel
Number of ball slides per rail
Design serial number
Added to the reference number.
Accuracy code (See Table 22.)
Preload code (See page A142.)
0: Z0, 1: Z1, 3: Z3, Z: ZZ, H: ZH

Reference number for ball slide of random-matching type

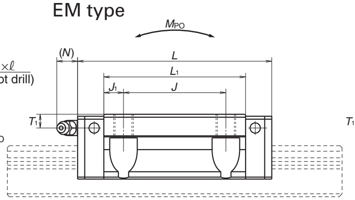
Ball slide **SAH 30 EM Z -K**

Random-matching ball slide series code
SAH: SH Series random-matching ball slide
Size
Ball slide shape code (See page A140.)
Preload code
Z: Slight preload, H: Medium preload
Option code
-K: Equipped with NSK K1
-F: Fluoride low temperature chrome plating+AS2 grease

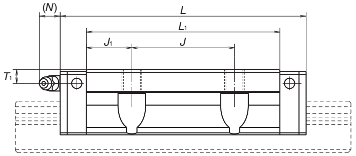
EM and GM types



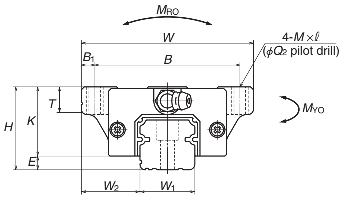
EM type



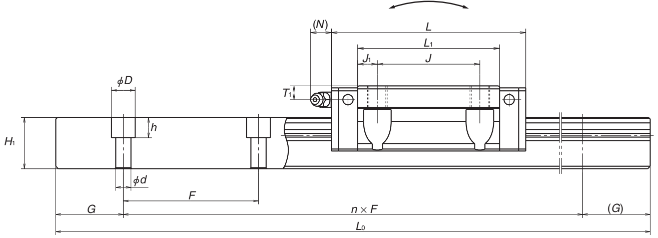
GM type



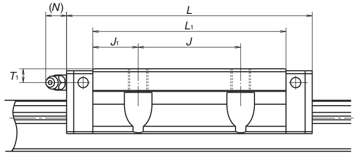
Front view of EM and GM types



Side view of EM type



Side view of GM type

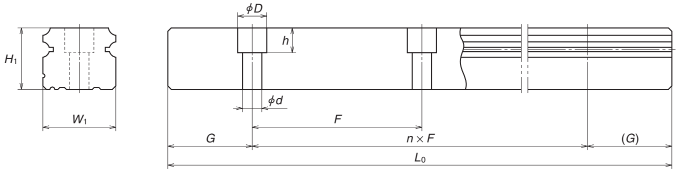


Reference number for rail of random-matching type

Rail **L1H 30 1200 L C N -✻✻ PC Z**

Random-matching rail series code
L1H: SH Series random-matching rail
Size
Rail length (mm)
Rail shape code: L
L: Standard
Material/surface treatment code (See Table 21.)
*Butting rail specification
N: Non-butting. L: Butting specification
Design serial number
Added to the reference number.
Accuracy code
PH: High precision grade
PC: Normal grade
Preload code (See page A142.)
Z: Slight preload (common rail for medium preload)

*Please consult with NSK for butting rail specification.



Model No.	Assembly			Ball slide													
	Height			Width	Length	Mounting hole									Grease fitting		
	H	E	W_2	W	L	B	J	M×pitch×ℓ	Q_2	B_1	L_1	J_1	K	T	Hole size	T_1	N
SH15EM **SH15GM**	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	ϕ3	4.5	3.3
SH20EM **SH20GM**	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
SH25EM **SH25GM**	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
SH30EM **SH30GM**	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
SH35EM **SH35GM**	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
SH45EM **SH45GM**	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
SH55EM **SH55GM**	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

Unit: mm

Model No.	Rail						Basic load rating							Weight	
	Width	Height	Pitch	Mounting bolt hole	G	Max. length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
						L_{0max}	C	C_0	M_{RO}	M_{PO}		M_{YO}			
	W_1	H_1	F	d×D×h	(reference)	( ) for stainless	(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
SH15EM **SH15GM**	15	15	60	4.5×7.5×5.3	20	2 000 (1 800)	10 100 13 400	18 800 28 200	98 147	87 193	525 1 020	73 162	440 855	0.17 0.25	1.6
SH20EM **SH20GM**	20	18	60	6×9.5×8.5	20	3 960 (3 500)	16 300 21 600	29 600 44 500	199 298	167 360	1 050 1 990	141 305	875 1 670	0.45 0.65	2.6
SH25EM **SH25GM**	23	22	60	7×11×9	20	3 960 (3 500)	22 400 32 000	37 500 62 500	295 490	246 615	1 540 3 300	207 515	1 290 2 780	0.63 0.93	3.6
SH30EM **SH30GM**	28	26	80	9×14×12	20	4 000 (3 500)	35 500 46 000	63 000 91 500	600 870	540 1 060	3 150 5 600	450 885	2 630 4 700	1.2 1.6	5.2
SH35EM **SH35GM**	34	29	80	9×14×12	20	4 000	47 500 61 500	80 500 117 000	950 1 380	780 1 600	4 500 8 300	655 1 340	3 750 7 000	1.7 2.4	7.2
SH45EM **SH45GM**	45	38	105	14×20×17	22.5	3 990	76 500 94 500	128 000 175 000	1 970 2 680	1 550 2 760	9 000 14 700	1 300 2 320	7 550 12 400	3 3.9	12.3
SH55EM **SH55GM**	53	44	120	16×23×20	30	3 960	113 000 140 000	181 000 247 000	3 300 4 550	2 640 4 800	15 100 24 800	2 210 4 050	12 700 20 800	5 6.5	16.9

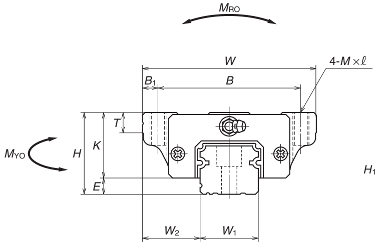
Notes: 1) Parenthesized dimensions are applicable to stainless steel products.
2) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.
3) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.
4) High-precision grade and medium preload of random-matching type are available for SH15 to SH45 of high-carbon steel products.

SH-EL (High-load type / Standard)
SH-GL (Super-high-load type / Long)

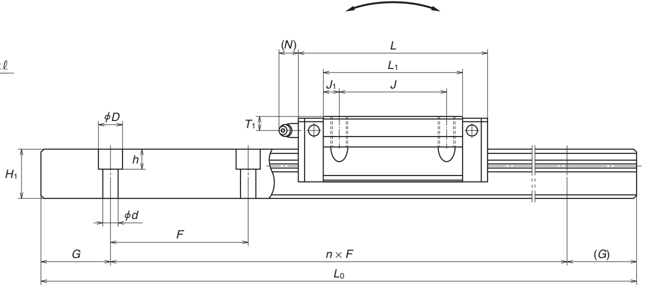
SH 30 1200 EL C 2 -✻✻ PC Z

- SH: Series name
- 30: Size
- 1200: Rail length (mm)
- EL: Ball slide shape code (See page A140.)
- C: Material/surface treatment code (See Table 21.)
  C: Special high carbon steel (NSK standard), K: Stainless steel
- 2: Number of ball slides per rail
- -✻✻: Design serial number
  Added to the reference number.
- PC: Accuracy code (See Table 22.)
- Z: Preload code (See page A142.)
  0: Z0, 1: Z1, 3: Z3, Z: ZZ

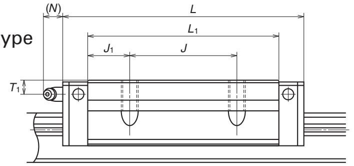
Front view of EL and GL types



Side view of EL type



Side view of GL type

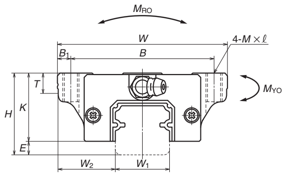


Reference number for ball slide of random-matching type

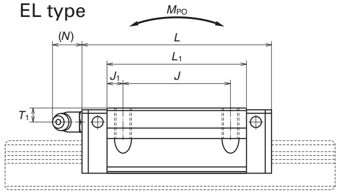
Ball slide **SAH 30 EL Z -K**

- SAH: Random-matching ball slide series code
  SAH: SH Series random-matching ball slide
- 30: Size
- EL: Ball slide shape code (See page A140.)
- Z: Preload code
  Z: Slight preload
- -K: Option code
  -K: Equipped with NSK K1
  -F: Fluoride low temperature chrome+AS2 grease

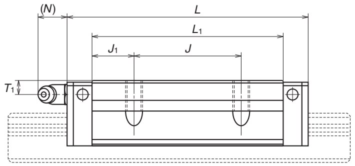
EL and GL types



EL type



GL type

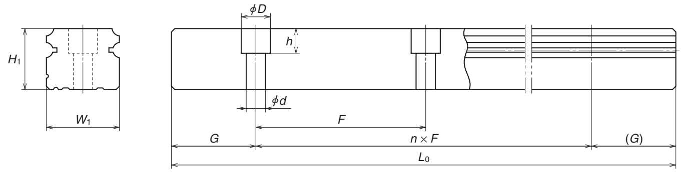


Reference number for rail of random-matching type

Rail **L1H 30 1200 L C N -✻✻ PC Z**

- L1H: Random-matching rail series code
  L1H: SH Series random-matching rail
- 30: Size
- 1200: Rail length (mm)
- L: Rail shape code: L
  L: Standard
- C: Material/surface treatment code (See Table 21.)
- N: *Butting rail specification
  N: Non-butting. L: Butting specification
- -✻✻: Design serial number
  Added to the reference number.
- PC: Accuracy code: PC
  PC: Normal grade is only available.
- Z: Preload code (See page A142.)
  Z: Slight preload only

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide													Rail						Basic load rating							Weight	
	Height			Width	Length	Mounting hole								Grease fitting			Width	Height	Pitch	Mounting bolt hole	G	Max. length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
																									M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	M×pitch×ℓ	B_1	L_1	J_1	K	T	Hole size	T_1	N	W_1	H_1	F	$d \times D \times h$	(reference)	L_{0max} ( ) for stainless	C (N)	C_0 (N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
SH15EL SH15GL	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	15	15	60	4.5×7.5×5.3	20	2 000 (1 800)	10 100 13 400	18 800 28 200	98 147	87 193	525 1 020	73 162	440 855	0.17 0.25	1.6
SH20EL SH20GL	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	20	18	60	6×9.5×8.5	20	3 960 (3 500)	16 300 21 600	29 600 44 500	199 298	167 360	1 050 1 990	141 305	875 1 670	0.45 0.65	2.6
SH25EL SH25GL	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	23	22	60	7×11×9	20	3 960 (3 500)	22 400 32 000	37 500 62 500	295 490	246 615	1 540 3 300	207 515	1 290 2 780	0.63 0.93	3.6
SH30EL SH30GL	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	28	26	80	9×14×12	20	4 000 (3 500)	35 500 46 000	63 000 91 500	600 870	540 1 060	3 150 5 600	450 885	2 630 4 700	1.2 1.6	5.2
SH35EL SH35GL	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	34	29	80	9×14×12	20	4 000	47 500 61 500	80 500 117 000	950 1 380	780 1 600	4 500 8 300	655 1 340	3 750 7 000	1.7 2.4	7.2
SH45EL SH45GL	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	45	38	105	14×20×17	22.5	3 990	76 500 94 500	128 000 175 000	1 970 2 680	1 550 2 760	9 000 14 700	1 300 2 320	7 550 12 400	3.0 3.9	12.3
SH55EL SH55GL	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	53	44	120	16×23×20	30	3 960	113 000 140 000	181 000 247 000	3 300 4 550	2 640 4 800	15 100 24 800	2 210 4 050	12 700 20 800	5.0 6.5	16.9

Notes: 1) Parenthesized dimensions are applicable to stainless steel products.
2) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.
3) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.
4) High-precision grade and medium preload of random-matching type are not available for EL and GL models.

SH-FL (High-load type / Standard)
SH-HL (Super-high-load type / Long)

SH 30 1200 FL C 2 -＊＊ PC Z

Series name

Size

Rail length (mm)

Ball slide shape code (See page A140.)

Material/surface treatment code (See Table 21.)

C: Special high carbon steel (NSK standard), K: Stainless steel

Preload code (See page A142.)

0: Z0, 1: Z1, 3: Z3, Z: ZZ

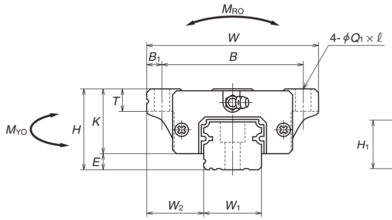
Accuracy code (See Table 22.)

Design serial number

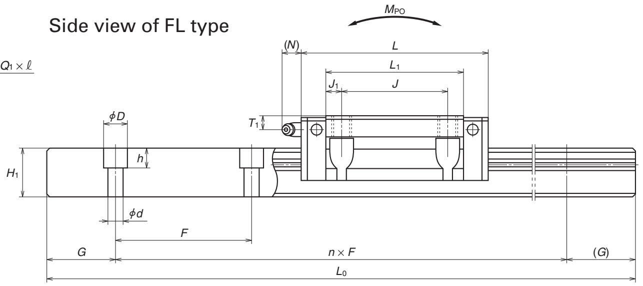
Added to the reference number.

Number of ball slides per rail

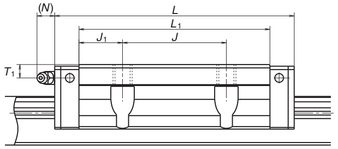
Front view of FL and HL types



Side view of FL type



Side view of HL type



Model No.	Assembly			Ball slide												
	Height			Width	Length	Mounting hole								Grease fitting		
	H	E	W_2	W	L	B	J	$Q_1 \times \ell$	B_1	L_1	J_1	K	T	Hole size	T_1	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	ϕ3	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

Notes: 1) Parenthesized dimensions are applicable to stainless steel products.
2) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.

Reference number for ball slide of random-matching type

Ball slide **SAH 30 FL Z -K**

Random-matching ball slide series code

SAH: SH Series random-matching ball slide

Size

Ball slide shape code (See page A140.)

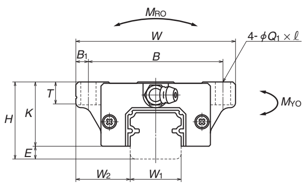
Option code

-K: Equipped with NSK K1
-F: Fluoride low temperature chrome plating+AS2 grease

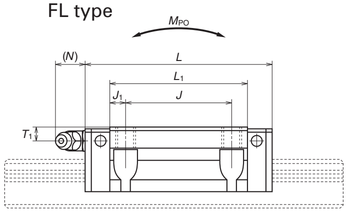
Preload code

Z: Slight preload

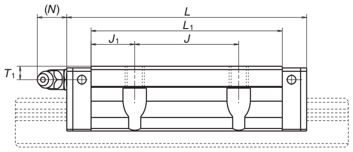
FL and HL types



FL type



HL type



Reference number for rail of random-matching type

Rail **L1H 30 1200 L C N -＊＊ PC Z**

Random-matching rail series code

L1H: SH Series random-matching rail

Size

Rail length (mm)

Rail shape code: L

L: Standard

Material/surface treatment code (See Table 21.)

Preload code (See page A142.)

Z: Slight preload only

Accuracy code: PC

PC: Normal grade is only available.

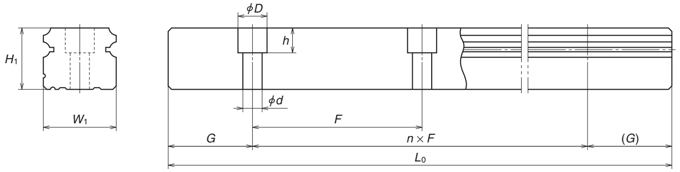
Design serial number

Added to the reference number.

*Butting rail specification

N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.

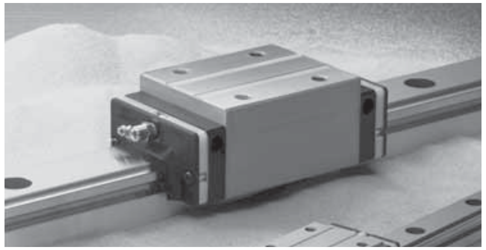


Unit: mm

Rail						Basic load rating							Weight	
Width	Height	Pitch	Mounting bolt hole	G	Max. length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
					L_{0max}	C	C_0	M_{RO}	M_{PO}		M_{YO}			
W_1	H_1	F	$d \times D \times h$	(reference)	( ) for stainless	(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
15	15	60	4.5×7.5×5.3	20	2 000 (1 800)	10 100 13 400	18 800 28 200	98 147	87 193	525 1 020	73 162	440 855	0.17 0.25	1.6
20	18	60	6×9.5×8.5	20	3 960 (3 500)	16 300 21 600	29 600 44 500	199 298	167 360	1 050 1 990	141 305	875 1 670	0.45 0.65	2.6
23	22	60	7×11×9	20	3 960 (3 500)	22 400 32 000	37 500 62 500	295 490	246 615	1 540 3 300	207 515	1 290 2 780	0.63 0.93	3.6
28	26	80	9×14×12	20	4 000 (3 500)	35 500 46 000	63 000 91 500	600 870	540 1 060	3 150 5 600	450 885	2 630 4 700	1.2 1.6	5.2
34	29	80	9×14×12	20	4 000	47 500 61 500	80 500 117 000	950 1 380	780 1 600	4 500 8 300	655 1 340	3 750 7 000	1.7 2.4	7.2
45	38	105	14×20×17	22.5	3 990	76 500 94 500	128 000 175 000	1 970 2 680	1 550 2 760	9 000 14 700	1 300 2 320	7 550 12 400	3 3.9	12.3
53	44	120	16×23×20	30	3 960	113 000 140 000	181 000 247 000	3 300 4 550	2 640 4 800	15 100 24 800	2 210 4 050	12 700 20 800	5 6.5	16.9

3) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.
4) High-precision grade and medium preload of random-matching type are not available for FL and HL models.

A-5-1.3 VH Series



1. Features

(1) High-performance end seals

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

(2) NSK K1™ lubrication unit (standard)

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

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

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

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

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

This increases the capacity to absorb errors in installation.

(5) High load carrying capacity to vertical direction

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

(6) High resistance against impact load

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

(7) High accuracy

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

(8) Random matching type

Random-matching of rails and ball slides are available.

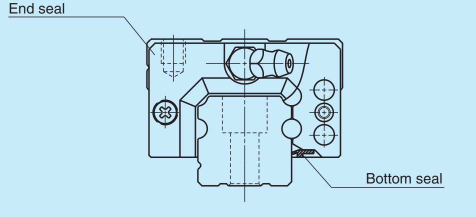


Fig. 1 VH Series

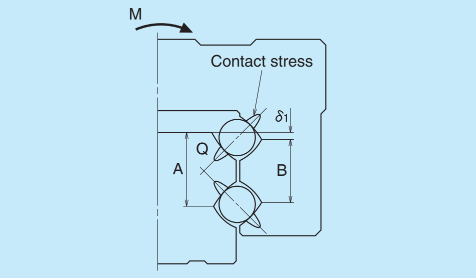


Fig. 2 Enlarged illustration of the offset Gothic arch groove

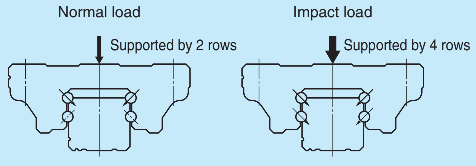


Fig. 3 When load is applied

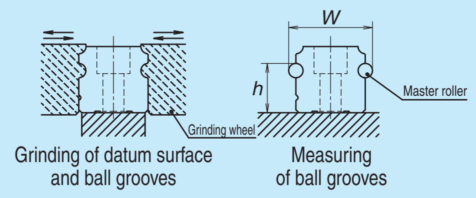


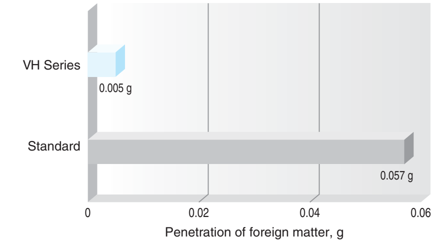
Fig. 4 Rail grinding and measuring

●Comparison with NSK standard products

Less than 1/10 the level of fine contaminants

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

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

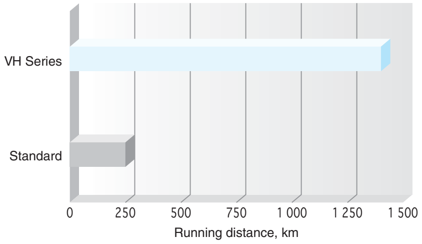


Operating life under contaminated environments is more than 5 times longer

Durability test with rubber fragments

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

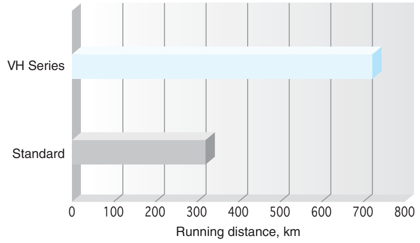
Test sample : VH30AN, preload code Z1
(preload of 245 N)
Rail orientation : Horizontal (wall mount)
Speed : 500 mm/sec
Lubrication : AS2 grease
(prepacked AS2 only)
Contaminant : Rubber fragments

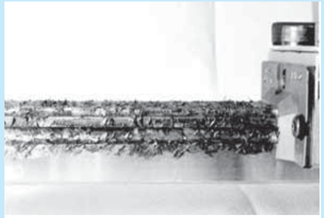


Durability test with fine wood particles

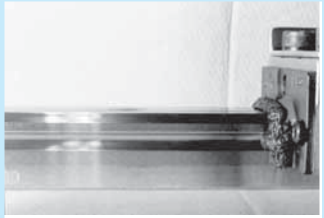
Extreme durability tests in a contaminated environment with fine wood particles show that durability of the VH Series is more than doubled compared to the standard series, as shown in the graph.

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



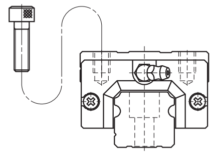
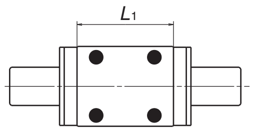
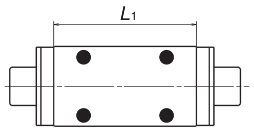
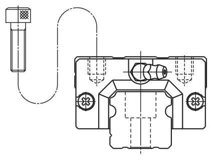
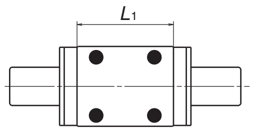
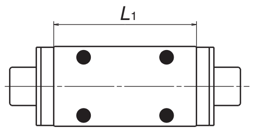
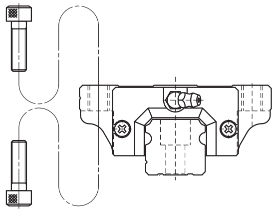
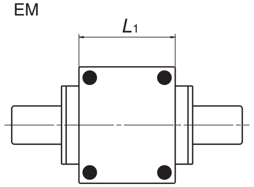
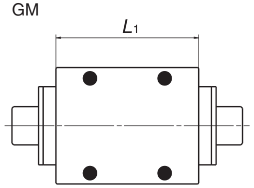
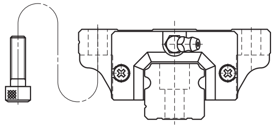
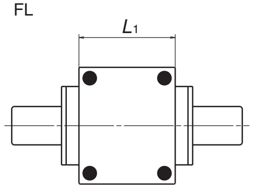
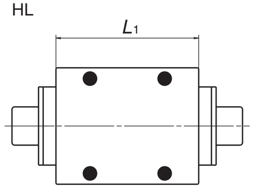
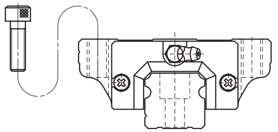
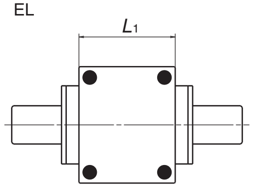
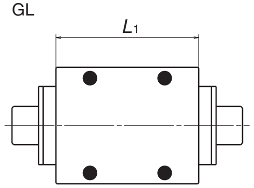


Before the passage of ball slide
(Heavily contaminated with wood particle)



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

2. Ball slide shape

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

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm)		Preloaded assembly (not random matching)					Random-matching type
over	or less	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	1 000	2.5	5	9	16	18	18
1 000	1 250	3	6	10	17	20	20
1 250	1 600	4	7	11	19	23	23
1 600	2 000	4.5	8	13	21	26	26
2 000	2 500	5	10	15	22	29	29
2 500	3 150	6	11	17	25	32	32
3 150	4 000	9	16	23	30	34	34

(2) Accuracy standard

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

- **Tolerance of preloaded assembly**

Table 2

Unit: μm

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

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

Table 3

Unit: μm

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

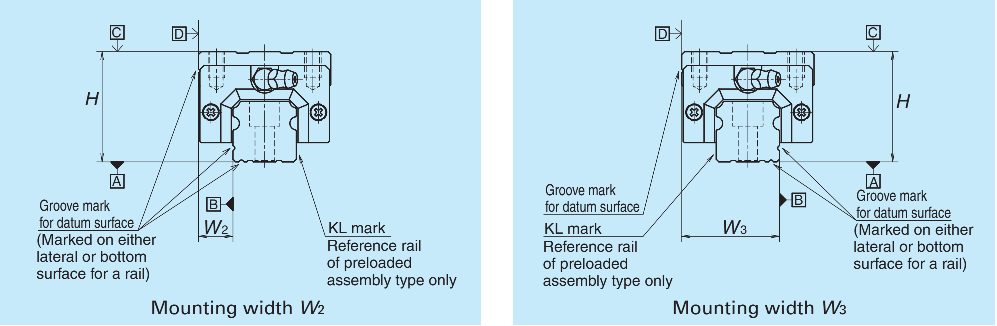
Note: ① Variation on the same rail ② Variation on multiple rails

(3) Combinations of accuracy and preload

Table 4

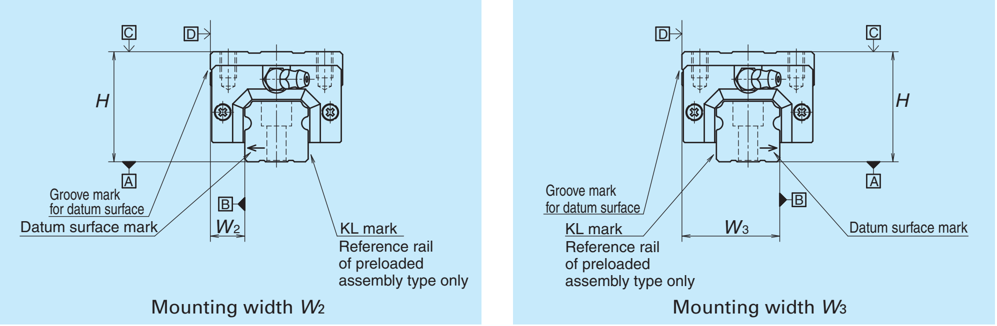
		Accuracy grade					
		Ultra precision	Super precision	High Precision	Precision grade	Normal grade	Normal grade
With NSK K1 lubrication unit		K3	K4	K5	K6	KN	KC
Preload	Fine clearance Z0	○	○	○	○	○	—
	Slight preload Z1	○	○	○	○	○	—
	Medium preload Z3	○	○	○	○	—	—
	Random-matching type with fine clearance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

(4) Assembled accuracy



Mounting width W_2 Mounting width W_3

Fig. 5 Special high carbon steel



Mounting width W_2 Mounting width W_3

Fig. 6 Stainless steel

(5) Preload and rigidity

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

- **Preload and rigidity of preloaded assembly**

Table 5

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

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

· **Preload of random-matching type**

Table 6 Unit: μm

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

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

4. Maximum rail length

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

Table 7 Length limitations of rails

Unit: mm

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

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

5. Installation

(1) Permissible values of mounting error

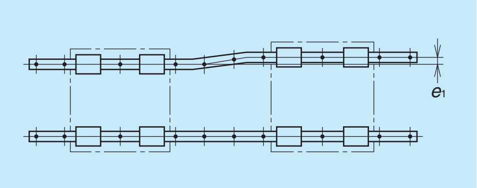


Fig. 7

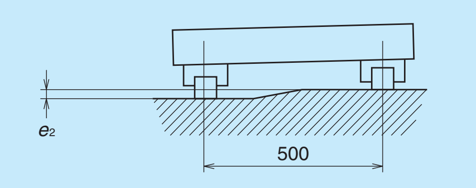


Fig. 8

Table 8

Unit: µm

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

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

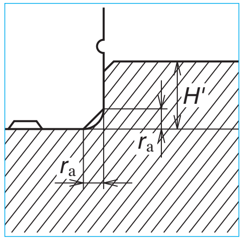


Fig. 9 Shoulder for the rail datum surface

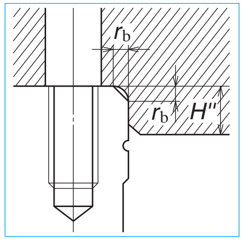


Fig. 10 Shoulder for the ball slide datum surface

Table 9

Unit: mm

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

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

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

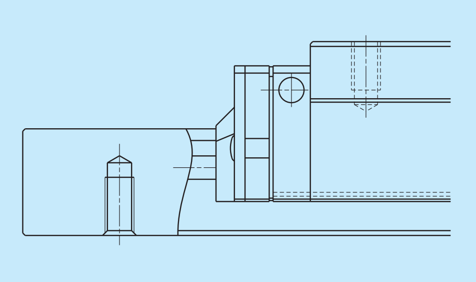


Fig. 11

6. Lubrication components

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

(1) Types of lubrication accessories

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

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

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

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

Please ask NSK for stainless lubrication accessories.

(2) Mounting position of lubrication accessories

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

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

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

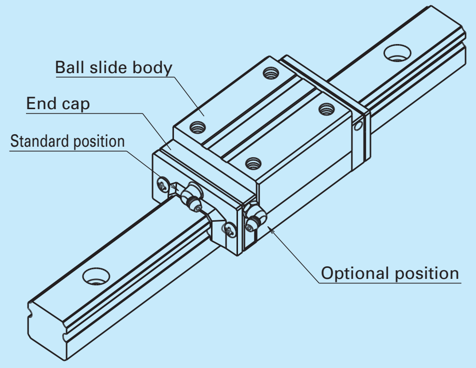


Fig. 13 Mounting position of lubrication accessories

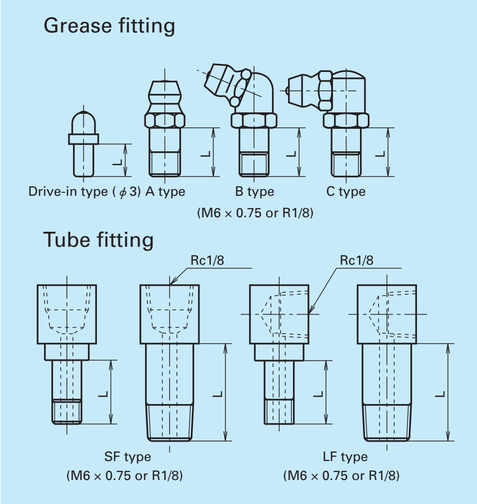


Fig. 12 Grease fitting and tube fitting

Table 10

Unit: mm

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

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

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

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

7. Dust-proof components

(1) Standard specification

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

Two NSK K1, one at each end, are installed as the standard equipment.

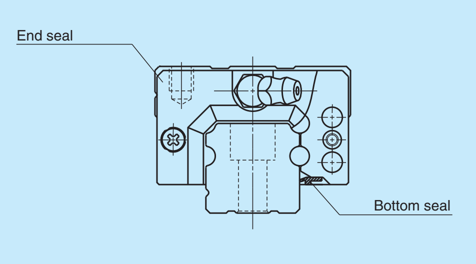


Fig. 14

Table 11 Seal friction per ball slide (maximum value)

Unit: N

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

(2) Double seal and protector

For VH Series, double-seal and protector can be installed only before shipping from the factory. Please consult NSK when you require them.

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

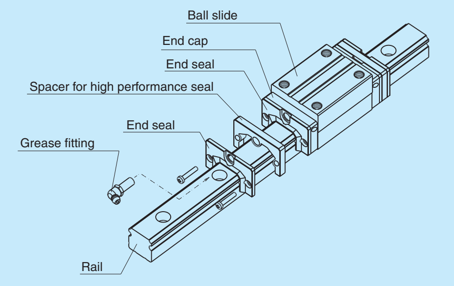


Fig. 15 Double seal

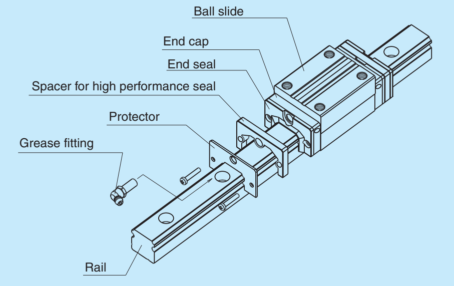
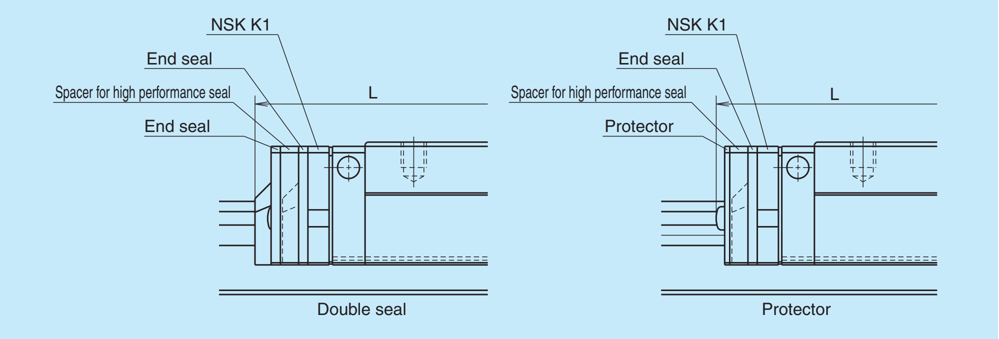


Fig. 16 Protector

Table 12 Dimension of installing dust-proof optional components

Unit: mm

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



Double seal

Protector

Fig. 17

(3) Cap to plug the rail mounting bolt hole

Table 13 Caps to plug rail bolt hole

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

(4) Inner seal

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

Table 14

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

8. Reference number

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

(1) Reference number for preloaded assembly

VH 30 1000 AN C 2 -** K5 3

Series name
Size
Rail length (mm)
Ball slide shape code (See page A165.)
Material/surface treatment code (See Table 15.)
C: Special high carbon steel (NSK standard), K: Stainless steel
Number of ball slides per rail
Design serial number
Added to the reference number.
Accuracy code (See Table 16.)
Preload code (See page A167.)
0: Z0, 1: Z1, 3: Z3

(2) Reference number for random-matching type

Ball slide

VAH 30 AN C -**KC Z

Random-matching ball slide series code
VAH: VH Series random-matching ball slide
Size
Ball slide shape code (See page A165.)
Material/surface treatment code (See Table 15.)
Design serial number
Added to the reference number.
Accuracy code: KC
KC: Normal grade is only available.
Preload code
T: Fine clearance. Z: Slight preload (See page A167.)

Rail

V1H 30 1000 L C N -** PC Z

Random-matching rail series code
V1H: VH Series random-matching rail
Size
Rail length (mm)
Rail shape code: L
L: Standard
Material/surface treatment code (See Table 15.)
*Butting rail specification
N: Non-butting. L: Butting specification
Design serial number
Added to the reference number.
Accuracy code: PC
PC: Normal grade is only available.
Preload code (See page A167.)
T: Fine clearance. Z: Slight preload

*Please consult with NSK for butting rail specification.

The reference number coding for the assembly of random-matching type is the same as that of preloaded assembly. However, the preload code of "fine clearance T" and "slight preload Z" is only applicable (refer to page A167).

Table 15 Material/surface treatment code

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

Table 16 Accuracy code

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

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

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

VH 30 1000 AN C 2 -✻✻ KC Z

Series name

Size

Rail length (mm)

Ball slide shape code (See page A165.)

Material/surface treatment code (See Table 15.)

C: Special high carbon steel (NSK standard), K: Stainless steel

Preload code (See page A167.)

0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ

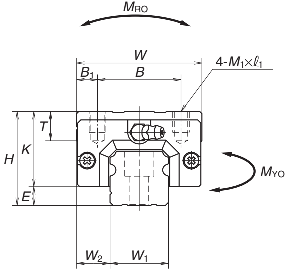
Accuracy code (See Table 16.)

Design serial number

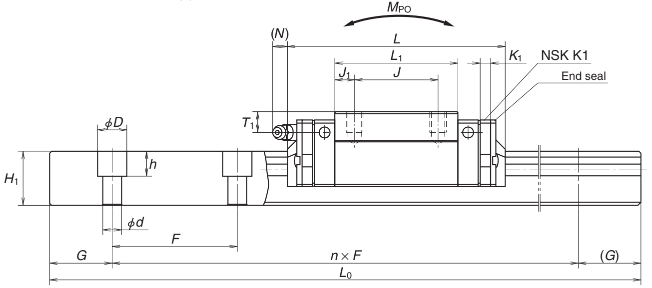
Added to the reference number.

Number of ball slides per rail

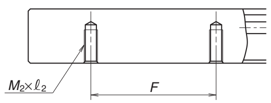
Front view of AN and BN type



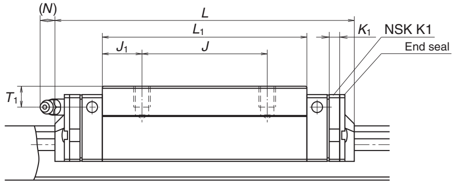
Side view of AN type



Specification for tapped holes on a rail bottom face



Side view of BN type



Reference number for ball slide of random-matching type

Ball slide **VAH 30 AN C -✻✻KC Z**

Random-matching ball slide series code

VAH: VH Series random-matching ball slide

Size

Ball slide shape code (See page A165.)

Material/surface treatment code (See Table 15.)

Preload code (See page A167.)

T: Fine clearance. Z: Slight preload

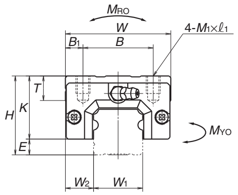
Accuracy code: KC

KC: Normal grade is only available.

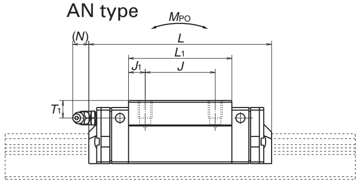
Design serial number

Added to the reference number.

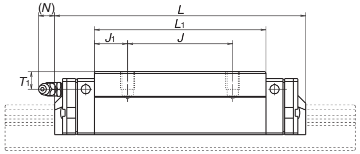
AN and BN types



AN type



BN type



Reference number for rail of random-matching type

Rail **V1H 30 1000 L C N -✻✻ PC Z**

Random-matching rail series code

V1H: VH Series random-matching rail

Size

Rail length (mm)

Rail shape code: L

L: Standard

Material/surface treatment code (See Table 15.)

Preload code (See page A167.)

T: Fine clearance. Z: Slight preload

Accuracy code: PC

PC: Normal grade is only available.

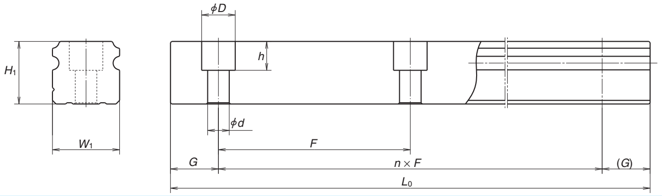
Design serial number

Added to the reference number.

*Butting rail specification

N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide											Grease fitting		
	Height			Width	Length	Mounting hole											
	H	E	W_2	W	L	B	J	M_1 × pitch × ℓ_1	B_1	L_1	J_1	K	T	K_1	Hole size	T_1	N
VH15AN	28	4.6	9.5	34	70.6〈 77〉	26	26	M4×0.7×6	4	39	6.5	23.4	8	4.5	ϕ3	8.5	1 〈 8.2〉
VH15BN					89.6〈 96〉					58	16						
VH20AN	30	5	12	44	87.4〈 94.2〉	32	36	M5×0.8×6	6	50	7	25	12	4.5	M6×0.75	5	11.1〈12.3〉
VH20BN					109.4〈116.2〉		50			72	11						
VH25AN	40	7	12.5	48	97 〈104.4〉	35	35	M6×1×9	6.5	58	11.5	33	12	5	M6×0.75	10	9.6〈12.9〉
VH25BN					125 〈132.4〉		50			86	18						
VH30AN	45	9	16	60	104.4〈114.8〉	40	40	M8×1.25×10	10	59	9.5	36	14	5	M6×0.75	10	11.4〈14.2〉
VH30BN					143.4〈153.8〉		60			98	19						
VH35AN	55	9.5	18	70	128.8〈139.2〉	50	50	M8×1.25×12	10	80	15	45.5	15	5.5	M6×0.75	15	10.9〈13.7〉
VH35BN					162.8〈173.2〉		72			114	21						
VH45AN	70	14	20.5	86	161.4〈174.2〉	60	60	M10×1.5×17	13	105	22.5	56	17	6.5	Rc1/8	20	12.5〈14.1〉
VH45BN					193.4〈206.2〉		80			137	28.5						
VH55AN	80	15	23.5	100	185.4〈198.2〉	75	75	M12×1.75×18	12.5	126	25.5	65	18	6.5	Rc1/8	21	12.5〈14.1〉
VH55BN					223.4〈236.2〉		95			164	34.5						

Model No.	Rail							Basic load rating							Weight	
	Width	Height	Pitch	Mounting hole	Tapped hole	G	Maximum length L_{0max} ( ) for stainless	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
								C	C_0	M_{RO}	M_{PO}		M_{YO}			
	W_1	H_1	F	d × D × h	M_2 × pitch × ℓ_2	(reference)		(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
VH15AN	15	15	60	4.5×7.5×5.3	M5×0.8×8	20	2 000	10 800	20 700	108	94.5	575	79.5	480	0.18	1.6
VH15BN							[1 800]	14 600	32 000	166	216	1 150	181	965	0.26	
VH20AN	20	18	60	6×9.5×8.5	M6×1×10	20	3 960	17 400	32 500	219	185	1 140	155	955	0.33	2.6
VH20BN							[3 500]	23 500	50 500	340	420	2 230	355	1 870	0.48	
VH25AN	23	22	60	7×11×9	M6×1×12	20	3 960	25 600	46 000	360	320	1 840	267	1 540	0.55	3.6
VH25BN							[3 500]	34 500	71 000	555	725	3 700	610	3 100	0.82	
VH30AN	28	26	80	9×14×12	M8×1.25×15	20	4 000	31 000	51 500	490	350	2 290	292	1 920	0.77	5.2
VH30BN							[3 500]	46 000	91 500	870	1 030	5 600	865	4 700	1.3	
VH35AN	34	29	80	9×14×12	M8×1.25×17	20	4 000	47 500	80 500	950	755	4 500	630	3 800	1.5	7.2
VH35BN								61 500	117 000	1 380	1 530	8 350	1 280	7 000	2.1	
VH45AN	45	38	105	14×20×17	M12×1.75×24	22.5	3 990	81 000	140 000	2 140	1 740	9 750	1 460	8 150	3.0	12.3
VH45BN								99 000	187 000	2 860	3 000	15 600	2 520	13 100	3.9	
VH55AN	53	44	120	16×23×20	M14×2×24	30	3 960	119 000	198 000	3 600	3 000	16 300	2 510	13 700	4.7	16.9
VH55BN								146 000	264 000	4 850	5 150	26 300	4 350	22 100	6.1	

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

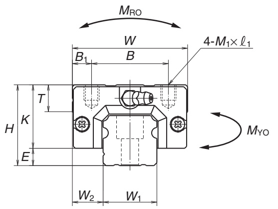
4) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.

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

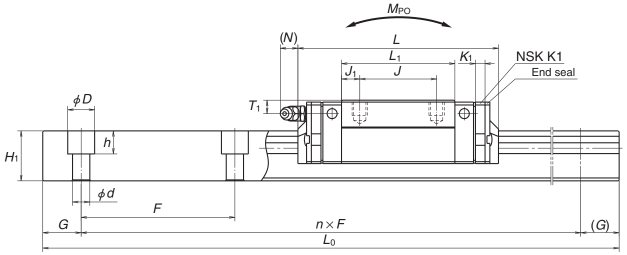
VH 30 1000 AL C 2 -∗∗ KC Z

Series name: VH
Size: 30
Rail length (mm): 1000
Ball slide shape code (See page A165.): AL
Material/surface treatment code (See Table 15.): C
C: Special high carbon steel (NSK standard), K: Stainless steel
Number of ball slides per rail: 2
Design serial number: -∗∗
Added to the reference number.
Accuracy code (See Table 16.): KC
Preload code (See page A167.): Z
0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ

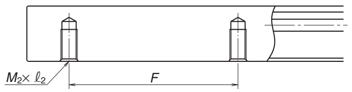
Front view of AL and BL type



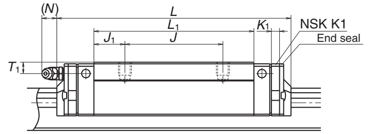
Side view of AL type



Specification for tapped holes on a rail bottom face



Side view of BL type

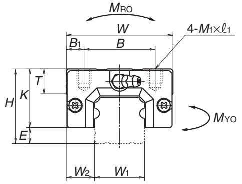


Reference number for ball slide of random-matching type

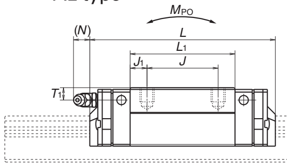
Ball slide **VAH 30 AL C -∗∗KC Z**

Random-matching ball slide series code: VAH
VAH: VH Series random-matching ball slide
Size: 30
Ball slide shape code (See page A165.): AL
Material/surface treatment code (See Table 15.): C
Design serial number: -∗∗
Added to the reference number.
Accuracy code: KC
KC: Normal grade is only available.
Preload code (See page A167.): Z
T: Fine clearance. Z: Slight preload

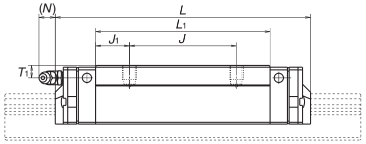
AL and BL types



AL type



BL type

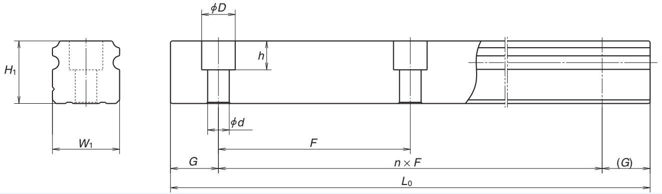


Reference number for rail of random-matching type

Rail **V1H 30 1000 L C N -∗∗ PC Z**

Random-matching rail series code: V1H
V1H: VH Series random-matching rail
Size: 30
Rail length (mm): 1000
Rail shape code: L
L: Standard
Material/surface treatment code (See Table 15.): C
*Butting rail specification: N
N: Non-butting. L: Butting specification
Design serial number: -∗∗
Added to the reference number.
Accuracy code: PC
PC: Normal grade is only available.
Preload code (See page A167.): Z
T: Fine clearance. Z: Slight preload

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide														Rail							Basic load rating							Weight	
	Height			Width	Length	Mounting hole									Grease fitting			Width	Height	Pitch	Mounting hole	Tapped hole	G	Maximum length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
																									C	C_0	M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	M_1 × pitch × ℓ_1	B_1	L_1	J_1	K	T	K_1	Hole size	T_1	N	W_1	H_1	F	d × D × h	M_2 × pitch × ℓ_2	(reference)	L_{0max} ( ) for stainless	(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
VH25AL	36	7	12.5	48	97 ⟨104.4⟩	35	35	M6×1×6	6.5	58	11.5	29	12	5	M6×0.75	6	9.6⟨12.9⟩	23	22	60	7×11×9	M6×1×12	20	3 960 [3 500]	25 600	46 000	360	320	1 840	267	1 540	0.46	3.6
VH25BL					125 ⟨132.4⟩		50			86	18														34 500	71 000	555	725	3 700	610	3 100	0.69	
VH30AL	42	9	16	60	104.4⟨114.8⟩	40	40	M8×1.25×8	10	59	9.5	33	14	5	M6×0.75	7	11.4⟨14.2⟩	28	26	80	9×14×12	M8×1.25×15	20	4 000 [3 500]	31 000	51 500	490	350	2 290	292	1 920	0.69	5.2
VH30BL					143.4⟨153.8⟩		60			98	19														46 000	91 500	870	1 030	5 600	865	4 700	1.16	
VH35AL	48	9.5	18	70	128.8⟨139.2⟩	50	50	M8×1.25×8	10	80	15	38.5	15	5.5	M6×0.75	8	10.9⟨13.7⟩	34	29	80	9×14×12	M8×1.25×17	20	4 000	47 500	80 500	950	755	4 500	630	3 800	1.2	7.2
VH35BL					162.8⟨173.2⟩		72			114	21														61 500	117 000	1 380	1 530	8 350	1 280	7 000	1.7	
VH45AL	60	14	20.5	86	161.4⟨174.2⟩	60	60	M10×1.5×10	13	105	22.5	46	17	6.5	Rc1/8	10	12.5⟨14.1⟩	45	38	105	14×20×17	M12×1.75×24	22.5	3 990	81 000	140 000	2 140	1 740	9 750	1 460	8 150	2.2	12.3
VH45BL					193.4⟨206.2⟩		80			137	28.5														99 000	187 000	2 860	3 000	15 600	2 520	13 100	2.9	
VH55AL	70	15	23.5	100	185.4⟨198.2⟩	75	75	M12×1.75×12	12.5	126	25.5	55	15	6.5	Rc1/8	11	12.5⟨14.1⟩	53	44	120	16×23×20	M14×2×24	30	3 960	119 000	198 000	3 600	3 000	16 300	2 510	13 700	3.7	16.9
VH55BL					223.4⟨236.2⟩		95			164	34.5														146 000	264 000	4 850	5 150	26 300	4 350	22 100	4.7	

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

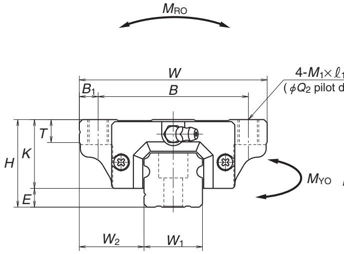
4) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.

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

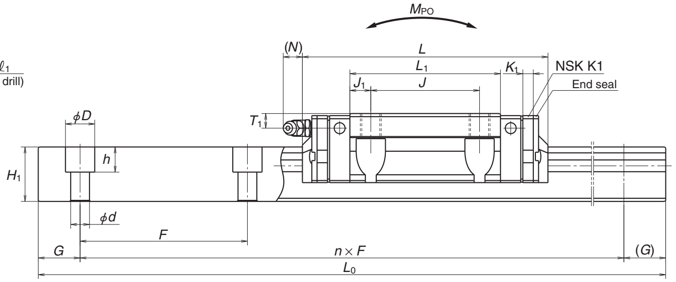
VH 30 1000 EM C 2 -＊＊ KC Z

- VH: Series name
- 30: Size
- 1000: Rail length (mm)
- EM: Ball slide shape code (See page A165.)
- C: Material/surface treatment code (See Table 15.)
  - C: Special high carbon steel (NSK standard), K: Stainless steel
- 2: Number of ball slides per rail
- -＊＊: Design serial number
  - Added to the reference number.
- KC: Accuracy code (See Table 16.)
- Z: Preload code (See page A167.)
  - 0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ

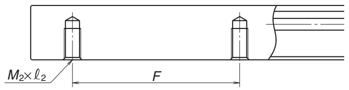
Front view of EM and GM type



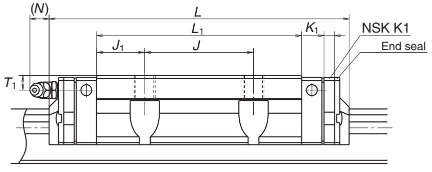
Side view of EM type



Specification for tapped holes on a rail bottom face



Side view of GM type

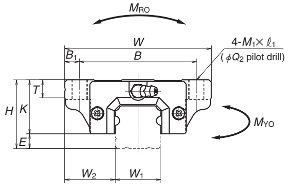


Reference number for ball slide of random-matching type

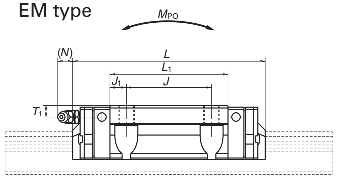
Ball slide **VAH 30 EM C -＊＊KC Z**

- VAH: Random-matching ball slide series code
  - VAH: VH Series random-matching ball slide
- 30: Size
- EM: Ball slide shape code (See page A165.)
- C: Material/surface treatment code (See Table 15.)
- -＊＊: Design serial number
  - Added to the reference number.
- KC: Accuracy code: KC
  - KC: Normal grade is only available.
- Z: Preload code (See page A167.)
  - T: Fine clearance. Z: Slight preload

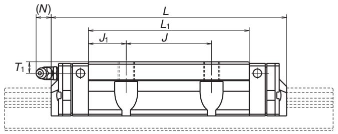
EM and GM types



EM type



GM type

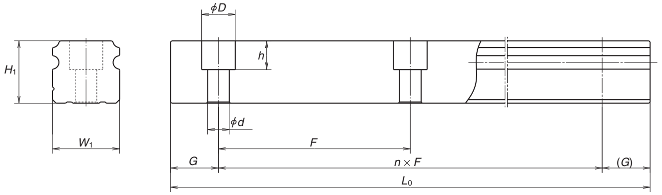


Reference number for rail of random-matching type

Rail **V1H 30 1000 L C N -＊＊ PC Z**

- V1H: Random-matching rail series code
  - V1H: VH Series random-matching rail
- 30: Size
- 1000: Rail length (mm)
- L: Rail shape code: L
  - L: Standard
- C: Material/surface treatment code (See Table 15.)
- N: *Butting rail specification
  - N: Non-butting. L: Butting specification
- -＊＊: Design serial number
  - Added to the reference number.
- PC: Accuracy code: PC
  - PC: Normal grade is only available.
- Z: Preload code (See page A167.)
  - T: Fine clearance. Z: Slight preload

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide														
	Height			Width	Length	Mounting hole										Grease fitting		
	H	E	W_2	W	L	B	J	$Q_1 \times \ell_1$ $M_1 \times$ pitch $\times \ell_1$	Q_2	B_1	L_1	J_1	K	T	K_1	Hole size	T_1	N
VH15EM **VH15GM**	24	4.6	16	47	70.6〈 77〉 89.6〈 96〉	38	30	M5×0.8×7	4.4	4.5	39 58	4.5 14	19.4	8	4.5	ϕ3	4.5	1 〈 8.2〉
VH20EM **VH20GM**	30	5	21.5	63	87.4〈 94.2〉 109.4〈116.2〉	53	40	M6×1×9.5	5.3	5	50 72	5 16	25	10	4.5	M6×0.75	5	11.1〈12.3〉
VH25EM **VH25GM**	36	7	23.5	70	97 〈104.4〉 125 〈132.4〉	57	45	M8×1.25×10 [M8×1.25×11.5]	6.8	6.5	58 86	6.5 20.5	29	11 [12]	5	M6×0.75	6	9.6〈12.9〉
VH30EM **VH30GM**	42	9	31	90	117.4〈127.8〉 143.4〈153.8〉	72	52	M10×1.5×12 [M10×1.5×14.5]	8.6	9	72 98	10 23	33	11 [15]	5	M6×0.75	7	11.4〈14.2〉
VH35EM **VH35GM**	48	9.5	33	100	128.8〈139.2〉 162.8〈173.2〉	82	62	M10×1.5×13	8.6	9	80 114	9 26	38.5	12	5.5	M6×0.75	8	10.9〈13.7〉
VH45EM **VH45GM**	60	14	37.5	120	161.4〈174.2〉 193.4〈206.2〉	100	80	M12×1.75×15	10.5	10	105 137	12.5 28.5	46	13	6.5	Rc1/8	10	12.5〈14.1〉
VH55EM **VH55GM**	70	15	43.5	140	185.4〈198.2〉 223.4〈236.2〉	116	95	M14×2×18	12.5	12	126 164	15.5 34.5	55	15	6.5	Rc1/8	11	12.5〈14.1〉

Rail							Basic load rating							Weight	
Width	Height	Pitch	Mounting hole	Tapped hole	G	Maximum length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
						L_{0max}	C	C_0	M_{RO}	M_{PO}		M_{YO}			
W_1	H_1	F	$d \times D \times h$	$M_2 \times$ pitch $\times \ell_2$	(reference)	( ) for stainless	(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
15	15	60	4.5×7.5×5.3	M5×0.8×8	20	2 000 [1 800]	10 800 14 600	20 700 32 000	108 166	94.5 216	575 1 150	79.5 181	480 965	0.17 0.25	1.6
20	18	60	6×9.5×8.5	M6×1×10	20	3 960 [3 500]	17 400 23 500	32 500 50 500	219 340	185 420	1 140 2 230	155 355	955 1 870	0.45 0.65	2.6
23	22	60	7×11×9	M6×1×12	20	3 960 [3 500]	25 600 34 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.63 0.93	3.6
28	26	80	9×14×12	M8×1.25×15	20	4 000 [3 500]	35 500 46 000	63 000 91 500	600 870	505 1 030	3 150 5 600	425 865	2 650 4 700	1.2 1.6	5.2
34	29	80	9×14×12	M8×1.25×17	20	4 000	47 500 61 500	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.7 2.4	7.2
45	38	105	14×20×17	M12×1.75×24	22.5	3 990	81 000 99 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	3.0 3.9	12.3
53	44	120	16×23×20	M14×2×24	30	3 960	119 000 146 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	5.0 6.5	16.9

Notes: 1) Figure inside 〈 〉 is the dimension when equipped with the protector.
2) Figure inside [ ] is applied to stainless products.
3) VH Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.
4) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.
5) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.

VH-EL (High-load type / Standard)
VH-GL (Super-high-load type / Long)

VH 30 1000 EL C 2 -＊＊ KC Z

Series name

Size

Rail length (mm)

Ball slide shape code (See page A165.)

Material/surface treatment code (See Table 15.)

C: Special high carbon steel (NSK standard), K: Stainless steel

Preload code (See page A167.)

0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ

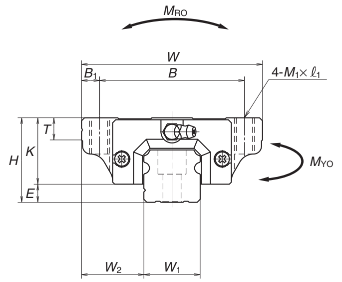
Accuracy code (See Table 16.)

Design serial number

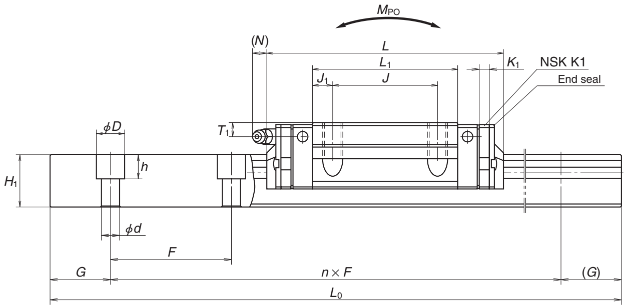
Added to the reference number.

Number of ball slides per rail

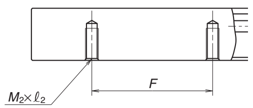
Front view of EL and GL type



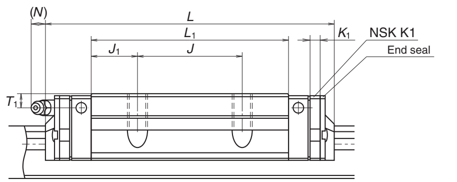
Side view of EL type



Specification for tapped holes on a rail bottom face



Side view of GL type



Model No.	Assembly			Ball slide													
	Height			Width	Length	Mounting hole									Grease fitting		
	H	E	W_2	W	L	B	J	M_1 × pitch × ℓ_1	B_1	L_1	J_1	K	T	K_1	Hole size	T_1	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	ϕ3	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⟩

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

Reference number for ball slide of random-matching type

Ball slide **VAH 30 EL C -＊＊KCZ**

Random-matching ball slide series code

VAH: VH Series random-matching ball slide

Size

Ball slide shape code (See page A165.)

Material/surface treatment code (See Table 15.)

Preload code (See page A167.)

T: Fine clearance. Z: Slight preload

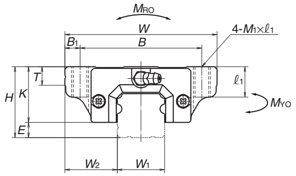
Accuracy code: KC

KC: Normal grade is only available.

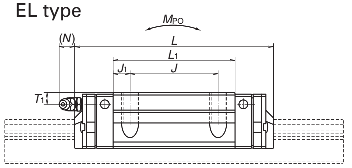
Design serial number

Added to the reference number.

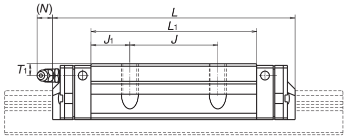
EL and GL types



EL type



GL type



Reference number for rail of random-matching type

Rail **V1H 30 1000 L C N -＊＊ PC Z**

Random-matching rail series code

V1H: VH Series random-matching rail

Size

Rail length (mm)

Rail shape code: L

L: Standard

Material/surface treatment code (See Table 15.)

Preload code (See page A167.)

T: Fine clearance. Z: Slight preload

Accuracy code: PC

PC: Normal grade is only available.

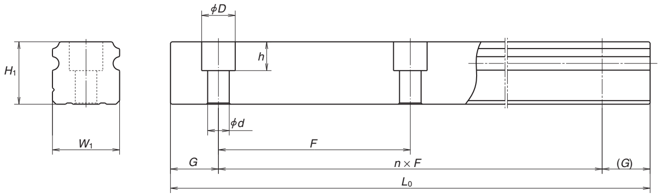
Design serial number

Added to the reference number.

＊Butting rail specification

N: Non-butting. L: Butting specification

＊Please consult with NSK for butting rail specification.



Unit: mm

Rail							Basic load rating							Weight	
Width	Height	Pitch	Mounting hole	Tapped hole	G	Maximum length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
W_1	H_1	F	d × D × h	M_2 × pitch × ℓ_2	(reference)	L_{0max} ( ) for stainless	C (N)	C_0 (N)	M_{RO}	M_{PO}		M_{YO}		(kg)	(kg/m)
										One slide	Two slides	One slide	Two slides		
15	15	60	4.5×7.5×5.3	M5×0.8×8	20	2 000 [1 800]	10 800 14 600	20 700 32 000	108 166	94.5 216	575 1 150	79.5 181	480 965	0.17 0.25	1.6
20	18	60	6×9.5×8.5	M6×1×10	20	3 960 [3 500]	17 400 23 500	32 500 50 500	219 340	185 420	1 140 2 230	155 355	955 1 870	0.45 0.65	2.6
23	22	60	7×11×9	M6×1×12	20	3 960 [3 500]	25 600 34 500	46 000 71 000	360 555	320 725	1 840 3 700	267 610	1 540 3 100	0.63 0.93	3.6
28	26	80	9×14×12	M8×1.25×15	20	4 000 [3 500]	35 500 46 000	63 000 91 500	600 870	505 1 030	3 150 5 600	425 865	2 650 4 700	1.2 1.6	5.2
34	29	80	9×14×12	M8×1.25×17	20	4 000	47 500 61 500	80 500 117 000	950 1 380	755 1 530	4 500 8 350	630 1 280	3 800 7 000	1.7 2.4	7.2
45	38	105	14×20×17	M12×1.75×24	22.5	3 990	81 000 99 000	140 000 187 000	2 140 2 860	1 740 3 000	9 750 15 600	1 460 2 520	8 150 13 100	3.0 3.9	12.3
53	44	120	16×23×20	M14×2×24	30	3 960	119 000 146 000	198 000 264 000	3 600 4 850	3 000 5 150	16 300 26 300	2 510 4 350	13 700 22 100	5.0 6.5	16.9

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

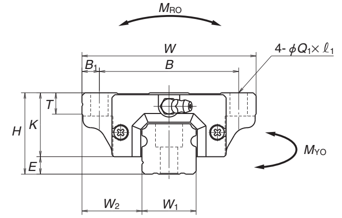
VH-FL (High-load type / Standard)
VH-HL (Super-high-load type / Long)

VH 30 1000 FL C 2 - KC Z**

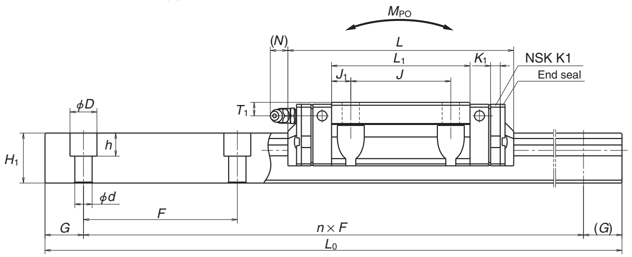
Series name
Size
Rail length (mm)
Ball slide shape code (See page A165.)
Material/surface treatment code (See Table 15.)
C: Special high carbon steel (NSK standard), K: Stainless steel

Preload code (See page A167.)
0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ
Accuracy code (See Table 16.)
Design serial number
Added to the reference number.
Number of ball slides per rail

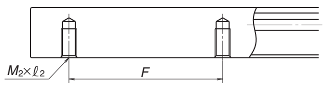
Front view of FL and HL type



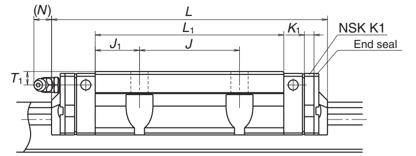
Side view of FL type



Specification for tapped holes on a rail bottom face



Side view of HL type



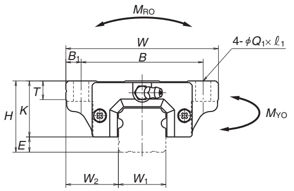
Reference number for ball slide of random-matching type

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

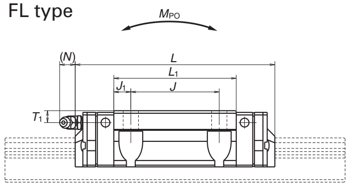
Random-matching ball slide series code
VAH: VH Series random-matching ball slide
Size
Ball slide shape code (See page A165.)
Material/surface treatment code (See Table 15.)

Preload code (See page A167.)
T: Fine clearance. Z: Slight preload
Accuracy code: KC
KC: Normal grade is only available.
Design serial number
Added to the reference number.

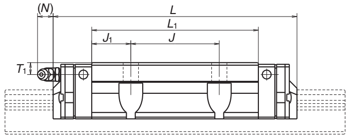
FL and HL types



FL type



HL type



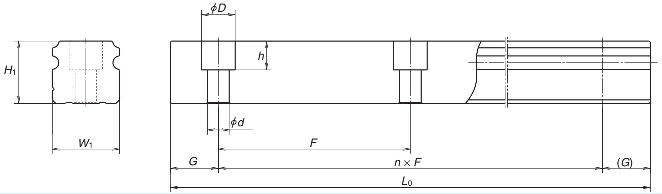
Reference number for rail of random-matching type

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

Random-matching rail series code
V1H: VH Series random-matching rail
Size
Rail length (mm)
Rail shape code: L
L: Standard
Material/surface treatment code (See Table 15.)

Preload code (See page A167.)
T: Fine clearance. Z: Slight preload
Accuracy code: PC
PC: Normal grade is only available.
Design serial number
Added to the reference number.
*Butting rail specification
N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly Height H	E	W2	Ball slide Width W	Length L	Mounting hole B	J	Q1 × ℓ1	B1	L1	J1	K	T	K1	Grease fitting Hole size	T1	N
VH15FL	24	4.6	16	47	70.6 〈 77〉	38	30	4.5×7	4.5	39	4.5	19.4	8	4.5	ϕ3	4.5	1 〈 8.2〉
VH15HL					89.6 〈96〉					58	14						
VH20FL	30	5	21.5	63	87.4 〈94.2〉	53	40	6×9.5	5	50	5	25	10	4.5	M6×0.75	5	11.1〈12.3〉
VH20HL					109.4〈116.2〉					72	16						
VH25FL	36	7	23.5	70	97 〈104.4〉	57	45	7×10[7×11.5]	6.5	58	6.5	29	11 [12]	5	M6×0.75	6	9.6〈12.9〉
VH25HL					125 〈132.4〉					86	20.5						
VH30FL	42	9	31	90	117.4〈127.8〉	72	52	9×12[9×14.5]	9	72	10	33	11 [15]	5	M6×0.75	7	11.4〈14.2〉
VH30HL					143.4〈153.8〉					98	23						
VH35FL	48	9.5	33	100	128.8〈139.2〉	82	62	9×13	9	80	9	38.5	12	5.5	M6×0.75	8	10.9〈13.7〉
VH35HL					162.8〈173.2〉					114	26						
VH45FL	60	14	37.5	120	161.4〈174.2〉	100	80	11×15	10	105	12.5	46	13	6.5	Rc1/8	10	12.5〈14.1〉
VH45HL					193.4〈206.2〉					137	28.5						
VH55FL	70	15	43.5	140	185.4〈198.2〉	116	95	14×18	12	126	15.5	55	15	6.5	Rc1/8	11	12.5〈14.1〉
VH55HL					223.4〈236.2〉					164	34.5						

Model No.	Rail Width W1	Height H1	Pitch F	Mounting hole d × D × h	Tapped hole M2 × pitch × ℓ2	G (reference)	Maximum length L0max ( ) for stainless	Basic load rating Dynamic C (N)	Static C0 (N)	Static moment (N·m) MRO	MPO One slide	MPO Two slides	MYO One slide	MYO Two slides	Weight Ball slide (kg)	Rail (kg/m)
VH15FL	15	15	60	4.5×7.5×5.3	M5×0.8×8	20	2 000 [1 800]	10 800	20 700	108	94.5	575	79.5	480	0.17	1.6
VH15HL								14 600	32 000	166	216	1 150	181	965	0.25	
VH20FL	20	18	60	6×9.5×8.5	M6×1×10	20	3 960 [3 500]	17 400	32 500	219	185	1 140	155	955	0.45	2.6
VH20HL								23 500	50 500	340	420	2 230	355	1 870	0.65	
VH25FL	23	22	60	7×11×9	M6×1×12	20	3 960 [3 500]	25 600	46 000	360	320	1 840	267	1 540	0.63	3.6
VH25HL								34 500	71 000	555	725	3 700	610	3 100	0.93	
VH30FL	28	26	80	9×14×12	M8×1.25×15	20	4 000 [3 500]	35 500	63 000	600	505	3 150	425	2 650	1.2	5.2
VH30HL								46 000	91 500	870	1 030	5 600	865	4 700	1.6	
VH35FL	34	29	80	9×14×12	M8×1.25×17	20	4 000	47 500	80 500	950	755	4 500	630	3 800	1.7	7.2
VH35HL								61 500	117 000	1 380	1 530	8 350	1 280	7 000	2.4	
VH45FL	45	38	105	14×20×17	M12×1.75×24	22.5	3 990	81 000	140 000	2 140	1 740	9 750	1 460	8 150	3.0	12.3
VH45HL								99 000	187 000	2 860	3 000	15 600	2 520	13 100	3.9	
VH55FL	53	44	120	16×23×20	M14×2×24	30	3 960	119 000	198 000	3 600	3 000	16 300	2 510	13 700	5.0	16.9
VH55HL								146 000	264 000	4 850	5 150	26 300	4 350	22 100	6.5	

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

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

A-5-1.4 TS Series

1. Features

(1) Inexpensive

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

(2) High capacity

Optimum ball diameter for higher capacity design.

(3) High dust proof capability

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

(4) Maintenance free

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

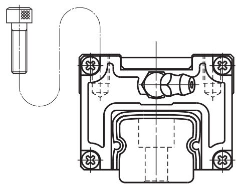
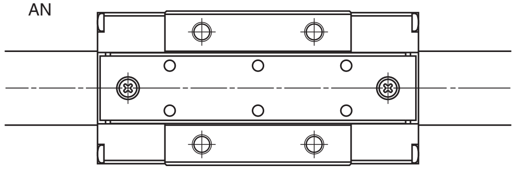
(5) Rust prevention

NSK provides a lineup of products with antirust surface treatment for corrosive environments.

(6) Fast delivery

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

2. Ball slide shape

Ball slide Model	Shape / installation method	Type
AN		AN 

3. Accuracy and preload

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

4. Maximum rail length

Table 1 shows the limitations of rail length.

Table 1 Length limitations of rails

Unit: mm

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

Note: Rails can be butted if user requirement exceeds the rail length shown in the table. In such a case, please consult NSK.

∗) The maximum length of a rail coated with fluoride low temperature chrome plate is 4 000 mm (G = 80).

5. Lubrication components

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

(1) Types of lubrication accessories

Fig. 1 and **Table 2** show grease fittings and tube fittings.

(2) Mounting position of lubrication accessories

The standard position of grease fittings is the end face of ball slide. You may mount them on the side of end cap for an option. (**Fig. 2**)

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

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

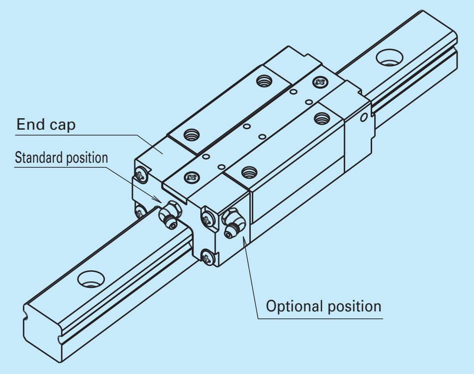


Fig. 2

6. Dust-proof components

(1) Standard specification

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

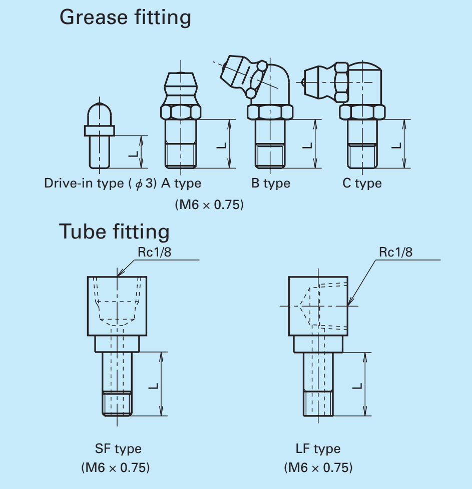


Fig. 1 Grease fitting and tube fitting

Table 2 Unit: mm

Model No.	Dust-proof specification	Grease fitting	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.

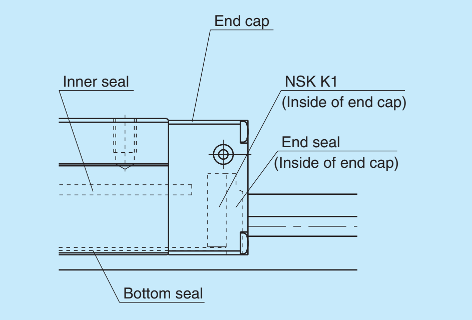


Fig. 3

(2) Protector

Please consult NSK as the protector for TS Series can be installed only before shipping from the factory.

Fig. 4 and **Table 3** show the ball slide length when protector is installed.

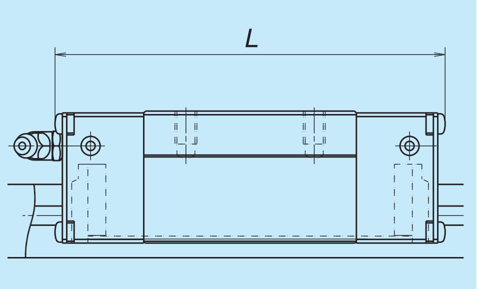


Fig. 4

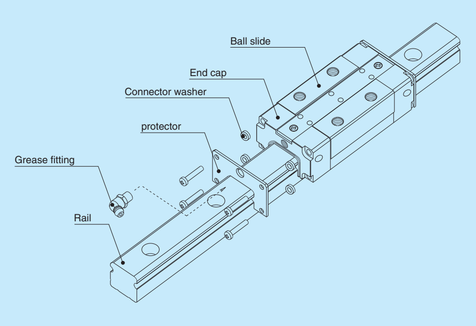


Fig. 5 Protector

Table 3 Dimension when equipped with the protector

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

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

(3) Cap to plug the rail mounting bolt hole

Table 4 Caps to plug rail bolt hole

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

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

7. Reference number

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

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

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

TS 30 2400 AN P 2 - KL S**

Series name

Size

Rail length (mm)

Ball slide shape code (See page A185.)

Surface treatment/Rail design code

P: No surface treatment/Counterbores on a rail top surface (Type I)
V: No surface treatment/Tapped holes on a rail bottom surface (Type II)
R: With surface treatment/Counterbores on a rail top surface (Type I)
W: With surface treatment/Tapped holes on a rail bottom surface (Type II)

Number of ball slides per rail

Design serial number

Added to the reference number.

Accuracy code: KL

KL: Normal grade is only available.

Preload code: S

S: Clearance of 60 μm or less

(2) Reference number for random-matching type

Ball slide

TAS 30 AN -F

Random-matching ball slide series code

TAS: TS Series random-matching ball slide

Size

Ball slide shape code (See page A185.)

Option code

No code: No surface treatment + AS2 grease
-F: Fluoride low temperature chrome plating + AS2 grease
-F50: Fluoride low temperature chrome plating + LG2 grease

Rail

T1S 30 2400 L P N - PL S**

Random-matching rail series code

T1S: TS Series random-matching rail

Size

Rail length (mm)

Rail shape code: L

L: Standard

Surface treatment/rail design code (See above.)

*Butting rail specification

N: Non-butting. L: Butting specification

Design serial number

Added to the reference number.

Accuracy code: PL

PL: Normal grade is only available.

Preload code: S

S: Clearance of 60 μm or less

*Please consult with NSK for butting rail specification.

8. Dimensions

TS 30 2400 AN P 2 -✻✻ KL S

Series name

Size

Rail length (mm)

Ball slide shape code (See page A185.)

Surface treatment/Rail design code

P: No surface treatment/Counterbores on a rail top surface (Type Ⅰ)

V: No surface treatment/Tapped holes on rail bottom surface (Type Ⅱ)

R: Fluoride low temperature chrome plating/Counterbores on rail topsurface (Type Ⅰ)

W: Fluoride low temperature chrome plating/Tapped holes on a rail bottom surface (Type Ⅱ)

Preload code: S

S: Clearance of 60 μm or less

Accuracy code: KL

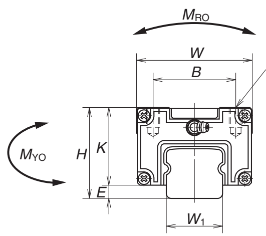
KL: Normal grade is only available.

Design serial number

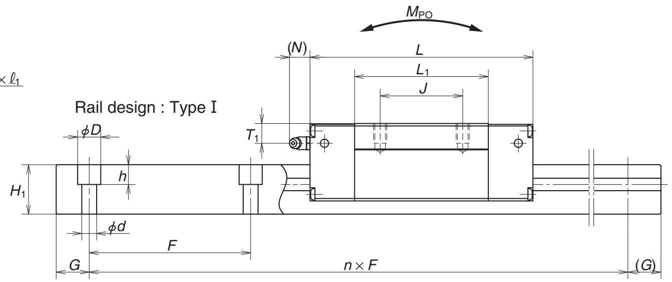
Added to the reference number.

Number of ball slides per rail

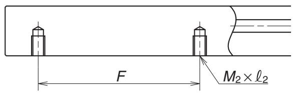
Front view



Side view



Rail design : Type Ⅱ



Reference number for ball slide of random-matching type

Ball slide **TAS 30 AN -F**

Random-matching ball slide series code

TAS: TS Series random-matching ball slide

Size

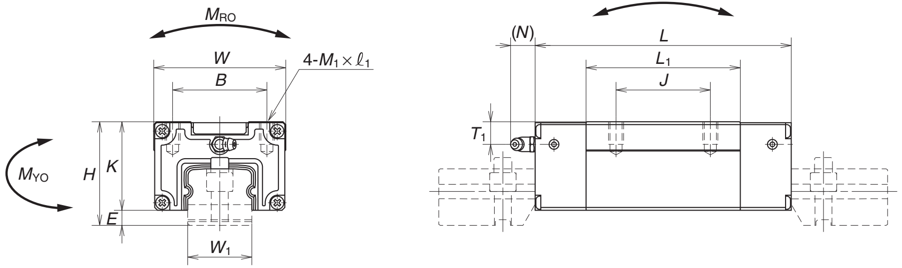
Ball slide shape code (See page A185.)

Option code

No code: No surface treatment + AS2 grease

-F: Fluoride low temperature chrome plating + AS2 grease

-F50: Fluoride low temperature chrome plating + LG2 grease



Reference number for rail of random-matching type

Rail **T1S 30 1200 L P N -✻✻ PL S**

Random-matching rail series code

T1S: TS Series random-matching rail

Size

Rail length (mm)

Rail shape code: L

L: Standard

Surface treatment/rail design code (See page A189.)

Preload code: S

S: Clearance of 60 μm or less

Accuracy code: PL

PL: Normal grade is only available.

Design serial number

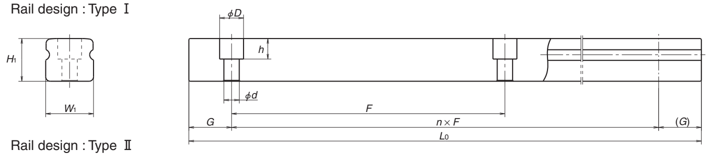
Added to the reference number.

*Butting rail specification

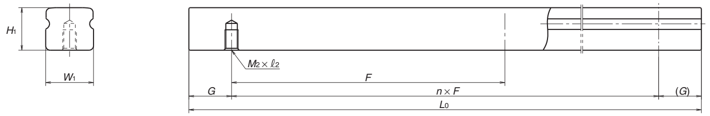
N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.

Rail design : Type Ⅰ



Rail design : Type Ⅱ



Unit: mm

Model No.	Assembly		Ball slide													Rail				Basic load rating							Weight	
	Height		Width	Length	Mounting hole					Grease fitting			width	height	Pitch	Mounting hole		G	Maximum length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
																Type Ⅰ	Type Ⅱ						M_{PO}		M_{YO}			
	$H_{\pm0.1}$	E	W	L	B	J	M_1 × pitch × ℓ_1	L_1	K	Hole size	T_1	N	W_1	H_1	F	d × D × h	M_2 × pitch × ℓ_2	(Reference)	L_{0max}	C (N)	C_0 (N)	M_{RO}	One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
TS15AN	28	3	34	72.2	26	26	M4×0.7×6	39	25	ϕ 3	6.5	5	15	14	120	4.5×7.5×5.3	M4×0.7×6	20	1 960	9 800	11 800	92	63.5	585	63.5	585	0.21	1.5
TS20AN	30	3	44	87	32	36	M5×0.8×8	50	27	M6×0.75	6.5	14	20	15	120	6×9.5×8.5	M5×0.8×8	20	2 920	15 700	19 100	196	137	1 110	137	1 110	0.37	2.1
TS25AN	40	4	48	100	35	35	M6×1×9	58	36	M6×0.75	9.5	14	23	20	120	7×11×9	M6×1×9	20	4 000	21 800	26 000	320	217	1 730	217	1 730	0.47	3.4
TS30AN	45	6.5	60	115	40	40	M8×1.25×10	70	38.5	M6×0.75	9.5	14	28	25	160	9×14×12	M8×1.25×12	20	4 040*	31 000	37 500	565	395	2 810	395	2 810	0.77	5.3
TS35AN	55	8	70	135.8	50	50	M8×1.25×12	81.8	47	M6×0.75	12	14	34	30	160	9×14×12	M8×1.25×12	20	4 040*	46 500	53 000	970	635	4 750	635	4 750	1.3	7.7

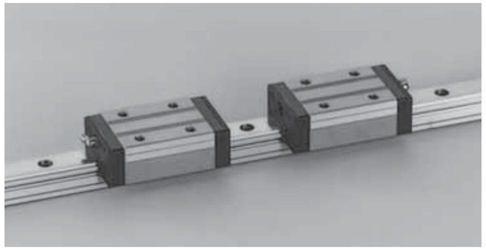
Notes: 1) TS Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.

2) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C_{100} 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.

✻ Maximum length of fluoride low-temperature chrome plated products is 4 000 (G = 80).

A-5-1.5 LS Series



1. Features

(1) High self aligning capability (rolling direction)

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

(2) High load carrying capacity to vertical direction

The contact angle is set at 50 degrees, and thus increasing load carrying capacity as well as rigidity 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 to the ball grooves 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 size of LS 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.

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

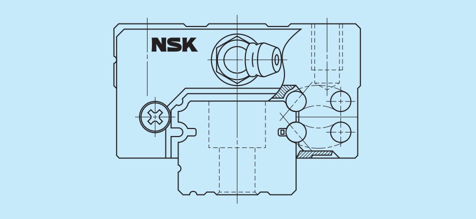


Fig. 1 LS Series

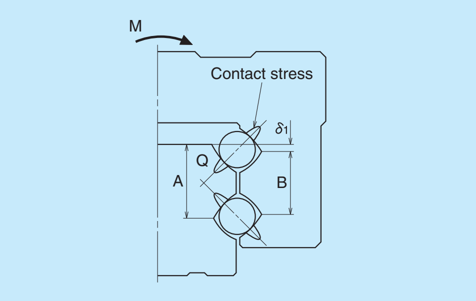


Fig. 2 Enlarged illustration of the offset Gothic arch groove

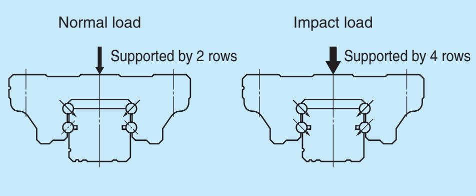
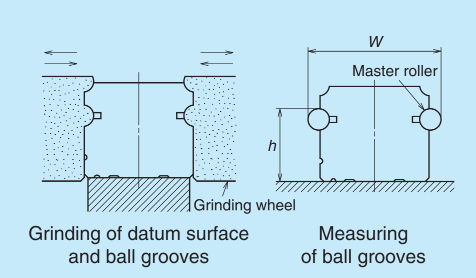


Fig. 3 When load is applied

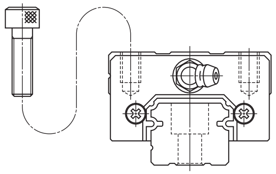
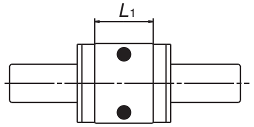
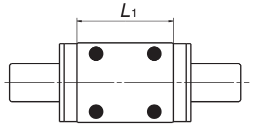
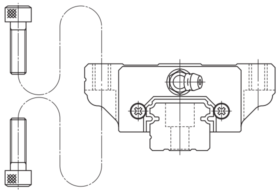
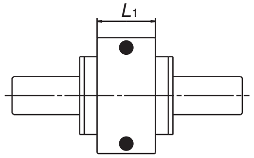
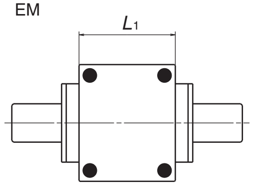
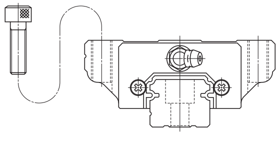
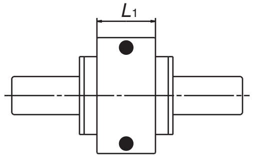
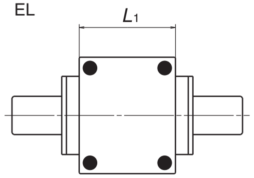
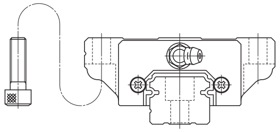
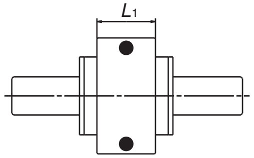
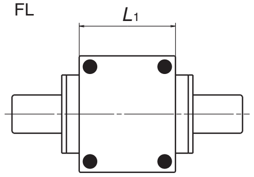


Grinding of datum surface and ball grooves

Measuring of ball grooves

Fig. 4 Rail-grinding and measuring

2. Ball slide shape

Ball slide Model	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		Medium-load type	High-load type
		Standard	Long
AL CL		CL 	AL 
EM JM		JM 	EM 
EL JL		JL 	EL 
FL KL		KL 	FL 

Note: High-precision grade and medium preload of random-matching type are not applicable to EL, JL, FL and KL models.

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

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

(2) Accuracy standard

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

- **Tolerance of preloaded assembly**

Table 2

Unit: μm

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

- **Tolerance of random-matching type**

Table 3

Unit: μm

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

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

(3) Combinations of accuracy and preload

Table 4

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

(4) Assembled accuracy

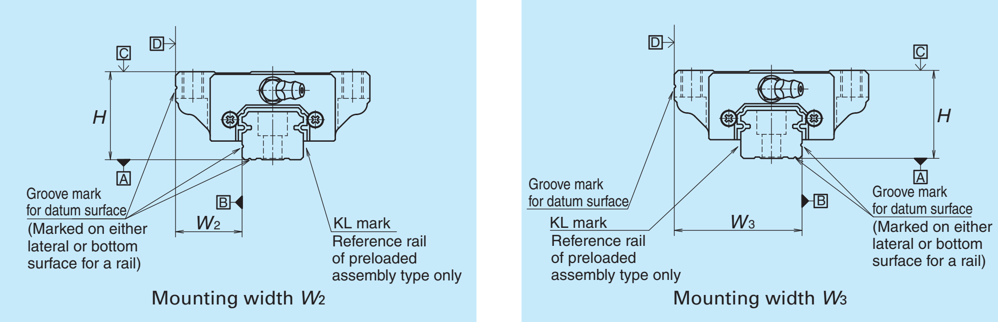


Fig. 5 Special high carbon steel

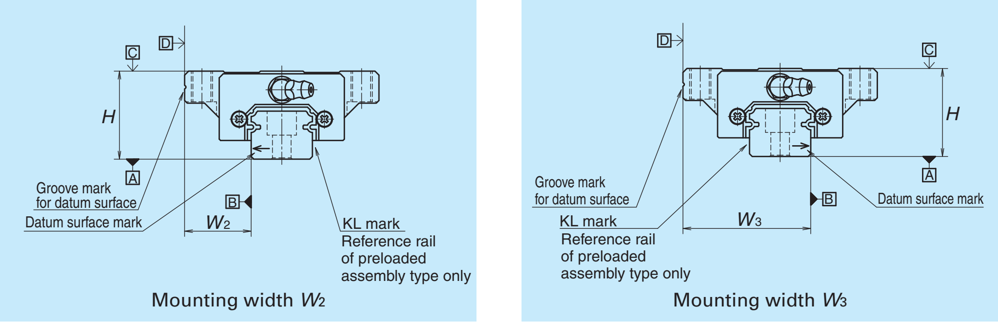


Fig. 6 Stainless steel

(5) Preload and rigidity

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

- **Preload and rigidity of preloaded assembly**

Table 5

Model No.		Preload (N)		Rigidity (N/μm)			
				Vertical direction		Lateral direction	
		Slight preload	Medium preload	Slight preload	Medium preload	Slight preload	Medium preload
		Z1	Z3	Z1	Z3	Z1	Z3
High-load type	LS15 AL, EM, EL, FL	69	390	127	226	88	167
	LS20 AL, EM, EL, FL	88	540	147	284	108	206
	LS25 AL, EM, EL, FL	147	880	206	370	147	275
	LS30 AL, EM, EL, FL	245	1 370	255	460	186	345
	LS35 AL, EM, EL, FL	345	1 960	305	550	216	400
Medium-load type	LS15 CL, JM, JL, KL	49	294	78	147	59	108
	LS20 CL, JM, JL, KL	69	390	108	186	78	137
	LS25 CL, JM, JL, KL	98	635	127	235	88	177
	LS30 CL, JM, JL, KL	147	980	147	275	108	206
	LS35 CL, JM, JL, KL	245	1 370	186	335	137	245

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

- **Clearance and preload of random-matching type**

Table 6

Unit: μm

Model No.	Fine clearance	Slight preload	Medium preload
	ZT	ZZ	ZH
LS15	–4 — 15	–4 — 0	–6.5 — –2
LS20	–4 — 15	–4 — 0	–7.5 — –3
LS25	–5 — 15	–5 — 0	–9 — –3.5
LS30	–5 — 15	–5 — 0	–10 — –4.5
LS35	–5 — 15	–6 — 0	–12 — –5

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

4. Maximum rail length

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

Table 7 Length limitations of rails

Unit: mm

Series	Size / Material	15	20	25	30	35
LS	Special high carbon steel	2 000	3 960	3 960	4 000	4 000
	Stainless steel	1 700	3 500	3 500	3 500	3 500

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

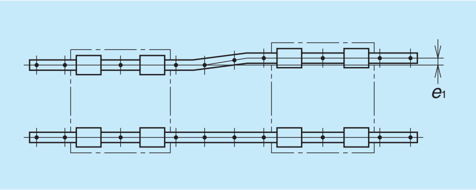


Fig. 7

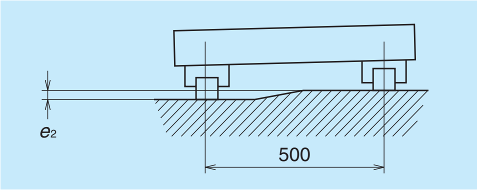


Fig. 8

Table 8

Unit: μm

Value	Preload	Model No.				
		LS15	LS20	LS25	LS30	LS35
Permissible values of parallelism in two rails e_1	Z0, ZT	20	22	30	35	40
	Z1, ZZ	15	17	20	25	30
	Z3, ZH	12	15	15	20	25
Permissible values of parallelism (height) in two rails e_2	Z0, ZT	375 μm/500 mm				
	Z1, ZZ, Z3, ZH	330 μm/500 mm				

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

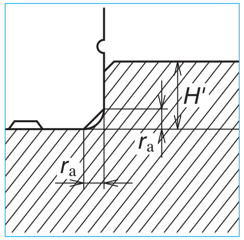


Fig. 9 Shoulder for the rail datum surface

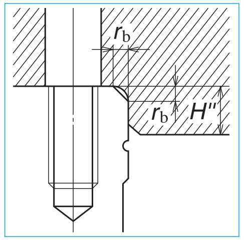


Fig. 10 Shoulder for the ball slide datum surface

Table 9

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	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 pages A38 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 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.

When you require stainless lubrication accessories, please ask NSK.

(2) Mounting position of lubrication accessories

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

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

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

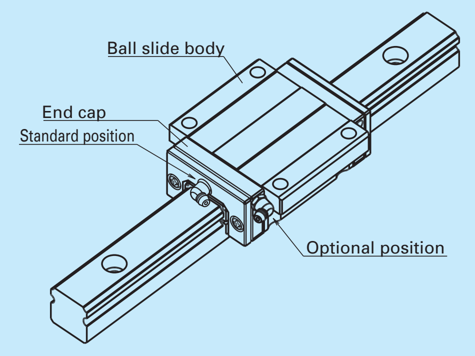


Fig. 12 Mounting position of lubrication accessories

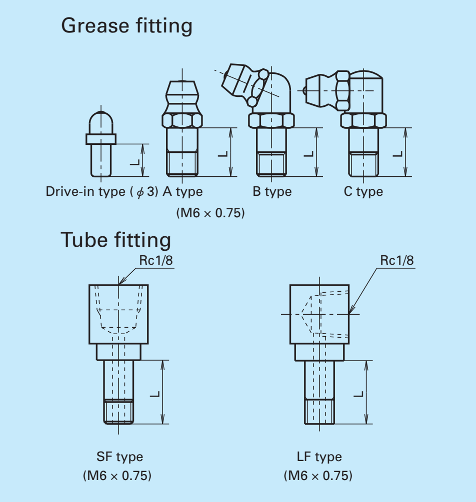


Fig. 11 Grease fitting and tube fitting

Table 10 Unit: mm

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

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

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7. Dust-proof components

(1) Standard specification

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

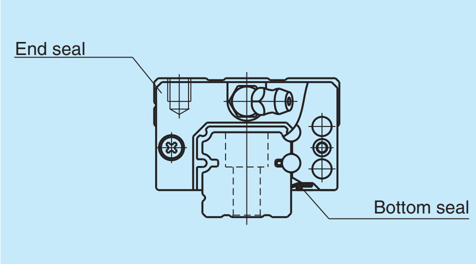


Fig. 13

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

Size / Series	15	20	25	30	35
LS	8	9	9	9	10

(2) NSK K1^{TM} lubrication unit

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

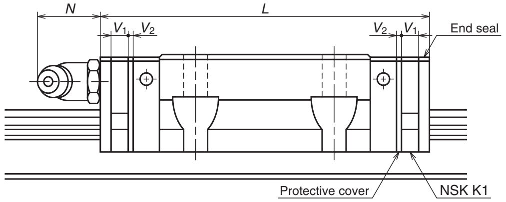


Table 12 Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_1	Protective cover thickness V_2	Protruding area of the grease fitting N
LS15	Standard	AL, EM, EL, FL	56.8	66.4	4.0	0.8	(5)
	Short	CL, JM, JL, KL	40.4	50			
LS20	Standard	AL, EM, EL, FL	65.2	75.8	4.5	0.8	(14)
	Short	CL, JM, JL, KL	47.2	57.8			
LS25	Standard	AL, EM, EL, FL	81.6	92.2	4.5	0.8	(14)
	Short	CL, JM, JL, KL	59.6	70.2			
LS30	Standard	AL, EM, EL, FL	96.4	108.4	5.0	1.0	(14)
	Short	CL, JM, JL, KL	67.4	79.4			
LS35	Standard	AL, EM, EL, FL	108	121	5.5	1.0	(14)
	Short	CL, JM, JL, KL	77	90			

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

(3) Double seal

Use a double seal set as showing in **Table 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 as showing **Fig.14** is required.

(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 as showing **Fig.15** is required.

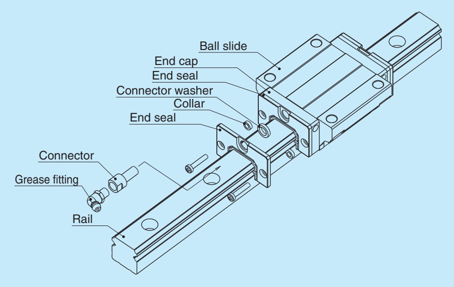


Fig. 14 Double seal

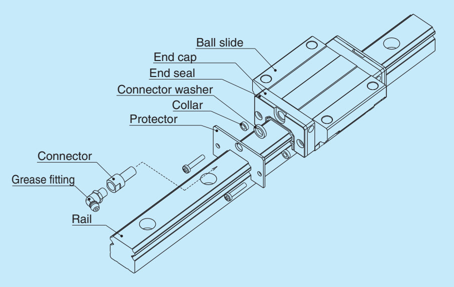


Fig. 15 Protector

Table 13 Double-seal set

Model No.	Reference No.		Increased thickness V_3 (mm)
	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_4 (mm)
	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.

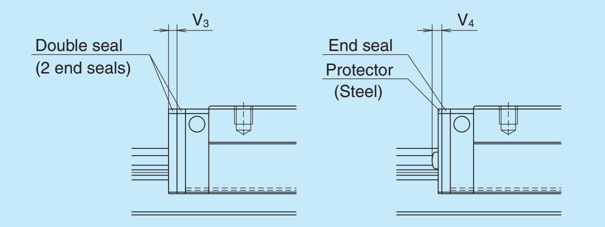


Fig. 16

(5) Cap to plug the rail mounting bolt hole

Table 15 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
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

(6) Inner seal

Inner seal is only available for the models shown below.

Table 16

Series	Model No.
LS	LS20, LS25, LS30, LS35

(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 as showing **Fig.7.7** on page A55.

- When NSK K1, double seals or protectors are used, the set screws of bellows fastener kit are unable to use.
  Please contact NSK for details.
- Bellows fastener is available only for the horizontal mounting positions. For other mounting positions, sliding plate is required (see **Fig. 7.10** on page A56).
  For fixing to the rail, make tap holes to the rail end surface. Fix the bellows mounting plate to the rail end surface through these tap holes by using a machine screw. NSK processes a tap hole to the rail end face when ordered with a linear guide.

Table 17 Bellows fastner 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

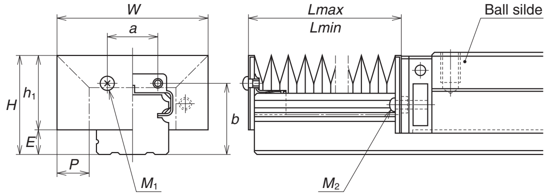


Fig. 17 Dimensions of bellows

Bellows reference number

J A S 15 L 08

Bellows

A: Bellows for the ends
B: Middle bellows

Bellows for LS series

Number of BL (fold number)

L: Low type

Size number of linear guide

Table 18 Dimensions of bellows

Unit: mm

Model No.	*H*	h_1	*E*	*W*	*P*	*a*	*b*	BL minimum length	M_1Tap x depth	M_2Tap x depth
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*min	34	68	102	136	170	204	238	272	306	340
JAS15L	Stroke	106	212	318	424	530	636	742	848	954	1 060
	*L*max	140	280	420	560	700	840	980	1 120	1 260	1 400
JAS20L	Stroke	106	212	318	424	530	636	742	848	954	1 060
	*L*max	140	280	420	560	700	840	980	1 120	1 260	1 400
JAS25L	Stroke	106	212	318	424	530	636	742	848	954	1 060
	*L*max	140	280	420	560	700	840	980	1 120	1 260	1 400
JAS30L	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	*L*max	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
JAS35L	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	*L*max	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100

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

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 1200 AL C 2 - P5 3**

Series name

Size

Rail length (mm)

Ball slide shape code (See page A192.)

Material/surface treatment code (See Table 20.)
C: Special high carbon steel (NSK standard), K: Stainless steel

Number of ball slides per rail

Design serial number
Added to the reference number.

Accuracy code (See Table 21.)

Preload code (See page A194.)
0: Z0, 1: Z1, 3: Z3

(2) Reference number for random-matching type

Ball slide

LAS 30 AL S Z -K

Random-matching ball slide series code
LAS: LS Series random-matching ball slide

Size

Ball slide shape code (See page A192.)

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

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

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

Rail

L1S 30 1200 L C N - PC Z**

Random-matching rail series code
L1S: LS Series random-matching rail

Size

Rail length (mm)

Rail shape code
L: Standard
T: LS15 with mounting holes for M4

Material/surface treatment code (See Table 20.)

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

Design serial number
Added to the reference number.

Accuracy code
PH: High precision grade random-matching type
PC: Normal grade random-matching type

Preload code (See page A194.)
T: Fine clearance.
Z: Slight preload (common rail for slight or medium preload)

*Please consult with NSK for butting rail specification.

The reference number coding for the assembly of random-matching type is the same as that of the preloaded assembly. However, only preload codes of "fine clearance T" and "slight preload Z" are available (refer to page A194).

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

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

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
High precision grade (random-matching type)	PH	KH	FH
Normal grade (random-matching type)	PC	KC	FC

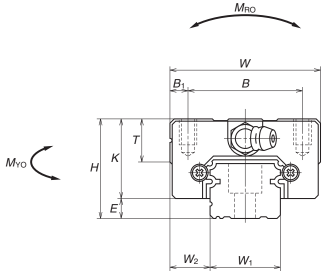
Note: Refer to pages A38 and A61 for NSK K1 lubrication unit.

9. Dimensions
LS-CL (Medium-load type / Short)
LS-AL (High-load type / Standard)

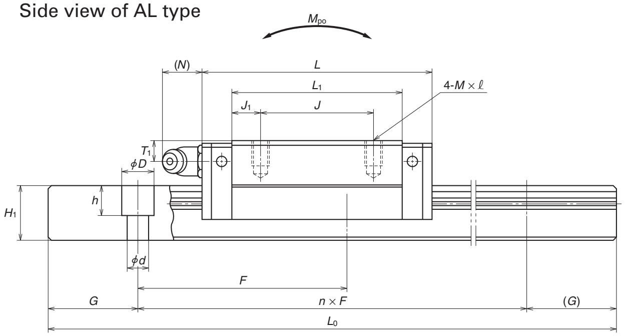
LS 30 1200 AL C 2 -＊＊ PC Z

- Series name (LS)
- Size (30)
- Rail length (mm) (1200)
- Ball slide shape code (See page A192.) (AL)
- Material/surface treatment code (See Table 20.) (C)
  C: Special high carbon steel (NSK standard), K: Stainless steel
- Number of ball slides per rail (2)
- Design serial number (-＊＊)
  Added to the reference number.
- Accuracy code (See Table 21.) (PC)
- Preload code (See page A194.) (Z)
  0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ, H: ZH

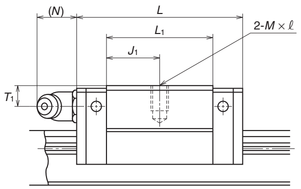
Front view of AL and CL type



Side view of AL type



Side view of CL type

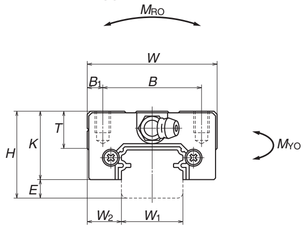


Reference number for ball slide of random-matching type

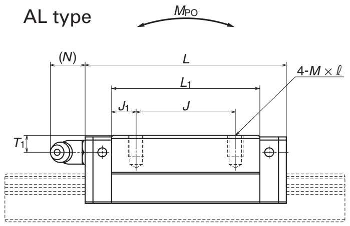
Ball slide **LAS 30 AL S Z -K**

- Random-matching ball slide series code (LAS)
  LAS: LS Series random-matching ball slide
- Size (30)
- Ball slide shape code (See page A192.) (AL)
- Material code (S)
  No code: Special high carbon steel (NSK standard), S: Stainless steel
- Preload code (Z)
  No code: Fine clearance, Z: Slight preload, H: Medium preload
- Option code (-K)
  -K: Equipped with NSK K1
  -F: Fluoride low temperature chrome plating + AS2 grease
  -F50: Fluoride low temperature chrome plating + LG2 grease

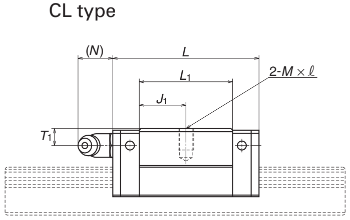
AL and CL types



AL type



CL type

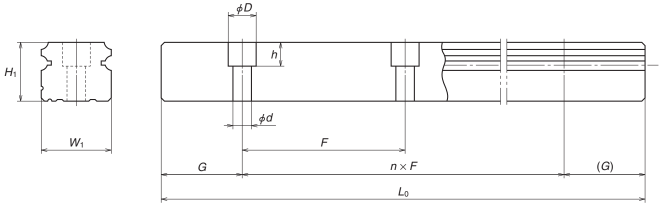


Reference number for rail of random-matching type

Rail **L1S 30 1200 L C N -＊＊ PC Z**

- Random-matching rail series code (L1S)
  L1S: LS Series random-matching rail
- Size (30)
- Rail length (mm) (1200)
- Rail shape code (L)
  L: Standard
  T: LS15 with mounting holes for M4
- Material/surface treatment code (See Table 20.) (C)
- ＊Butting rail specification (N)
  N: Non-butting. L: Butting specification
- Design serial number (-＊＊)
  Added to the reference number.
- Accuracy code (PC)
  PH: High-precision grade
  PC: Normal grade
- Preload code (See page A194.) (Z)
  T: Fine clearance.
  Z: Slight preload(common rail for medium preload)

＊Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide												
	Height			Width	Length	Mounting hole								Grease fitting		
	H	E	W_2	W	L	B	J	M × pitch × ℓ	B_1	L_1	J_1	K	T	Hole size	T_1	N
LS15CL **LS15AL**	24	4.6	9.5	34	40.4 56.8	26	— 26	M4×0.7×6	4	23.6 40	11.8 7	19.4	10	ϕ3	6	3
LS20CL **LS20AL**	28	6	11	42	47.2 65.2	32	— 32	M5×0.8×7	5	30 48	15 8	22	12	M6×0.75	5.5	11
LS25CL **LS25AL**	33	7	12.5	48	59.6 81.6	35	— 35	M6×1×9	6.5	38 60	19 12.5	26	12	M6×0.75	7	11
LS30CL **LS30AL**	42	9	16	60	67.4 96.4	40	— 40	M8×1.25×12	10	42 71	21 15.5	33	13	M6×0.75	8	11
LS35CL **LS35AL**	48	10.5	18	70	77 108	50	— 50	M8×1.25×12	10	49 80	24.5 15	37.5	14	M6×0.75	8.5	11

Model No.	Rail						Basic load rating							Weight	
	Width	Height	Pitch	Mounting bolt hole	G	Max. length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
	W_1	H_1	F	d × D × h	(reference)	$L_{0max.}$ ( ) for stainless	C (N)	C_0 (N)	M_{RO}	M_{PO}		M_{YO}		(kg)	(kg/m)
										One slide	Two slides	One slide	Two slides		
LS15CL **LS15AL**	15	12.5	60	＊3.5×6×4.5 4.5×7.5×5.3	20	2 000 (1 700)	5 400 8 350	9 100 16 900	45.5 84.5	24.5 77	196 470	20.5 64.5	165 395	0.14 0.20	1.4
LS20CL **LS20AL**	20	15.5	60	6×9.5×8.5	20	3 960 (3 500)	7 900 11 700	13 400 23 500	91.5 160	46.5 133	330 755	39 111	279 630	0.19 0.28	2.3
LS25CL **LS25AL**	23	18	60	7×11×9	20	3 960 (3 500)	12 700 18 800	20 800 36 500	164 286	91 258	655 1 470	76 217	550 1 230	0.34 0.51	3.1
LS30CL **LS30AL**	28	23	80	7×11×9	20	4 000 (3 500)	18 700 28 800	29 600 55 000	282 520	139 435	1 080 2 650	116 365	905 2 220	0.58 0.85	4.8
LS35CL **LS35AL**	34	27.5	80	9×14×12	20	4 000 (3 500)	26 000 40 000	40 000 74 500	465 865	220 695	1 670 4 000	185 580	1 400 3 350	0.86 1.3	7.0

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

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

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

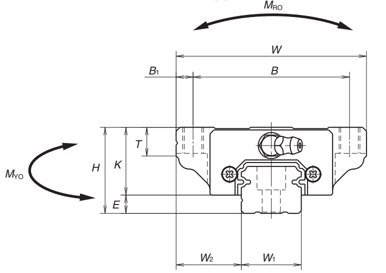
＊ Standard mounting hole of LS15 rail is for M3 bolts (Hole size: 3.5 × 6 × 4.5).
If you require mounting hole for M4 bolts (Hole size: 4.5 × 7.5 × 5.3), please specify when ordering.

LS-JM (Medium-load type / Short)
LS-EM (High-load type / Standard)

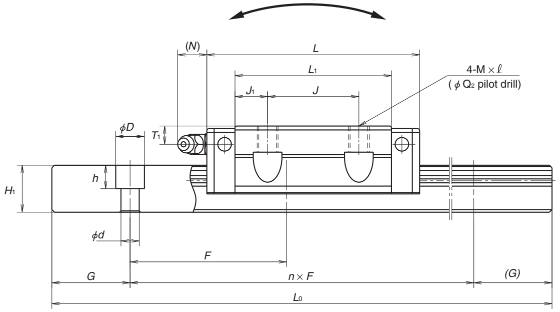
LS 30 1200 EM C 2 -＊＊ PC Z

- LS: Series name
- 30: Size
- 1200: Rail length (mm)
- EM: Ball slide shape code (See page A192.)
- C: Material/surface treatment code (See Table 20.)
  C: Special high carbon steel (NSK standard), K: Stainless steel
- 2: Number of ball slides per rail
- -＊＊: Design serial number
  Added to the reference number.
- PC: Accuracy code (See Table 21.)
- Z: Preload code (See page A194.)
  0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ, H: ZH

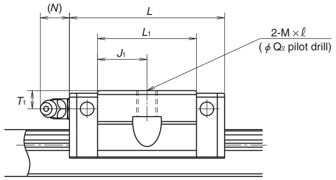
Front view of EM and JM type



Side view of EM type



Side view of JM type

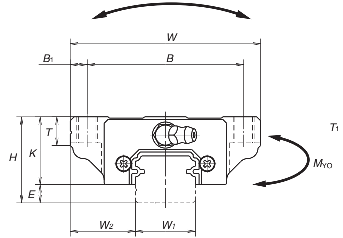


Reference number for ball slide of random-matching type

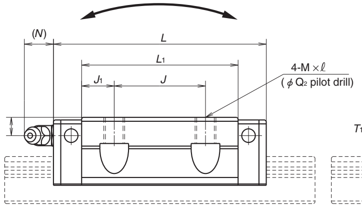
Ball slide **LAS 30 EM S Z -K**

- LAS: Random-matching ball slide series code
  LAS: LS Series random-matching ball slide
- 30: Size
- EM: Ball slide shape code (See page A192.)
- S: Material code
  No code: Special high carbon steel (NSK standard), S: Stainless steel
- Z: Preload code
  No code: Fine clearance, Z: Slight preload, H: Medium preload
- -K: Option code
  -K: Equipped with NSK K1
  -F: Fluoride low temperature chrome plating + AS2 grease
  -F50: Fluoride low temperature chrome plating + LG2 grease

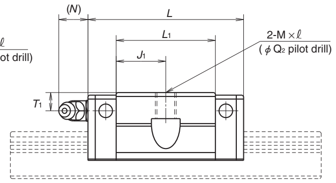
EM and JM types



EM type



JM type

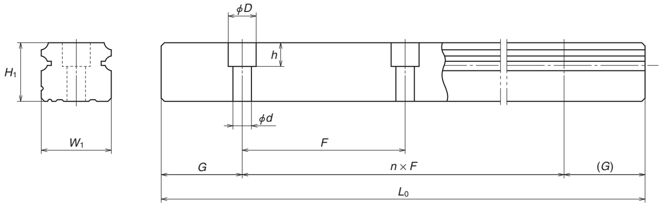


Reference number for rail of random-matching type

Rail **L1S 30 1200 L C N -＊＊ PC Z**

- L1S: Random-matching rail series code
  L1S: LS Series random-matching rail
- 30: Size
- 1200: Rail length (mm)
- L: Rail shape code
  L: Standard
  T: LS15 with mounting holes for M4
- C: Material/surface treatment code (See Table 20.)
- N: *Butting rail specification
  N: Non-butting. L: Butting specification
- -＊＊: Design serial number
  Added to the reference number.
- PC: Accuracy code
  PH: High-precision grade
  PC: Normal grade
- Z: Preload code (See page A194.)
  T: Fine clearance.
  Z: Slight preload(common rail for medium preload)

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide														Rail						Basic load rating							Weight	
	Height			Width	Length	Mounting hole									Grease fitting			Width	Height	Pitch	Mounting bolt hole	G	Max. length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
																								C	C_0	M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	M × pitch × ℓ	Q_2	B_1	L_1	J_1	K	T	Hole size	T_1	N	W_1	H_1	F	d × D × h	(reference)	L_{0max}. ( ) for stainless	(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
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	ϕ3	6	3	15	12.5	60	＊3.5×6×4.5 4.5×7.5×5.3	20	2 000 (1 700)	5 400 8 350	9 100 16 900	45.5 84.5	24.5 77	196 470	20.5 64.5	165 395	0.17 0.26	1.4
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	20	15.5	60	6×9.5×8.5	20	3 960 (3 500)	7 900 11 700	13 400 23 500	91.5 160	46.5 133	330 755	39 111	279 630	0.24 0.35	2.3
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	23	18	60	7×11×9	20	3 960 (3 500)	12 700 18 800	20 800 36 500	164 286	91 258	655 1 470	76 217	550 1 230	0.44 0.66	3.1
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	28	23	80	7×11×9	20	4 000 (3 500)	18 700 28 800	29 600 55 000	282 520	139 435	1 080 2 650	116 365	905 2 220	0.76 1.2	4.8
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	34	27.5	80	9×14×12	20	4 000 (3 500)	26 000 40 000	40 000 74 500	465 865	220 695	1 670 4 000	185 580	1 400 3 350	1.2 1.7	7

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

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

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

＊ Standard mounting hole of LS15 rail is for M3 bolts (Hole size: 3.5 × 6 × 4.5).
If you require mounting hole for M4 bolts (Hole size: 4.5 × 7.5 × 5.3), please specify when ordering.

LS-JL (Medium-load type / Short)
LS-EL (High-load type / Standard)

LS 30 1200 EL C 2 -∗∗ PC Z

Series name

Size

Rail length (mm)

Ball slide shape code (See page A192.)

Material/surface treatment code (See Table 20.)

C: Special high carbon steel (NSK standard), K: Stainless steel

Preload code (See page A194.)

0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ

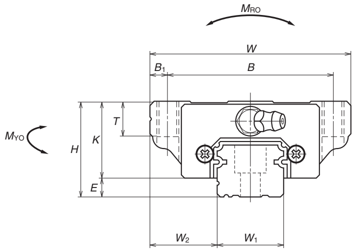
Accuracy code (See Table 21.)

Design serial number

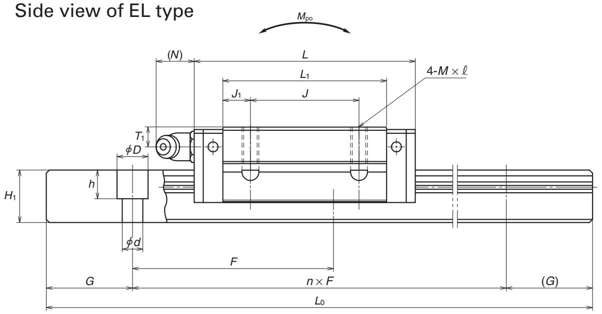
Added to the reference number.

Number of ball slides per rail

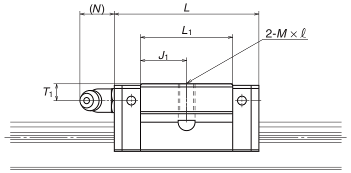
Front view of EL and JL type



Side view of EL type



Side view of JL type



Reference number for ball slide of random-matching type

Ball slide **LAS 30 EL S Z -K**

Random-matching ball slide series code

LAS: LS Series random-matching ball slide

Size

Ball slide shape code (See page A192.)

Option code

-K: Equipped with NSK K1

-F: Fluoride low temperature chrome plating + AS2 grease

-F50: Fluoride low temperature chrome plating + LG2 grease

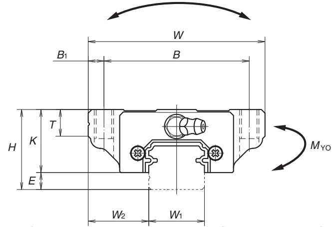
Preload code

No code:Fine clearance, Z:Slight preload

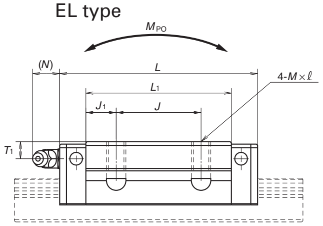
Material code

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

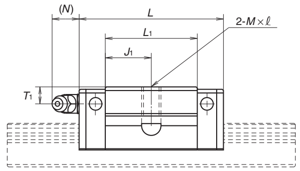
EL and JL types



EL type



JL type



Reference number for rail of random-matching type

Rail **L1S 30 1200 L C N -∗∗ PC Z**

Random-matching rail series code

L1S: LS Series random-matching rail

Size

Rail length (mm)

Rail shape code

L: Standard
T: LS15 with mounting holes for M4

Material/surface treatment code (See Table 20.)

Preload code (See page A194.)

T: Fine clearance. Z: Slight preload

Accuracy code: PC

PC: Normal grade is only available.

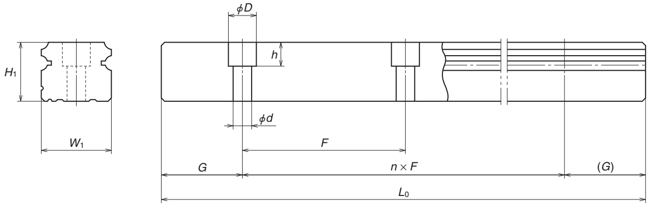
Design serial number

Added to the reference number.

*Butting rail specification

N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide												
	Height			Width	Length	Mounting hole								Grease fitting		
	H	E	W_2	W	L	B	J	M × pitch × ℓ	B_1	L_1	J_1	K	T	Hole size	T_1	N
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	ϕ3	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	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)	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)	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)	M6×0.75	8.5	11

Model No.	Rail						Basic load rating								Weight	
	Width	Height	Pitch	Mounting bolt hole	G	Max. length L_{0max}. ( ) for stainless	Dynamic	Static	Static moment (N·m)						Ball slide	Rail
	W_1	H_1	F	d × D × h	(reference)		C	C_0	M_{RO}	M_{PO}		M_{YO}				
							(N)	(N)		One slide	Two slides	One slide	Two slides		(kg)	(kg/m)
LS15JL **LS15EL**	15	12.5	60	∗3.5×6×4.5 4.5×7.5×5.3	20	2 000 (1 700)	5 400 8 350	9 100 16 900	45.5 84.5	24.5 77	196 470	20.5 64.5	165 395		0.17 0.26	1.4
LS20JL **LS20EL**	20	15.5	60	6×9.5×8.5	20	3 960 (3 500)	7 900 11 700	13 400 23 500	91.5 160	46.5 133	330 755	39 111	279 630		0.24 0.35	2.3
LS25JL **LS25EL**	23	18	60	7×11×9	20	3 960 (3 500)	12 700 18 800	20 800 36 500	164 286	91 258	655 1 470	76 217	550 1 230		0.44 0.66	3.1
LS30JL **LS30EL**	28	23	80	7×11×9	20	4 000 (3 500)	18 700 28 800	29 600 55 000	282 520	139 435	1 080 2 650	116 365	905 2 220		0.76 1.2	4.8
LS35JL **LS35EL**	34	27.5	80	9×14×12	20	4 000 (3 500)	26 000 40 000	40 000 74 500	465 865	220 695	1 670 4 000	185 580	1 400 3 350		1.2 1.7	7.0

Notes: 1) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.
2) Parenthesized dimensions are for items made of stainless steel.
3) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.
4) High-precision grade and medium preload random-matching type are not available for JL and EL models.

∗ Standard mounting hole of LS15 rail is for M3 bolts (Hole size: 3.5 × 6 × 4.5).
If you require mounting hole for M4 bolts (Hole size: 4.5 × 7.5 × 5.3), please specify when ordering.

LS-KL (Medium-load type / Short)
LS-FL (High-load type / Standard)

LS 30 1200 FL C 2 - ✻✻ **PC Z**

Series name

Size

Rail length (mm)

Ball slide shape code (See page A192.)

Material/surface treatment code (See Table 20.)

C: Special high carbon steel (NSK standard), K: Stainless steel

Preload code (See page A194.)

0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ

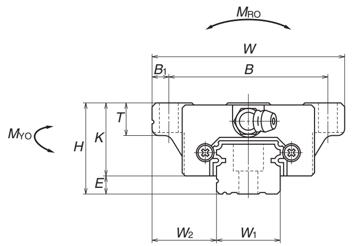
Accuracy code (See Table 21.)

Design serial number

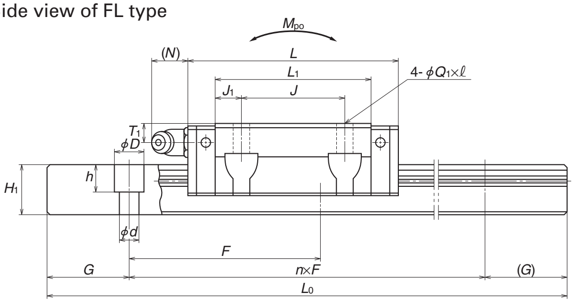
Added to the reference number.

Number of ball slides per rail

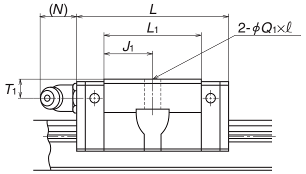
Front view of FL and KL type



Side view of FL type



Side view of KL type



Reference number for ball slide of random-matching type

Ball slide **LAS 30 FL S Z -K**

Random-matching ball slide series code

LAS: LS Series random-matching ball slide

Size

Ball slide shape code (See page A192.)

Option code

-K: Equipped with NSK K1

-F: Fluoride low temperature chrome plating + AS2 grease

-F50: Fluoride low temperature chrome plating + LG2 grease

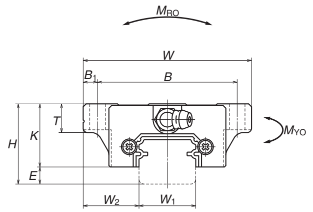
Preload code

No code:Fine clearance, Z:Slight preload

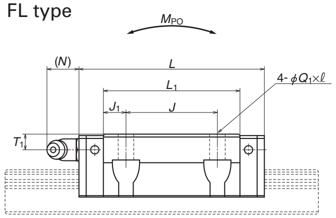
Material code

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

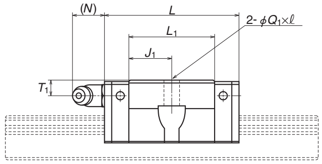
FL and KL types



FL type



KL type



Reference number for rail of random-matching type

Rail **L1S 30 1200 L C N -** ✻✻ **PC Z**

Random-matching rail series code

L1S: LS Series random-matching rail

Size

Rail length (mm)

Rail shape code

L: Standard
T: LS15 with mounting holes for M4

Material/surface treatment code (See Table 20.)

Preload code (See page A194.)

T: Fine clearance. Z: Slight preload

Accuracy code: PC

PC: Normal grade is only available.

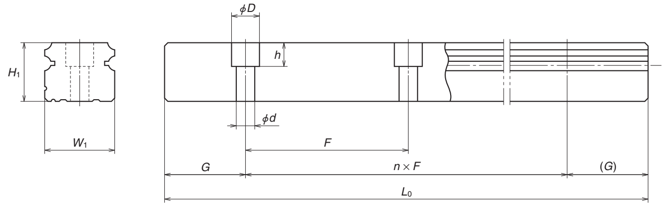
Design serial number

Added to the reference number.

*Butting rail specification

N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide											
	Height			Width	Length	Mounting hole							Grease fitting		
	H	E	W_2	W	L	B	J	$Q_1 \times \ell$	B_1	L_1	J_1	K	T	Hole size	T_1	N
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	ϕ3	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

Rail						Basic load rating							Weight	
Width	Height	Pitch	Mounting bolt hole	G	Max. length L_{0max}. ( ) for stainless	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
						C	C_0	M_{RO}	M_{PO}		M_{YO}			
W_1	H_1	F	$d \times D \times h$	(reference)		(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
15	12.5	60	✻3.5×6×4.5 4.5×7.5×5.3	20	2 000 (1 700)	5 400 8 350	9 100 16 900	45.5 84.5	24.5 77	196 470	20.5 64.5	165 395	0.17 0.26	1.4
20	15.5	60	6×9.5×8.5	20	3 960 (3 500)	7 900 11 700	13 400 23 500	91.5 160	46.5 133	330 755	39 111	279 630	0.24 0.35	2.3
23	18	60	7×11×9	20	3 960 (3 500)	12 700 18 800	20 800 36 500	164 286	91 258	655 1 470	76 217	550 1 230	0.44 0.66	3.1
28	23	80	7×11×9	20	4 000 (3 500)	18 700 28 800	29 600 55 000	282 520	139 435	1 080 2 650	116 365	905 2 220	0.76 1.2	4.8
34	27.5	80	9×14×12	20	4 000 (3 500)	26 000 40 000	40 000 74 500	465 865	220 695	1 670 4 000	185 580	1 400 3 350	1.2 1.7	7

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

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

4) High-precision grade and medium preload random-matching type are not available for KL and FL models.

✻ Standard mounting hole of LS15 rail is for M3 bolts (Hole size: 3.5 × 6 × 4.5).
If you require mounting hole for M4 bolts (Hole size: 4.5 × 7.5 × 5.3), please specify when ordering.

A-5-1.6 SS Series

1. Features

(1) Lower noise and gentler tone

Incorporating a retaining piece and optimizing the circulation path enables steel ball circulation stability and the prevention of ball collision, and thus 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 the Gothic arch and the center of the top and bottom grooves are offset as shown in **Fig. 2**. The vertical load is generally carried by the top rows, at where balls are contacting at two points. Because of this design, the bottom rows will carry load when a large impact load is applied vertically as shown in **Fig. 3**. This assures high resistance to the impact load.

(7) High accuracy

As showing in **Fig. 4**, fixing the master rollers to the ball groove 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.
High-precision grade is also available in random matching. (Special high carbon steel products)

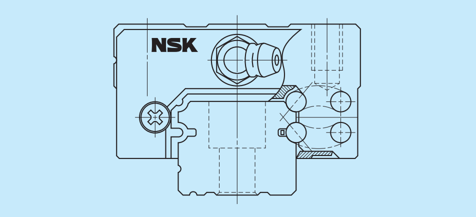


Fig. 1 SS Series

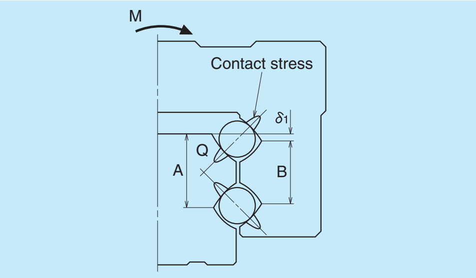


Fig. 2 Enlarged illustration of the offset Gothic arch groove

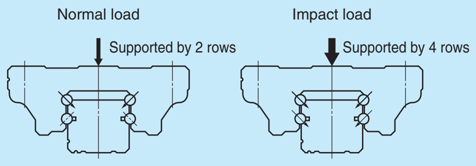
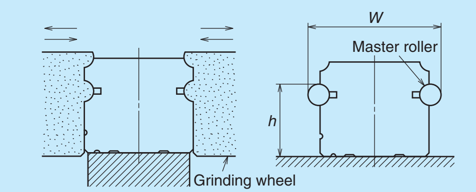


Fig. 3 When load is applied

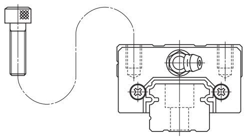
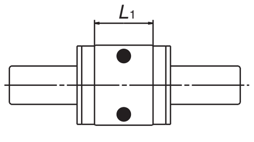
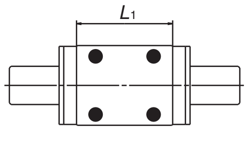
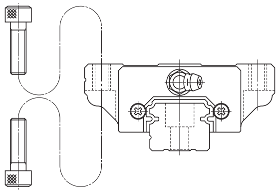
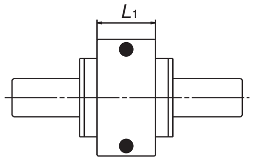
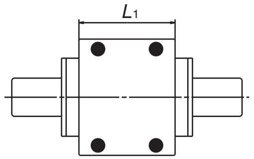
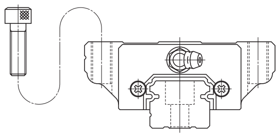
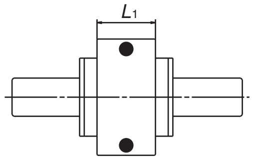
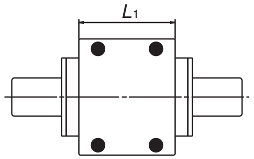
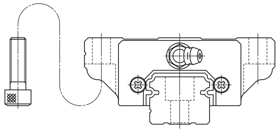
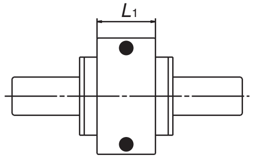
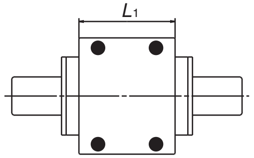


Grinding of datum surface and ball grooves

Measuring of ball grooves

Fig. 4 Rail grinding and measuring

2. Ball slide shape

Ball slide Model	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		Medium-load type	High-load type
		Standard	Long
AL CL		CL 	AL 
EM JM		JM 	EM 
EL JL		JL 	EL 
FL KL		KL 	FL 

Note: High-precision grade of random-matching type is not applicable to EL, JL, FL and KL models.

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

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

(2) Accuracy standard

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

- **Tolerance of preloaded assembly**

Table 2

Unit: μm

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

- **Tolerance of random-matching type**

Table 3

Unit: μm

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

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

(3) Combinations of accuracy and preload

Table 4

		Accuracy grade						
		Ultra precision	Super precision	High precision	Precision grade	Normal grade	High precision	Normal grade
Without NSK K1 lubrication unit		P3	P4	P5	P6	PN	PH	PC
With NSK K1 lubrication unit		K3	K4	K5	K6	KN	KH	KC
Preload	Fine clearance Z0	○	○	○	○	○	—	—
	Slight preload Z1	○	○	○	○	○	—	—
	Medium preload Z3	○	○	○	○	—	—	—
	Random-matching type with slight preload ZZ	—	—	—	—	—	○	○

(4) Assembled accuracy

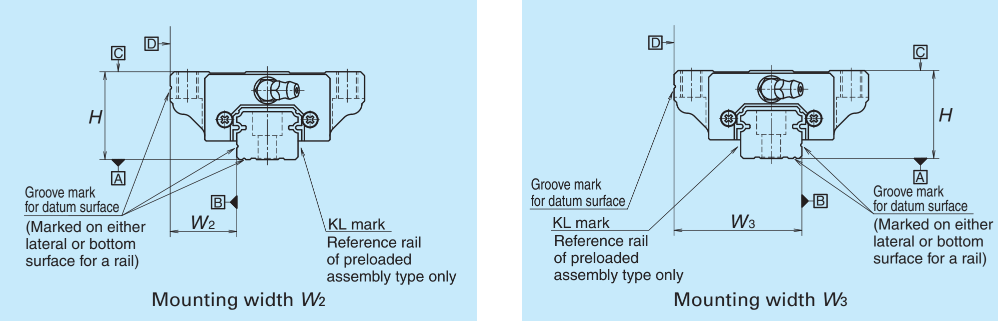


Fig. 5 Special high carbon steel

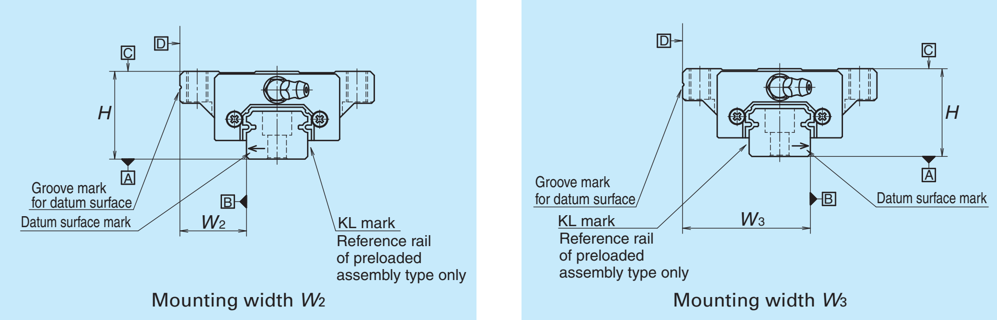


Fig. 6 Stainless steel

(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.

- **Preload and rigidity of preloaded assembly**

Table 5

	Model No.	Preload (N)		Rigidity (N/μm)			
				Vertical direction		Lateral direction	
		Slight preload (Z1)	Medium preload (Z3)	Slight preload (Z1)	Medium preload (Z3)	Slight preload (Z1)	Medium preload (Z3)
High-load type	SS15 AL, EM, EL, FL	69	392	118	216	88	157
	SS20 AL, EM, EL, FL	88	490	147	255	108	186
	SS25 AL, EM, EL, FL	147	833	196	353	137	255
	SS30 AL, EM, EL, FL	245	1 370	245	441	176	323
	SS35 AL, EM, EL, FL	294	1 860	284	539	205	392
Medium-load type	SS15 CL, JM, JL, KL	39	245	69	127	49	88
	SS20 CL, JM, JL, KL	59	343	88	157	59	118
	SS25 CL, JM, JL, KL	98	588	108	206	78	147
	SS30 CL, JM, JL, KL	147	882	127	235	98	176
	SS35 CL, JM, JL, KL	196	1 180	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

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

4. Maximum rail length

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

Table 7 Length limitation of rails

Unit: mm

Series	Size / Material	15	20	25	30	35
SS	Special high carbon steel	2 000	3 960	3 960	4 000	4 000
	Stainless steel	1 700	3 500	3 500	3 500	3 500

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

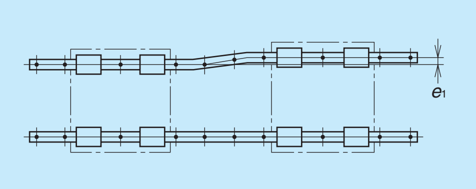


Fig. 7

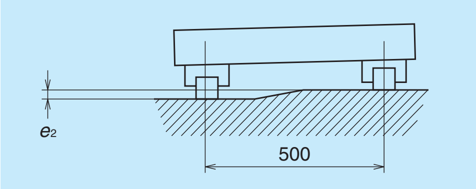


Fig. 8

Table 8

Unit: μm

Value	Preload	Model No. SS15	SS20	SS25	SS30	SS35
Permissible values of parallelism in two rails e_1	Z0	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	375 μm/500 mm				
	Z1, ZZ, Z3	330 μm/500 mm				

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

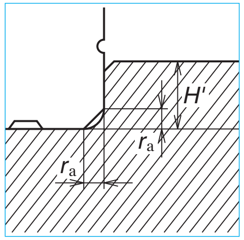


Fig. 9 Shoulder for the rail datum surface

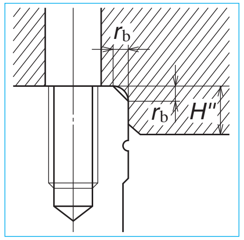


Fig. 10 Shoulder for the ball slide datum surface

Table 9

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
SS15	0.5	0.5	4	4
SS20	0.5	0.5	4.5	5
SS25	0.5	0.5	5	5
SS30	0.5	0.5	6	6
SS35	0.5	0.5	6	6

6. Lubrication components

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

(1) Types of lubrication accessories

Fig. 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.

When you require stainless lubrication accessories, please ask NSK.

(2) Mounting position of lubrication accessories

- The standard position of grease fittings is the end face of ball slide. We mount them on a side of end cap for an option. (**Fig. 12**)
  Please consult NSK for installation of grease or tube fittings to the ball slide body or side of end cap.
- When using a piping unit with thread of M6 × 1, you require a connector to connect to a grease fitting mounting hole with M6 × 0.75. The connector is available from NSK.

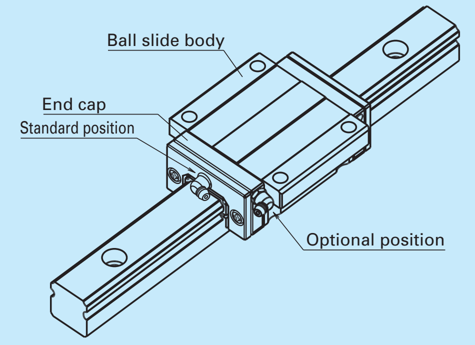


Fig. 12 Mounting position of lubrication accessories

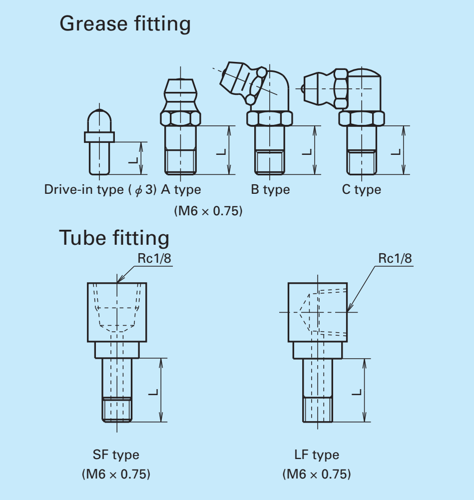


Fig. 11 Grease fitting and tube fitting

Table 10 Unit: mm

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

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

7. Dust-proof components

(1) Standard specification

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

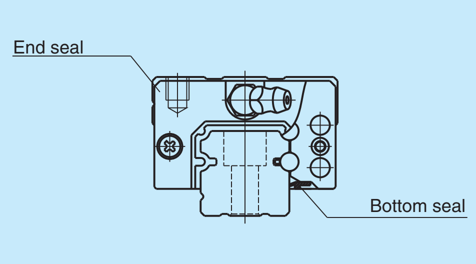


Fig. 13

Table 11 Seal friction per ball slide (maximum value)

Unit: N

Series \ Size	15	20	25	30	35
SS	8	9	9	9	10

(2) NSK K1™ lubrication unit

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

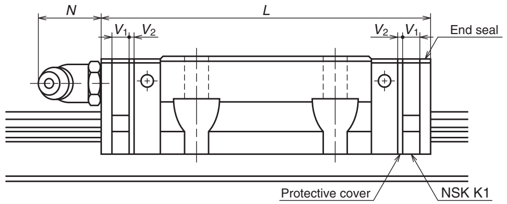


Table 12 Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_1	Protective cover thickness V_2	Protruding area of the grease fitting N
SS15	Standard	AL, EM, EL, FL	56.8	66.4	4.0	0.8	(5)
	Short	CL, JM, JL, KL	40.4	50			
SS20	Standard	AL, EM, EL, FL	65.2	75.8	4.5	0.8	(14)
	Short	CL, JM, JL, KL	47.2	57.8			
SS25	Standard	AL, EM, EL, FL	81.6	92.2	4.5	0.8	(14)
	Short	CL, JM, JL, KL	59.6	70.2			
SS30	Standard	AL, EM, EL, FL	96.4	108.4	5.0	1.0	(14)
	Short	CL, JM, JL, KL	67.4	79.4			
SS35	Standard	AL, EM, EL, FL	108	121	5.5	1.0	(14)
	Short	CL, JM, JL, KL	77	90			

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

(3) Double seal

Use a double seal set as showing in **Table 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 as showing **Fig.14** is required.

(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 as showing **Fig.15** is required.

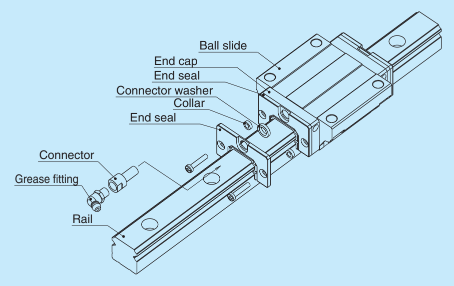


Fig. 14 Double seal

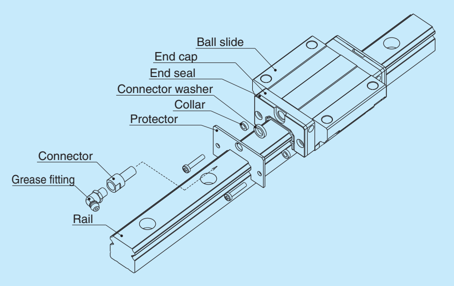


Fig. 15 Protector

Table 13 Double-seal set

Model No.	Reference No.		Increased thickness V_3 (mm)
	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_4 (mm)
	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.

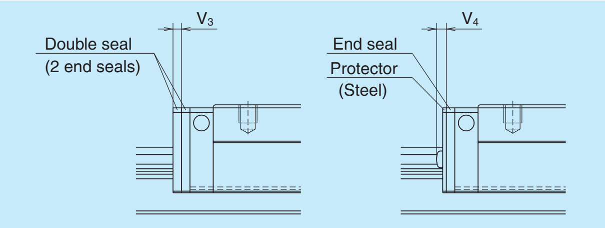


Fig. 16

(5) Cap to plug the rail mounting bolt hole

Table 15 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
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 as showing **Fig.7.7** on page A55.
- When NSK K1, double seals or protectors are used, the set screws of bellows fastener kit are unable to use.

  Please contact NSK for details.
- Bellows fastener is available only for the horizontal mounting positions. For other mounting positions, sliding plate is required (see **Fig. 7.10** on page A56).

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

(6) Inner seal

Inner seal is only available for models shown below.

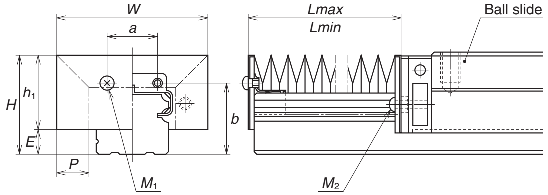
Table 16

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

A: Bellows for the ends
B: Middle bellows — A

For SS and LS series — S

Size number of linear guide — 15

L: Low type — L

Number of BL (fold number) — 08

Fig. 17 Dimension of bellows

Table 18 Dimensions of bellows Unit: mm

Model No.	*H*	h_1	*E*	*W*	*P*	*a*	*b*	BL minimum length	M_1Tap x depth	M_2Tap x depth
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*min	34	68	102	136	170	204	238	272	306	340
JAS15L	Stroke	106	212	318	424	530	636	742	848	954	1 060
	*L*max	140	280	420	560	700	840	980	1 120	1 260	1 400
JAS20L	Stroke	106	212	318	424	530	636	742	848	954	1 060
	*L*max	140	280	420	560	700	840	980	1 120	1 260	1 400
JAS25L	Stroke	106	212	318	424	530	636	742	848	954	1 060
	*L*max	140	280	420	560	700	840	980	1 120	1 260	1 400
JAS30L	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	*L*max	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
JAS35L	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	*L*max	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100

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

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

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 1200 AL C 2 -∗∗ P5 3

Series name
Size
Rail length (mm)
Ball slide shape code (See page A214.)
Material/surface treatment code (See Table 20.)
C: Special high carbon steel (NSK standard), K: Stainless steel
Number of ball slides per rail
Design serial number
Added to the reference number.
Accuracy code (See Table 21.)
Preload code (See page A216.)
0: Z0, 1: Z1, 3: Z3

(2) Reference number for random-matching type

Ball slide

SAS 30 AL Z -K

Random-matching ball slide series code
SAS: SS Series random-matching ball slide
Size
Ball slide shape code (See page A214.)
Preload code
Z: Slight preload
Option code
-K: Equipped with NSK K1
-F: Fluoride low temperature chrome plating + AS2 grease

Rail

L1S 30 1200 L C N -∗∗ PC Z

Random-matching rail series code
L1S: SS Series random-matching rail
Size
Rail length (mm)
Rail shape code
L: Standard
T: SS15 with mounting hole for M4
Material/surface treatment code (See Table 20.)
*Butting rail specification
N: Non-butting. L: Butting specification
Design serial number
Added to the reference number.
Accuracy code
PH: High precision grade random-matching type
PC: Normal grade random-matching type
Preload code (See page A216.)
Z: Slight preload only

*Please consult with NSK for butting rail specification.

The reference number coding for the assembly of random-matching type is the same as that of the preloaded assembly. However, only preload code of "slight preload Z" is available (refer to page A216).

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

Notes: High-precision grade of random-matching type is not available in stainless steel.

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
High precision grade (random-matching type)	PH	KH
Normal grade (random-matching type)	PC	KC

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

9. Dimensions

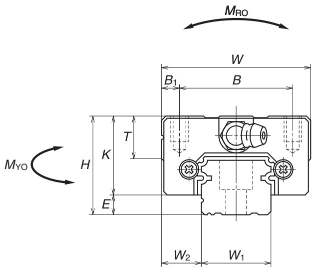
SS-CL (Medium-load type / Short)

SS-AL (High-load type / Standard)

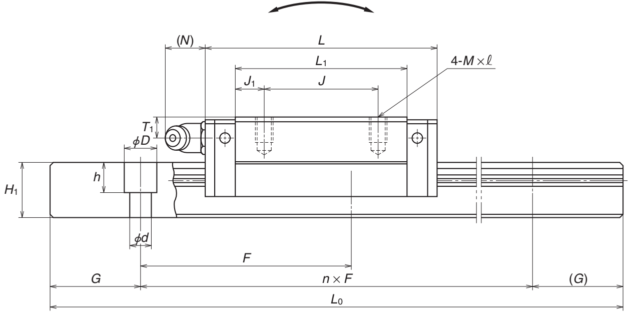
SS 30 1200 AL C 2 - PC Z**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A214.)
- Material/surface treatment code (See Table 20.)
  C: Special high carbon steel (NSK standard), K: Stainless steel
- Preload code (See page A216.)
  0: Z0, 1: Z1, 3: Z3, Z: ZZ
- Accuracy code (See Table 21.)
- Design serial number
  Added to the reference number.
- Number of ball slides per rail

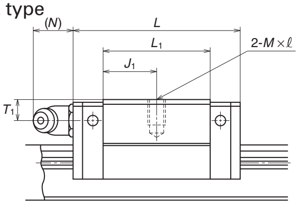
Front view of AL and CL types



Side view of AL type



Side view of CL type



Model No.	Assembly			Ball slide												
	Height			Width	Length	Mounting hole								Grease fitting		
	H	E	W_2	W	L	B	J	M×pitch×ℓ	B_1	L_1	J_1	K	T	Hole size	T_1	N
SS15CL **SS15AL**	24	4.6	9.5	34	40.4 56.8	26	– 26	M4×0.7×6	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	M5×0.8×7	5	30 48	15 8	22	12	M6×0.75	5.5	11
SS25CL **SS25AL**	33	7	12.5	48	59.6 81.6	35	– 35	M6×1×9	6.5	38 60	19 12.5	26	12	M6×0.75	7	11
SS30CL **SS30AL**	42	9	16	60	67.4 96.4	40	– 40	M8×1.25×12	10	42 71	21 15.5	33	13	M6×0.75	8	11
SS35CL **SS35AL**	48	10.5	18	70	77 108	50	– 50	M8×1.25×12	10	49 80	24.5 15	37.5	14	M6×0.75	8.5	11

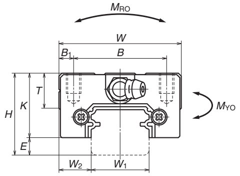
Notes: 1) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.

Reference number for ball slide of random-matching type

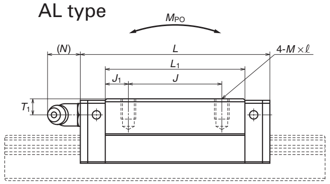
SAS 30 AL Z -K

- Random-matching ball slide series code
  SAS: SS Series random-matching ball slide
- Size
- Ball slide shape code (See page A214.)
- Option code
  -K: Equipped with NSK K1
  -F: Fluoride low temperature chrome plating + AS2 grease
- Preload code
  Z: Slight preload

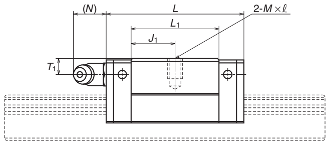
AL and CL types



AL type



CL type

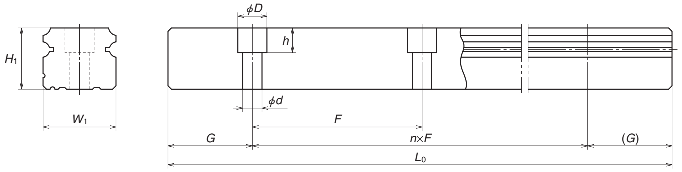


Reference number for rail of random-matching type

Rail **L1S 30 1200 L C N -** PC Z**

- Random-matching rail series code
  L1S: SS Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code
  L: Standard
  T: SS15 with mounting hole for M4
- Material/surface treatment code (See Table 20.)
- Preload code (See page A216.)
  Z: Slight preload only
- Accuracy code
  PH: High precision grade
  PC: Normal grade
- Design serial number
  Added to the reference number.
- *Butting rail specification
  N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Rail						Basic load rating							Weight	
	Width	Height	Pitch	Mounting bolt hole	G	Max. length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
						L_{0max}	C	C_0	M_{RO}	M_{PO}		M_{YO}			
	W_1	H_1	F	d×D×h	(reference)	( ) for stainless	(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
SS15CL **SS15AL**	15	12.5	60	*3.5×6×4.5 4.5×7.5×5.3	20	2 000 (1 700)	4 900 7 900	7 800 15 600	39 78	21.1 73.5	171 435	17.7 61.5	143 365	0.14 0.2	1.4
SS20CL **SS20AL**	20	15.5	60	6×9.5×8.5	20	3 960 (3 500)	7 250 11 100	11 800 21 800	80 149	40.5 124	295 700	34 104	247 590	0.19 0.28	2.3
SS25CL **SS25AL**	23	18	60	7×11×9	20	3 960 (3 500)	12 700 17 900	20 800 33 500	164 266	96.5 242	650 1 370	81 203	545 1 150	0.34 0.51	3.1
SS30CL **SS30AL**	28	23	80	7×11×9	20	4 000 (3 500)	18 700 27 300	29 600 50 500	282 480	153 415	1 060 2 450	128 350	890 2 050	0.58 0.85	4.8
SS35CL **SS35AL**	34	27.5	80	9×14×12	20	4 000 (3 500)	26 000 38 000	40 000 68 500	465 800	234 620	1 650 3 750	196 520	1 380 3 150	0.86 1.3	7

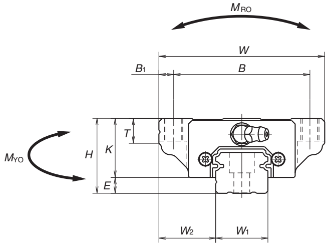
2) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.
3) High-precision grade of random-matching type is available for special-high carbon steel products.
* Standard mounting hole of SS15 rail is for M3 bolts (Hole size: 3.5 × 6 × 4.5).
If you require mounting hole for M4 bolts (Hole size: 4.5 × 7.5 × 5.3), please specify when ordering.

SS-JM (Medium-load type / Short)
SS-EM (High-load type / Standard)

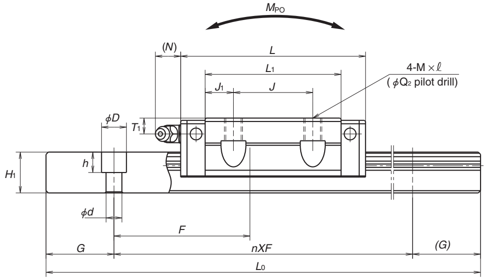
SS 30 1200 EM C 2 -＊＊ PC Z

Series name: SS
Size: 30
Rail length (mm): 1200
Ball slide shape code (See page A214.): EM
Material/surface treatment code (See Table 20.): C
C: Special high carbon steel (NSK standard), K: Stainless steel
Number of ball slides per rail: 2
Design serial number: -＊＊
Added to the reference number.
Accuracy code (See Table 21.): PC
Preload code (See page A216.): Z
0: Z0, 1: Z1, 3: Z3, Z: ZZ

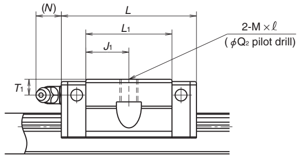
Front view of EM and JM types



Side view of EM type



Side view of JM type

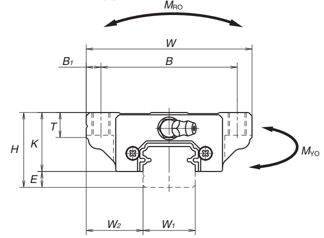


Reference number for ball slide of random-matching type

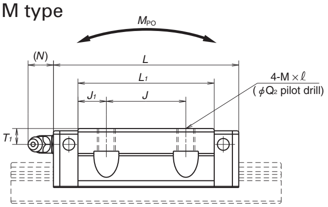
SAS 30 EM Z -K

Random-matching ball slide series code: SAS
SAS: SS Series random-matching ball slide
Size: 30
Ball slide shape code (See page A214.): EM
Preload code: Z
Z: Slight preload
Option code: -K
-K: Equipped with NSK K1
-F: Fluoride low temperature chrome plating + AS2 grease

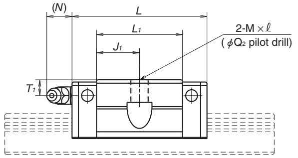
EM and JM types



EM type



JM type

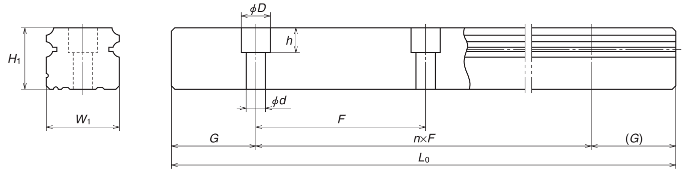


Reference number for rail of random-matching type

L1S 30 1200 L C N -＊＊ PC Z

Random-matching rail series code: L1S
L1S: SS Series random-matching rail
Size: 30
Rail length (mm): 1200
Rail shape code: L
L: Standard
T: SS15 with mounting hole for M4
Material/surface treatment code (See Table 20.): C
*Butting rail specification: N
N: Non-butting. L: Butting specification
Design serial number: -＊＊
Added to the reference number.
Accuracy code: PC
PH: High precision grade
PC: Normal grade
Preload code (See page A216.): Z
Z: Slight preload only

*Please consult with NSK for butting rail specification.



Model No.	Assembly Height H	Assembly E	Assembly W_2	Ball slide Width W	Ball slide Length L	Mounting hole B	Mounting hole J	Mounting hole M×pitch×ℓ	Mounting hole Q_2	B_1	L_1	J_1	K	T	Grease fitting Hole size	Grease fitting T_1	Grease fitting 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

Notes: 1) Parenthesized dimensions are applicable to stainless steel products.
2) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.

Unit: mm

Model No.	Rail Width W_1	Rail Height H_1	Rail Pitch F	Rail Mounting bolt hole d × D × h	Rail G (reference)	Rail Max. length L_{0max} ( ) for stainless	Basic load rating Dynamic C (N)	Basic load rating Static C_0 (N)	Static moment (N·m) M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	Weight Ball slide (kg)	Weight Rail (kg/m)
SS15JM **SS15EM**	15	12.5	60	＊ 3.5×6×4.5 4.5×7.5×5.3	20	2 000 (1 700)	4 900 7 900	7 800 15 600	39 78	21.1 73.5	171 435	17.7 61.5	143 365	0.17 0.26	1.4
SS20JM **SS20EM**	20	15.5	60	6×9.5×8.5	20	3 960 (3 500)	7 250 11 100	11 800 21 800	80 149	40.5 124	295 700	34 104	247 590	0.24 0.35	2.3
SS25JM **SS25EM**	23	18	60	7×11×9	20	3 960 (3 500)	12 700 17 900	20 800 33 500	164 266	96.5 242	650 1 370	81 203	545 1 150	0.44 0.66	3.1
SS30JM **SS30EM**	28	23	80	7×11×9	20	4 000 (3 500)	18 700 27 300	29 600 50 500	282 480	153 415	1 060 2 450	128 350	890 2 050	0.76 1.2	4.8
SS35JM **SS35EM**	34	27.5	80	9×14×12	20	4 000 (3 500)	26 000 38 000	40 000 68 500	465 800	234 620	1 650 3 750	196 520	1 380 3 150	1.2 1.7	7

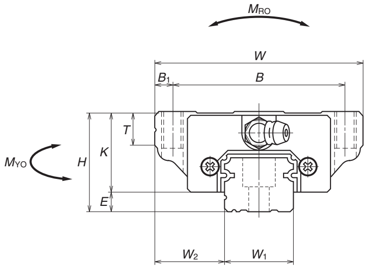
3) Basic dynamic load rating is a load that allows for a 50 km rating fatigue life and is a vertical and constant load to the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.
4) High-precision grade of random-matching type is available for special-high carbon steel products.
＊ Standard mounting hole of SS15 rail is for M3 bolts (Hole size: 3.5 × 6 × 4.5).
If you require mounting hole for M4 bolts (Hole size: 4.5 × 7.5 × 5.3), please specify when ordering.

SS-JL (Medium-load type / Short)
SS-EL (High-load type / Standard)

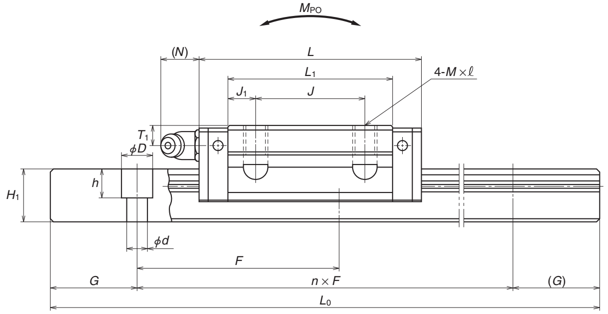
SS 30 1200 EL C 2 -✽✽ PC Z

Series name
Size
Rail length (mm)
Ball slide shape code (See page A214.)
Material/surface treatment code (See Table 20.)
C: Special high carbon steel (NSK standard), K: Stainless steel
Preload code (See page A216.)
0: Z0, 1: Z1, 3: Z3, Z: ZZ
Accuracy code (See Table 21.)
Design serial number
Added to the reference number.
Number of ball slides per rail

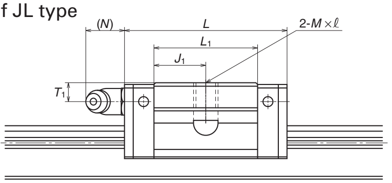
Front view of EL and JL types



Side view of EL type



Side view of JL type

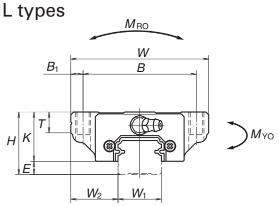


Reference number for ball slide of random-matching type

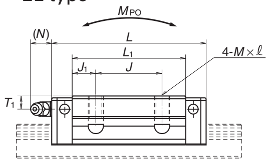
SAS 30 EL Z -K

Random-matching ball slide series code
SAS: SS Series random-matching ball slide
Size
Ball slide shape code (See page A214.)
Option code
-K: Equipped with NSK K1
-F: Fluoride low temperature chrome plating + AS2 grease
Preload code
Z: Slight preload

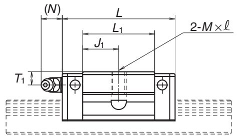
EL and JL types



EL type



JL type

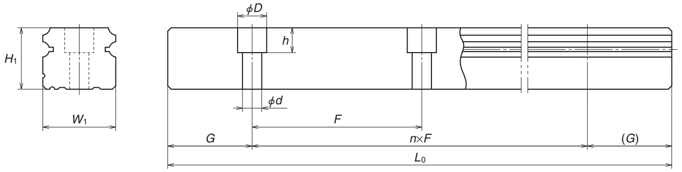


Reference number for rail of random-matching type

L1S 30 1200 L C N -✽✽ PC Z

Random-matching rail series code
L1S: SS Series random-matching rail
Size
Rail length (mm)
Rail shape code
L: Standard
T: SS15 with mounting hole for M4
Material/surface treatment code (See Table 20.)
Preload code (See page A216.)
Z: Slight preload only
Accuracy code: PC
PC: Normal grade is only available.
Design serial number
Added to the reference number.
*Butting rail specification
N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly Height H	Assembly E	Assembly W2	Ball slide Width W	Ball slide Length L	Mounting hole B	Mounting hole J	Mounting hole M×pitch×ℓ	B1	L1	J1	K	T	Grease fitting Hole size	Grease fitting T1	Grease fitting N
SS15JL **SS15EL**	24	4.6	18.5	52	40.4 56.8	41	– 26	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	– 32	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	– 35	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	– 40	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	– 50	M10×1.5×20 (M10×1.5×15)	9	49 80	24.5 15	37.5	12 (15)	M6×0.75	8.5	11

Model No.	Rail Width W1	Rail Height H1	Rail Pitch F	Rail Mounting bolt hole d×D×h	Rail G (reference)	Rail Max. length L0max ( ) for stainless	Basic load rating Dynamic C (N)	Basic load rating Static C0 (N)	Static moment (N·m) MRO	Static moment (N·m) MPO One slide	Static moment (N·m) MPO Two slides	Static moment (N·m) MYO One slide	Static moment (N·m) MYO Two slides	Weight Ball slide (kg)	Weight Rail (kg/m)
SS15JL **SS15EL**	15	12.5	60	✽3.5×6×4.5 4.5×7.5×5.3	20	2 000 (1 700)	4 900 7 900	7 800 15 600	39 78	21.1 73.5	171 435	17.7 61.5	143 365	0.17 0.26	1.4
SS20JL **SS20EL**	20	15.5	60	6×9.5×8.5	20	3 960 (3 500)	7 250 11 100	11 800 21 800	80 149	40.5 124	295 700	34 104	247 590	0.24 0.35	2.3
SS25JL **SS25EL**	23	18	60	7×11×9	20	3 960 (3 500)	12 700 17 900	20 800 33 500	164 266	96.5 242	650 1 370	81 203	545 1 150	0.44 0.66	3.1
SS30JL **SS30EL**	28	23	80	7×11×9	20	4 000 (3 500)	18 700 27 300	29 600 50 500	282 480	153 415	1 060 2 450	128 350	890 2 050	0.76 1.2	4.8
SS35JL **SS35EL**	34	27.5	80	9×14×12	20	4 000 (3 500)	26 000 38 000	40 000 68 500	465 800	234 620	1 650 3 750	196 520	1 380 3 150	1.2 1.7	7

Notes: 1) Parenthesized dimensions are applicable to stainless steel products.
2) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.

3) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.
4) High-precision grade of random-matching type is not available for JL and EL models.
✽ Standard mounting hole of SS15 rail is for M3 bolts (Hole size: 3.5 × 6 × 4.5).
If you require mounting hole for M4 bolts (Hole size: 4.5 × 7.5 × 5.3), please specify when ordering.

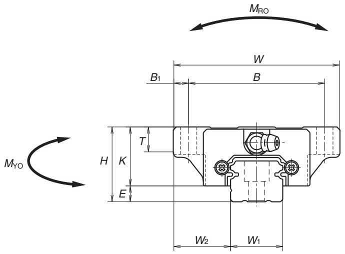
SS-KL (Medium-load type / Short)
SS-FL (High-load type / Standard)

SS 30 1200 FL C 2 -∗∗ PC Z

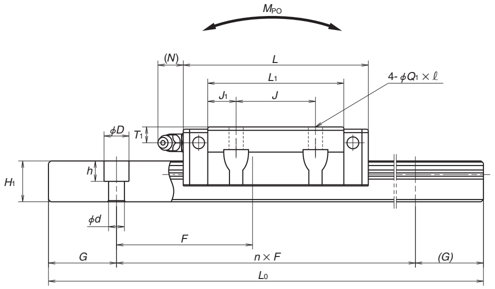
Series name
Size
Rail length (mm)
Ball slide shape code (See page A214.)
Material/surface treatment code (See Table 20.)
C: Special high carbon steel (NSK standard), K: Stainless steel

Preload code (See page A216.)
0: Z0, 1: Z1, 3: Z3, Z: ZZ
Accuracy code (See Table 21.)
Design serial number
Added to the reference number.
Number of ball slides per rail

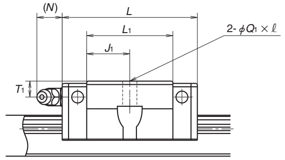
Front view of FL and KL types



Side view of FL type



Side view of KL type



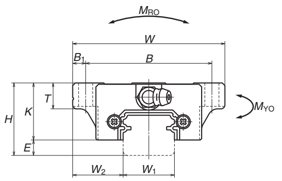
Reference number for ball slide of random-matching type

SAS 30 FL Z -K

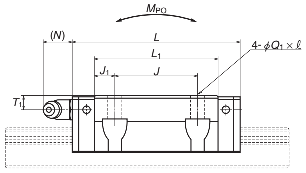
Random-matching ball slide series code
SAS: SS Series random-matching ball slide
Size
Ball slide shape code (See page A214.)

Option code
-K: Equipped with NSK K1
-F: Fluoride low temperature chrome plating + AS2 grease
Preload code
Z: Slight preload

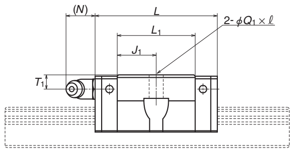
FL and KL types



FL type



KL type



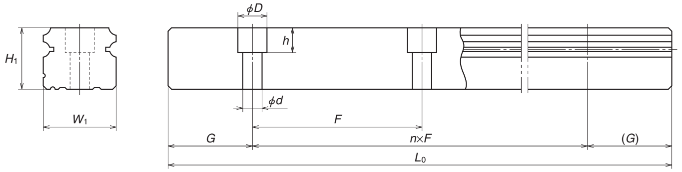
Reference number for rail of random-matching type

L1S 30 1200 L C N -∗∗ PC Z

Random-matching rail series code
L1S: SS Series random-matching rail
Size
Rail length (mm)
Rail shape code
L: Standard
T: SS15 with mounting hole for M4
Material/surface treatment code (See Table 20.)

Preload code (See page A216.)
Z: Slight preload only
Accuracy code: PC
PC: Normal grade is only available.
Design serial number
Added to the reference number.
*Butting rail specification
N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.



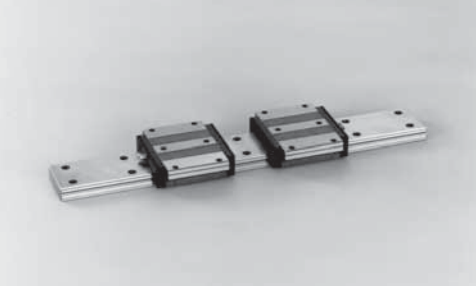
Unit: mm

Model No.	Assembly			Ball slide													Rail						Basic load rating							Weight	
	Height			Width	Length	Mounting hole								Grease fitting			Width	Height	Pitch	Mounting bolt hole	G	Max. length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
																						L_{0max}	C	C_0	M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	$Q_1×\ell$	B_1	L_1	J_1	K	T	Hole size	T_1	N	W_1	H_1	F	$d×D×h$	(reference)	( ) for stainless	(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
SS15KL	24	4.6	18.5	52	40.4	41	–	4.5×7	5.5	23.6	11.8	19.4	8	ϕ3	6	3	15	12.5	60	∗ 3.5×6×4.5	20	2 000	4 900	7 800	39	21.1	171	17.7	143	0.17	1.4
SS15FL					56.8		26			40	7									4.5×7.5×5.3		(1 700)	7 900	15 600	78	73.5	435	61.5	365	0.26	
SS20KL	28	6	19.5	59	47.2	49	–	5.5×9(5.5×9.5)	5	30	15	22	10	M6×0.75	5.5	11	20	15.5	60	6×9.5×8.5	20	3 960	7 250	11 800	80	40.5	295	34	247	0.24	2.3
SS20FL					65.2		32			48	8											(3 500)	11 100	21 800	149	124	700	104	590	0.35	
SS25KL	33	7	25	73	59.6	60	–	7×10(7×11.5)	6.5	38	19	26	11	M6×0.75	7	11	23	18	60	7×11×9	20	3 960	12 700	20 800	164	96.5	650	81	545	0.44	3.1
SS25FL					81.6		35			60	12.5		(12)									(3 500)	17 900	33 500	266	242	1 370	203	1 150	0.66	
SS30KL	42	9	31	90	67.4	72	–	9×12(9×14.5)	9	42	21	33	11	M6×0.75	8	11	28	23	80	7×11×9	20	4 000	18 700	29 600	282	153	1 060	128	890	0.76	4.8
SS30FL					96.4		40			71	15.5		(15)									(3 500)	27 300	50 500	480	415	2 450	350	2 050	1.2	
SS35KL	48	10.5	33	100	77	82	–	9×13(9×14.5)	9	49	24.5	37.5	12	M6×0.75	8.5	11	34	27.5	80	9×14×12	20	4 000	26 000	40 000	465	234	1 650	196	1 380	1.2	7
SS35FL					108		50			80	15		(15)									(3 500)	38 000	68 500	800	620	3 750	520	3 150	1.7	

Notes: 1) Parenthesized dimensions are applicable to stainless steel products.
2) External appearance of stainless steel ball slides differs from those of carbon steel ball slides.

3) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.
4) High-precision grade of random-matching type is not available for KL and FL models.
∗ Standard mounting hole of SS15 rail is for M3 bolts (Hole size: 3.5 × 6 × 4.5).
If you require mounting hole for M4 bolts (Hole size: 4.5 × 7.5 × 5.3), please specify when ordering.

A-5-1.7 LW Series



1. Features

(1) Ideal for use of single rail

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

(2) High load carrying capacity to vertical direction

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

(3) High resistance against impact load

Same as the LH and LS series, the offset Gothic arch grooves support a large load, such as an impact, by four rows.

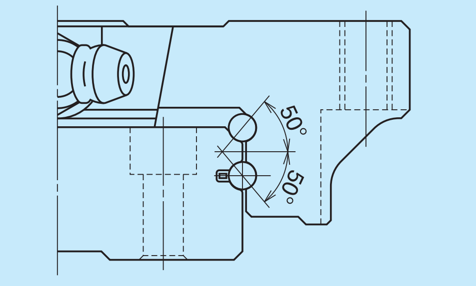


Fig. 1 Balls in contact

(4) High accuracy

Fixing master rollers to ball grooves is easy thanks to the Gothic arch groove. This makes easy and accurate measuring of ball grooves.

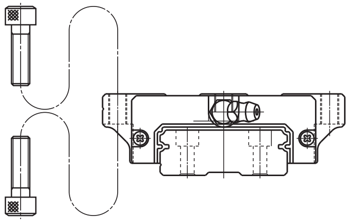
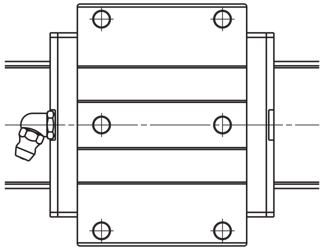
(5) Easy to handle, and designed with safety in mind.

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

(6) Fast delivery

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

2. Ball slide shape

Ball slide Model	Shape / installation method	Type
EL		EL 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

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

(2) Accuracy standard

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

- **Tolerance of preloaded assembly type**

Table 2

Unit: μm

Characteristics \ Accuracy grade	High precision P5	Precision grade P6	Normal grade PN
Mounting height *H* Variation of *H* (All ball slides on a set of rails)	±20 7	±40 15	±80 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±25 10	±50 20	±100 30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in **Table 1** and **Fig. 2**		

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

Table 3

Unit: μm

Characteristics \ Model No.	LW17, 21, 27, 35, 50
Mounting height *H*	±20
Variation of mounting height *H*	15① 30②
Mounting width W_2 or W_3	±30
Variation of mounting width W_2 or W_3	25
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	See **Table 1** and **Fig. 2**

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

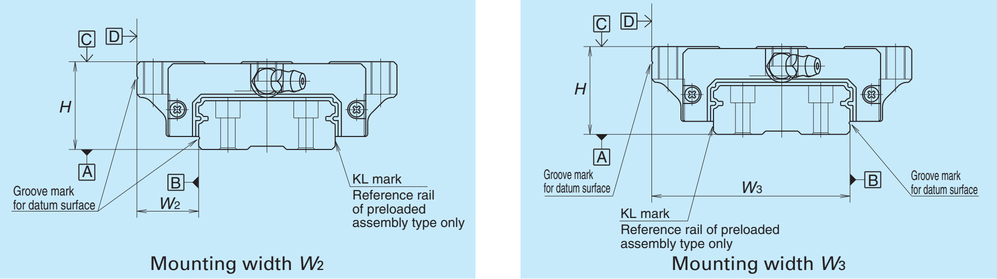
(3) Combination of accuracy and preload

Table 4

		Accuracy grade			
		High precision	Precision grade	Normal grade	Normal grade
Without NSK K1 lubrication unit		P5	P6	PN	PC
With NSK K1 lubrication unit		K5	K6	KN	KC
With NSK K1 for food and medical equipment		F5	F6	FN	FC
Preload	Fine clearance Z0	○	○	○	—
	Slight preload Z1	○	○	○	—
	Medium preload Z3	○	○	—	—
	Random-matching type with fine clearance ZT	—	—	—	○
	Random-matching type with slight preload ZZ	—	—	—	○

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

(4) Assembled accuracy



Mounting width W_2 Mounting width W_3

Fig. 2

(5) Preload and rigidity

We offer five levels of preload: Slight preload Z1, Medium preload Z3 and Fine clearance Z0, along with Random-matching type of Fine clearance ZT and Slight preload ZZ. Rigidities are for the median of the preload range.

- **Preload and rigidity of preloaded assembly**

Table 5

Model No.	Preload (N)		Rigidity (N/μm)			
			Vertical direction		Lateral direction	
	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3	Slight preload Z1	Medium preload Z3
LW17 EL	0 – 245	–	156	–	112	–
LW21 EL	0 – 294	–	181	–	130	–
LW27 EL	0 – 390	–	226	–	167	–
LW35 EL	0 – 490	785	295	440	213	315
LW50 EL	0 – 590	1 470	345	600	246	425

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

- **Clearance and preload of random-matching type**

Table 6 Unit: μm

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

Note: Minus sign denotes elastic deformation of balls representing.

4. Maximum rail length

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

Table 7 Length limitations of rails

Unit: mm

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

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

5. Installation

(1) Permissible values of mounting error

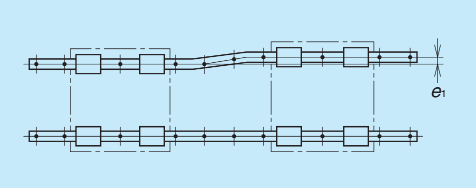


Fig. 3

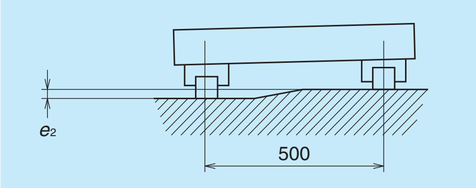


Fig. 4

Table 8 Unit: μm

Value	Preload	Model No.				
		LW17	LW21	LW27	LW35	LW50
Permissible values of parallelism in two rails e_1	Z0, ZT	20	20	25	38	50
	Z1, ZZ	9	9	13	23	34
Permissible values of parallelism (height) in two rails e_2	Z0, ZT	100 μm/500 mm				
	Z1, ZZ	45 μm/500 mm				

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

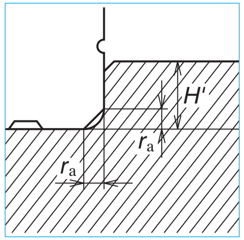


Fig. 5 Shoulder for the rail datum surface

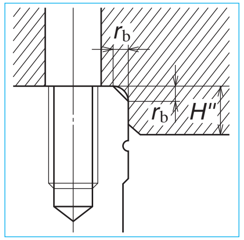


Fig. 6 Shoulder for the ball slide datum surface

Table 9 Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
LW17	0.3	0.3	2.2	4
LW21	0.3	0.3	2.5	5
LW27	0.5	0.5	3.5	5
LW35	0.5	0.8	3.5	5
LW50	0.8	0.8	4	6

6. Lubrication components

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

(1) Types of lubrication accessories

Fig. 7 and **Table 10** show grease fittings and tube fittings.

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

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

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

Please ask NSK for stainless lubrication accessories.

Table 10 Unit: mm

Model No.	Dust-proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
LW17	Standard	5	–
	With NSK K1	10	–
	Double seal	*	–
	Protector	*	–
LW21	Standard	5	–
	With NSK K1	12	–
	Double seal	10	–
	Protector	10	–
LW27	Standard	5	5
	With NSK K1	12	12
	Double seal	10	9
	Protector	10	9
LW35	Standard	5	6
	With NSK K1	14	13
	Double seal	10	9
	Protector	10	9
LW50	Standard	8	17
	With NSK K1	18	19
	Double seal	14	17
	Protector	14	17

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

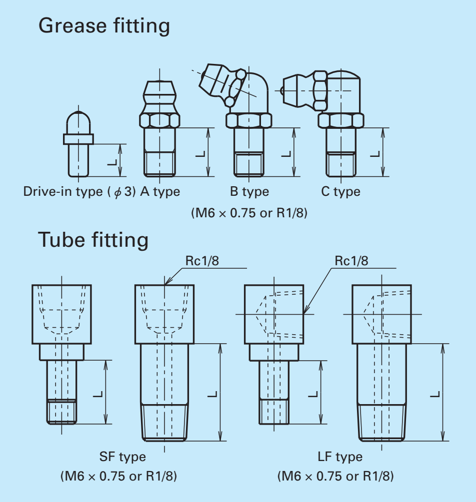


Fig. 7 Grease fitting and tube fitting

(2) Mounting position of lubrication accessories

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

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

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

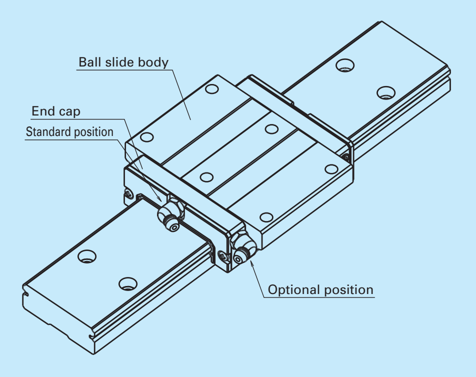


Fig. 8 Mounting position of lubrication accessories

7. Dust-proof components

(1) Standard Specification

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

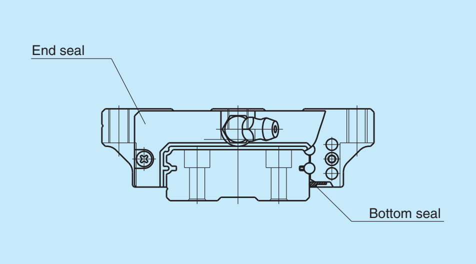


Fig. 9

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

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

(2) NSK K1™ lubrication unit

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

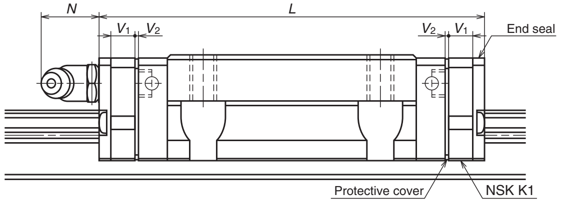


Table 12 Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_1	Protective cover thickness V_2	Protruding area of the grease fitting N
LW17	Standard	EL	51.4	61.6	4.5	0.6	(5)
LW21	Standard	EL	58.8	71.4	5.5	0.8	(13)
LW27	Standard	EL	74	86.6	5.5	0.8	(13)
LW35	Standard	EL	108	123	6.5	1.0	(13)
LW50	Standard	EL	140.6	155.6	6.5	1.0	(14)

Note: 1) NSK K1 for food and medical equipments are available for the models of LW17 to LW35.
2) Ball slide length equipped with NSK K1 = (Standard ball slide length) + (Thickness of NSK K1, V_1 x Number of NSK K1) + (Thickness of the protective cover, V_2 x 2)

(3) Double seal

Use a double seal set as showing in **Table 13**, when installing an extra seal to completed standard products. (**Fig. 10**)
When installing a grease fitting after the installation of double seals, a connector as showing **Fig.10** is required.

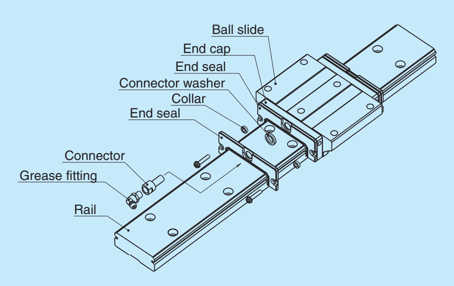


Fig. 10 Double seal

Table 13 Double-seal set

Model No.	Reference No.		Increased thickness V_3 (mm)
	Without connector	With connector	
LW17	LW17WS-01	∗	2.6
LW21	LW21WS-01	LW21WSC-01	2.8
LW27	LW27WS-01	LW27WSC-01	2.5
LW35	LW35WS-01	LW35WSC-01	3
LW50	LW50WS-01	LW50WSC-01	3.6

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

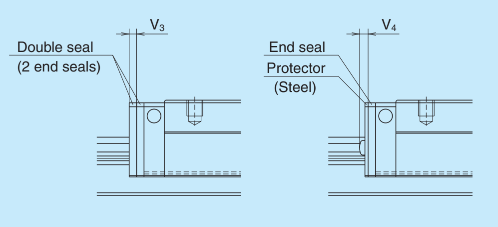


Fig. 12

(4) Protector

Use a protector set as showing **Table 14**, when installing a protector to completed standard products. (**Fig.11**)
When installing a grease fitting after the installation of protectors, a connector as showing **Fig.11** is required.

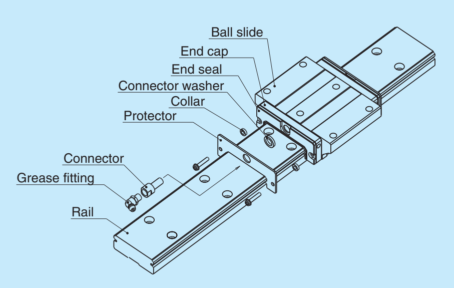


Fig. 11 Protector seal

Table 14 Protector set

Model No.	Reference No.		Increased thickness V_4 (mm)
	Without connector	With connector	
LW17	LW17PT-01	∗	3.2
LW21	LW21PT-01	LW21PTC-01	3.2
LW27	LW27PT-01	LW27PTC-01	2.9
LW35	LW35PT-01	LW35PTC-01	3.6
LW50	LW50PT-01	LW50PTC-01	4.2

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

(5) Cap to plug the rail mounting bolt hole

Table 15 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
LW17, LW21, LW27	M4	LG-CAP/M4	20
LW35	M6	LG-CAP/M6	20
LW50	M8	LG-CAP/M8	20

(6) Bellows

· Make tap holes to the rail end face to fix the bellows mounting plate. NSK processes tap holes to the rail end face when ordered with a linear guide.

Dimension tables of bellows
LW series

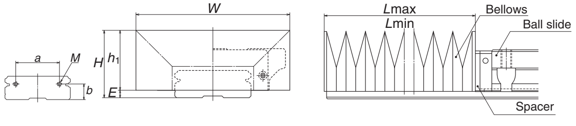


Fig. 13

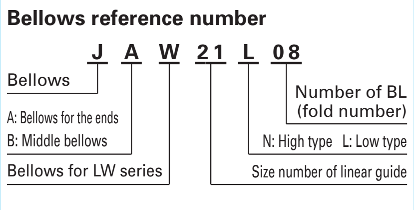


Table 16 Dimensions of bellows

Unit: mm

Model No.	H	h_1	E	W	P	a	b	BL minimum length	Tap (M) x depth
JAW17N	25.5	23	2.5	68	15	22	6	17	M3 × 6
JAW21N	29	26	3	75	17	26	7	17	M3 × 6
JAW27N	37	33	4	85	20	28	10	17	M3 × 6
JAW35L	34	30	4	100	14	48	12	17	M4 × 8
JAW35N	41	37		115	20				
JAW50L	46.5	42	4.5	135	20	70	14	17	M4 × 8
JAW50N	56.5	52		160	30				

Table 17 Numbers of folds (BL) and length of bellows

Unit: mm

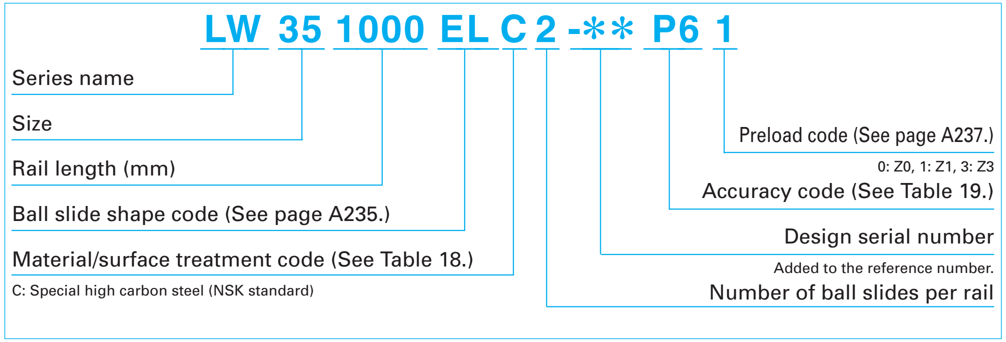
Model No.	Number of BL	2	4	6	8	10	12	14	16	18	20
	Lmin	34	68	102	136	170	204	238	272	306	340
JAW17N	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
	Lmax	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
JAW21N	Stroke	204	408	612	816	1 020	1 224	1 428	1 632	1 836	2 040
	Lmax	238	476	714	952	1 190	1 428	1 666	1 904	2 142	2 380
JAW27N	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
	Lmax	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
JAW35L	Stroke	162	324	486	648	810	972	1 134	1 296	1 458	1 620
	Lmax	196	392	588	784	980	1 176	1 372	1 568	1 764	1 960
JAW35N	Stroke	218	436	654	872	1 090	1 308	1 526	1 744	1 962	2 180
	Lmax	252	504	756	1 008	1 260	1 512	1 764	2 016	2 268	2 520
JAW50L	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
	Lmax	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
JAW50N	Stroke	386	772	1 158	1 544	1 930	2 316	2 702	3 088	3 474	3 860
	Lmax	420	840	1 260	1 680	2 100	2 520	2 940	3 360	3 780	4 200

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

8. Reference number

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

(1) Reference number for preloaded assembly



LW 35 1000 EL C 2 -** P6 1

Series name

Size

Rail length (mm)

Ball slide shape code (See page A235.)

Material/surface treatment code (See Table 18.)
C: Special high carbon steel (NSK standard)

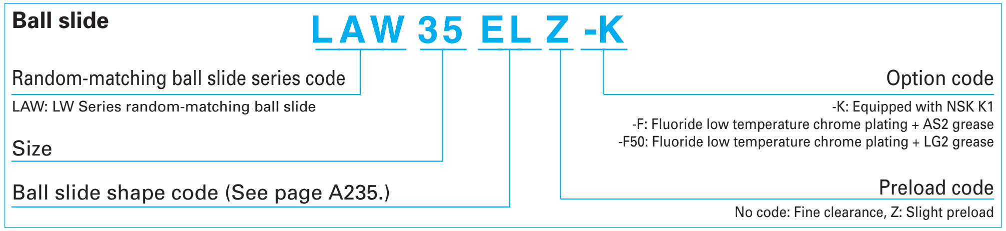
Preload code (See page A237.)
0: Z0, 1: Z1, 3: Z3

Accuracy code (See Table 19.)

Design serial number
Added to the reference number.

Number of ball slides per rail

(2) Reference number for random-matching type



Ball slide

LAW 35 EL Z -K

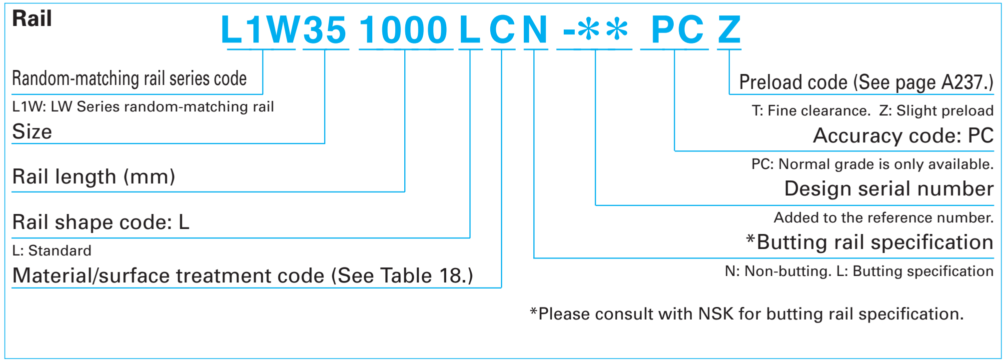
Random-matching ball slide series code
LAW: LW Series random-matching ball slide

Size

Ball slide shape code (See page A235.)

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

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



Rail

L1W35 1000 L C N -** PC Z

Random-matching rail series code
L1W: LW Series random-matching rail

Size

Rail length (mm)

Rail shape code: L
L: Standard

Material/surface treatment code (See Table 18.)

Preload code (See page A237.)
T: Fine clearance. Z: Slight preload

Accuracy code: PC
PC: Normal grade is only available.

Design serial number
Added to the reference number.

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

*Please consult with NSK for butting rail specification.

The reference number coding for the assembly of random-matching type is the same as that of preloaded assembly. However, only preload codes of "fine clearance T" and "slight preload Z" are available (refer to page A237).

Table 18 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
Z	Other, special

Table 19 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1	With NSK K1 for food and medical equipment
High precision grade	P5	K5	F5
Precision grade	P6	K6	F6
Normal grade	PN	KN	FN
Normal grade (random-matching type)	PC	KC	FC

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

(9) Dimensions

LW-EL

LW 35 1000 EL C 2 -✻✻ PC Z

Series name

Size

Rail length (mm)

Ball slide shape code (See page A235.)

Material/surface treatment code (See Table 18.)

C: Special high carbon steel (NSK standard)

Preload code (See page A237.)

0: Z0, 1: Z1, 3: Z3, T: ZT, Z: ZZ

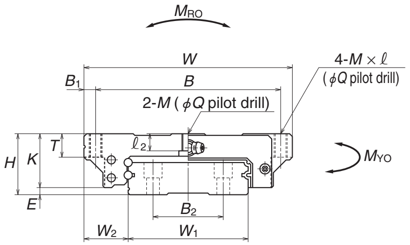
Accuracy code (See Table 19.)

Design serial number

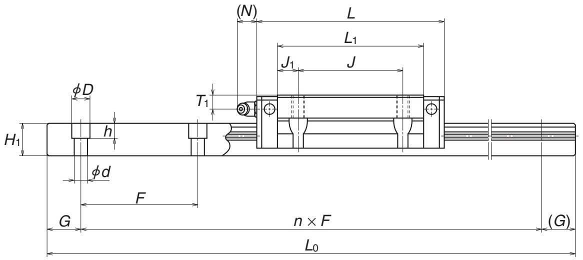
Added to the reference number.

Number of ball slides per rail

Front view



Side view



Reference number for ball slide of random-matching type

LAW 35 EL Z -K

Random-matching ball slide series code

LAW: LW Series random-matching ball slide

Size

Ball slide shape code (See page A235.)

Option code

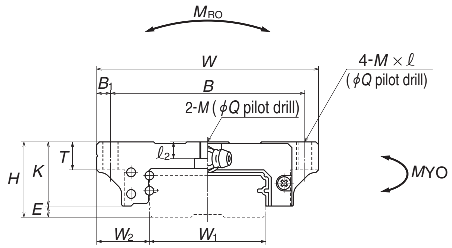
-K: Equipped with NSK K1

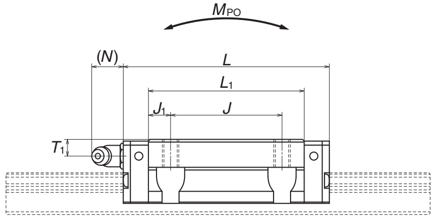
-F: Fluoride low temperature chrome plating + AS2 grease

-F50: Fluoride low temperature chrome plating + LG2 grease

Preload code

No code: Fine clearance, Z: Slight preload





Reference number for rail of random-matching type

Rail **L1W35 1000 L C N -✻✻ PC Z**

Random-matching rail series code

L1W: LW Series random-matching rail

Size

Rail length (mm)

Rail shape code: L

L: Standard

Material/surface treatment code (See Table 18.)

Preload code (See page A237.)

T: Fine clearance. Z: Slight preload

Accuracy code: PC

PC: Normal grade is only available.

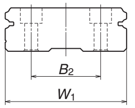
Design serial number

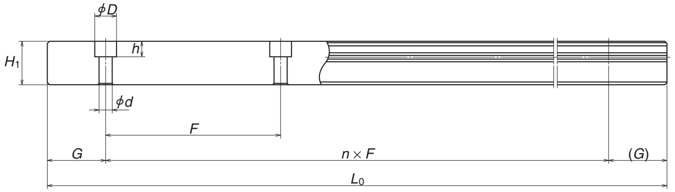
Added to the reference number.

*Butting rail specification

N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.





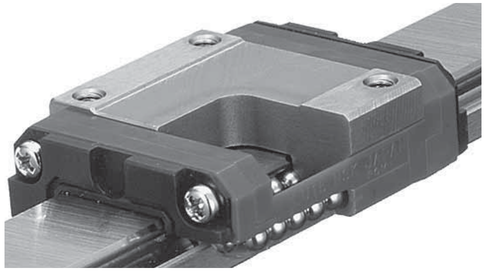
Unit: mm

Model No.	Assembly			Ball slide															Rail							Basic load rating							Weight	
	Height			Width	Length	Mounting hole										Grease fitting			Width	Height		Pitch	Mounting bolt hole	G (Reference)	Maximum length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
																												M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	M × pitch × ℓ	$ℓ_2$	Q	B_1	L_1	J_1	K	T	Hole size	T_1	N	W_1	H_1	B_2	F	$d \times D \times h$		L_{0max}	C (N)	C_0 (N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
LW17EL	17	2.5	13.5	60	51.4	53	26	M4×0.7×6	3.2	3.3	3.5	35	4.5	14.5	6	ϕ3	4	3	33	8.7	18	40	4.5×7.5×5.3	15	1 000	5 600	11 300	135	44	288	37	242	0.2	2.1
LW21EL	21	3	15.5	68	58.8	60	29	M5×0.8×8	3.7	4.4	4	41	6	18	8	M6×0.75	4.5	11	37	10.5	22	50	4.5×7.5×5.3	15	1 600	6 450	13 900	185	65.5	400	55	335	0.3	2.9
LW27EL	27	4	19	80	74	70	40	M6×1×10	6	5.3	5	56	8	23	10	M6×0.75	6	11	42	15	24	60	4.5×7.5×5.3	20	2 000	12 800	26 900	400	171	970	143	815	0.5	4.7
LW35EL	35	4	25.5	120	108	107	60	M8×1.25×14	9	6.8	6.5	84	12	31	14	M6×0.75	8	11	69	19	40	80	7×11×9	20	2 000	33 000	66 500	1 690	645	3 550	545	2 990	1.5	9.6
LW50EL	50	4.5	36	162	140.6	144	80	M10×1.5×18	14	8.6	9	108	14	45.5	18	Rc1/8	14	14	90	24	60	80	9×14×12	20	2 000	61 500	117 000	3 900	1 530	8 200	1 280	6 900	4.0	15.8

Note: Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface.
To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.

A-5-2 Liquid Crystal Display and Semiconductor

A-5-2.1 PU Series (Miniature type)



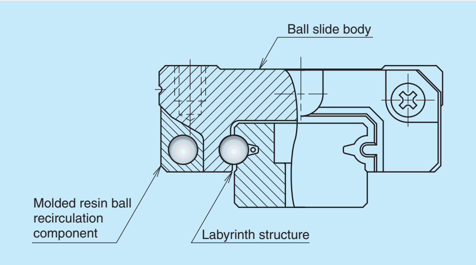


Fig. 1

1. Features

(1) Motion performance

Newly designed recirculation component facilitates smooth circulation of steel balls.

(2) Lightweight

The ball slide is fabricated to be approximately 20% lighter than LU Series by the application of resin to a part of its body.

(3) Reduced noise intensity

Resin components applied in ball circulating circuits reduce collision noise between steel balls and the inner wall of circulating circuits.

(4) Low dust generation

The structure is designed to prevent dust generation.

(5) Excellent dust-proofing

It is designed to minimize the clearance between the side of rails and the inner walls of the slide, and prevent foreign matters from entering the ball slide.

(6) High corrosion resistance

High corrosion-resistant martensite stainless steel is incorporated as a standard feature to provides excellent corrosion resistance.

(7) Easy to handle

Safety design includes a retainer that prevents steel balls from dropping out of the ball slide even when the slide is removed from the rail.

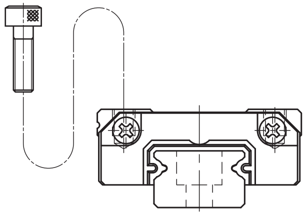
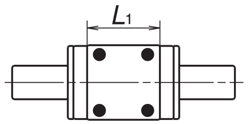
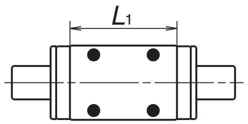
(8) Long-term maintenance-free

Superb features of NSK K1 Lubrication unit realize a long-term, maintenance-free operation.

(9) Fast delivery

Lineup of random-matching rails and ball slides facilitates fast delivery. (PU09 to PU15)

2. Ball slide shape

Ball slide Model	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		Standard type	High-load type
		Standard	Long
AR TR AL UR BL BR		TR, AR, AL 	UR, BL, BR 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm)		Preloaded assembly type (not random matching)				Random-matching type
		Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC
over	or less					
–	50	2	2	4.5	6	6
50	80	2	3	5	6	6
80	125	2	3.5	5.5	6.5	6.5
125	200	2	4	6	7	7
200	250	2.5	5	7	8	8
250	315	2.5	5	8	9	9
315	400	3	6	9	11	11
400	500	3	6	10	12	12
500	630	3.5	7	12	14	14
630	800	4.5	8	14	16	16
800	1 000	5	9	16	18	18
1 000	1 250	6	10	17	20	20

(2) Accuracy standard

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

Table 2 shows the accuracy standard for the preloaded assembly type while **Table 3** shows the accuracy standard for the random-matching types.

- **Tolerance of preloaded assembly**

Table 2

Unit: μm

Accuracy grade / Characteristics	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height *H* Variation of *H* (All ball slides on a set of rails)	±10 5	±15 7	±20 15	±40 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±15 7	±20 10	±30 20	±50 30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in **Table 1** and **Fig. 2**			

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

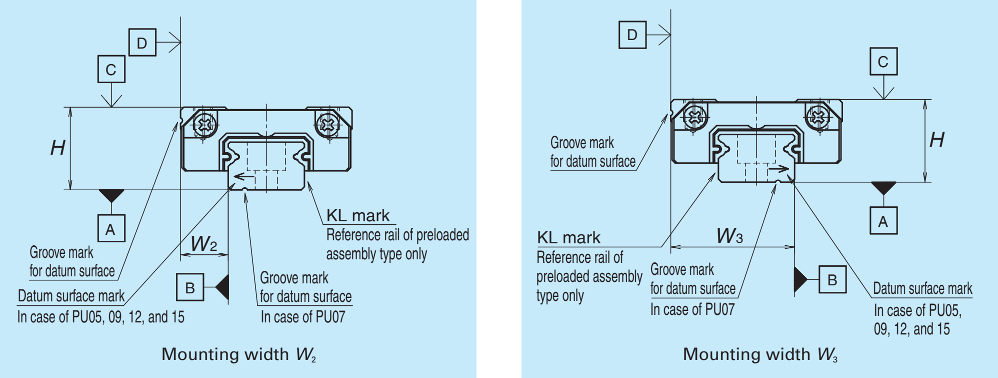
Table 3

Unit: μm

Model No. / Characteristics	PU09, 12 and 15
Mounting height *H*	±20
Variation of mounting height *H*	15① 30②
Mounting width W_2 or W_3	±20
Variation of mounting width W_2 or W_3	20
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in **Table 1** and **Fig. 2**

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

(3) Assembled accuracy



Mounting width W_2

Mounting width W_3

Fig. 2

Note: Please refer to page A67 for marks on the datum surfaces.

(4) Preload and rigidity

We offer three levels of preload: Slight preload Z1 and Fine clearance Z0 for preloaded assembly type, along with Fine clearance ZT for random-matching type. Values for preload and rigidity of the preloaded assembly type are shown in **Table 4**. Rigidities are for the median of the preload range.

- **Preload and rigidity of preloaded assembly**

Table 4

Model No.		Preload (N)	Rigidity (N/μm)
		Slight preload (Z1)	Slight preload (Z1)
Standard type	PU05TR	0 – 3	17
	PU07AR	0 – 8	22
	PU09TR	0 – 10	30
	PU12TR	0 – 17	33
	PU15AL	0 – 33	45
High-load type	PU09UR	0 – 14	46
	PU12UR	0 – 25	52
	PU15BL	0 – 51	75

Note: Clearance of Fine clearance Z0 is 0 to 3 μm. Therefore, preload is zero.

- **Clearance of random-matching type**

Table 5

Unit: μm

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

4. Maximum rail length

Table 6 shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grade.

Table 6 Length limitations of rails

Unit: mm

Series	Size / Material	05	07	09	12	15
PU	Stainless steel	210	375	600	800	1 000

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

5. Installation

(1) Permissible values of mounting error

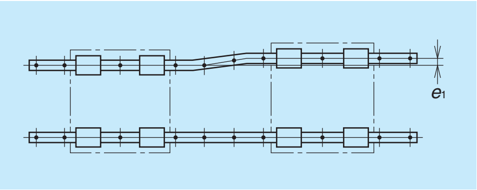


Fig. 3

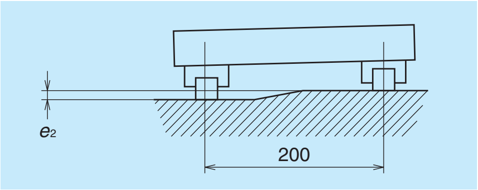


Fig. 4

Table 7

Unit: μm

Value	Preload	Model No.				
		PU05	PU07	PU09	PU12	PU15
Permissible values of parallelism in two rails e_1	Z0, ZT	10	12	15	20	25
	Z1	7	10	13	15	21
Permissible values of parallelism (height) in two rails e_2	Z0, ZT	150 μm/200 mm				
	Z1	90 μm/200 mm				

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

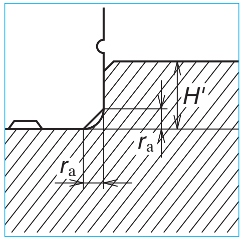


Fig. 5 Shoulder for the rail datum surface

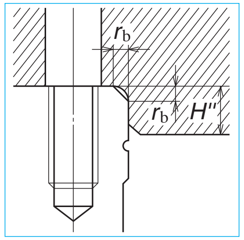


Fig. 6 Shoulder for the ball slide datum surface

Table 8

Unit: mm

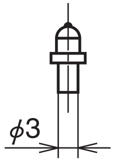
Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H′	H″*
PU05	0.2	0.2	0.7	2.3
PU07	0.2	0.3	1.2	2.5
PU09	0.3	0.3	1.9	2.6
PU12	0.3	0.3	2.5	3.4
PU15	0.3	0.5	3.5	4.4

*) H″ is the minimum recommended value based on the dimension T in dimension table.

6. Lubrication accessory

Model of PU15 can select drive-in type grease fitting as an option.

For the models of PU05 to PU12, apply grease directly to the ball grooves of rail using a point nozzle.



Drive-in type

7. Dust-proof components

(1) Standard specification

An end seal provided to both ends of a ball slide as a standard feature.

Seal friction per standard ball slide is shown in **Table 9**.

Table 9 Seal friction per ball slide (maximum value)

Unit: N

Series \ Size	05	07	09	12	15
PU	0.3	0.3	0.5	0.5	0.5

(2) NSK K1™ lubrication unit

Table 10 shows the dimension of linear guides equipped with the NSK K1 lubrication unit.

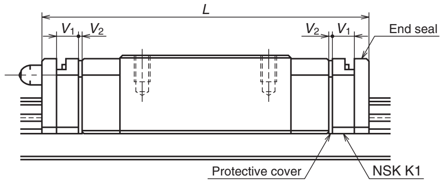


Table 10

Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length equipped with two NSK K1 L	Thickness of NSK K1, V_1	Thickness of protective cover, V_2
PU05	Standard	TR	19.4	24.4	2	0.5
PU07	Standard	AR	23.4	29.4	2.5	0.5
PU09	Standard	TR	30	36.4	2.7	0.5
	Long	UR	41	47.4		
PU12	Standard	TR	35	42	3	0.5
	Long	UR	48.7	55.7		
PU15	Standard	AL	43	51.2	3.5	0.6
	Long	BL	61	69..2		

Note: Ball slide length equipped with NSK K1 =
(Standard ball slide length) + (Thickness of NSK K1, $V_1 \times$ 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

PU 15 0470 AL K 2 - P5 1**

Series name

Size

Rail length (mm)

Ball slide shape code (See page A252.)

Material/surface treatment code (See Table 11.)
K: Stainless steel

Preload code (See page A254.)
0: Z0, 1: Z1

Accuracy code (See Table 12.)

Design serial number
Added to the reference number.

Number of ball slides per rail

(2) Reference number for random-matching type

Ball slide

PAU 15 AL S -K

Random-matching ball slide series code
PAU: PU Series random-matching ball slide

Size

Ball slide shape code (See page A252.)

Option code
-K: Equipped with NSK K1

Material code
S: Stainless steel

Rail

P1U 15 0470 R K N - PC T**

Random-matching rail series code
P1U: PU Series random-matching rail

Size

Rail length (mm)

Rail shape code
S: PU09, 12. R: PU15

Material/surface treatment code (See Table 11.)

Preload code (See page A254.)
T: Fine clearance

Accuracy code: PC
PC: Normal grade is only available.

Design serial number
Added to the reference number.

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

*Please consult with NSK for butting rail specification.

The reference number coding for the assembly of random-matching type is the same as that of preloaded assembly. However, only preload code of "fine clearance T" is available (refer to page A254).

Table 11 Material/surface treatment code

Code	Description
K	Stainless steel
H	Stainless steel with surface treatment
Z	Other, special

Table 12 Accuracy code

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

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

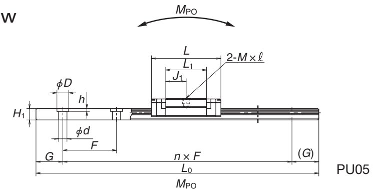
9. Dimensions

PU-TR, AR, AL (Standard type / Standard)
PU-UR, BL (High-load type / Long)

PU 15 0470 AL K 2 -✻✻ PC T

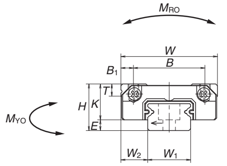
Series name
Size
Rail length (mm)
Ball slide shape code (See page A252.)
Material/surface treatment code (See Table 11.)
K: Stainless steel
Preload code (See page A254.)
0: Z0, 1: Z1, T: ZT
Accuracy code (See Table 21.)
Design serial number
Added to the reference number.
Number of ball slides per rail

Side view

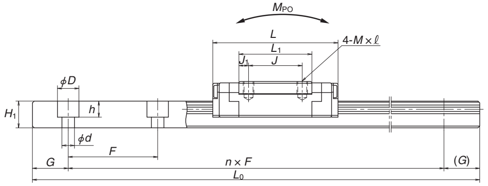


PU05

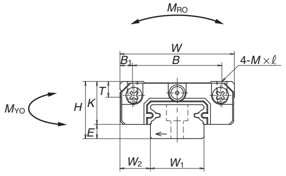
Front view



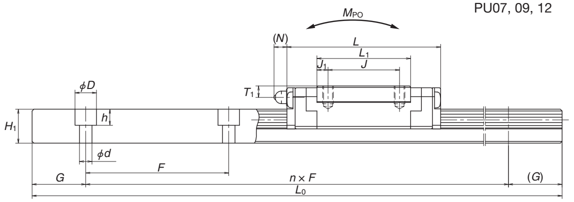
PU05, 07, 09, 12



PU07, 09, 12



PU15

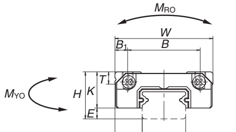


PU15

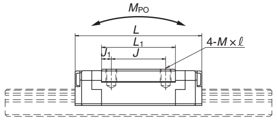
Reference number for ball slide of random-matching type

PAU 15 AL S -K

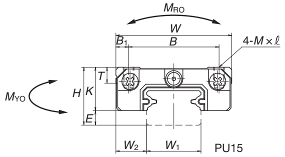
Random-matching ball slide series code
PAU: PU Series random-matching ball slide
Size
Ball slide shape code (See page A252.)
Option code
-K: Equipped with NSK K1
Material code
S: Stainless steel



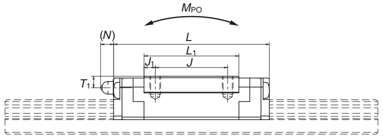
PU09, 12



PU09, 12



PU15



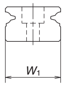
PU15

Reference number for rail of random-matching type

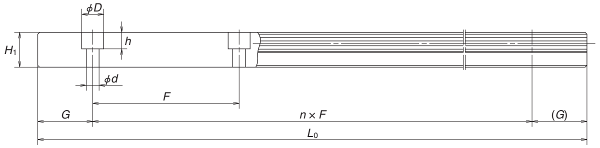
Rail P1U 15 0470 R K N -✻✻ PC T

Random-matching rail series code
P1U: PU Series random-matching rail
Size
Rail length (mm)
Rail shape code
S: PU09, 12. R: PU15
Material/surface treatment code (See Table 11.)
Preload code (See page A254.)
T: Fine clearance
Accuracy code: PC
PC: Normal grade is only available.
Design serial number
Added to the reference number.
*Butting rail specification
N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.



PU09,12,15



Unit: mm

Model No.	Assembly			Ball slide													Rail						Basic load rating							Weight	
	Height			Width	Length	Mounting hole								Oil hole			Width	Height	Pitch	Mounting bolt hole	G	Maximum length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
														Hole size									C	C_0	M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	M×Pitch×ℓ	B_1	L_1	J_1	K	T		T_1	N	W_1	H_1	F	d×D×h	(Reference)	L_{0max}	(N)	(N)		One slide	Two slides	One slide	Two slides	(g)	(g/100 mm)
PU05TR	6	1	3.5	12	19.4	8	—	M2×0.4×1.5	2	11.4	5.7	5	2.3	ϕ0.9	1.5	—	5	3.2	15	2.3×3.3×0.8	5	210	520	775	2.06	1.28	9.90	1.28	9.90	4	11
PU07AR	8	1.5	5	17	23.4	12	8	M2×0.4×2.4	2.5	13.3	2.65	6.5	2.45	ϕ1.5	1.8	—	7	4.7	15	2.4×4.2×2.3	5	375	1 090	1 370	5.20	2.70	21.8	2.70	21.8	8	23
PU09TR	10	2.2	5.5	20	30	15	10	M3×0.5×3	2.5	19.6	4.8	7.8	2.6	—	—	—	9	5.5	20	3.5×6×4.5	7.5	600	1 490	2 150	9.90	6.10	41.0	6.10	41.0	16	35
PU09UR					41		16			30.6	7.3												2 100	3 500	16.2	15.6	88.0	15.6	88.0	25	
PU12TR	13	3	7.5	27	35	20	15	M3×0.5×3.5	3.5	20.4	2.7	10	3.4	—	—	—	12	7.5	25	3.5×6×4.5	10	800	2 830	3 500	21.1	11.4	73.5	11.4	73.5	32	65
PU12UR					48.7		20			34.1	7.05												4 000	5 700	34.5	28.3	174	28.3	174	53	
PU15AL	16	4	8.5	32	43	25	20	M3×0.5×5	3.5	26.2	3.1	12	4.4	ϕ3	3.2	(3.6)	15	9.5	40	3.5×6×4.5	15	1 000	5 550	6 600	49.5	25.6	190	25.6	190	59	105
PU15BL					61		25			44.2	9.6												8 100	11 300	84.5	69.5	435	69.5	435	100	

Notes: 1) The ball slide of PU05TR has only two mounting tap holes in the center.

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

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

A-5-2.2 LU Series (Miniature type)

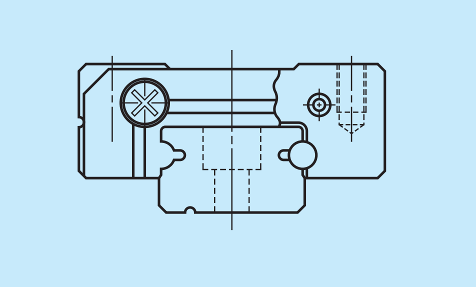


Fig. 1 LU Series

1. Features

(1) Super-small type

This compact guide owes its design to the single ball groove on both right and left sides (Gothic arch) .

(2) Equal load carrying capacity in vertical and lateral directions

The contact angle is set at 45 degrees, thus facilitating the equal load carrying capacity in vertical and lateral directions. This also provides equal rigidity in both directions.

(3) Stainless steel is also standardized

Items made of the martensitic stainless steel are available as standard.

(4) Some series have a ball retainer

Ball slide types AR and TR come with a ball retainer. Balls are retained in the retainer and do not fall out when the ball slide is withdrawn from the rail. (Ball slides of random-matching type as well as LU15 come with ball retainer.)

(5) Fast delivery

Random-matching of rails and ball slides are available. (LU09 to LU15)

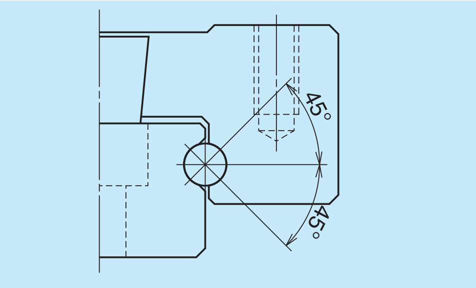
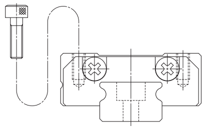
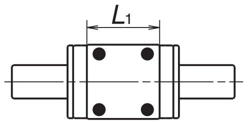
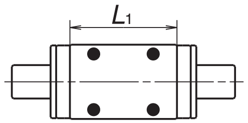


Fig. 2 Balls are in contact.

2. Ball slide shape

Ball slide Model	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		Standard type	High-load type
		Standard	Long
AL TL AR TR BL UL		AL, TL, TR, AR 	BL, UL 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm)		Preloaded assembly type (not random matching)				Random-matching type
		Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC
over	or less					
–	50	2	2	4.5	6	6
50	80	2	3	5	6	6
80	125	2	3.5	5.5	6.5	6.5
125	200	2	4	6	7	7
200	250	2.5	5	7	8	8
250	315	2.5	5	8	9	9
315	400	3	6	9	11	11
400	500	3	6	10	12	12
500	630	3.5	7	12	14	14
630	800	4.5	8	14	16	16
800	1000	5	9	16	18	18
1000	1250	6	10	17	20	20

(2) Accuracy standard

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

Table 2 shows the accuracy standard for the preloaded assembly type, while **Table 3** shows the accuracy standard for the random-matching type.

- **Tolerance of preloaded assembly**

Table 2

Unit: μm

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

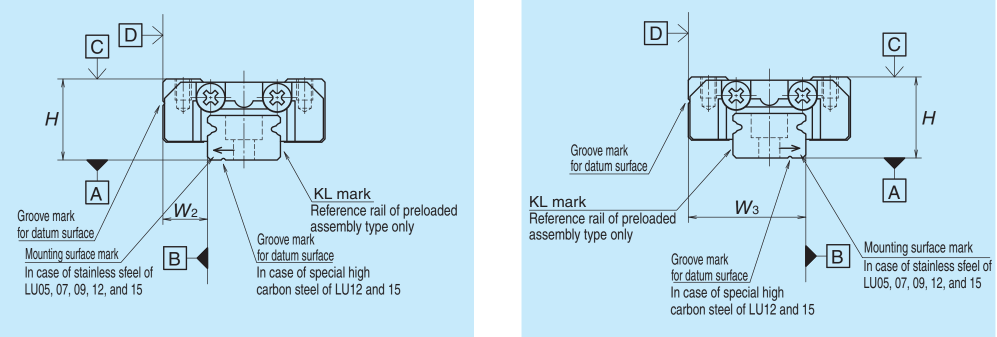
- **Tolerance of random-matching type: Normal grade PC**

Table 3

Unit: μm

Characteristics \ Accuracy grade	LU09, 12, 15
Mounting height *H*	±20
Variation of mounting height *H*	40
Mounting width W_2 or W_3	±20
Variation of mounting width W_2 or W_3	40
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Refer to **Table 1** and **Fig. 3**

(3) Assembled accuracy



Mounting width W_2

Mounting width W_3

Fig. 3

Note: Please refer to page A67 for marks on the datum surfaces.

(4) Preload and rigidity

We offer three levels of preload: Slight preload Z1 and Fine clearance Z0, along with random-matching type of Fine clearance ZT. Values for preload and rigidity of the preloaded assembly type are shown in **Table 4**. Rigidities are for the median of the preload range.

- **Preload and rigidity of preloaded assembly**

Table 4

Model No.		Preload (N)	Rigidity (N/μm)
		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 μm. Therefore, preload is zero. However, the clearance of the Z0 of PN grade is 3 to 10 μm.

- **Clearance of random-matching type**

Table 5

Unit: μm

Model No.	Fine clearance ZT
LU09	0 – 15
LU12	
LU15	

4. Maximum rail length

Table 6 shows the limitations of rail length.

However, the limitations vary by accuracy grades.

Table 6 Length limitation of rails

Unit: mm

Series	Material \ Size	05	07	09	12	15
LU	Special high carbon steel	–	–	1 200	1 800	2 000
	Stainless steel	210	375	600	800	1 000

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

5. Installation

(1) Permissible values of mounting error

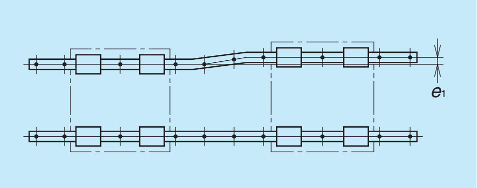


Fig. 4

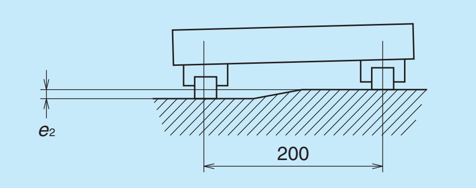


Fig. 5

Table 7 Unit: μm

Value	Preload	Model No.				
		LU05	LU07	LU09	LU12	LU15
Permissible values of parallelism in two rails e_1	Z0, ZT	10	12	15	20	25
	Z1	7	10	13	15	21
Permissible values of parallelism (height) in two rails e_2	Z0, ZT	150 μm/200 mm				
	Z1	90 μm/200 mm				

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

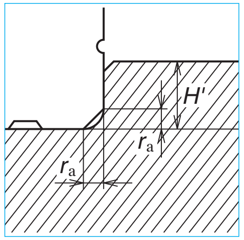


Fig. 6 Shoulder for the rail datum surface

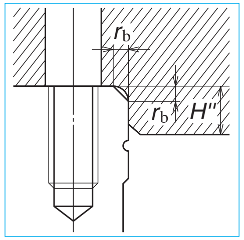


Fig. 7 Shoulder for the ball slide datum surface

Table 8 Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
LU05	0.2	0.2	0.7	2
LU07	0.2	0.3	1.2	3
LU09	0.3	0.3	1.9	3
LU12	0.3	0.3	2.5	4
LU15	0.3	0.5	3.5	5

6. Lubrication accessories

There is no standard grease fitting for LU05 to LU15.

For the LU Series, apply grease directly to the ball grooves of rail using a point nozzle.

7. Dust-proof components

(1) Standard specification

End seal: Provided to both ends of the ball slide as a standard feature.

LU05TL, LU07AL, LU09AL, and LU09TL can install the side seal as an option.

- Seal friction per standard ball slide is shown in **Table 9**.

Table 9 Seal friction per ball slide (maximum value)

Unit: N

Series \ Size	05	07	09	12	15
LU	0.3	0.3	0.5	0.5	0.5

(2) NSK K1™ lubrication unit

The installed dimensions of the NSK K1 lubrication unit are shown in **Table 10**.

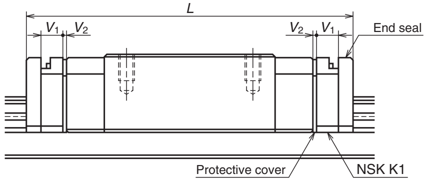


Table 10 Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_1	Protective cover thickness V_2
LU05	Standard	TL	18*	24.4	2.0	0.5
LU07	Standard	AL	20.4*	29.4	2.5	0.5
LU09	Standard	AR, TR	30	36.4	2.7	0.5
	Standard	AL, TL	26.8*	34.2		
	Long	BL, UL	41	47.4		
LU12	Standard	AR, TR	35.2	42.2	3.0	0.5
	Standard	AL, TL	34	41		
	Long	BL, UL	47.5	54.5		
LU15	Standard	AL	43.6	51.8	3.5	0.6
	Long	BL	61	69.2		

*) Standard ball slide length of LU05TL, LU07AL, LU09AL and LU09TL does not include the thickness of the end seal (1.5 mm). However, it includes the height of the screw head for end cap installation (Included length – LU05, 0.8 mm; LU07, no projection; LU09, 1 mm)

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

8. Reference number

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

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

(1) Reference number for preloaded assembly

LU 12 0270 AR K 2 - P5 1**

Series name

Size

Rail length (mm)

Ball slide shape code (See page A262.)

Material/surface treatment code (See Table 11.)

C: Special high carbon steel (NSK standard), K: Stainless steel

Preload code (See page A264.)

0: Z0, 1: Z1

Accuracy code (See Table 12.)

Design serial number

Added to the reference number.

Number of ball slides per rail

(2) Reference number for random-matching type

Ball slide

LAU 12 AR S -K

Random-matching ball slide series code

LAU: LU Series random-matching ball slide

Size

Ball slide shape code (See page A262.)

Option code

-K: Equipped with NSK K1

Material code

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

Rail

L1U 12 0270 R K N - PC T**

Random-matching rail series code

L1U: LU Series random-matching rail

Size

Rail length (mm)

Rail shape code

L: Standard. R: LU09 and LU12 standard, equipped with ball retainer.
S: LU09 and LU12 with ball retainer and mounting holes for M3
T: LU09 and LU12 without ball retainer and mounting holes for M3

Material/surface treatment code (See Table 11.)

Preload code (See page A264.)

T: Fine clearance

Accuracy code: PC

PC: Normal grade is only available.

Design serial number

Added to the reference number.

*Butting rail specification

N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.

The reference number coding for the assembly of random-matching type is the same as that of the preloaded assembly. However, only the preload code of "Fine clearance T" is available (refer to page A264).

Table 11 Material/surface treatment code

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

Table 12 Accuracy code

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

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

9. Dimensions

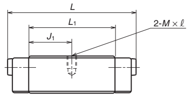
LU-AL (Standard type / Standard, LU15 is equipped with ball retainer)
LU-TL (Standard type / Standard, Large mounting hole)
LU-AR (Standard type / Standard, With ball retainer)
LU-TR (Standard type / Standard, Large mounting hole, with ball retainer)

LU 12 0270 AR K 2 - PC T**

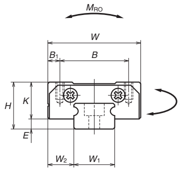
- LU: Series name
- 12: Size
- 0270: Rail length (mm)
- AR: Ball slide shape code (See page A262.)
- K: Material/surface treatment code (See Table 11.)
  C: Special high carbon steel (NSK standard), K: Stainless steel
- 2: Number of ball slides per rail
- -**: Design serial number
  Added to the reference number.
- PC: Accuracy code (See Table 12.)
- T: Preload code (See page A254.)
  0: Z0, 1: Z1, T: ZT

Front view

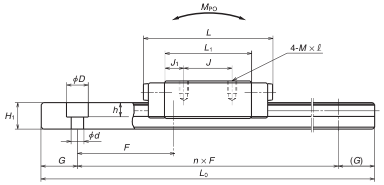
Side view



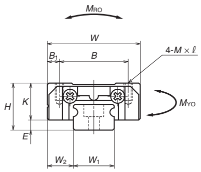
LU05TL



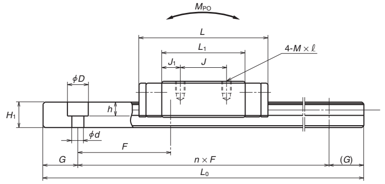
LU05TL, LU07AL
LU09AL, TL



LU07AL
LU09AL, TL



LU09AR, TR
LU12AL, TL, AR, TR
LU15AL



LU09AR, TR
LU12AL, TL, AR, TR
LU15AL

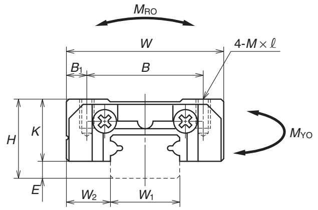
Reference number for ball slide of random-matching type

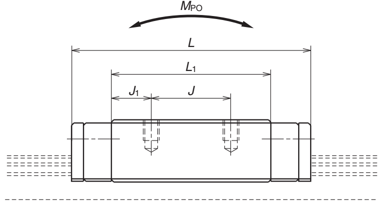
Random matching with retainer: LU09 - 12 are AR/TR, LU15 is AL.

LAU-AR (With ball retainer)
LAU-TR (Large mounting hole, with ball retainer)
LAU-AL (LU15 is equipped with ball retainer)

LAU 12 AR S -K

- LAU: Random-matching ball slide series code
  LAU: LU Series random-matching ball slide
- 12: Size
- AR: Ball slide shape code (See page A262.)
- S: Material code
  No code: Special high carbon steel (NSK standard), S: Stainless steel
- -K: Option code
  -K: Equipped with NSK K1



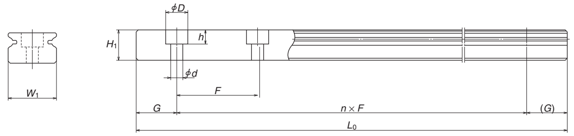


Reference number for rail of random-matching type

L1U 12 0270 R K N - PC T**

- L1U: Random-matching rail series code
  L1U: LU Series random-matching rail
- 12: Size
- 0270: Rail length (mm)
- R: Rail shape code
  L: Standard. R:LU09 and LU12 standard equipped with ball retainer.
  S: LU09 and LU12 with ball retainer and mounting holes for M3
  T: LU09 and LU12 without ball retainer and mounting holes for M3
- K: Material/surface treatment code (See Table 11.)
- N: *Butting rail specification
  N: Non-butting. L: Butting specification
- -**: Design serial number
  Added to the reference number.
- PC: Accuracy code: PC
  PC: Normal grade is only available.
- T: Preload code (See page A264.)
  T: Fine clearance

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide									Rail						Basic load rating							Weight	
	Height			Width	Length	Mounting hole							Width	Height	Pitch	Mounting bolt hole	G	Max. length L_{0MAX}. ( ) for stainless	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
	H	E	W_2	W	L	B	J	M×pitch×ℓ	B_1	L_1	J_1	K	W_1	H_1	F	d×D×h	(Reference)		C (N)	C_0 (N)	M_{RO}	M_{PO}		M_{YO}		(g)	(g/100 mm)
																						One slide	Two slides	One slide	Two slides		
LU05TL	6	1	3.5	12	18	8	—	M2×0.4×1.5	2	12	6	5	5	3.2	15	2.3×3.3×1.5	5	— (210)	545	740	1.93	1.22	8.85	1.22	8.85	4	11
LU07AL	8	1.5	5	17	20.4	12	8	M2×0.4×2.4	2.5	13.6	2.8	6.5	7	4.7	15	2.4×4.2×2.3	5	— (375)	1 090	1 370	4.90	2.66	18.6	2.66	18.6	10	23
LU09AL LU09TL	10	2.2	5.5	20	26.8	15	13 10	M2×0.4×2.5 M3×0.5×3	2.5	18	2.5 4	7.8	9	5.5	20	2.6×4.5×3 3.5×6×4.5	7.5	1 200 (600)	1 760	2 220	10.2	6.10	38.5	6.10	38.5	17	35
LU09AR LU09TR	10	2.2	5.5	20	30	15	13 10	M2×0.4×2.5 M3×0.5×3	2.5	20	3.5 5	7.8	9	5.5	20	2.6×4.5×3 3.5×6×4.5	7.5	— (600)	1 490	2 150	9.9	6.10	41.0	6.10	41.0	19	35
LU12AL LU12TL	13	3	7.5	27	34	20	15	M2.5×0.45×3 M3×0.5×3.5	3.5	21.8	3.4	10	12	7.5	25	3×5.5×3.5 3.5×6×4.5	10	1 800 (800)	2 830	3 500	21.1	11.4	78.5	11.4	78.5	38	65
LU12AR LU12TR	13	3	7.5	27	35.2	20	15	M2.5×0.45×3 M3×0.5×3.5	3.5	21.8	3.4	10	12	7.5	25	3×5.5×3.5 3.5×6×4.5	10	— (800)	2 830	3 500	21.1	11.4	81.5	11.4	81.5	38	65
LU15AL	16	4	8.5	32	43.6	25	20	M3×0.5×4	3.5	27	3.5	12	15	9.5	40	3.5×6×4.5	15	2 000 (1 000)	5 550	6 600	49.5	25.6	193	25.6	193	70	105

Notes 1) LU05TL, LU07AL, LU09TL, LU09AR, LU09TR, LU12AR and LU12TR come in stainless steel only.
2) Ball slide of LU05TL has only two mounting tap holes in the center.
3) End seals of LU05TL, LU07AL, LU09AL and LU09TL are available on request.

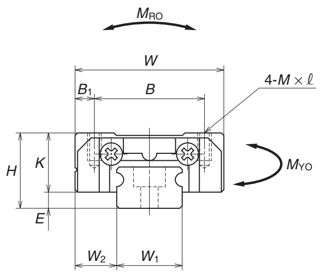
4) To fix rail of LU05TL, use M2 × 0.4 cross-recessed pan head machine screw for precision instrument.
(JCIS 10-70 No. 0 pan head machine screw No.1.)
(JCIS: Japanese Camera Industrial Standard.)
5) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.

LU-BL (High-load type / Long)
LU-UL (High-load type / Long, large mounting hole)

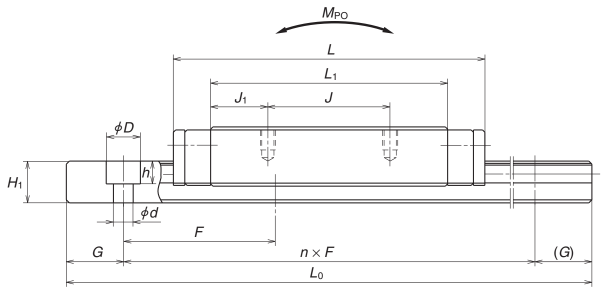
LU 12 0270 BL K 2 -＊＊ P5 1

Series name: LU
Size: 12
Rail length (mm): 0270
Ball slide shape code (See page A262.): BL
Material/surface treatment code (See Table 11.): K
C: Special high carbon steel (NSK standard), K: Stainless steel
Number of ball slides per rail: 2
Design serial number: -＊＊
Added to the reference number.
Accuracy code (See Table 12.): P5
Preload code (See page A254.): 1
0: Z0, 1: Z1

Front view



Side view



Unit: mm

Model No.	Assembly			Ball slide											Rail				Basic load rating							Weight	
	Height			Width	Length	Mounting hole							Width	Height	Pitch	Mounting bolt hole	G	Max. length L_{0MAX}. ( ) for stainless	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
																			C	C_0	M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	M×pitch×ℓ	B_1	L_1	J_1	K	W_1	H_1	F	d×D×h	(Reference)		(N)	(N)		One slide	Two slides	One slide	Two slides	(g)	(g/100 mm)
LU09BL **LU09UL**	10	2.2	5.5	20	41	15	16	M2×0.4×2.5 M3×0.5×3	2.5	31.2	7.6	7.8	9	5.5	20	2.6×4.5×3 3.5×6×4.5	7.5	1 200 (600)	2 600	3 900	17.9	17.2	98.0	17.2	98.0	29	35
LU12BL **LU12UL**	13	3	7.5	27	47.5	20	20	M2.5×0.45×3 M3×0.5×3.5	3.5	35.3	7.65	10	12	7.5	25	3×5.5×3.5 3.5×6×4.5	10	1 800 (800)	4 000	5 700	34.5	28.3	169	28.3	169	59	65
LU15BL	16	4	8.5	32	61	25	25	M3×0.5×4	3.5	44.4	9.7	12	15	9.5	40	3.5×6×4.5	15	2 000 (1 000)	8 100	11 300	84.5	69.5	435	69.5	435	107	105

Notes 1) LU09UL is available only in stainless steel.
2) LU15BL is equipped with ball retainer.

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

A-5-2.3 PE Series (Miniature wide type)

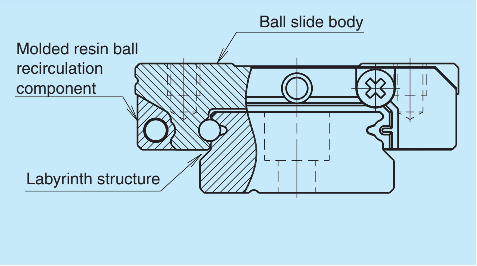


Fig. 1

1. Features

(1) Ideal for use of single rail

The PE Series linear guides are miniature and wide rail type. Thanks to the wide rail, load carrying capacity is high against moment load from rolling direction.

(2) Motion performance

Newly designed recirculation component facilitates smooth circulation of steel balls.

(3) Lightweight

The ball slide is fabricated to be approximately 20% lighter than that of the LE Series by the application of resin to a part of its body.

(4) Reduced noise intensity

Resin components applied in ball circulating circuits reduce collision noise between steel balls and the inner wall of circulating circuits.

(5) Low dust generation

The structure is designed to prevent dust generation.

(6) Excellent dust-proofing

It is designed to minimize the clearance between the side of rails and the inner walls of the slide, and prevent foreign matters from entering the ball slide.

(7) High corrosion resistance

High corrosion-resistant martensite stainless steel incorporated as a standard feature provides excellent resistance to corrosion.

(8) Easy to handle

Safety design includes a retainer that prevents steel balls from dropping out of the ball slide even when the slide is removed from the rail.

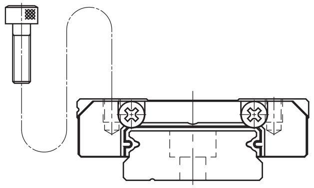
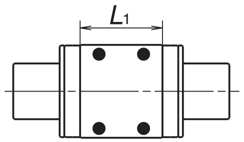
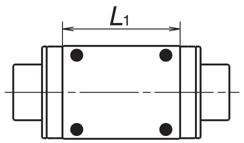
(9) Long-term maintenance-free

Equipped with NSK K1 Lubrication Unit realizes long-term, maintenance-free use.

(10) Fast delivery

Lineup of random-matching rails and ball slides in the series supports random matching and facilitates fast delivery. (PE09 to PE15)

2. Ball slide shape

Ball slide Model	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)	
		Standard type	High-load type
		Standard	Long
AR TR UR BR		AR, TR 	UR, BR 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm)		Preloaded assembly type (not random matching)				Random-matching type
over	or less	Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC
–	50	2	2	4.5	6	6
50	80	2	3	5	6	6
80	125	2	3.5	5.5	6.5	6.5
125	200	2	4	6	7	7
200	250	2.5	5	7	8	8
250	315	2.5	5	8	9	9
315	400	3	6	9	11	11
400	500	3	6	10	12	12
500	630	3.5	7	12	14	14
630	800	4.5	8	14	16	16
800	1 000	5	9	16	18	18
1 000	1 250	6	10	17	20	20

(2) Accuracy standard

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

Table 2 shows the accuracy standard for the preloaded assembly type while **Table 3** shows the accuracy standard for the random-matching types.

- **Tolerance of preloaded assembly**

Table 2

Unit: μm

Characteristics \ Accuracy grade	Super precision P4	High precision P5	Precision grade P6	Normal grade PN
Mounting height *H* Variation of *H* (All ball slides on a set of rails)	±10 5	±15 7	±20 15	±40 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±15 7	±20 10	±30 20	±50 30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in **Table 1** and **Fig. 2**			

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

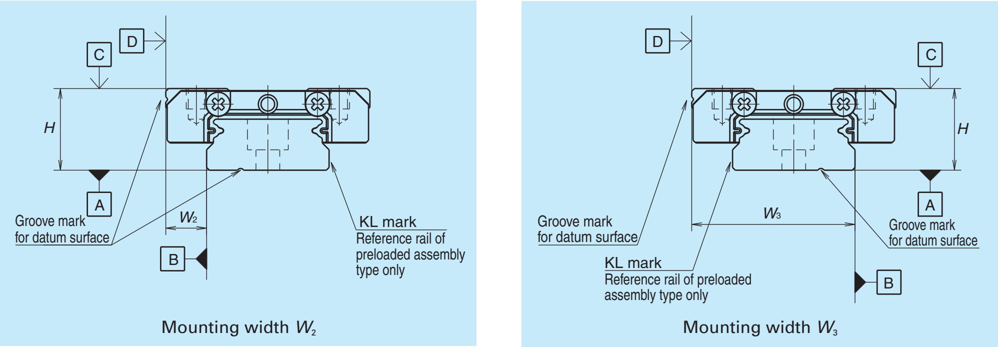
Table 3

Unit: μm

Characteristics \ Model No.	PE09, 12 and 15
Mounting height *H*	±20
Variation of mounting height *H*	15① 30②
Mounting width W_2 or W_3	±20
Variation of mounting width W_2 or W_3	20
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in **Table 1** and **Fig. 2**

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

(3) Assembled accuracy



Mounting width W_2 Mounting width W_3

Fig. 2

(4) Preload and rigidity

We offer three levels of preload: Slight preload Z1 and Fine clearance Z0, along with random-matching type of Fine clearance ZT. Values for preload and rigidity of the preloaded assembly types are shown in **Table 4**. Rigidities are for the median of the preload range.

- **Preload and rigidity of preloaded assembly**

Table 4

	Model No.	Preload (N) Slight preload (Z1)	Rigidity (N/μm) Slight preload (Z1)
Standard type	PE05AR	0 – 28	45
	PE07TR	0 – 29	46
	PE09TR	0 – 37	61
	PE12AR	0 – 40	63
	PE15AR	0 – 49	66
High-load type	PE09UR	0 – 54	86
	PE12BR	0 – 59	97
	PE15BR	0 – 75	114

Note: Clearance of Fine clearance Z0 is 0 to 3 μm. Therefore, preload is zero.

- **Clearance of random-matching type**

Table 5

Unit: μm

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

4. Maximum rail length

Table 6 shows the limitations of rail length.

However, the limitations vary by accuracy grades.

Table 6 Length limitations of rails

Unit: mm

Series	Material \ Size	05	07	09	12	15
PE	Stainless steel	150	600	800	1 000	1 200

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

5. Installation

(1) Permissible values of mounting error

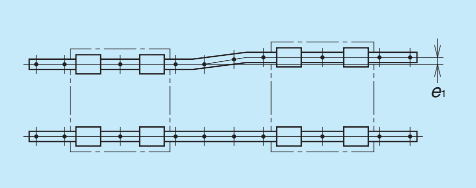


Fig. 3

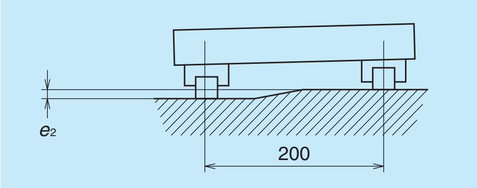


Fig. 4

Table 7 Unit: μm

Value	Preload	Model No.				
		PE05	PE07	PE09	PE12	PE15
Permissible values of parallelism in two rails e_1	Z0, ZT	10	12	15	18	22
	Z1	5	7	10	13	17
Permissible values of parallelism (height) in two rails e_2	Z0, ZT	50 μm/200 mm				
	Z1	35 μm/200 mm				

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

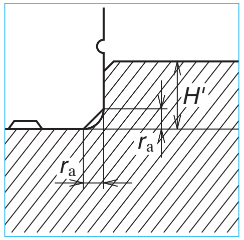


Fig. 5 Shoulder for the rail datum surface

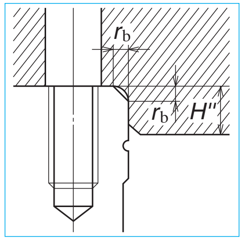


Fig. 6 Shoulder for the ball slide datum surface

Table 8 Unit: mm

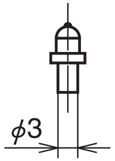
Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H′	H″*
PE05	0.2	0.2	1.1	2.5
PE07	0.2	0.3	1.7	3
PE09	0.3	0.3	3.5	2.8
PE12	0.3	0.3	3.5	3.2
PE15	0.3	0.5	3.5	4.1

*) H″ is the minimum recommended value based on the dimension T in dimension table.

6. Lubrication accessory

Model of PE15 can select drive-in type grease fitting as an option.

For the model of PE05 to PE12, apply grease directly to the ball grooves of rail using a point nozzle.



Drive-in type

7. Dust-proof components

(1) Standard specification

End seal: Provided to both ends of the ball slide as a standard feature.
Seal friction per standard ball slide is shown in **Table 9**.

Table 9 Seal friction per ball slide (maximum value) Unit: N

Series \ Size	05	07	09	12	15
PE	0.4	0.4	0.8	1	1.2

(2) NSK K1^{TM} lubrication unit

Table 10 shows the dimension of linear guides equipped with the NSK K1 lubrication unit.

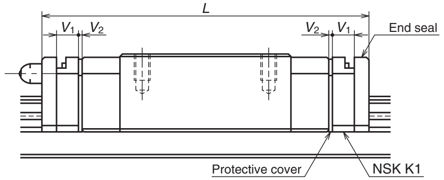


Table 10 Unit: mm

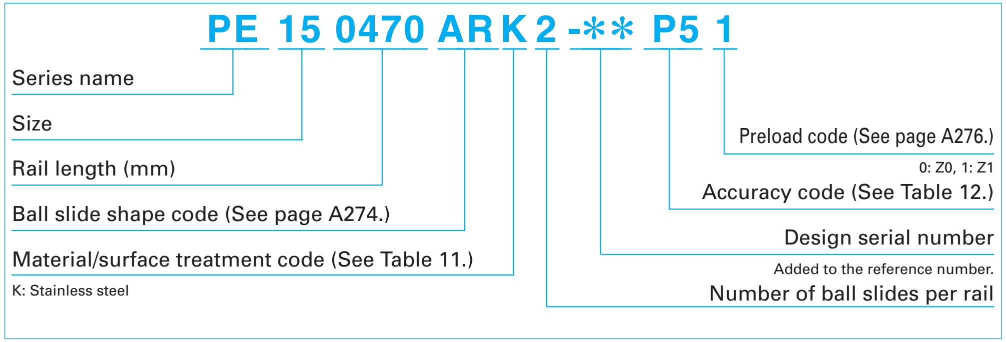
Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length equipped with two NSK K1 L	Thickness of NSK K1, V_1	Thickness of protective cover, V_2
PE05	Standard	AR	24.1	28.9	2	0.4
PE07	Standard	TR	31.1	37.1	2.5	0.5
PE09	Standard	TR	39.8	46.8	3	0.5
	Long	UR	51.2	58.2		
PE12	Standard	AR	45	53	3.5	0.5
	Long	BR	60	68		
PE15	Standard	AR	56.6	66.2	4	0.8
	Long	BR	76	85.6		

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

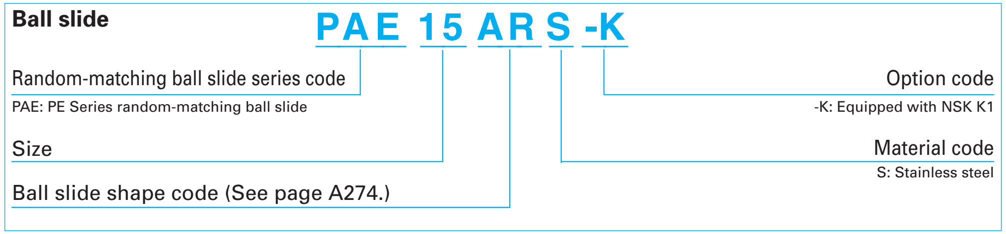
8. Reference number

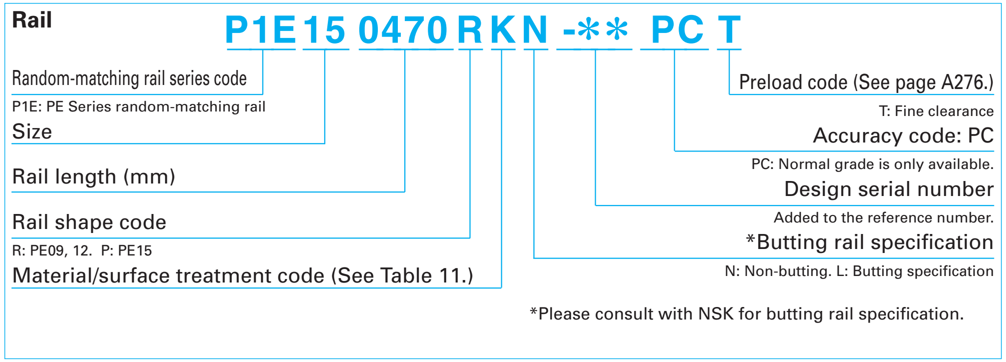
Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications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

(1) Reference number for preloaded assembly



(2) Reference number for random-matching type





Reference number coding for the assembly of random-matching type is the same as that of the preloaded assembly. However, only preload code of "Fine clearance T" is available (refer to page A276).

Table 11 Material/surface treatment code

Code	Description
K	Stainless steel
H	Stainless steel with surface treatment
Z	Other, special

Table 12 Accuracy code

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

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

9. Dimensions
PE-AR, TR (Standard type / Standard)
PE-UR, BR (High-load type / Long)

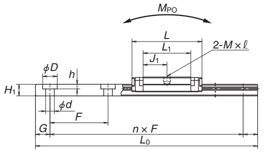
PE 15 0470 AR K 2 -＊＊ PC T

Series name
Size
Rail length (mm)
Ball slide shape code (See page A274.)
Material/surface treatment code (See Table 11.)
K: Stainless steel

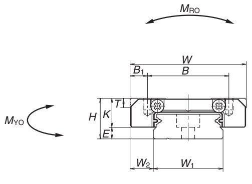
Preload code (See page A276.)
0: Z0, 1: Z1, T: ZT
Accuracy code (See Table 12.)
Design serial number
Added to the reference number.
Number of ball slides per rail

Front view

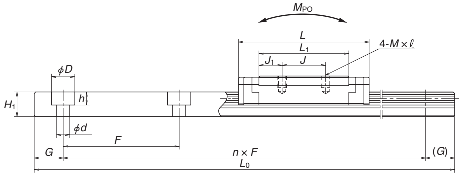
Side view



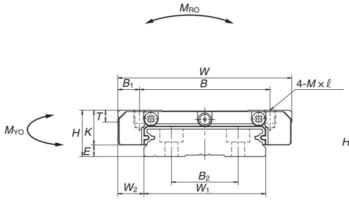
PE05



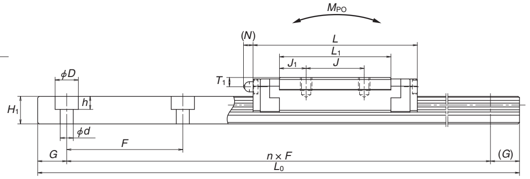
PE05, 07, 09, 12



PE07, 09, 12



PE15



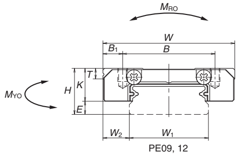
PE15

Reference number for ball slide of random-matching type

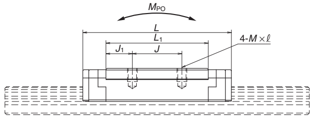
PAE 15 AR S -K

Random-matching ball slide series code
PAE: PE Series random-matching ball slide
Size
Ball slide shape code (See page A274.)

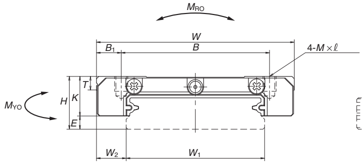
Option code
-K: Equipped with NSK K1
Material code
S: Stainless steel



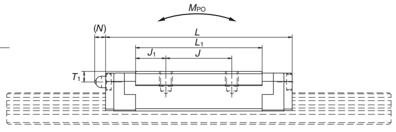
PE09, 12



PE09, 12



PE15



PE15

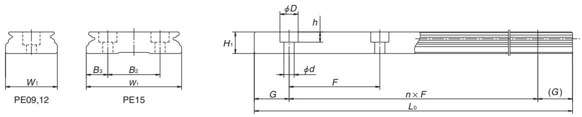
Reference number for rail of random-matching type

P1E 15 0470 R K N -＊＊ PC T

Random-matching rail series code
P1E: PE Series random-matching rail
Size
Rail length (mm)
Rail shape code
R: PE09, 12. P: PE15
Material/surface treatment code (See Table 11.)

Preload code (See page A276.)
T: Fine clearance
Accuracy code: PC
PC: Normal grade is only available.
Design serial number
Added to the reference number.
*Butting rail specification
N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.



Unit: mm

Model No.	Assembly			Ball slide														Rail							Basic load rating							Weight	
	Height			Width	Length	Mounting hole									Oil hole			Width	Height		Pitch	Mounting bolt hole	G	Maximum length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
	H	E	W_2	W	L	B	J	M×Pitch×ℓ	B_1	L_1	J_1	K	T		Hole size	T_1	N	W_1	H_1	B_2	F	d×D×h	(Reference)	L_{0max}	C (N)	C_0 (N)	M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	(g)	(g/100 mm)
PE05AR	6.5	1.4	3.5	17	24.1	13	—	M2.5×0.45×1.5	2	16.4	8.2	5.1	2.5		ϕ0.9	1.3	—	10	4	—	20	3×5×1.6	7.5	150	690	1 160	6.00	2.75	17.5	2.75	17.5	7	34
PE07TR	9	2	5.5	25	31.1	19	10	M3×0.5×2.8	3	20.8	5.4	7	3		ϕ1.9	1.9	—	14	5.2	—	30	3.5×6×3.2	10	600	1 580	2 350	16.7	7.20	46.0	7.20	46.0	19	55
PE09TR **PE09UR**	12	4	6	30	39.8 51.2	21 23	12 24	M3×0.5×3	4.5 3.5	26.6 38	7.3 7	8	2.8		ϕ2	2.3	—	18	7.5	—	30	3.5×6×4.5	10	800	3 000 4 000	4 500 6 700	36.5 54.5	17.3 37.5	113 210	17.3 37.5	113 210	35 50	95
PE12AR **PE12BR**	14	4	8	40	45 60	28	15 28	M3×0.5×4	6	31 46	8 9	10	3.2		ϕ2.5	2.7	—	24	8.5	—	40	4.5×8×4.5	15	1 000	4 350 5 800	6 350 9 550	70.5 106	29.3 63.5	180 345	29.3 63.5	180 345	66 98	140
PE15AR **PE15BR**	16	4	9	60	56.6 76	45	20 35	M4×0.7×4.5	7.5	38.4 57.8	9.2 11.4	12	4.1		ϕ3	3.2	(3.3)	42	9.5	23	40	4.5×8×4.5	15	1 200	7 600 10 300	10 400 16 000	207 320	59.0 135	370 740	59.0 135	370 740	140 211	275

Notes: 1) Ball slide of PE05AR has only two mounting tap holes in the center.

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

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

A-5-2.4 LE Series (Miniature wide type)

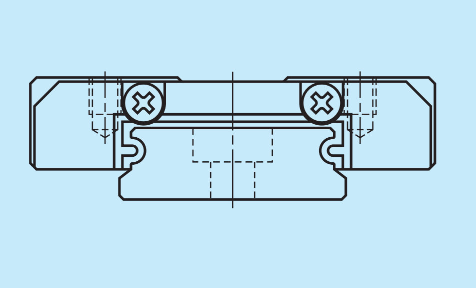


Fig. 1 LE Series

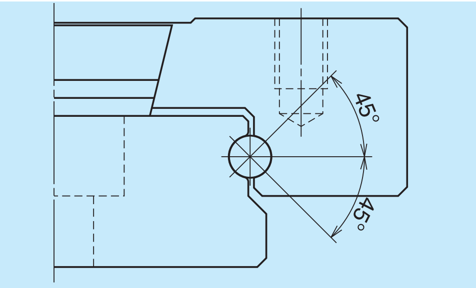


Fig. 2 Balls in contact

1. Features

(1) Ideal for use of single rail

The LE Series linear guides are miniature and wide rail type. Thanks to the wide rail, load carrying capacity is high against moment load from rolling direction.

(2) Equal load carrying capacity in vertical and lateral directions

Contact angle is set at 45 degrees, equally dispersing the load from vertical and lateral directions. This also provides equal rigidity in the two directions.

(3) Guides are super-thin.

Super-thin guides owe their design to the single ball groove on right and left sides (Gothic arch).

(4) High accuracy

Fixing the master rollers to the ball grooves is easy thanks to the Groove arch groove. This makes easy and accurate measuring of ball grooves.

(5) Stainless steel is standard.

Rails and ball slides are made of martensitic stainless steel.

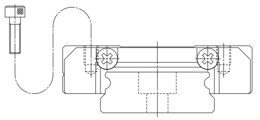
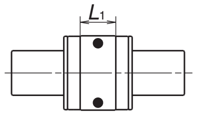
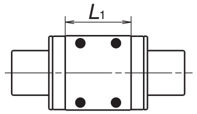
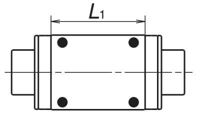
(6) Ball retainer is available in some series.

Some series come with a ball retainer (ball slide shape: AR and TR). Balls are retained in the retainer and do not fall out when a ball slide is withdrawn from the rail (random-maching type ball slides come with a ball retainer).

(7) Fast delivery

Random matching of rails and ball slides are available. (LE09 to LE15)

2. Ball slide shape

Ball slide Model	Shape/installation method	Type (Upper row, Rating: Lower row, Ball slide length)		
		Medium-load type	Standard type	High-load type
		Short	Standard	Long
AL TL AR TR BL UL CL SL		CL, SL  	AL, TL, AR, TR  	BL, UL 

Specification	Detail	Type		
Mounting hole	Normal	CL*	AL, AR	BL*
	Large	SL*	TL, TR	UL*
Ball retainer	Without	CL, SL	AL, TL	BL, UL
	With	—	AR, TR	—

* Only applicable to LE09

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

	Preloaded assembly type (not random matching)			Random-matching type
Rail length (mm) over | or less	High precision P5	Precision grade P6	Normal grade PN	Normal grade PC
– 50	2	4.5	6	6
50 – 80	3	5	6	6
80 – 125	3.5	5.5	6.5	6.5
125 – 200	4	6	7	7
200 – 250	5	7	8	8
250 – 315	5	8	9	9
315 – 400	6	9	11	11
400 – 500	6	10	12	12
500 – 630	7	12	14	14
630 – 800	8	14	16	16
800 – 1 000	9	16	18	18
1 000 – 1 250	10	17	20	20

(2) Accuracy standard

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

Table 2 shows the accuracy standard for the preloaded assembly type while **Table 3** shows the accuracy standard for the random-matching type.

- **Tolerance of preloaded assembly**

Table 2 Unit: μm

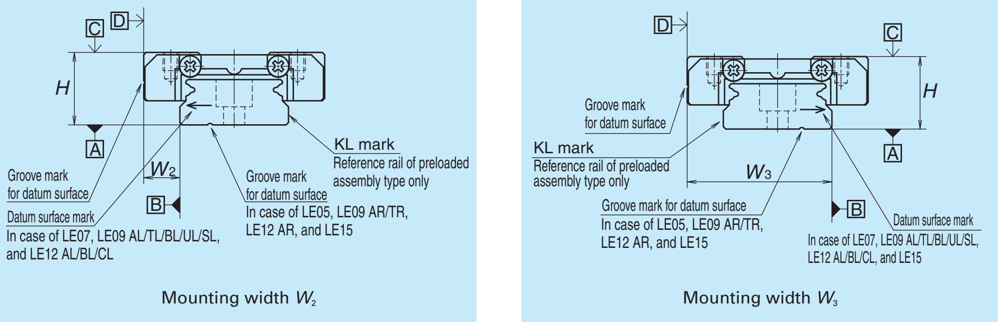
Accuracy grade / Characteristics	High precision P5	Precision grade P6	Normal grade PN
Mounting height *H* Variation of *H* (All ball slides on a set of rails)	±15 7	±20 15	±40 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±20 10	±30 20	±50 30
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Refer to **Table 1** and **Fig. 3**		

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

Table 3 Unit: μm

Accuracy grade / Characteristics	LE09, 12, 15
Mounting height *H*	±20
Variation of mounting height *H*	40
Mounting width W_2 or W_3	±20
Variation of mounting width W_2 or W_3	40
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Refer to **Table 1** and **Fig. 3**

(3) Assembled accuracy



Mounting width W_2

Mounting width W_3

Fig. 3

(4) Preload and rigidity

We offer three levels of preload: Slight preload Z1 and Fine clearance Z0 for the preloaded assembly type, along with Fine clearance ZT for the random-matching type. Values for preload and rigidity of the preloaded assembly type are shown in **Table 4**. Rigidities are for the median of the preload range.

- **Preload and rigidity of preloaded assembly**

Table 4

	Model No.	Preload (N) Slight preload (Z1)	Rigidity (N/μm) Slight preload (Z1)
Standard type	LE05 AL	0 – 23	36
	LE07 TL	0 – 29	46
	LE09 AL, TL, AR, TR	0 – 37	61
	LE12 AL, AR	0 – 40	63
	LE15 AL, AR	0 – 49	66
Medium-load type	LE05 CL	0 – 18	29
	LE07 SL	0 – 16	28
	LE09 CL, SL	0 – 21	33
	LE12 CL	0 – 23	36
	LE15 CL	0 – 29	44
High-load type	LE07 UL	0 – 43	71
	LE09 BL, UL	0 – 54	86
	LE12 BL	0 – 59	97
	LE15 BL	0 – 75	114

Note: The clearance of Fine clearance Z0 is 0 to 3 μm. Therefore, preload is zero.
However, the clearance of the Z0 of PN grade is 3 to 10 μm.

- **Clearance of random-matching type**

Table 5 Unit: μm

Model No.	Fine clearance ZT
LE09	0 – 15
LE12	
LE15	

4. Maximum rail length

Table 6 shows the limitations of rail length. The limitations vary by accuracy grades.

Table 6 Length limitation of rails

Unit: mm

Series	Size / Material	05	07	09	12	15
LE	Stainless steel	150	600	800	1 000	1 200

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

5. Installation

(1) Permissible values of mounting error

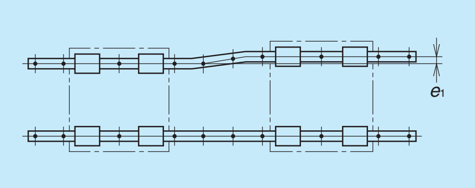


Fig. 4

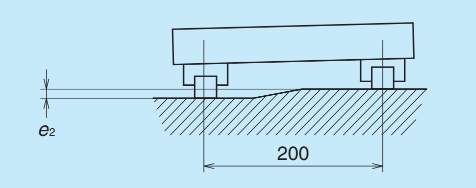


Fig. 5

Table 7 Unit: μm

Value	Preload	Model No.				
		LE05	LE07	LE09	LE12	LE15
Permissible values of parallelism in two rails e_1	Z0, ZT	10	12	15	18	22
	Z1	5	7	10	13	17
Permissible values of parallelism (height) in two rails e_2	Z0, ZT	50 μm/200 mm				
	Z1	35 μm/200 mm				

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

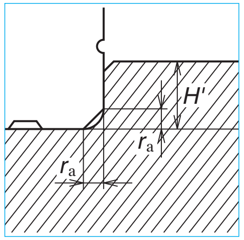


Fig. 6 Shoulder for the rail datum surface

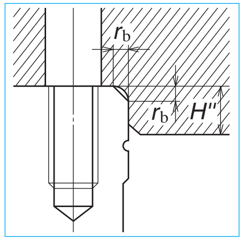


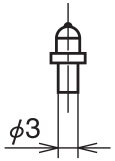
Fig. 7 Shoulder for the ball slide datum surface

Table 8 Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
LE05	0.2	0.2	1.1	2
LE07	0.2	0.3	1.7	3
LE09	0.3	0.3	3.5	3
LE12	0.3	0.3	3.5	4
LE15	0.3	0.5	3.5	5

6. Lubrication accessories

Model of LE15AR can select drive-in type grease fitting as option.
There is no standard grease fitting for LE05 to LE12.
For the models of LE05 to LE15 except for LE15AR, apply grease directly to the ball grooves of rail, using a point nozzle.



Drive-in type

7. Dust-proof components

(1) Standard specification

End seal: Provided to both ends of the ball slide as a standard feature.

- Seal friction per standard ball slide is shown in **Table 9**.

Table 9 Seal friction per ball slide (maximum value) Unit: N

Series \ Size	05	07	09	12	15
LE	0.4	0.4	0.8	1.0	1.2

(2) NSK K1^{TM} lubrication unit

The installed dimensions of NSK K1 lubrication unit are shown in **Table 10**.

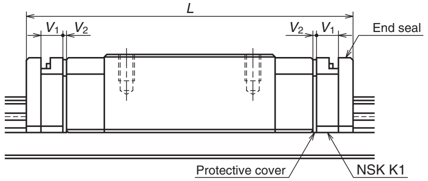


Table 10 Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_1	Protective cover thickness V_2
LE07	Standard	TL	31	37	2.5	0.5
	Long	UL	42	48		
	Short	SL	22.4	28.4		
LE09	Standard	AL, TL	39	46	3.0	0.5
	Standard	AR, TR	39.8	46.8		
	Long	BL, UL	50.4	57.4		
	Short	CL, SL	26.4	33.4		
LE12	Standard	AL	44	52	3.5	0.5
	Standard	AR	45	53		
	Long	BL	59	67		
	Short	CL	30.5	38.5		
LE15	Standard	AL	55.0	64.6	4.0	0.8
	Standard	AR	56.6	66.2		
	Long	BL	74.4	84		
	Short	CL	41.4	51		

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

8. Reference number

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

(1) Reference number for preloaded assembly

LE 15 0310 AR K 2 - P5 1**

Series name
Size
Rail length (mm)
Ball slide shape code (See page A284.)
Material/surface treatment code (See Table 11.)
K: Stainless steel
Number of ball slides per rail
Design serial number
Added to the reference number.
Accuracy code (See Table 12.)
Preload code (See page A286.)
0: Z0, 1: Z1

(2) Reference number for random-matching type

Ball slide

LAE 15 AR S -K

Random-matching ball slide series code
LAE: LE Series random-matching ball slide
Size
Ball slide shape code (See page A284.)
Material code
S: Stainless steel
Option code
-K: Equipped with NSK K1

Rail

L1E 15 0310 R K N - PC T**

Random-matching rail series code
L1E: LE Series random-matching rail
Size
Rail length (mm)
Rail shape code
R: LE09 and LE12 standard, equipped with ball retainer
Material/surface treatment code (See Table 11.)
*Butting rail specification
N: Non-butting. L: Butting specification
Design serial number
Added to the reference number.
Accuracy code: PC
PC: Normal grade is only available.
Preload code (See page A286.)
T: Fine clearance

*Please consult with NSK for butting rail specification.

The reference number coding for the assembly of random-matching type is the same as that of the preloaded assembly. However, only the preload code of "Fine clearance T" is available (refer to page A286).

Table 11 Material/surface treatment code

Code	Description
K	Stainless steel
H	Stainless steel with surface treatment
Z	Other, special

Table 12 Accuracy code

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

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

9. Dimensions

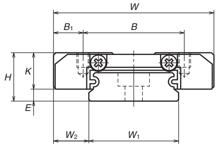
LE-AL (Standard type / Standard)
LE-TL (Standard type / Standard, large mounting hole)
LE-AR (Standard type / Standard, with ball retainer)
LE-TR (Standard type / Standard, large mounting hole, with ball retainer)

LE 15 0310 AR K 2 -✻✻ PC T

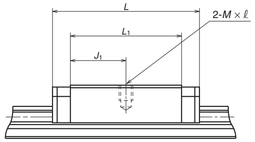
- LE: Series name
- 15: Size
- 0310: Rail length (mm)
- AR: Ball slide shape code (See page A284.)
- K: Material/surface treatment code (See Table 11.)
  - K: Stainless steel
- 2: Number of ball slides per rail
- -✻✻: Design serial number
  - Added to the reference number.
- PC: Accuracy code (See Table 12.)
- T: Preload code (See page A286.)
  - 0: Z0, 1: Z1, T: ZT

Front view

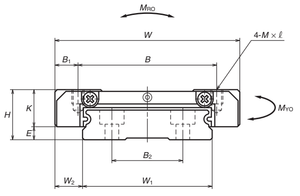
Side view



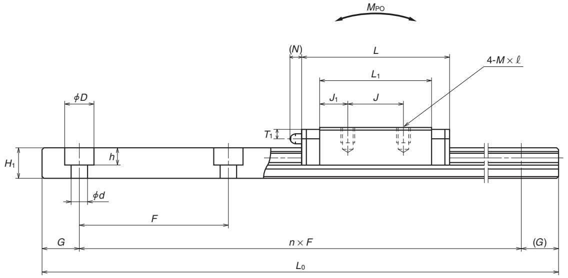
LE05, 07, 09, 12



LE05



LE15



LE07, 09, 12, 15

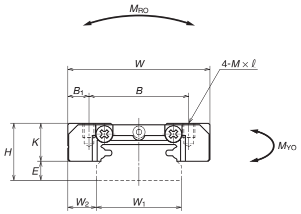
Reference number for ball slide of random-matching type

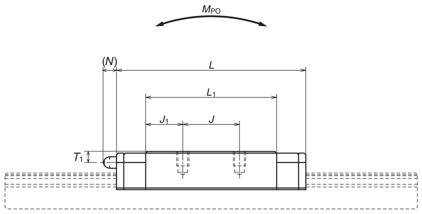
Random matching with retainer: LAE09AR/TR, LAE12AR, LAE15AR

LAE-AR (With ball retainer)
LAE-TR (Large mounting hole with ball retainer)

LAE 15 AR S -K

- LAE: Random-matching ball slide series code
  - LAE: LE Series random-matching ball slide
- 15: Size
- AR: Ball slide shape code (See page A284.)
- S: Material code
  - S: Stainless steel
- -K: Option code
  - -K: Equipped with NSK K1



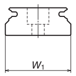


Reference number for rail of random-matching type

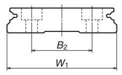
Rail **L1E 15 0310 R K N -✻✻ PC T**

- L1E: Random-matching rail series code
  - L1E: LE Series random-matching rail
- 15: Size
- 0310: Rail length (mm)
- R: Rail shape code
  - R: LE09 and LE12 standard equipped with ball retainer
- K: Material/surface treatment code (See Table 11.)
- N: *Butting rail specification
  - N: Non-butting. L: Butting specification
- -✻✻: Design serial number
  - Added to the reference number.
- PC: Accuracy code: PC
  - PC: Normal grade is only available.
- T: Preload code (See page A286.)
  - T: Fine clearance

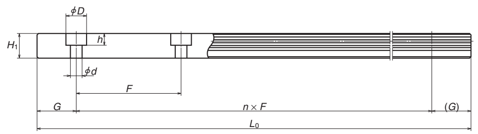
*Please consult with NSK for butting rail specification.



LE09, 12



LE15



Unit: mm

Model No.	Assembly			Ball slide									Grease fitting			Width	Height	Rail					Basic load rating							Weight	
	Height			Width	Length	Mounting hole							Hole size						Pitch	Mounting bolt hole	G	Max. length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
																							C	C_0	M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	M × pitch × ℓ	B_1	L_1	J_1	K	size	T_1	N	W_1	H_1	B_2	F	d × D × h	(Reference)	L_{0max}	(N)	(N)		One slide	Two slides	One slide	Two slides	(g)	(g/100 mm)
LE05AL	6.5	1.4	3.5	17	24	13	—	M2.5×0.45×2	2	17	8.5	5.1	—	—	—	10	4	—	20	3×5×1.6	7.5	150	725	1 110	5.65	2.58	16.9	2.58	16.9	11	34
LE07TL	9	2	5.5	25	31	19	10	M3×0.5×3	3	21.2	5.6	7	—	—	—	14	5.2	—	30	3.5×6×3.2	10	600	1 580	2 350	16.7	7.20	46.0	7.20	46.0	25	55
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	—	30	3.5×6×4.5	10	800	3 000	4 500	36.5	17.3	110	17.3	110	40	95
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	—	30	3.5×6×4.5	10	800	3 000	4 500	36.5	17.3	113	17.3	113	40	95
LE12AL **LE12AR**	14	4	8	40	44 45	28	15	M3×0.5×4	6	31	8	10	—	—	—	24	8.5	—	40	4.5×8×4.5	15	1 000	4 350	6 350	70.5	29.3	175 180	29.3	175 180	75	140
LE15AL **LE15AR**	16	4	9	60	55 56.6	45	20	M4×0.7×4.5	7.5	38.4	9.2	12	— ϕ 3	— 3.2	— 3	42	9.5	23	40	4.5×8×4.5	15	1 200	7 600	10 400	207	59.0	360 370	59.0	360 370	150	275

Notes: 1) Ball slide of LE05 has only two mounting tap holes.

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

3) For fixing a rail of LE05AL, use M2.5 × 0.45 cross-recessed pan head machine screw for precision instruments. (JCIS 10-70: No.0 pan head machine screw No.3) (JCIS: Japanese Camera Industrial Standard)

LE-BL (High-load type / Long)
LE-UL (High-load type / Long, large mounting hole)

LE 15 0310 BL K 2 -＊＊ P5 1

Series name

Size

Rail length (mm)

Ball slide shape code (See page A284.)

Material/surface treatment code (See Table 11.)

K: Stainless steel

Preload code (See page A286.)

0: Z0, 1: Z1

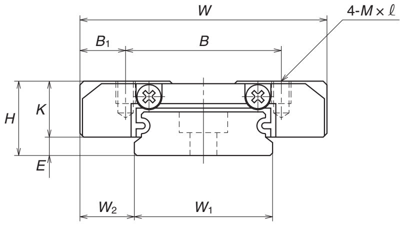
Accuracy code (See Table 12.)

Design serial number

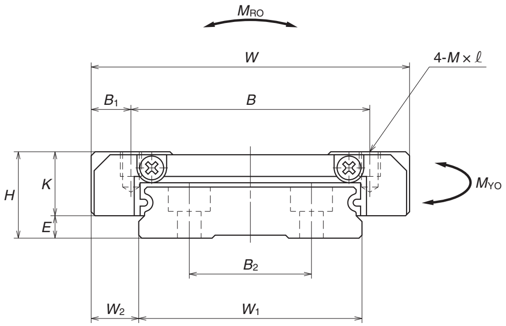
Added to the reference number.

Number of ball slides per rail

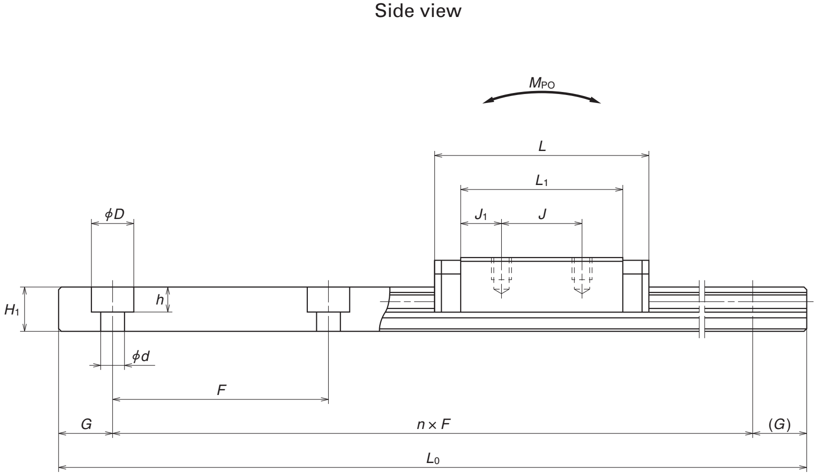
Front view



LE07, 09, 12



LE15



Unit: mm

Model No.	Assembly			Ball slide											Rail					Basic load rating							Weight	
	Height			Width	Length	Mounting hole							Width	Height		Pitch	Mounting bolt hole	G	Max. length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
																				C	C_0	M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	M × pitch × ℓ	B_1	L_1	J_1	K	W_1	H_1	B_2	F	d × D × h	(Reference)	L_{0max}	(N)	(N)		One slide	Two slides	One slide	Two slides	(g)	(g/100 mm)
LE07UL	9	2	5.5	25	42	19	19	M3×0.5×3	3	32.2	6.6	7	14	5.2	—	30	3.5×6×3.2	10	600	2 180	3 700	26.4	17.3	94.5	17.3	94.5	39	55
LE09BL **LE09UL**	12	4	6	30	50.4	23	24	M2.6×0.45×3 M3×0.5×3	3.5	39	7.5	8	18	7.5	—	30	3.5×6×4.5	10	800	4 000	6 700	54.5	37.5	206	37.5	206	58	95
LE12BL	14	4	8	40	59	28	28	M3×0.5×4	6	46	9	10	24	8.5	—	40	4.5×8×4.5	15	1 000	5 800	9 550	106	63.5	340	63.5	340	115	140
LE15BL	16	4	9	60	74.4	45	35	M4×0.7×4.5	7.5	57.8	11.4	12	42	9.5	23	40	4.5×8×4.5	15	1 200	10 300	16 000	320	135	725	135	725	235	275

Note: Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface.
To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.

LE-CL (Medium-load type / Short)
LE-SL (Medium-load type / Short, large mounting hole)

LE 15 0310 CL K 2 -✻✻ P5 1

Series name

Size

Rail length (mm)

Ball slide shape code (See page A284.)

Material/surface treatment code (See Table 11.)
K: Stainless steel

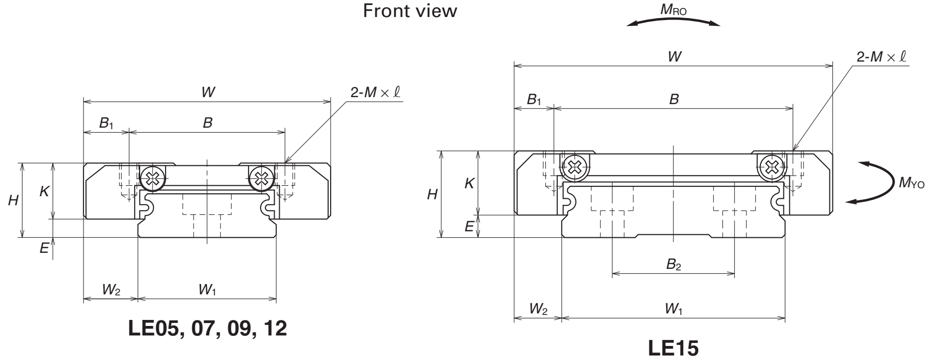
Preload code (See page A286.)
0: Z0, 1: Z1

Accuracy code (See Table 12.)

Design serial number
Added to the reference number.

Number of ball slides per rail

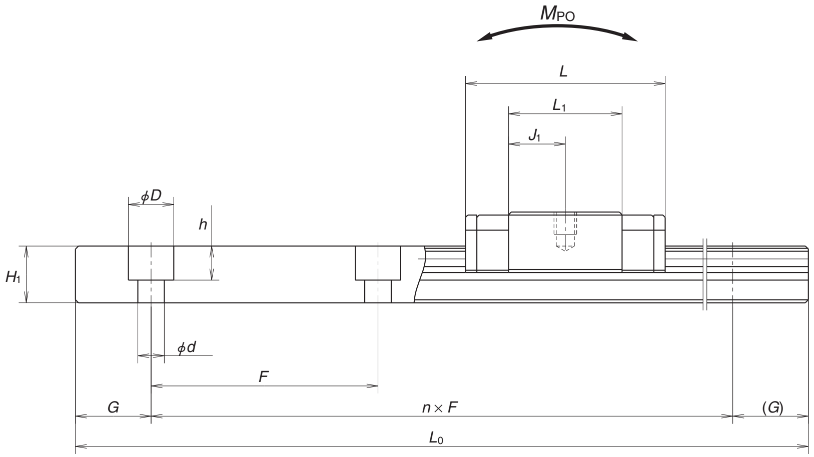
Front view



LE05, 07, 09, 12

LE15

Side view



Unit: mm

Model No.	Assembly			Ball slide											Rail					Basic load rating							Weight	
	Height			Width	Length	Mounting hole							Width	Height		Pitch	Mounting bolt hole	G	Max. length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
																				C	C_0	M_{RO}	M_{PO}		M_{YO}			
																							One slide	Two slides	One slide	Two slides		
	H	E	W_2	W	L	B	J	$M \times$ pitch $\times \ell$	B_1	L_1	J_1	K	W_1	H_1	B_2	F	$d \times D \times h$	(Reference)	L_{0max}	(N)	(N)						(g)	(g/100 mm)
LE05CL	6.5	1.4	3.5	17	20	13	—	M2.5×0.45×2	2	13	6.5	5.1	10	4	—	20	3×5×1.6	7.5	150	595	835	4.25	1.51	10.0	1.51	10.0	8	34
LE07SL	9	2	5.5	25	22.4	19	—	M3×0.5×3	3	12.6	6.3	7	14	5.2	—	30	3.5×6×3.2	10	600	980	1 170	8.35	2.01	18.5	2.01	18.5	17	55
LE09CL **LE09SL**	12	4	6	30	26.4	21	—	M2.6×0.45×3 M3×0.5×3	4.5	15	7.5	8	18	7.5	—	30	3.5×6×4.5	10	800	1 860	2 240	18.2	4.85	41.0	4.85	41.0	25	95
LE12CL	14	4	8	40	30.5	28	—	M3×0.5×4	6	17.5	8.75	10	24	8.5	—	40	4.5×8×4.5	15	1 000	2 700	3 150	35.0	8.15	67.0	8.15	67.0	50	140
LE15CL	16	4	9	60	41.4	45	—	M4×0.7×4.5	7.5	24.8	12.4	12	42	9.5	23	40	4.5×8×4.5	15	1 200	5 000	5 650	113	19.4	162	19.4	162	110	275

Notes: 1) Ball slide of CL and SL types have only two mounting tap holes in the center.

2) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load to the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide 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 (JCIS 10-70: Japan Camera Industry Association, No.0, class 3).

A-3-2.5 LL Series

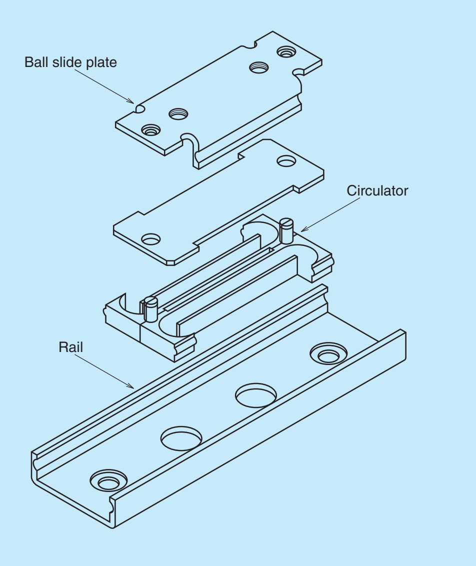


Fig. 1 LL Series structure

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.

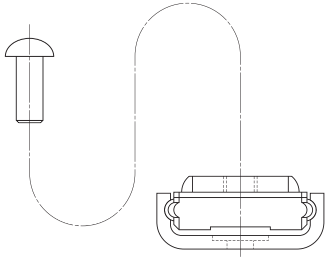
(2) Compact

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

The LL Series has a Normal grade PN as the accuracy grade.
Table 1 shows the tolerance.

Table 1 Tolerance of Normal grade (PN)

Unit: μm

Characteristic \ Model No.	LL15
Mounting height	±20
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	20 (See **Fig. 2**.)

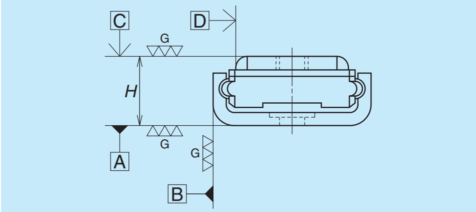


Fig. 2 Standard LL

(2) Preload

We offer clearance for the LL Series.
Table 2 shows the specification of clearance.

Table 2 Radial clearance

Unit: μm

Model No.	Clearance
LL15	0 – 10

4. Maximum rail length

Table 3 Length limitation of rails

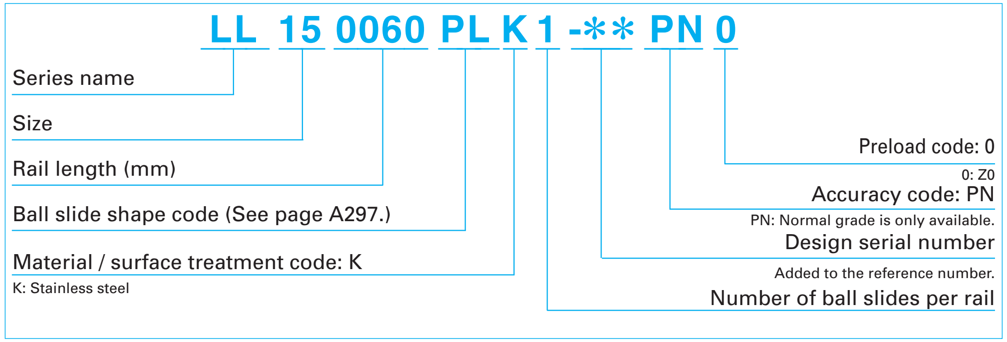
Unit: mm

Series	Size \ Material	15				
LL	Stainless steel	40	60	75	90	120

5. Reference number

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

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



LL 15 0060 PL K 1 -** PN 0

Series name

Size

Rail length (mm)

Ball slide shape code (See page A297.)

Material / surface treatment code: K

K: Stainless steel

Preload code: 0

0: Z0

Accuracy code: PN

PN: 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

Size

Rail length (mm)

Ball slide shape code (See page A297.)

Material / surface treatment code: K

K: Stainless steel

Preload code: 0

0: Z0

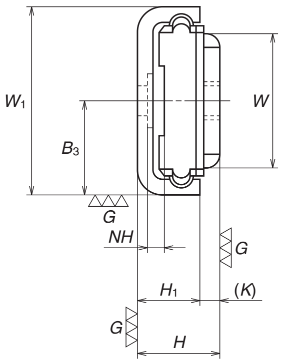
Accuracy code: PN

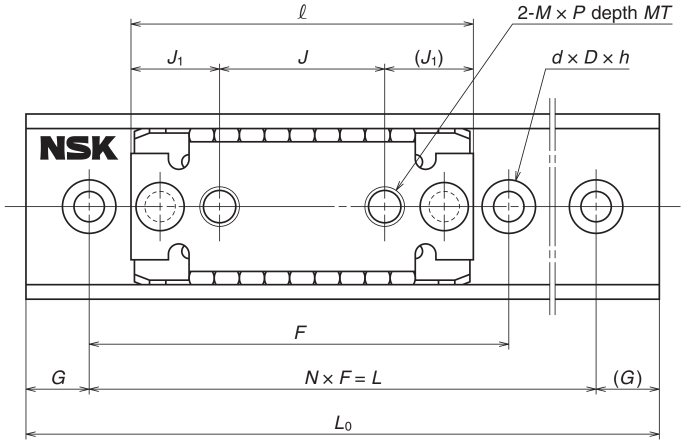
PN: Normal grade is only available.

Design serial number

Added to the reference number.

Number of ball slides per rail





Unit: mm

Model No.	Assembly		Ball slide										Rail					Basic load rating					Ball dia.	Weight	
	Height		Width	Length	Mounting hole					Height	Pitch		Mounting bolt hole				Length	Dynamic	Static	Static moment				Ball slide	Rail
	H	W_1	W	ℓ	J	$M\times$pitch	MT	J_1	K	H_1	F	N	$d\times D\times h$	NH	B_3	G	L_0	C (N)	C_0 (N)	M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	(g)	(g)
LL15	6.5	15	10.6	27	13	M3×0.5	1.2	7	1.5	5	30	1	2.4×5×0.4	1.2	7.5	5	40	880	785	7	3	3	2	6	9
											40	1				10	60								11
											30	2				7.5	75								13
											40	2				5	90								16
											50	2				10	120								21

Notes:

1) The LL Series does not have a ball retainer. Be aware that the balls fall out when the ball slide is withdrawn from the rail.
2) Seals are not available. Please provide the dust-prevention measures on the equipment.
3) Do not use an installation screw on the ball slide which exceeds the dimension MT (maximum screw-in depth) in the dimension table.
4) To fix the rail, use M2 × 0.4 cross recessed machine screw for precision instrument.
   (JCIS10-70 No.0 pan head machine screw No.1)
   (JCIS: Japanese Camera Industrial Standard)

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

A-5-3 Machine Tools

A-5-3.1 RA Series

1. Features

(1) Super-high load capacity

By installing rollers that are the largest possible diameter and length within the existing standard cross-section dimension in a rational layout based on our advanced analysis technology, we have realized the world's highest load capacity,* far superior to conventional roller guides. Super-long life is achieved and impact load can be sufficiently handled.

(2) Super-high rigidity

Using NSK's advanced analysis technology, we pursued a complete, optimal design, down to the detailed shape of roller slides and rails, thereby realizing super-high rigidity superior to that of competitor's roller guides.

(3) Super-high motion accuracy

NSK has developed its own unique method of simulating rolling element passage vibration and method of designing optimal roller slide specifications for damping roller passage vibration. These developments have dramatically enhanced roller slide motion accuracy for the RA series.

(4) Smooth motion

Installation of a retaining piece between rollers restrains the roller skew peculiar to roller slides, thereby achieving smooth motion.

(5) Low friction

Using rollers for rolling elements helps minimize dynamic friction.

(6) Random matching

Random-matching of rails and roller slides are available. (RA25 to RA65)

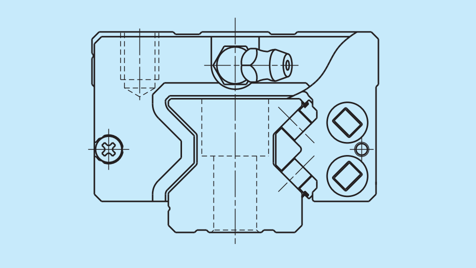


Fig. 1 RA Series

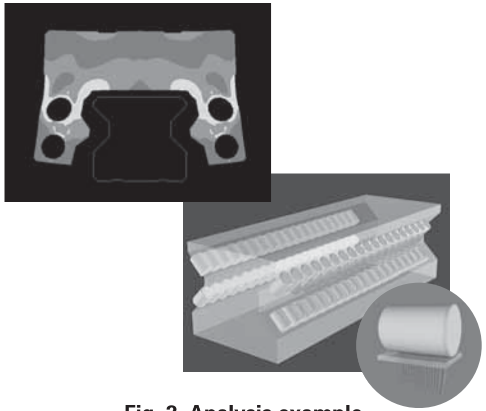


Fig. 2 Analysis example

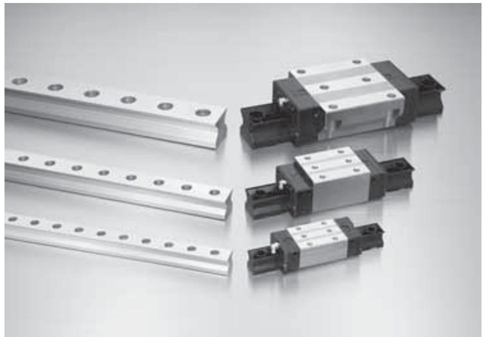


Fig. 3 Random-matching type

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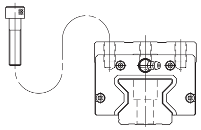
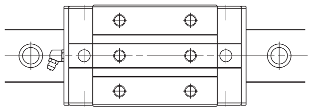
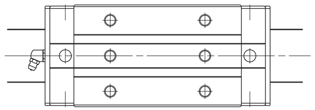
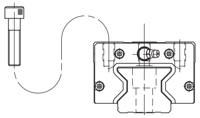
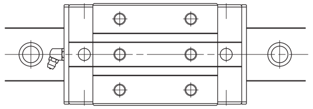
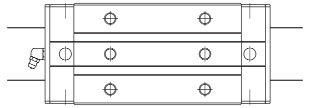
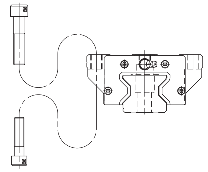
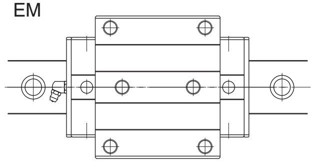
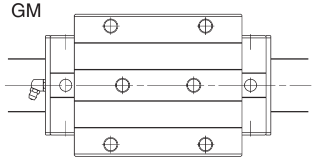
* As of September 1, 2003; NSK's reserch and comparison on the existing products of the same sizes.

2. Roller slide shape

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

3. Accuracy and preload

(1) Running parallelism of roller slide

Table 1

Unit: μm

Rail length (mm)		Preloaded assembly			Random-matching type
over	or less	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 only.

- **Tolerance of preloaded assembly**

Table 2

Unit: μm

Accuracy grade Characteristics	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6
Mounting height *H* Variation of *H* (All roller slides on a set of rails)	±8 3	±10 5	±20 7	±40 15
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All roller slides on reference rail)	±10 3	±15 7	±25 10	±50 20
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Shown in **Table 1** and **Fig. 4**			

- **Tolerance of random-matching type**

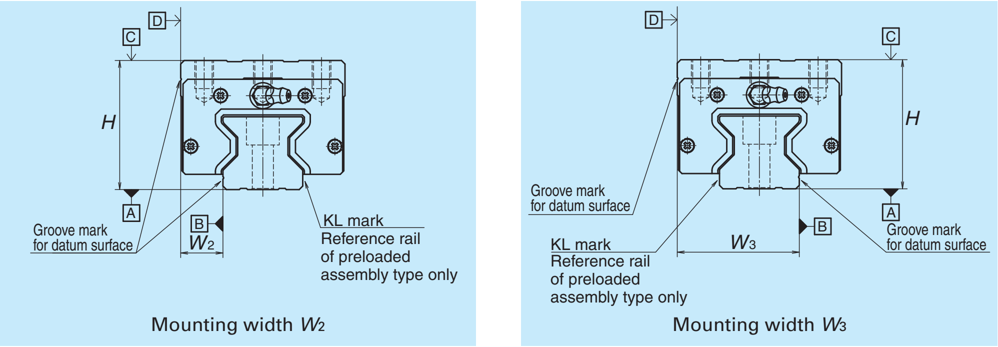
Table 3

Unit: μm

Accuracy grade Characteristics	Random-matching with precision grade P6
Mounting height *H*	±20
Variation of mounting height *H*	15① 30②
Mounting width W_2 or W_3	±25
Variation of mounting width W_2 or W_3	20
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	See **Table 1** and **Fig. 4**

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

(3) Assembled accuracy



Mounting width W_2

Mounting width W_3

Fig. 4

(4) Preload and rigidity

Four types of preload are available: Medium preload Z3 and Slight preload Z1 for preloaded assembly, and Medium preload ZZ for Random-matching type.

- **Preload of preloaded assembly**

Table 4

	Model No.	Preload (N)	
		Slight preload (Z1)	Medium preload (Z3)
High-load type	RA15 AN, AL, EM	—	1 030
	RA20 AN, EM	—	1 920
	RA25 AN, AL, EM	880	2 920
	RA30 AN, AL, EM	1 170	3 890
	RA35 AN, AL, EM	1 600	5 330
	RA45 AN, AL, EM	2 780	9 280
	RA55 AN, AL, EM	3 870	12 900
	RA65 AN, EM	6 300	21 000
Super-high-load type	RA15 BN, BL, GM	—	1 300
	RA20 BN, GM	—	2 400
	RA25 BN, BL, GM	1 060	3 540
	RA30 BN, BL, GM	1 430	4 760
	RA35 BN, BL, GM	2 020	6 740
	RA45 BN, BL, GM	3 480	11 600
	RA55 BN, BL, GM	5 040	16 800
	RA65 BN, GM	8 640	28 800

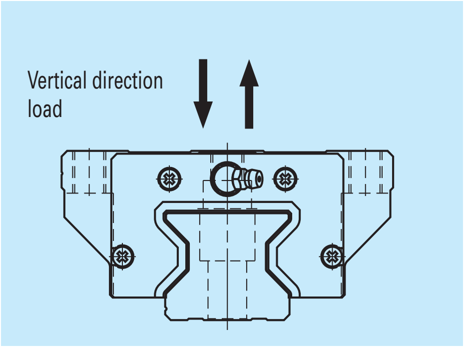


Fig. 5 Direction of load

• **Rigidity of medium preload**

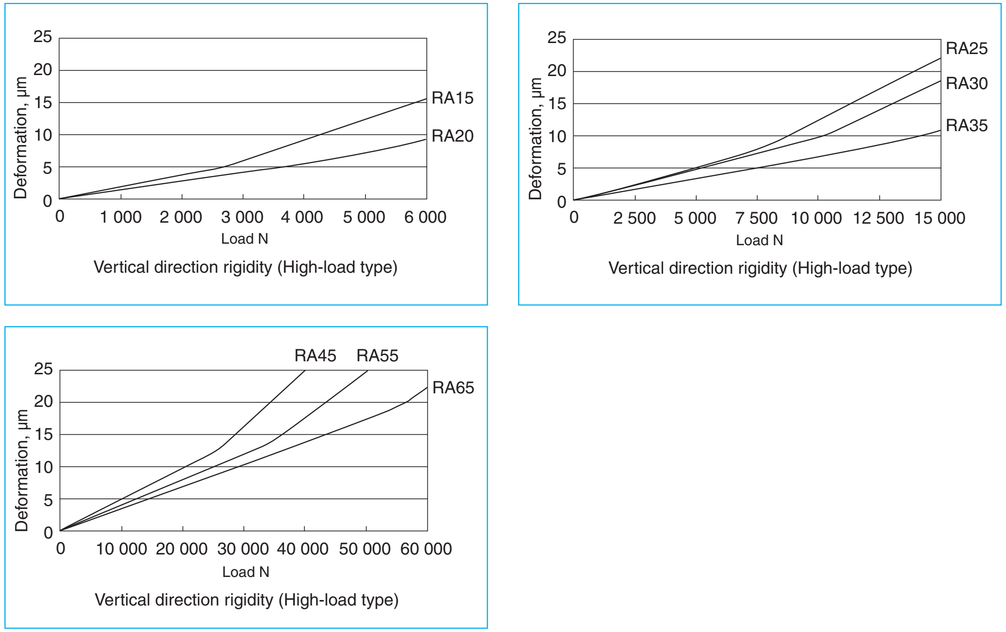


Fig. 6 Vertical direction theoretical rigidity line: High-load type (Roller slide shape: AN, AL, EM)

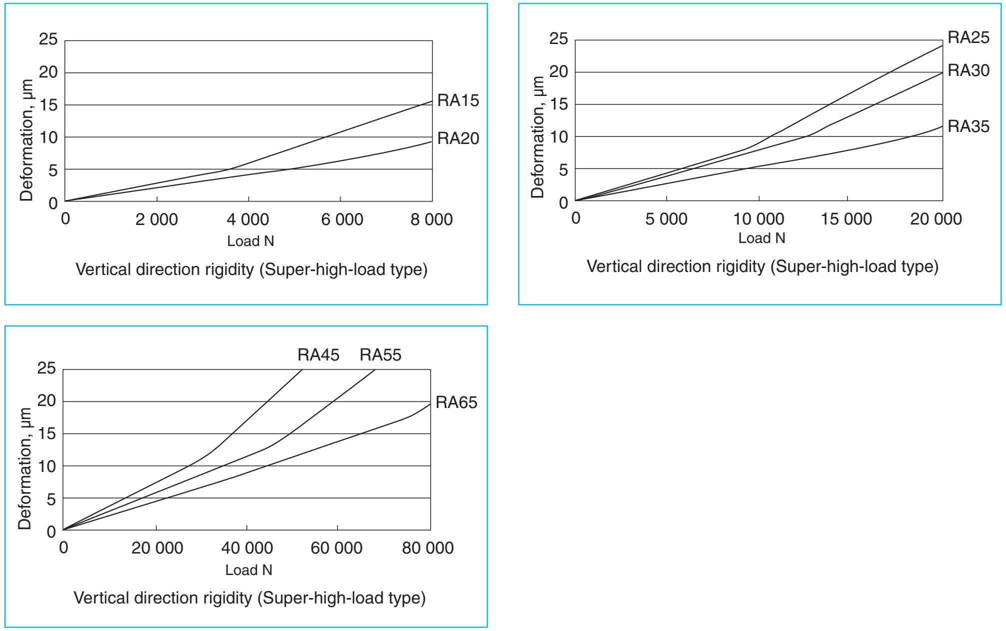


Fig. 7 Vertical direction theoretical rigidity line: Super-high-load type (Roller slide shape: BN, BL, GM)

4. Maximum rail length

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

Table 5 Length limitation of rails

Unit: mm

Series \ Size	15	20	25	30	35	45	55	65
RA	2 000	3 000	3 000	3 500	3 500	3 500	3 500	3 500

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

5. Installation

(1) Permissible values of mounting error

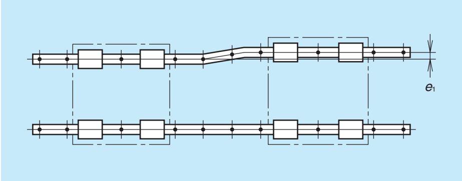


Fig. 8

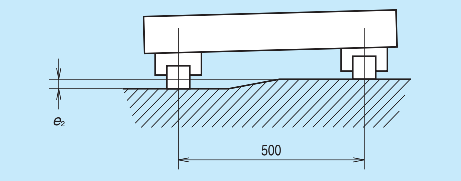


Fig. 9

Table 6

Unit: μm

Value	Preload	Model No.							
		RA15	RA20	RA25	RA30	RA35	RA45	RA55	RA65
Permissible values of parallelism in two rails e_1	Z1	—	—	14	18	21	27	31	49
	Z3 · ZZ	5	7	9	11	13	17	19	30
Permissible values of parallelism (height) in two rails e_2	Z1	—		290 μm / 500 mm					
	Z3 · ZZ	150 μm / 500 mm							

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

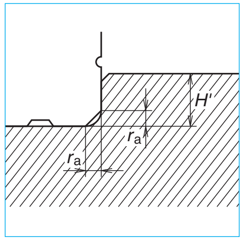


Fig. 10 Shoulder for the rail datum surface

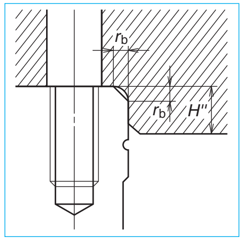


Fig. 11 Shoulder for the roller slide datum surface

Table 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 pages A38 and D13 for the lubrication of linear guides.

(1) Types of lubrication accessories

Fig. 14 and **Table 10** show grease fittings and tube fittings.

(2) Mounting position of lubrication accessories

- The standard position of grease fittings and tube fittings is the end face of roller slide. We can mount them on a side of end cap for an option. (**Fig. 12**) Please consult NSK for installation of grease or tube fittings to the roller slide body or the side of end cap.
- A lubrication hole can also be provided on the top of the end cap. **Fig.13**, **Table 8** and **Table 9** show the mounting position. A spacer is required for AN and BN shape roller slides. The spacers are available from NSK.
- When using a piping unit with thread of M6 × 1, you require a connector to connect it to a grease fitting mounting hole with M6 × 0.75. The connectors are available from NSK.

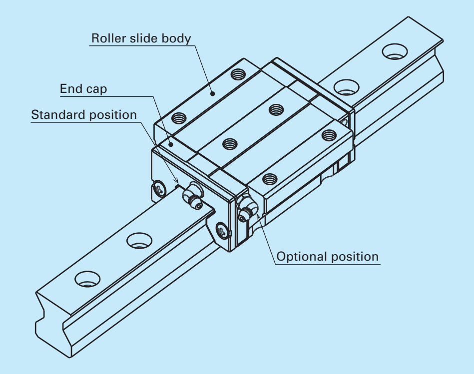


Fig. 12 Mounting position of lubrication accessories

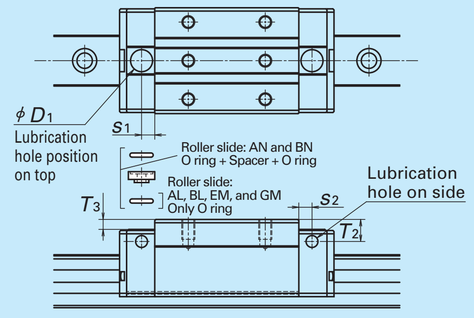


Fig.13 Top and side lubrication hole positions

Table 8 Top and side lubrication hole positions

Unit: mm

Model No.	Roller slide model	Grease fitting size	s_2	T_2	O ring (JIS)	Spacer	D_1	s_1	T_3
RA15	AN, BN	ϕ3	4	7	P5	Necessary	8.2	4.4	4.2
RA20		ϕ3	4	4	P6	—	9.2	5.4	0.2
RA25		M6×0.75	6	10	P7	Necessary	10.2	6	4.5
RA30		M6×0.75	5	10	P7	Necessary	10.2	6	3.5
RA35		M6×0.75	5.5	15	P7	Necessary	10.2	7	7.4
RA45		Rc 1/8	7.2	20	P7	Necessary	10.2	7.2	10.4
RA55		Rc 1/8	7.2	21	P7	Necessary	10.2	7.2	10.4
RA65		Rc 1/8	7.2	19	P7	—	10.2	7.2	0.4

Table 9 Top and side lubrication hole positions

Unit: mm

Model No.	Roller slide model	Grease fitting size	s_2	T_2	O ring (JIS)	D_1	s_1	T_3
RA15	AL, BL, EM, GM	ϕ3	4	3	P5	8.2	4.4	0.2
RA20	EM, GM	ϕ3	4	4	P6	9.2	5.4	0.2
RA25	AL, BL, EM, GM	M6×0.75	6	6	P7	10.2	6	0.4
RA30		M6×0.75	5	7	P7	10.2	6	0.4
RA35		M6×0.75	5.5	8	P7	10.2	7	0.4
RA45		Rc 1/8	7.2	10	P7	10.2	7.2	0.4
RA55		Rc 1/8	7.2	11	P7	10.2	7.2	0.4
RA65	EM, GM	Rc 1/8	7.2	19	P7	10.2	7.2	0.4

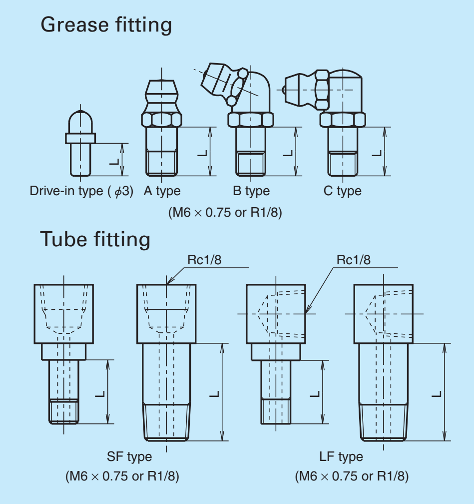


Fig. 14 Grease fitting and tube fitting

7. Dust-proof components

(1) Standard specification

The RA series is equipped with end, inner* and bottom seals to prevent foreign matter from entering the inside of the roller slide. Under normal applications, the RA series can be used without modification.

For severe usage conditions, optional rail covers** are available. Contact NSK for information on how to mount the cover.

*) Inner seals for the models of RA15 and RA20 are available as options.

**) The rail cover is available to the models of RA25 to RA65.

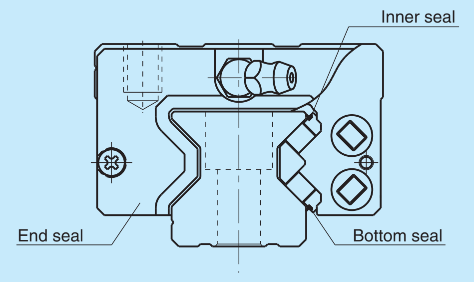


Fig. 15

Table 10

Unit: mm

Model No.	Dust-proof specification	Grease fitting Drive-in fitting	Tube fitting
		Thread body length L	Thread body length L
RA15	Standard	5	–
	With NSK K1	10	–
	Double seal	8	–
	Protector	8	–
RA20	Standard	5	–
	With NSK K1	10	–
	Double seal	8	–
	Protector	10	–
RA25	Standard	5	5
	With NSK K1	12	12
	Double seal	10	9
	Protector	10	9
RA30	Standard	5	6
	With NSK K1	14	15
	Double seal	12	11
	Protector	12	11
RA35	Standard	5	6
	With NSK K1	14	15
	Double seal	12	11
	Protector	12	11
RA45	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
RA55	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
RA65	Standard	8	17
	With NSK K1	20	20
	Double seal	14	17
	Protector	14	17

Fig. 16 Rail cover

Table 11 Seal friction per roller slide (maximum value)

Unit: N

Series \ Size	15	20	25	30	35	45	55	65
RA	4	5.5	5	5	6	8	8	14

(2) NSK K1™ lubrication unit

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

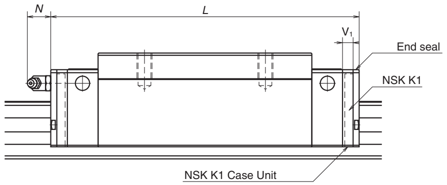


Table 12

Unit: mm

Model No.	Roller slide length	Roller slide model	Standard roller slide length	With two NSK K1	Thickness of NSK K1 V_1	Protruding area of the grease fitting N
RA15	Standard	AN, AL, EM	70	79	4.5	(3)
	Long	BN, BL, GM	85.4	94.4		
RA20	Standard	AN, EM	86.5	95.5	4.5	(3)
	Long	BN, GM	106.3	115.3		
RA25	Standard	AN, AL, EM	97.5	107.5	5	(11)
	Long	BN, BL, GM	115.5	125.5		
RA30	Standard	AN, AL, EM	110.8	122.8	6	(11)
	Long	BN, BL, GM	135.4	147.4		
RA35	Standard	AN, AL, EM	123.8	136.8	6.5	(11)
	Long	BN, BL, GM	152	165		
RA45	Standard	AN, AL, EM	154	168	7	(14)
	Long	BN, BL, GM	190	204		
RA55	Standard	AN, AL, EM	184	198	7	(14)
	Long	BN, BL, GM	234	248		
RA65	Standard	AN, EM	228.4	243.4	7.5	(14)
	Long	BN, GM	302.5	317.5		

Note: Roller slide length equipped with NSK K1 = (Standard roller slide length) + (Thickness of NSK K1 Case Unit × Number of NSK K1 Case Unit)

(3) Double seal and protector

For RA Series, double seal and protector can be installed only before shipping from the factory. **Table 13** shows the increased thickness when end seal and protector are installed.

Table 13

Unit: mm

Model No.	Thickness of end seal V_3	Thickness of protector V_4
RA15	3	2.7
RA20	3	3.3
RA25	3.2	3.3
RA30	3.4	3.6
RA35	3.4	3.6
RA45	4	4.2
RA55	4	4.2
RA65	5	5.5

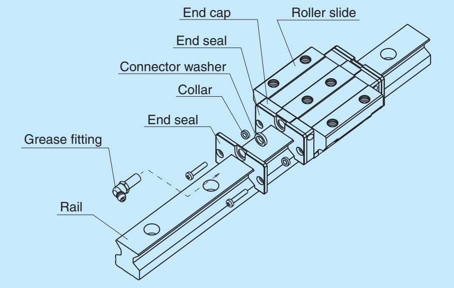


Fig. 17 Double seal

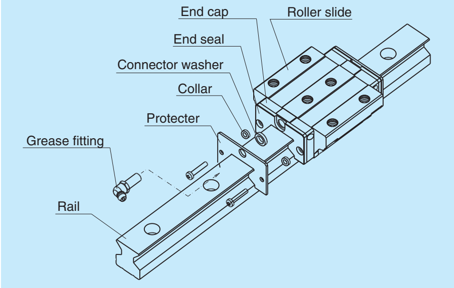


Fig. 18 Protector

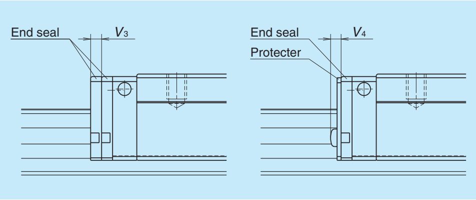


Fig. 19

(4) Rail cover

When the rail cover is used, use the cover bracket to secure the rail cover. **Fig.20** shows the dimensions for the cover bracket. The required room at the end of the rail is:

- Inside: 10.5 mm or less
- Outside: 4 mm or less (Common to the models of RA25 to RA65)

  Please confirm the interference with your machine at the stroke end.
- Machine stroke
- Room for the end of the rail

The height of the rail with the rail cover is shown in **Table 14**.

Table 14 Height of rails equipped with rail cover

Unit: mm

Model No.	Standard height H_1	Cover installation
RA25	24	24.25
RA30	28	28.25
RA35	31	31.25
RA45	38	38.3
RA55	43.5	43.8
RA65	55	55.3

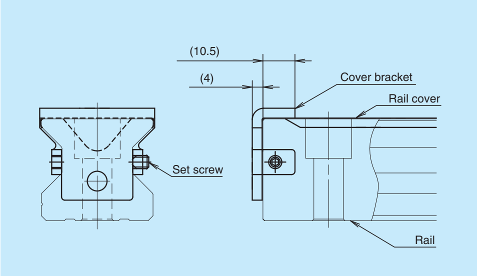


Fig. 20 End configuration of rail equipped with the rail cover

(5) Cap to plug the rail mounting bolt hole

Table 15 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
RA15	M4	LG-CAP/M4	20
RA20	M5	LG-CAP/M5	20
RA25	M6	LG-CAP/M6	20
RA30, RA35	M8	LG-CAP/M8	20
RA45	M12	LG-CAP/M12	20
RA55	M14	LG-CAP/M14	20
RA65	M16	LG-CAP/M16	20

8. Reference number

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

(1) Reference number for preloaded assembly

RA 35 1000 AN C 2 - P6 3**

Series name
Size
Rail length (mm)
Roller slide shape code (See page A304.)
Material/surface treatment code (See Table 16.)
C: Special high carbon steel (NSK standard)
Number of roller slides per rail
Design serial number
Added to the reference number.
Accuracy code (See Table 17.)
Preload code (See page A306.)
1: Z1, 3: Z3

(2) Reference number for random-matching type

Roller slide

RAA 35 AN P6 Z -F

Random-matching roller slide series code
RAA: RA Series random-matching roller slide
Size
Roller slide shape code (See page A304.)
Accuracy code
P6 and K6: Precision grade is only available. (See Table 17.)
Preload code: Z
Z: Medium preload is only available.
Option code
No code: No surface treatment
-F: Fluoride low temperature chrome plating
-C: No surface treatment + Rail cover
-CF: Fluoride low temperature chrome plating + Rail cover

Rail

R1A 35 1000 L C N - P6 Z**

Random-matching rail series code
R1A: RA Series random-matching rail
Size
Rail length (mm)
Rail shape code: L
L: Standard
Material/surface treatment code (See Table 16.)
*Butting rail specification
N: Non-butting. L: Butting specification
Design serial number
Added to the reference number.
Accuracy code (See Table 17.)
P6: Precision grade is only available.
Preload code: Z
Z: Medium preload is only available.

*Please consult with NSK for butting rail specification.

The reference number coding for the assembly of random-matching type is the same as that of the preloaded assembly. However, the applicable preload code is "medium preload Z" only.

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 pages A38 for NSK K1 lubrication unit.

9. Dimensions

RA-AN (High-load type / Standard)

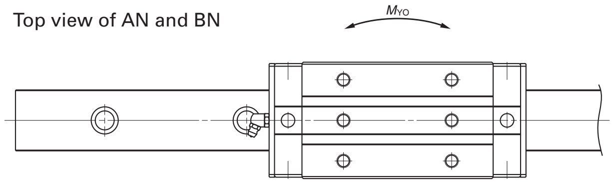
RA-BN (Super-high-load type / Long)

RA 35 1000 AN C 2 -＊＊ P6 Z

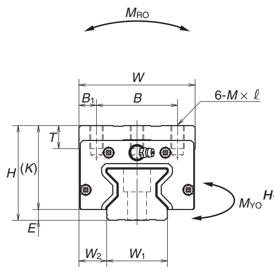
Series name
Size
Rail length (mm)
Roller slide shape code (See page A304.)
Material/surface treatment code (See Table 16.)
C: Special high carbon steel (NSK standard)

Preload code (See page A306.)
1: Z1, 3: Z3, Z: ZZ
Accuracy code (See Table 17.)
Design serial number
Added to the reference number.
Number of roller slides per rail

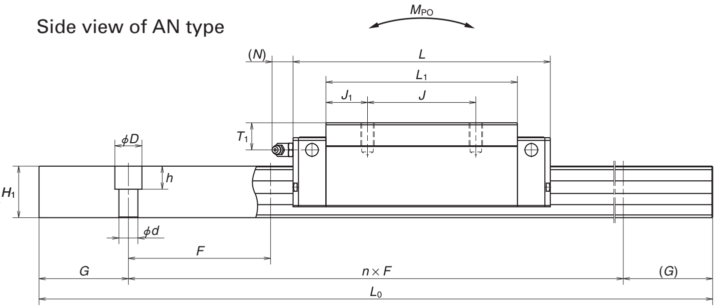
Top view of AN and BN



Front view of AN and BN types



Side view of AN type



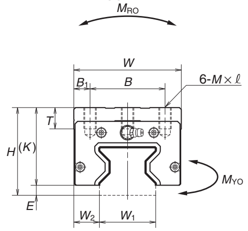
Reference number for roller slide of random-matching type

Ball slide **RAA 35 AN P6 Z -F**

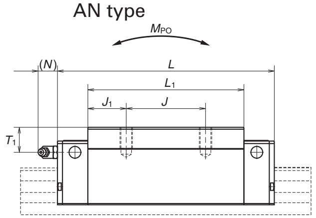
Random-matching roller slide series code
RAA: RA Series random-matching roller slide
Size
Roller slide shape code (See page A304.)

Option code
No code: No surface treatment
-F: Fluoride low temperature chrome plating
-C: No surface treatment + Rail cover
-CF:Fluoride low temperature chrome plating + Rail cover
Preload code: Z
Z: Medium preload is only available.
Accuracy code
P6 and K6: Precision grade is only available. (See Table 17.)

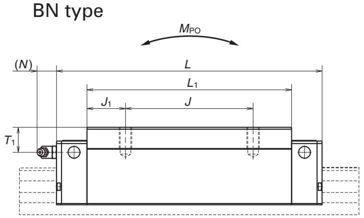
AN and BN types



AN type



BN type

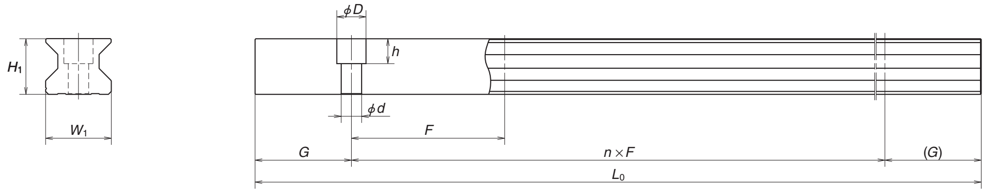


Reference number for rail of random-matching type

Rail **R1A 35 1000 L C N -＊＊ P6 Z**

Random-matching rail series code
R1A: RA Series random-matching rail
Size
Rail length (mm)
Rail shape code: L
L: Standard
Material/surface treatment code (See Table 16.)

Preload code: Z
Z: Medium preload is only available.
Accuracy code (See Table 17.)
P6 and K6: Precision grade is only available.
Design serial number
Added to the reference number.
*Butting rail specification
N: Non-butting. L: Butting specification
*Please consult with NSK for butting rail specification.



Model No.	Assembly			Roller slide													Rail						Basic load rating							Weight	
	Height			Width	Length	Mounting hole								Grease fitting			Width	Height	Pitch	Mounting bolt hole	G	Maximum length	Dynamic	Static	Static moment (N·m)					Roller slide	Rail
																							C	C_0	M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	M × pitch × ℓ	B_1	L_1	J_1	K	T	Hole size	T_1	N	W_1	H_1	F	$d \times D \times h$	(Reference)	L_{0max}	(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
RA15AN **RA15BN**	28	4	9.5	34	70 85.4	26	26	M4×0.7×6	4	44.8 60.2	9.4 17.1	24	8	ϕ3	8	3	15	16.3	60 (30)	4.5×7.5×5.3	20	2 000	10 300 13 000	27 500 37 000	260 350	210 375	1 320 2 130	210 375	1 320 2 130	0.21 0.30	1.6
RA20AN **RA20BN**	30	5	12	44	86.5 106.3	32	36 50	M5×0.8×6	6	57.5 77.3	10.75 13.65	25	12	ϕ3	4	3	20	20.8	60 (30)	6×9.5×8.5	20	3 000	19 200 24 000	52 500 70 000	665 890	505 900	3 100 5 000	505 900	3 100 5 000	0.38 0.50	2.6
RA25AN **RA25BN**	40	5	12.5	48	97.5 115.5	35	35 50	M6×1×9	6.5	65.5 83.5	15.25 16.75	35	12	M6×0.75	10	11	23	24	30 (60)	7×11×9	20	3 000	29 200 35 400	72 700 92 900	970 1 240	760 1 240	4 850 7 200	760 1 240	4 850 7 200	0.60 0.91	3.4
RA30AN **RA30BN**	45	6.5	16	60	110.8 135.4	40	40 60	M8×1.25×11	10	74 98.6	17 19.3	38.5	14	M6×0.75	10	11	28	28	40 (80)	9×14×12	20	3 500	38 900 47 600	93 500 121 000	1 670 2 170	1 140 1 950	7 100 11 500	1 140 1 950	7 100 11 500	1.0 1.3	4.9
RA35AN **RA35BN**	55	6.5	18	70	123.8 152	50	50 72	M8×1.25×12	10	83.2 111.4	16.6 19.7	48.5	15	M6×0.75	15	11	34	31	40 (80)	9×14×12	20	3 500	53 300 67 400	129 000 175 000	2 810 3 810	1 800 3 250	11 000 17 800	1 800 3 250	11 000 17 800	1.6 2.1	6.8
RA45AN **RA45BN**	70	8	20.5	86	154 190	60	60 80	M10×1.5×17	13	105.4 141.4	22.7 30.7	62	17	Rc1/8	20	14	45	38	52.5 (105)	14×20×17	22.5	3 500	92 800 116 000	229 000 305 000	6 180 8 240	4 080 7 150	24 000 39 000	4 080 7 150	24 000 39 000	3.0 4.1	10.9
RA55AN **RA55BN**	80	9	23.5	100	184 234	75	75 95	M12×1.75×18	12.5	128 178	26.5 41.5	71	18	Rc1/8	21	14	53	43.5	60 (120)	16×23×20	30	3 500	129 000 168 000	330 000 462 000	10 200 14 300	7 060 13 600	41 000 72 000	7 060 13 600	41 000 72 000	4.9 6.7	14.6
RA65AN **RA65BN**	90	13	31.5	126	228.4 302.5	76	70 120	M16×2×20	25	155.4 229.5	42.7 54.75	77	22	Rc1/8	19	14	63	55	75 (150)	18×26×22	35	3 500	210 000 288 000	504 000 756 000	19 200 28 700	12 700 28 600	78 500 153 000	12 700 28 600	78 500 153 000	9.3 12.2	22.0

Notes: 1) Select either one of two F dimensions, the standard or the parenthesized semi-standard dimension, for the pitch of rail fixing bolt holes. If not specified, the standard dimension of F is applied.

2) The random-matching type is available for the models of RA25 to RA65.

3) Basic load rating complies with ISO standards (ISO14728-1, ISO14728-2).
If above basic dynamic load rating (100-km rating) is converted into 50-km rating, use the following formula:
$C_{50\ km} = 1.23 \times C_{100\ km}$

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

RA 35 1000 AL C 2 -** P6 Z

Series name

Size

Rail length (mm)

Roller slide shape code (See page A304.)

Material/surface treatment code (See Table 16.)

C: Special high carbon steel (NSK standard)

Preload code (See page A306.)

1: Z1, 3: Z3, Z: ZZ

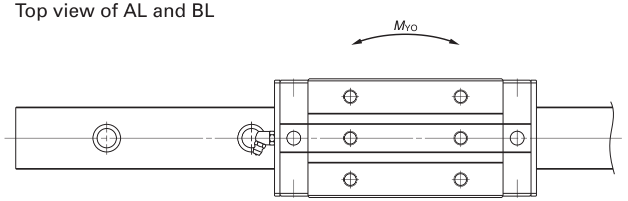
Accuracy code (See Table 17.)

Design serial number

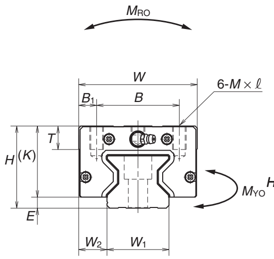
Added to the reference number.

Number of roller slides per rail

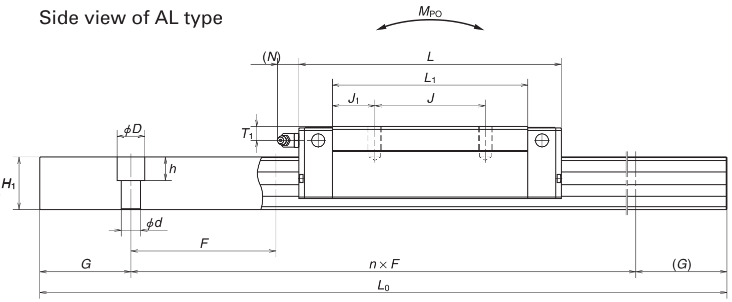
Top view of AL and BL



Front view of AL and BL types



Side view of AL type



Reference number for roller slide of random-matching type

Ball slide RAA 35 AL P6 Z -F

Random-matching roller slide series code

RAA: RA Series random-matching roller slide

Size

Roller slide shape code (See page A304.)

Option code

No code: No surface treatment

-F: Fluoride low temperature chrome plating

-C: No surface treatment + Rail cover

-CF: Fluoride low temperature chrome plating + Rail cover

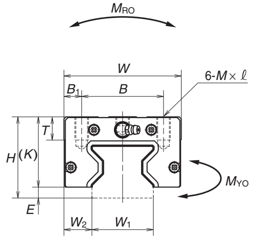
Preload code: Z

Z: Medium preload is only available.

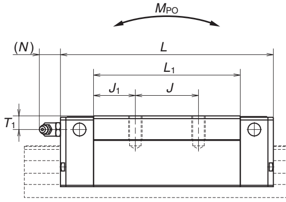
Accuracy code

P6 and K6: Precision grade is only available. (See Table 17.)

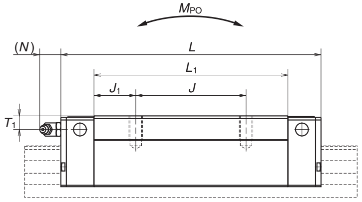
AL and BL types



AL type



BL type



Reference number for rail of random-matching type

Rail R1A35 1000 L C N -** P6 Z

Random-matching rail series code

R1A: RA Series random-matching rail

Size

Rail length (mm)

Rail shape code: L

L: Standard

Material/surface treatment code (See Table 16.)

Preload code: Z

Z: Medium preload is only available.

Accuracy code (See Table 17.)

P6 and K6: Precision grade is only available.

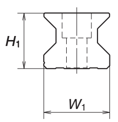
Design serial number

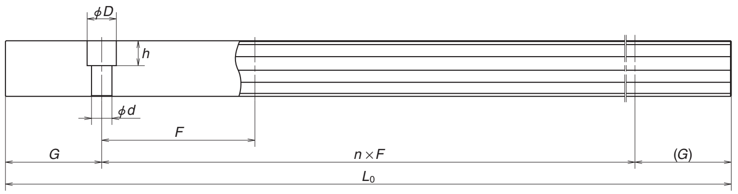
Added to the reference number.

*Butting rail specification

N: Non-butting. L: Butting specification

*Please consult with NSK for butting rail specification.





Model No.	Assembly			Roller slide													Rail						Basic load rating							Weight	
	Height			Width	Length	Mounting hole								Grease fitting			Width	Height	Pitch	Mounting bolt hole	G	Maximum length	Dynamic	Static	Static moment (N·m)					Roller slide	Rail
																									M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	M × pitch × ℓ	B_1	L_1	J_1	K	T	Hole size	T_1	N	W_1	H_1	F	d × D × h	(Reference)	L_{0max}	C (N)	C_0 (N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
RA15AL **RA15BL**	24	4	9.5	34	70 85.4	26	26	M4×0.7×5.5	4	44.8 60.2	9.4 17.1	20	8	ϕ3	4	3	15	16.3	60 (30)	4.5×7.5×5.3	20	2 000	10 300 13 000	27 500 37 000	260 350	210 375	1 320 2 130	210 375	1 320 2 130	0.17 0.25	1.6
RA25AL **RA25BL**	36	5	12.5	48	97.5 115.5	35	35 50	M6×1×8	6.5	65.5 83.5	15.25 16.75	31	12	M6×0.75	6	11	23	24	30 (60)	7×11×9	20	3 000	29 200 35 400	72 700 92 900	970 1 240	760 1 240	4 850 7 200	760 1 240	4 850 7 200	0.45 0.80	3.4
RA30AL **RA30BL**	42	6.5	16	60	110.8 135.4	40	40 60	M8×1.25×11	10	74 98.6	17 19.3	35.5	14	M6×0.75	7	11	28	28	40 (80)	9×14×12	20	3 500	38 900 47 600	93 500 121 000	1 670 2 170	1 140 1 950	7 100 11 500	1 140 1 950	7 100 11 500	0.85 1.1	4.9
RA35AL **RA35BL**	48	6.5	18	70	123.8 152	50	50 72	M8×1.25×12	10	83.2 111.4	16.6 19.7	41.5	15	M6×0.75	8	11	34	31	40 (80)	9×14×12	20	3 500	53 300 67 400	129 000 175 000	2 810 3 810	1 800 3 250	11 000 17 800	1 800 3 250	11 000 17 800	1.2 1.7	6.8
RA45AL **RA45BL**	60	8	20.5	86	154 190	60	60 80	M10×1.5×16	13	105.4 141.4	22.7 30.7	52	17	Rc1/8	10	14	45	38	52.5 (105)	14×20×17	22.5	3 500	92 800 116 000	229 000 305 000	6 180 8 240	4 080 7 150	24 000 39 000	4 080 7 150	24 000 39 000	2.5 3.4	10.9
RA55AL **RA55BL**	70	9	23.5	100	184 234	75	75 95	M12×1.75×18	12.5	128 178	26.5 41.5	61	18	Rc1/8	11	14	53	43.5	60 (120)	16×23×20	30	3 500	129 000 168 000	330 000 462 000	10 200 14 300	7 060 13 600	41 000 72 000	7 060 13 600	41 000 72 000	4.1 5.7	14.6

Notes: 1) Select either one of two F dimensions, the standard or the parenthesized semi-standard dimension, for the pitch of rail fixing bolt holes. If not specified, the standard dimension of F is applied.

2) The random-matching type is available for the models of RA25 to RA55.

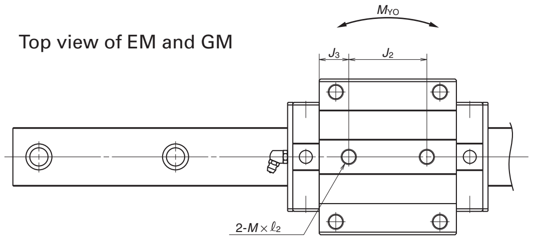
3) Basic load rating complies with ISO standards (ISO14728-1, ISO14728-2).
If above basic dynamic load rating (100-km rating) is converted into 50-km rating, use the following formula:
$C_{50\text{ km}} = 1.23 \times C_{100\text{ km}}$

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

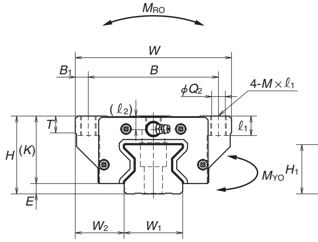
RA 35 1000 EM C 2 -∗∗ P6 Z

Series name
Size
Rail length (mm)
Roller slide shape code (See page A304.)
Material/surface treatment code (See Table 16.)
C: Special high carbon steel (NSK standard)
Number of roller slides per rail
Design serial number
Added to the reference number.
Accuracy code (See Table 17.)
Preload code (See page A306.)
1: Z1, 3: Z3, Z: ZZ

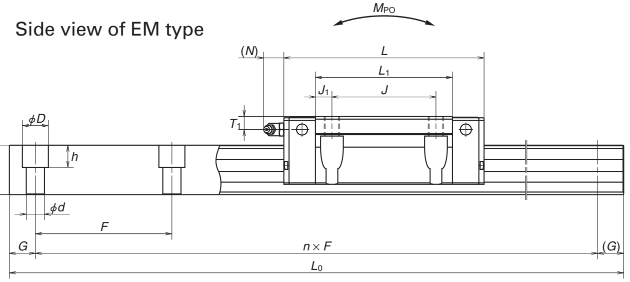
Top view of EM and GM



Front view of EM and GM types



Side view of EM type

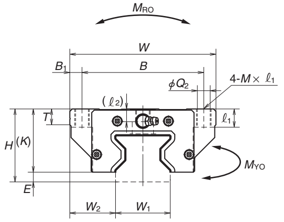


Reference number for roller slide of random-matching type

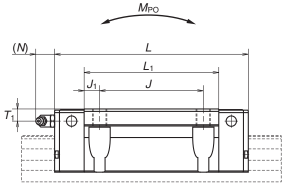
Ball slide **RAA 35 EM P6 Z -F**

Random-matching roller slide series code
RAA: RA Series random-matching roller slide
Size
Roller slide shape code (See page A304.)
Accuracy code
P6 and K6: Precision grade is only available. (See Table 17.)
Preload code: Z
Z: Medium preload is only available.
Option code
No code: No surface treatment
-F: Fluoride low temperature chrome plating
-C: No surface treatment + Rail cover
-CF: Fluoride low temperature chrome plating + Rail cover

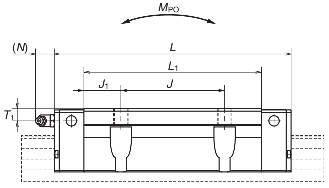
EM and GM types



EM type



GM type

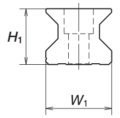


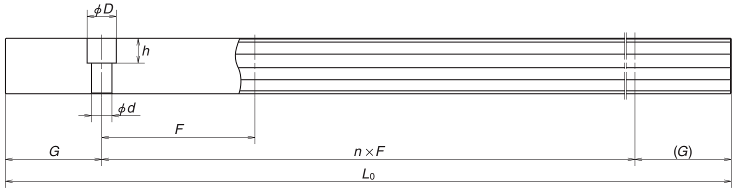
Reference number for rail of random-matching type

Rail **R1A35 1000 L C N -∗∗ P6 Z**

Random-matching rail series code
R1A: RA Series random-matching rail
Size
Rail length (mm)
Rail shape code: L
L: Standard
Material/surface treatment code (See Table 16.)
*Butting rail specification
N: Non-butting. L: Butting specification
Design serial number
Added to the reference number.
Accuracy code (See Table 17.)
P6 and K6: Precision grade is only available.
Preload code: Z
Z: Medium preload is only available.

*Please consult with NSK for butting rail specification.





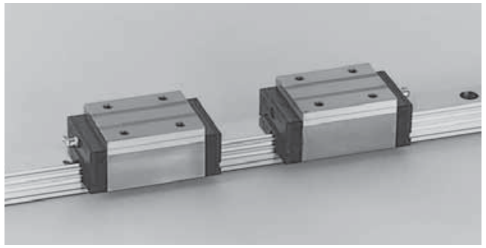
Model No.	Assembly			Roller slide																Rail						Basic load rating							Weight	
	Height			Width	Length	Mounting hole											Grease fitting			Width	Height	Pitch	Mounting bolt hole	G	Maximum length	Dynamic	Static	Static moment (N·m)					Roller slide	Rail
																												M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	J_2	M×pitch×$\ell_1(\ell_2)$	Q_2	B_1	L_1	J_1	J_3	K	T	Hole size	T_1	N	W_1	H_1	F	d×D×h	(Reference)	$L_{0\max}$	C (N)	C_0 (N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
RA15EM **RA15GM**	24	4	16	47	70 85.4	38	30	26	M5×0.8×8.5 (6.5)	4.4	4.5	44.8 60.2	7.4 15.1	9.4 17.1	20	8	ϕ3	4	3	15	16.3	60 (30)	4.5×7.5×5.3	20	2 000	10 300 13 000	27 500 37 000	260 350	210 375	1 320 2 130	210 375	1 320 2 130	0.21 0.28	1.6
RA20EM **RA20GM**	30	5	21.5	63	86.5 106.3	53	40	35	M6×1×9.5 (8)	5.3	5	57.5 77.3	8.75 18.65	11.25 21.15	25	10	ϕ3	4	3	20	20.8	60 (30)	6×9.5×8.5	20	3 000	19 200 24 000	52 500 70 000	665 890	505 900	3 100 5 000	505 900	3 100 5 000	0.45 0.65	2.6
RA25EM **RA25GM**	36	5	23.5	70	97.5 115.5	57	45	40	M8×1.25×10 (11)	6.8	6.5	65.5 83.5	10.25 19.25	12.75 21.75	31	11	M6×0.75	6	11	23	24	30 (60)	7×11×9	20	3 000	29 200 35 400	72 700 92 900	970 1 240	760 1 240	4 850 7 200	760 1 240	4 850 7 200	0.80 1.1	3.4
RA30EM **RA30GM**	42	6.5	31	90	110.8 135.4	72	52	44	M10×1.5×12 (12.5)	8.6	9	74 98.6	11 23.3	15 27.3	35.5	11	M6×0.75	7	11	28	28	40 (80)	9×14×12	20	3 500	38 900 47 600	93 500 121 000	1 670 2 170	1 140 1 950	7 100 11 500	1 140 1 950	7 100 11 500	1.3 1.7	4.9
RA35EM **RA35GM**	48	6.5	33	100	123.8 152	82	62	52	M10×1.5×13 (7)	8.6	9	83.2 111.4	10.6 24.7	15.6 29.7	41.5	12	M6×0.75	8	11	34	31	40 (80)	9×14×12	20	3 500	53 300 67 400	129 000 175 000	2 810 3 810	1 800 3 250	11 000 17 800	1 800 3 250	11 000 17 800	1.7 2.3	6.8
RA45EM **RA45GM**	60	8	37.5	120	154 190	100	80	60	M12×1.75×15 (10.5)	10.5	10	105.4 141.4	12.7 30.7	22.7 40.7	52	13	Rc1/8	10	14	45	38	52.5 (105)	14×20×17	22.5	3 500	92 800 116 000	229 000 305 000	6 180 8 240	4 080 7 150	24 000 39 000	4 080 7 150	24 000 39 000	3.2 4.3	10.9
RA55EM **RA55GM**	70	9	43.5	140	184 234	116	95	70	M14×2×18 (13)	12.5	12	128 178	16.5 41.5	29 54	61	15	Rc1/8	11	14	53	43.5	60 (120)	16×23×20	30	3 500	129 000 168 000	330 000 462 000	10 200 14 300	7 060 13 600	41 000 72 000	7 060 13 600	41 000 72 000	5.4 7.5	14.6
RA65EM **RA65GM**	90	13	53.5	170	228.4 302.5	142	110	82	M16×2×24 (18.5)	14.6	14	155.4 229.5	22.7 59.75	36.7 73.75	77	22	Rc1/8	19	14	63	55	75 (150)	18×26×22	35	3 500	210 000 288 000	504 000 756 000	19 200 28 700	12 700 28 600	78 500 153 000	12 700 28 600	78 500 153 000	12.2 16.5	22.0

Notes: 1) Select either one of two F dimensions, the standard or the parenthesized semi-standard dimension, for the pitch of rail fixing bolt holes. If not specified, the standard dimension of F is applied.

2) The random-matching type is available for the models of RA25 to RA65.

3) Basic load rating complies with ISO standards (ISO14728-1, ISO14728-2).
If above basic dynamic load rating (100-km rating) is converted into 50-km rating, use the following formula:
$C_{50\,\mathrm{km}} = 1.23 \times C_{100\,\mathrm{km}}$

A-5-3.2 LA Series



1. Features

(1) High rigidity and high load carrying capacity

A set of three ball grooves is made on both sides of ball slide and a rail. This contributes to the increased rigidity and load carrying capacity. The top and bottom groove are formed in the circular arc with a closer radius of ball, which ensures great rigidity and load carrying capacity. With the Gothic arch center groove, rigidity and load carrying capacity are further increased.

(2) Moderate friction

A well-balanced combination of 2-point contacts at the top and bottom grooves and 4 points contact at the center groove provides moderate friction while ensuring rigidity by appropriate preload.

(3) Four-way equal load distribution

The contact angle of balls is set at 45 degrees in all grooves, thereby dispersing the load equally to four rows irrespective of load direction. This realizes equal rigidity and load carrying capacity in vertical and lateral directions and provides well-balanced design.

(4) Strong against shock load

Load from any direction, vertical and lateral, is received by four ball rows at all times. The number of the ball rows which receive the load is larger than in other linear guides, making this series stronger against shock load.

(5) High accuracy

As showing in **Fig. 4**, fixing the measuring rollers is easy thanks to the Gothic arch groove of the central ball groove. This benefits an accurate and measuring of ball groove for a highly precise and stable manufacturing.

(6) The dust protection design

The rail's cross section is designed as simple as possible, thereby improving the sealing efficiency combined with the enhanced sealing function. In addition, optional inner seals are available.

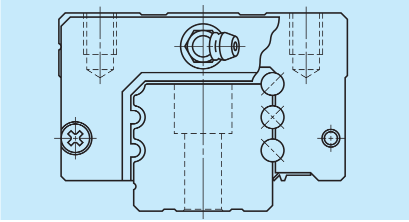


Fig. 1 LA Series

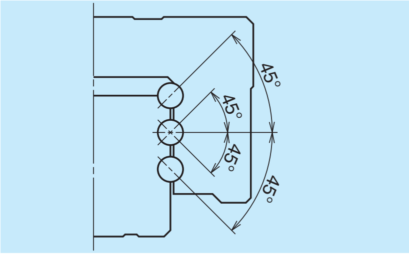


Fig. 2 Super rigidity design

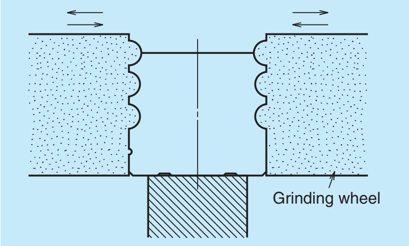


Fig. 3 Rail grinding

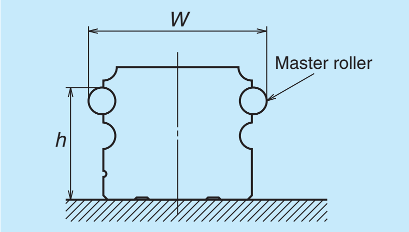
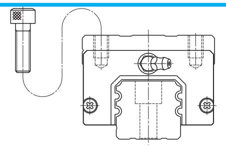
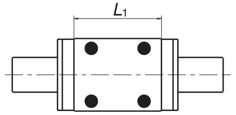
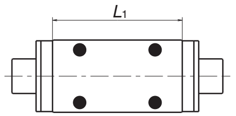
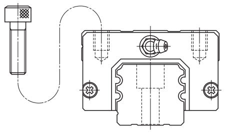
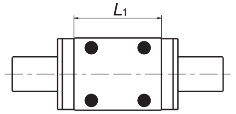
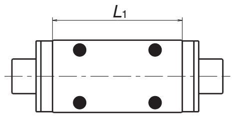
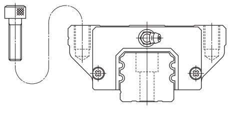
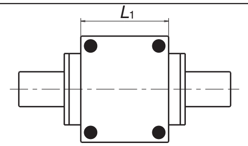
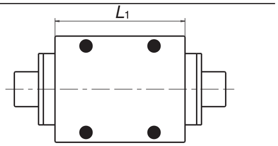
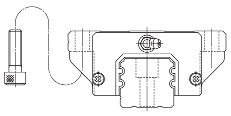
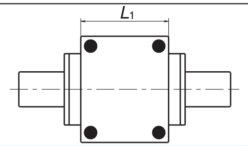
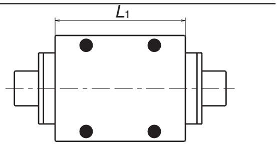


Fig. 4 Measuring groove accuracy

2. Ball slide shape

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

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

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

(2) Accuracy standard

The LA Series has four accuracy grades: Ultra precision P3, Super precision P4, High precision P5, and Precision grade P6.

Table 2

Unit: µm

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

(3) Assembled accuracy

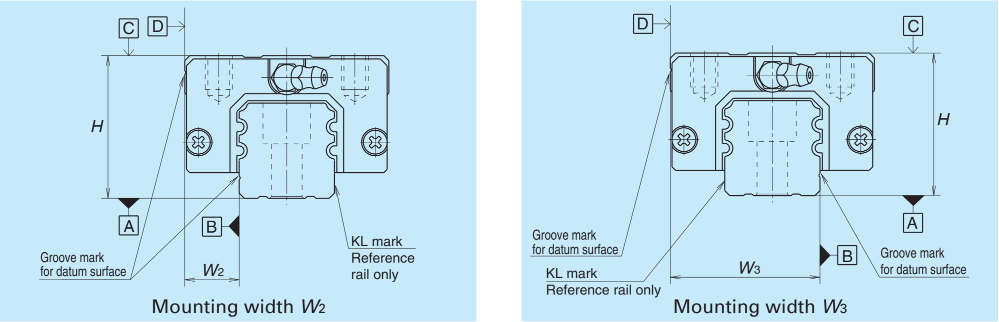


Fig. 5

4. Preload and rigidity

Table 3 shows preload and rigidity of LA Series.

The LA Series has two types of preload specification: Medium preload Z3 and Heavy preload Z4.

Table 3

	Model No.	Preload (N)		Rigidity (N/µm)	
		Medium preload Z3	Heavy preload Z4	Medium preload Z3	Heavy preload Z4
High-load type	LA25 AL, AN, EL, FL	1 670	2 110	475	550
	LA30 AL, AN, EL, FL	2 450	3 140	705	835
	LA35 AL, AN, EL, FL	3 450	4 300	825	970
	LA45 AL, AN, EL, FL	5 050	6 350	1 100	1 240
	LA55 AL, AN, EL, FL	8 100	10 200	1 400	1 540
	LA65 AN, EL, FL	13 800	18 800	1 730	2 030
Super-high-load type	LA25 BL, BN, GL, HL	2 260	2 840	700	820
	LA30 BL, BN, GL, HL	3 250	4 050	1 000	1 180
	LA35 BL, BN, GL, HL	4 450	5 650	1 200	1 400
	LA45 BL, BN, GL, HL	6 150	7 750	1 450	1 640
	LA55 BL, BN, GL, HL	9 550	12 100	1 840	2 020
	LA65 BN, GL, HL	18 000	24 400	2 450	2 840

4. Maximum rail length

Table 4 shows the limitations of rail length. However, the limitations vary by accuracy grades.

Table 4 Length limitations of rails

Unit: mm

Size / Series	25	30	35	45	55	65
LA	3 960	4 000	4 000	3 990	3 960	3 900

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

5. Installation

(1) Permissible values of mounting error

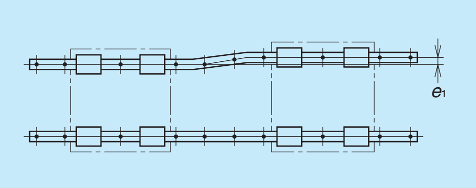


Fig. 6

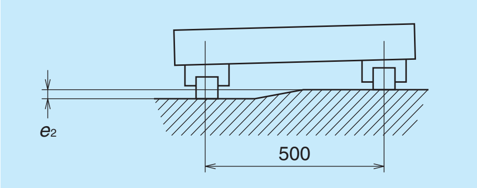


Fig. 7

Table 5

Unit: µm

Value	Preload	Model No.					
		LA25	LA30	LA35	LA45	LA55	LA65
Permissible values of parallelism in two rails e_1	Z3	15	17	20	25	30	40
	Z4	13	15	17	20	25	30
Permissible values of parallelism (height) in two rails e_2	Z3, Z4	185 µm/500 mm					

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

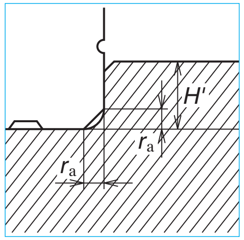


Fig. 8 Shoulder for the rail datum surface

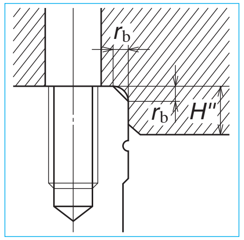


Fig. 9 Shoulder for the ball slide datum surface

Table 6

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	*H'*	*H''*
LA25	0.5	0.5	5	5
LA30	0.5	0.5	6	6
LA35	0.5	0.5	6	6
LA45	0.7	0.7	8	8
LA55	0.7	0.7	10	10
LA65	1	1	11	11

6. Lubrication components

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

(1) Types of lubrication accessories

Fig. 10 and **Table 7** show grease fittings and tube fittings.

(2) Mounting position of lubrication accessories

- The standard position of grease fittings is the end face of ball slide. We mount them on a side of end cap for an option. (**Fig. 11**) .
- Please consult NSK for installation of grease or tube fittings to the ball slide body or side of end cap.
- When using a piping unit with thread of M6 × 1, you require a connector to connect to a grease fitting mounting hole with M6 × 0.75. The connector is available from NSK.

Table 7 Unit: mm

Model No.	Dust proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
LA25	Standard	5	5
	With NSK K1	14	12
	Double seal	10	9
	Protector	10	9
LA30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
LA35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
LA45	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
LA55	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
LA65	Standard	8	17
	With NSK K1	22	25.5
	Double seal	16	19
	Protector	16	17

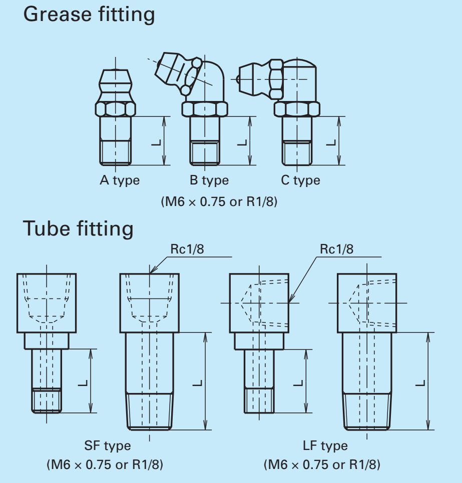


Fig. 10 Grease fitting and tube fitting

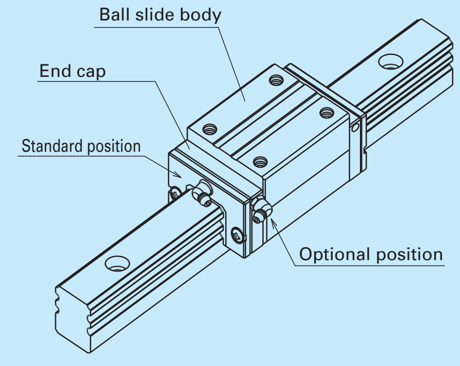


Fig. 11 Mounting position of lubrication accessories

7. Dust-proof components

(1) Standard Specification

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

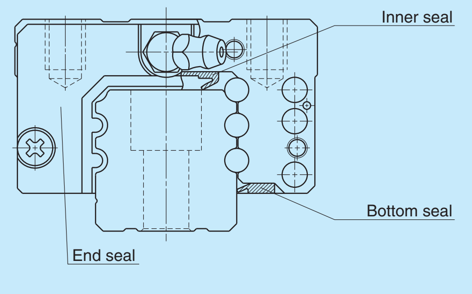


Fig. 12

Table 8 Seal friction per ball slide (maximum value) Unit: N

Series \ Size	25	30	35	45	55	65
LA	11	11	12	17	17	23

(2) NSK K1™ lubrication unit

Table 9 shows the dimension of linear guides equipped with the NSK K1 lubrication unit.

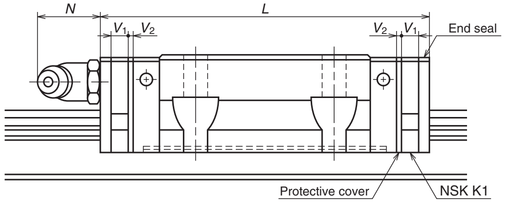


Table 9 Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_1	Protective cover thickness V_2	Protruding area of the grease fitting N
LA25	Standard	AL, AN, EL, FL	79.8	91.8	5.0	1.0	(14)
	Long	BL, BN, GL, HL	107.8	119.8			
LA30	Standard	AL, AN, EL, FL	100.2	113.2	5.5	1.0	(14)
	Long	BL, BN, GL, HL	126.2	139.2			
LA35	Standard	AL, AN, EL, FL	110.6	123.6	5.5	1.0	(14)
	Long	BL, BN, GL, HL	144.6	157.6			
LA45	Standard	AL, AN, EL, FL	141.4	156.4	6.5	1.0	(15)
	Long	BL, BN, GL, HL	173.4	188.4			
LA55	Standard	AL, AN, EL, FL	165.4	180.4	6.5	1.0	(15)
	Long	BL, BN, GL, HL	203.4	218.4			
LA65	Standard	AN, EL, FL	196.2	214.2	8.0	1.0	(16)
	Long	BN, GL, HL	256.2	274.2			

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

(3) Double seal and protector

For the LA Series, a double seal and a protector can be installed only before shipping from the factory. Please consult with NSK when the double seal and the protectors are required.

Table 10 shows the increased thickness of V_3 and V_4 when end seals and protectors are installed (**Fig. 15**).

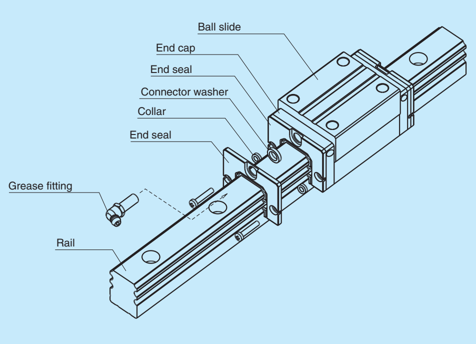


Fig. 13 Double seal

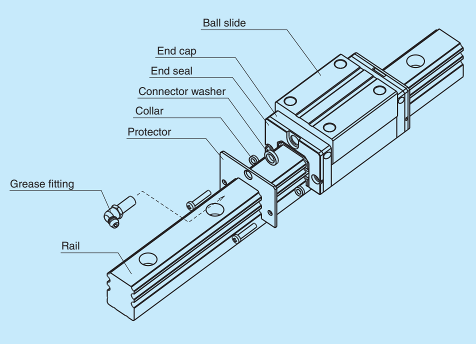


Fig. 14 Protector

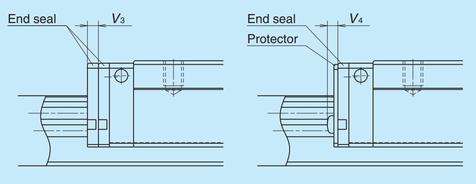


Fig. 15

Table 10

Unit: mm

Model No.	Thickness of end seal: V_3	Thickness of protector: V_4
LA25	3.2	3.6
LA30	4.4	4.2
LA35	4.4	4.2
LA45	5.5	4.9
LA55	5.5	4.9
LA65	6.5	5.5

(4) Cap to plug the rail mounting bolt hole

Table 11 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
LA25	M6	LG-CAP/M6	20
LA30, LA35	M8	LG-CAP/M8	20
LA45	M12	LG-CAP/M12	20
LA55	M14	LG-CAP/M14	20
LA65	M16	LG-CAP/M16	20

(5) Bellows

Make tap holes to the rail end face to fix the bellows mounting plate.

NSK processes tap holes to the rail end face when ordered with a linear guide.

Dimension tables of bellows
LA Series

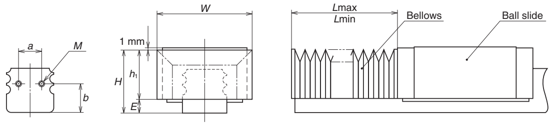


Fig. 16 Dimensions of bellows

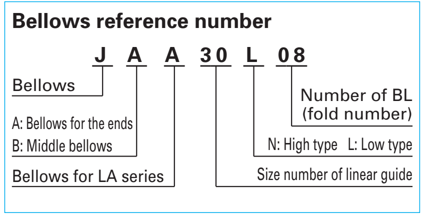


Table 12 Dimensions of bellows

Unit: mm

Model No.	H	h_1	E	W	P	a	b	Length of BL	Tap (M) × depth
JAA25L	35	29.5	5.5	55	12	12	13.8	17	M3 × 5
JAA25N	39	33.5	5.5	61	15	12	13.8	17	M3 × 5
JAA30L	41	33.5	7.5	60	12	14	17.5	17	M4 × 6
JAA30N	44	36.5	7.5	66	15	14	17.5	17	M4 × 6
JAA35L	47	39.5	7.5	72	15	15	18.8	17	M4 × 6
JAA35N	54	46.5	7.5	82	20	15	18.8	17	M4 × 6
JAA45L	59	49	10	93	20	25	22.5	17	M5 × 8
JAA45N	69	59	10	113	30	25	22.5	17	M5 × 8
JAA55L	69	57	12	101	20	35	27.1	17	M5 × 8
JAA55N	79	67	12	121	30	35	27.1	17	M5 × 8
JAA65N	89	75	14	131	30	40	33.3	17	M6 × 12

Table 13 Numbers of folds (BL) and length of bellows

Unit: mm

Type	Model No.	Length of BL	2	4	6	8	10	12	14	16	18	20
		*L*min	34	68	102	136	170	204	238	272	306	340
Low type	JAA25L	Stroke	134	268	402	536	670	804	938	1 072	1 206	1 340
		*L*max	168	336	504	672	840	1 008	1 176	1 344	1 512	1 680
High type	JAA25N	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
		*L*max	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
Low type	JAA30L	Stroke	134	268	402	536	670	804	938	1 072	1 206	1 340
		*L*max	168	336	504	672	840	1 008	1 176	1 344	1 512	1 680
High type	JAA30N	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
		*L*max	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
Low type	JAA35L	Stroke	176	352	528	704	880	1 056	1 232	1 408	1 584	1 760
		*L*max	210	420	630	840	1 050	1 260	1 470	1 680	1 890	2 100
High type	JAA35N	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
		*L*max	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
Low type	JAA45L	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
		*L*max	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
High type	JAA45N	Stroke	386	772	1 158	1 544	1 930	2 316	2 702	3 088	3 474	3 860
		*L*max	420	840	1 260	1 680	2 100	2 520	2 940	3 360	3 780	4 200
Low type	JAA55L	Stroke	246	492	738	984	1 230	1 476	1 722	1 968	2 214	2 460
		*L*max	280	560	840	1 120	1 400	1 680	1 960	2 240	2 520	2 800
High type	JAA55N	Stroke	386	772	1 158	1 544	1 930	2 316	2 702	3 088	3 474	3 860
		*L*max	420	840	1 260	1 680	2 100	2 520	2 940	3 360	3 780	4 200
Low/high type	JAA65N*	Stroke	386	772	1 158	1 544	1 930	2 316	2 702	3 088	3 474	3 860
		*L*max	420	840	1 260	1 680	2 100	2 520	2 940	3 360	3 780	4 200

∗ Bellows for LA65 is for both low and high types.

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

8. Reference number

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

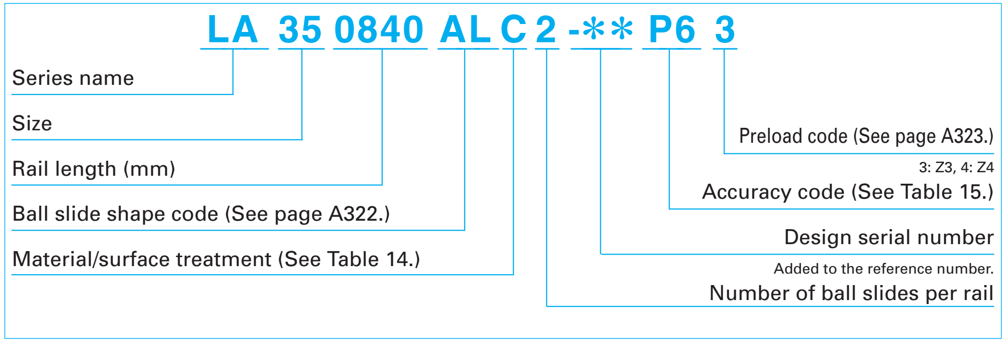


Table 14 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
Z	Other, special

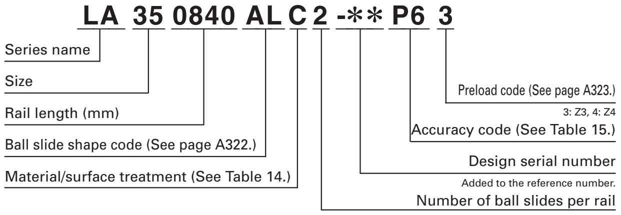
Table 15 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5
Precision grade	P6	K6

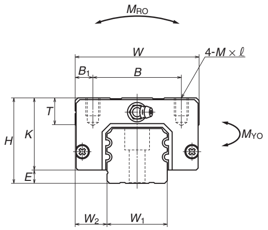
Note: Refer to pages A38 for NSK K1 lubrication unit.

9. Dimensions

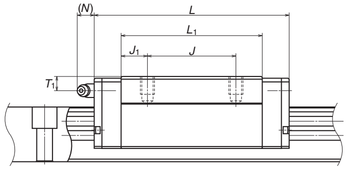
LA-AL (High-load type / Standard)
LA-BL (Super-high-load type / Long)



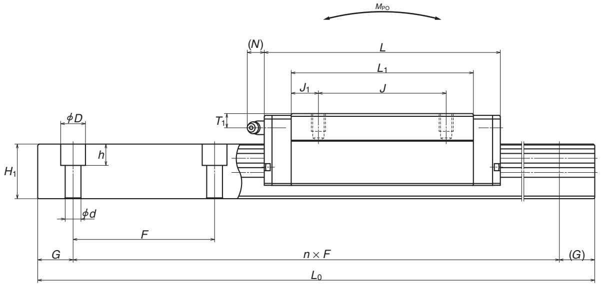
Front view of AL and BL types



Side view of AL type



Side view of BL type



Model No.	Assembly			Ball slide												
	Height			Width	Length	Mounting hole								Grease fitting		
	H	E	W_2	W	L	B	J	M×pitch×ℓ	B_1	L_1	J_1	K	T	Hole size	T_1	N
LA25AL	36	5.5	12.5	48	79.8	35	35	M6×1×7	6.5	58	11.5	30.5	8	M6×0.75	6	11
LA25BL					107.8		50			86	18					
LA30AL	42	7.5	16	60	100.2	40	40	M8×1.25×10	10	72	16	34.5	11	M6×0.75	6.5	11
LA30BL					126.2		60			98	19					
LA35AL	48	7.5	18	70	110.6	50	50	M8×1.25×10	10	80	15	40.5	15	M6×0.75	8	11
LA35BL					144.6		72			114	21					
LA45AL	60	10	20.5	86	141.4	60	60	M10×1.5×16	13	105	22.5	50	17	Rc1/8	10	13
LA45BL					173.4		80			137	28.5					
LA55AL	70	12	23.5	100	165.4	75	75	M12×1.75×16	12.5	126	25.5	58	18	Rc1/8	11	13
LA55BL					203.4		95			164	34.5					

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

Unit: mm

Model No.	Rail						Basic load rating							Weight	
	Width	Height	Pitch	Mounting bolt hole	G	Max. length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
							C	C_0	M_{RO}	M_{PO}		M_{YO}			
	W_1	H_1	F	d×D×h	(Reference)	L_{0max}	(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
LA25AL	23	22	60	7×11×9	20	3 960	30 000	50 000	290	410	2 490	410	2 490	0.5	3.7
LA25BL							40 500	77 000	445	935	5 000	935	5 000	0.8	
LA30AL	28	28	80	9×14×12	20	4 000	47 000	77 500	535	820	4 800	820	4 800	0.8	5.8
LA30BL							58 000	105 000	725	1 470	8 050	1 470	8 050	1.2	
LA35AL	34	30.8	80	9×14×12	20	4 000	61 500	98 000	845	1 130	6 750	1 130	6 750	1.3	7.7
LA35BL							80 500	143 000	1 240	2 330	12 500	2 330	12 500	1.6	
LA45AL	45	36	105	14×20×17	22.5	3 990	91 000	148 000	1 840	2 210	12 900	2 210	12 900	2.5	12.0
LA45BL							111 000	197 000	2 460	3 850	20 600	3 850	20 600	3.2	
LA55AL	53	43.2	120	16×23×20	30	3 960	139 000	215 000	3 150	3 800	22 000	3 800	22 000	3.9	17.2
LA55BL							172 000	292 000	4 250	6 800	36 000	6 800	36 000	5.1	

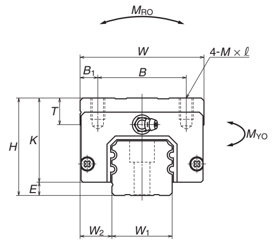
2) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface.
To convert C to C_{100} for a 100 km-rating fatigue life, divide C by 1.26.

LA-AN (High-load type / Standard)
LA-BN (Super-high-load type / Long)

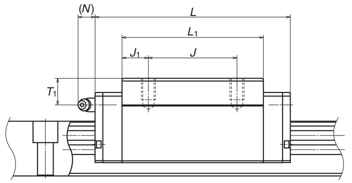
LA 35 0840 AN C 2 -∗∗ P6 3

- Series name — LA
- Size — 35
- Rail length (mm) — 0840
- Ball slide shape code (See page A322.) — AN
- Material/surface treatment (See Table 14.) — C
- Number of ball slides per rail — 2
- Design serial number — -∗∗ (Added to the reference number.)
- Accuracy code (See Table 15.) — P6
- Preload code (See page A323.) — 3 (3: Z3, 4: Z4)

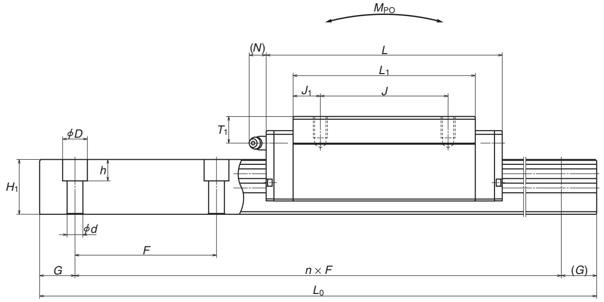
Front view of AN and BN types



Side view of AN type



Side view of BN type



Unit: mm

Model No.	Assembly			Ball slide												
	Height			Width	Length	Mounting hole								Grease fitting		
	H	E	W_2	W	L	B	J	M×pitch×ℓ	B_1	L_1	J_1	K	T	Hole size	T_1	N
LA25AN	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
LA25BN					107.8		50			86	18					
LA30AN	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
LA30BN					126.2		60			98	19					
LA35AN	55	7.5	18	70	110.6	50	50	M8×1.25×12	10	80	15	47.5	15	M6×0.75	15	11
LA35BN					144.6		72			114	21					
LA45AN	70	10	20.5	86	141.4	60	60	M10×1.5×16	13	105	22.5	60	17	Rc1/8	20	13
LA45BN					173.4		80			137	28.5					
LA55AN	80	12	23.5	100	165.4	75	75	M12×1.75×18	12.5	126	25.5	68	18	Rc1/8	21	13
LA55BN					203.4		95			164	34.5					
LA65AN	90	14	31.5	126	196.2	76	70	M16×2×19	25	147	38.5	76	22	Rc1/8	19	13
LA65BN					256.2		120			207	43.5					

Model No.	Rail						Basic load rating							Weight	
	Width	Height	Pitch	Mounting bolt hole	G	Max. length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
	W_1	H_1	F	d×D×h	(Reference)	L_{0max}	C (N)	C_0 (N)	M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	(kg)	(kg/m)
LA25AN	23	22	60	7×11×9	20	3 960	30 000	50 000	290	410	2 490	410	2 490	0.6	3.7
LA25BN							40 500	77 000	445	935	5 000	935	5 000	0.9	
LA30AN	28	28	80	9×14×12	20	4 000	47 000	77 500	535	820	4 800	820	4 800	0.9	5.8
LA30BN							58 000	105 000	725	1 470	8 050	1 470	8 050	1.3	
LA35AN	34	30.8	80	9×14×12	20	4 000	61 500	98 000	845	1 130	6 750	1 130	6 750	1.5	7.7
LA35BN							80 500	143 000	1 240	2 330	12 500	2 330	12 500	2.1	
LA45AN	45	36	105	14×20×17	22.5	3 990	91 000	148 000	1 840	2 210	12 900	2 210	12 900	3.0	12.0
LA45BN							111 000	197 000	2 460	3 850	20 600	3 850	20 600	3.9	
LA55AN	53	43.2	120	16×23×20	30	3 960	139 000	215 000	3 150	3 800	22 000	3 800	22 000	4.7	17.2
LA55BN							172 000	292 000	4 250	6 800	36 000	6 800	36 000	6.1	
LA65AN	63	55	150	18×26×22	35	3 900	260 000	420 000	7 300	9 050	51 000	9 050	51 000	7.7	25.9
LA65BN							340 000	615 000	10 700	18 700	95 000	18 700	95 000	10.8	

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

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

LA-EL (High-load type / Standard)
LA-GL (Super-high-load type / Long)

LA 35 0840 EL C 2 - P6 3**

Series name

Size

Rail length (mm)

Ball slide shape code (See page A322.)

Material/surface treatment (See Table 14.)

Preload code (See page A323.)

3: Z3, 4: Z4

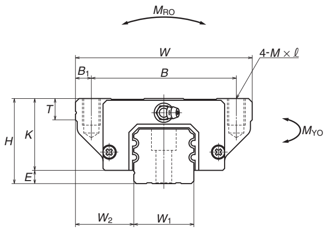
Accuracy code (See Table 15.)

Design serial number

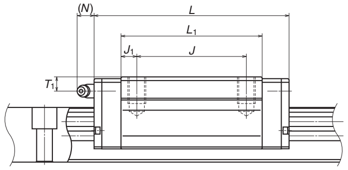
Added to the reference number.

Number of ball slides per rail

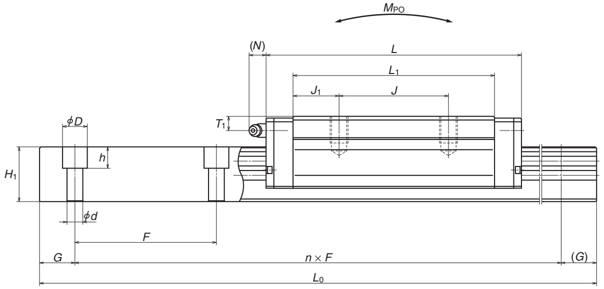
Front view of EL and GL types



Side view of EL type



Side view of GL type



Unit: mm

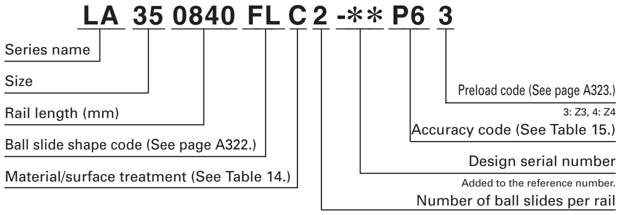
Model No.	Assembly			Ball slide												
	Height			Width	Length	Mounting hole								Grease fitting		
	H	E	W_2	W	L	B	J	M×pitch×ℓ	B_1	L_1	J_1	K	T	Hole size	T_1	N
LA25EL	36	5.5	23.5	70	79.8	57	45	M8×1.25×12	6.5	58	6.5	30.5	11	M6×0.75	6	11
LA25GL					107.8					86	20.5					
LA30EL	42	7.5	31	90	100.2	72	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					

Model No.	Rail						Basic load rating							Weight	
	Width	Height	Pitch	Mounting bolt hole	G	Max. length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
	W_1	H_1	F	d×D×h	(Reference)	L_{0max}	C (N)	C_0 (N)	M_{RO}	M_{PO}		M_{YO}		(kg)	(kg/m)
										One slide	Two slides	One slide	Two slides		
LA25EL	23	22	60	7×11×9	20	3 960	30 000	50 000	290	410	2 490	410	2 490	0.8	3.7
LA25GL							40 500	77 000	445	935	5 000	935	5 000	1.1	
LA30EL	28	28	80	9×14×12	20	4 000	47 000	77 500	535	820	4 800	820	4 800	1.3	5.8
LA30GL							58 000	105 000	725	1 470	8 050	1 470	8 050	1.8	
LA35EL	34	30.8	80	9×14×12	20	4 000	61 500	98 000	845	1 130	6 750	1 130	6 750	1.9	7.7
LA35GL							80 500	143 000	1 240	2 330	12 500	2 330	12 500	2.6	
LA45EL	45	36	105	14×20×17	22.5	3 990	91 000	148 000	1 840	2 210	12 900	2 210	12 900	3.3	12.0
LA45GL							111 000	197 000	2 460	3 850	20 600	3 850	20 600	4.3	
LA55EL	53	43.2	120	16×23×20	30	3 960	139 000	215 000	3 150	3 800	22 000	3 800	22 000	5.5	17.2
LA55GL							172 000	292 000	4 250	6 800	36 000	6 800	36 000	7.2	
LA65EL	63	55	150	18×26×22	35	3 900	260 000	420 000	7 300	9 050	51 000	9 050	51 000	11.0	25.9
LA65GL							340 000	615 000	10 700	18 700	95 000	18 700	95 000	15.5	

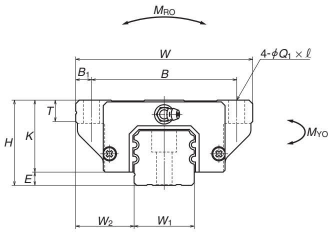
Notes: 1) LA Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.

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

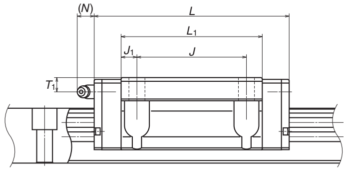
LA-FL (High-load type / Standard)
LA-HL (Super-high-load type / Long)



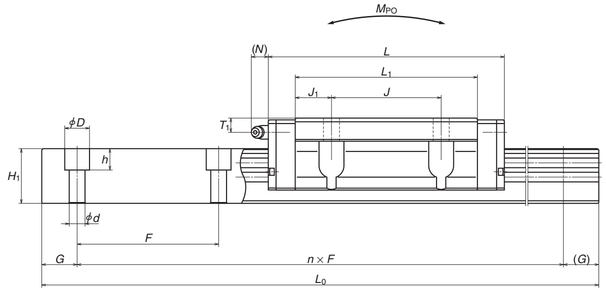
Front view of FL and HL types



Side view of FL type



Side view of HL type



Unit: mm

Model No.	Assembly			Ball slide												
	Height			Width	Length	Mounting hole								Grease fitting		
	H	E	W_2	W	L	B	J	$Q_1 \times \ell$	B_1	L_1	J_1	K	T	Hole size	T_1	N
LA25FL	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
LA25HL					107.8					86	20.5					
LA30FL	42	7.5	31	90	100.2	72	52	9×12	9	72	10	34.5	11	M6×0.75	6.5	11
LA30HL					126.2					98	23					
LA35FL	48	7.5	33	100	110.6	82	62	9×13	9	80	9	40.5	12	M6×0.75	8	11
LA35HL					144.6					114	26					
LA45FL	60	10	37.5	120	141.4	100	80	11×15	10	105	12.5	50	13	Rc1/8	10	13
LA45HL					173.4					137	28.5					
LA55FL	70	12	43.5	140	165.4	116	95	14×18	12	126	15.5	58	15	Rc1/8	11	13
LA55HL					203.4					164	34.5					
LA65FL	90	14	53.5	170	196.2	142	110	16×23	14	147	18.5	76	22	Rc1/8	19	13
LA65HL					256.2					207	48.5					

Model No.	Rail						Basic load rating							Weight	
	Width	Height	Pitch	Mounting bolt hole	G	Max. length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
							C	C_0	M_{RO}	M_{PO}		M_{YO}			
	W_1	H_1	F	$d \times D \times h$	(Reference)	L_{0max}	(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
LA25FL	23	22	60	7×11×9	20	3 960	30 000	50 000	290	410	2 490	410	2 490	0.8	3.7
LA25HL							40 500	77 000	445	935	5 000	935	5 000	11	
LA30FL	28	28	80	9×14×12	20	4 000	47 000	77 500	535	820	4 800	820	4 800	1.3	5.8
LA30HL							58 000	105 000	725	1 470	8 050	1 470	8 050	1.8	
LA35FL	34	30.8	80	9×14×12	20	4 000	61 500	98 000	845	1 130	6 750	1 130	6 750	1.9	7.7
LA35HL							80 500	143 000	1 240	2 330	12 500	2 330	12 500	2.6	
LA45FL	45	36	105	14×20×17	22.5	3 990	91 000	148 000	1 840	2 210	12 900	2 210	12 900	3.3	12.0
LA45HL							111 000	197 000	2 460	3 850	20 600	3 850	20 600	4.3	
LA55FL	53	43.2	120	16×23×20	30	3 960	139 000	215 000	3 150	3 800	22 000	3 800	22 000	5.5	17.2
LA55HL							172 000	292 000	4 250	6 800	36 000	6 800	36 000	7.2	
LA65FL	63	55	150	18×26×22	35	3 900	260 000	420 000	7 300	9 050	51 000	9 050	51 000	11.0	25.9
LA65HL							340 000	615 000	10 700	18 700	95 000	18 700	95 000	15.5	

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

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

A-5-4 High-Precision Machine and High-Precision Measuring Equipment

A-5-4.1 HA Series

1. Features

(1) High motion accuracy

High motion accuracy is achieved in both narrow and wide ranges by the adoption of ultra-long ball slides and the optimum design of the ball recirculation component.

(2) Ball passage vibration reduced to one-third of our conventional models

Our extensive performance tests show ball passage vibration has been reduced to one-third of our conventional models, dramatically improving straightness in table unit.

(3) Installation of rail with greater accuracy

Increased counterbore depth of the rail mounting hole reduces rail deflection, which is caused by bolt tightening when fixing the rail to the mounting base to 50% or less. This feature restrains the pitching motion of ball slide whose frequency matches to the mounting hole pitch.

In addition, the length of mounting hole pitch has been reduced by one-half of the conventional models, so the rail can be more accurately installed in position.

(4) High rigidity and load capacity with lower friction

High rigidity, high load capacity and low friction are achieved by increasing the number of balls.

(5) Compact design

Reduced body size enables more compact machinery.

(6) Four-way equal load distribution

Contact angle is set at 45 degrees in all grooves, dispersing the load to four ball rows irrespective of load direction. This realizes equal rigidity and load carrying capacity in vertical and lateral directions and provides well-balanced design.

(7) Strong against shock load

Load from any direction, vertical and lateral, is received by four ball rows at all times. The number of the ball row which receives the load is larger than in other linear guides, making this series stronger against shock load.

(8) High accuracy at manufacturing

Fixing the measuring rollers to the ball grooves is easy thanks to the Gothic arch groove. Ball-groove measuring is accurate and simple. This benefits a highly precise and stable manufacturing.

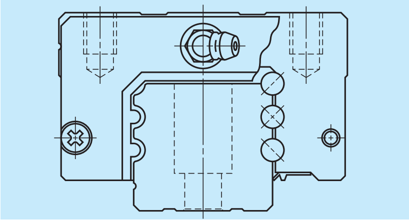


Fig. 1 HA Series

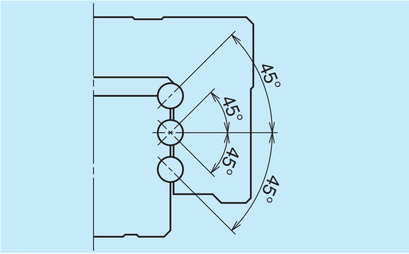


Fig. 2 Super rigidity design

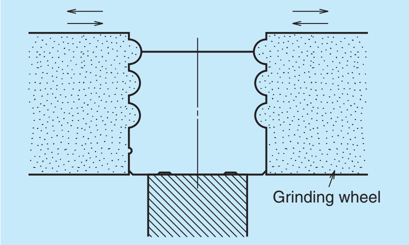


Fig. 3 Rail grinding

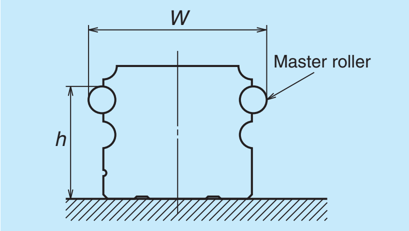


Fig. 4 Measuring groove accuracy

Measurement results of ball passage vibration

Ball passage vibration can translate into posture changes in the ball slide which result from ball passage (circulation). In the HA Series, this vibration has been substantially reduced to one-third of conventional models.

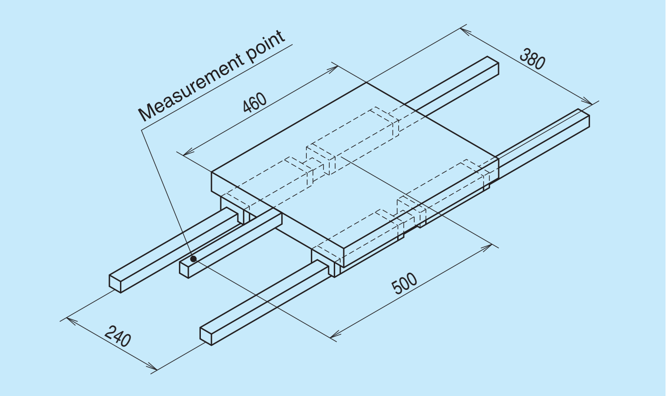


Fig. 5 Schematic view of measurement of ball passage vibration

HA Series

Model No.: HA30
Preload: Z3
Table dimensions: 460 mm × 380 mm

Conventional Series

Model No.: LA30
Preload: Z3
Table dimensions: 460 mm × 380 mm

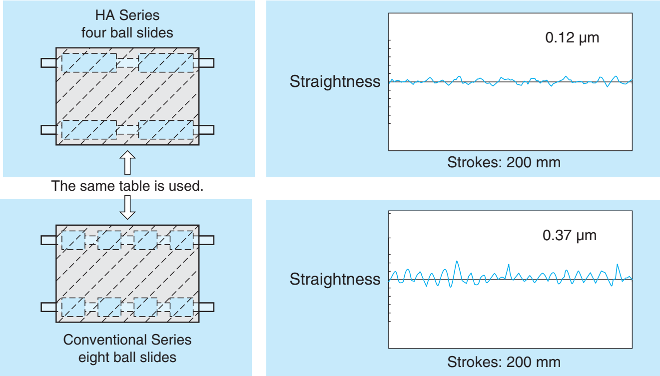
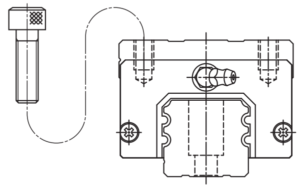
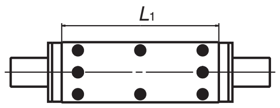
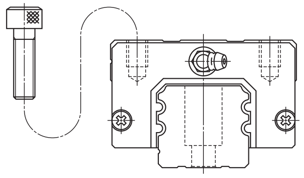
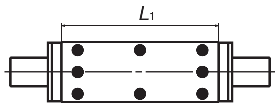
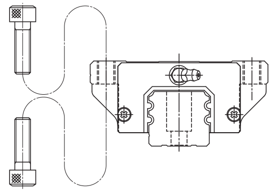
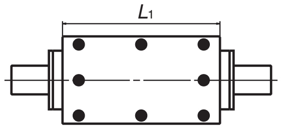


Fig. 6 Measurement results of HA Series and conventional Series

2. Ball slide shape

Ball slide Model	Shape/installation method	Type
AN		AN 
AL		AL 
EM		EM 

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm) over – or less	Preloaded assembly Ultra precision P3	Super precision P4	High precision P5
– 200	2	2	4
200 – 250	2	2.5	5
250 – 315	2	2.5	5
315 – 400	2	3	6
400 – 500	2	3	6
500 – 630	2	3.5	7
630 – 800	2	4.5	8
800 – 1 000	2.5	5	9
1 000 – 1 250	3	6	10
1 250 – 1 600	4	7	11
1 600 – 2 000	4.5	8	13
2 000 – 2 500	5	10	15
2 500 – 3 150	6	11	17
3 150 – 4 000	9	16	23

(2) Accuracy standard

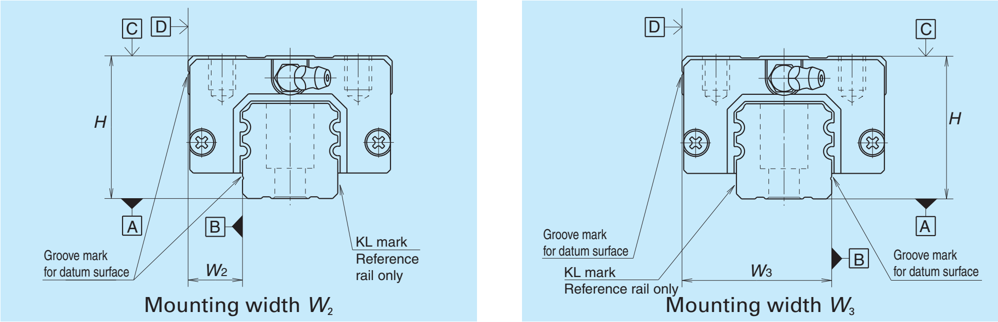
Three accuracy grades are available: Ultra precision P3, Super precision P4 and High precision P5.

Table 2

Unit: μm

Accuracy grade Characteristics	Ultra precision P3	Super precision P4	High precision P5
Mounting height H Variation of H (All ball slides on a set of rails)	±10 3	±10 5	±20 7
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±15 3	±15 7	±25 10
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Refer to **Table 1** and **Fig. 7**		

(3) Assembled accuracy



Mounting width W_2

Mounting width W_3

Fig. 7

(4) Preload and rigidity

Slight preload Z1 and Medium preload Z3 are available for preload, which can be selected for specific applications.

Table 3

Model No.	Preload (N) Slight preload (Z1)	Medium preload (Z3)	Rigidity (N/μm) Slight preload (Z1)	Medium preload (Z3)
HA25	735	2 990	635	1 030
HA30	1 030	4 400	880	1 270
HA35	1 470	6 100	1 030	1 620
HA45	1 960	8 150	1 230	2 060
HA55	3 150	13 100	1 520	2 450

4. Maximum rail length

Table 4 shows the limitations of rail length.
However, the limitations vary by accuracy grades.

Table 4 Length limitations of rails

Unit: mm

Size Series	25	30	35	45	55
HA	3 960	4 000	4 000	3 990	3 960

Note: Rails can be butted if user requirement exceeds the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

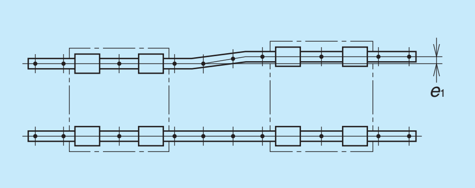


Fig. 8

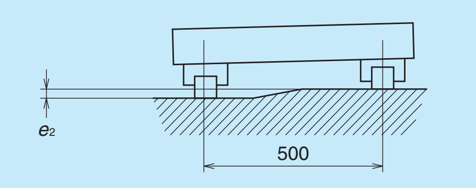


Fig. 9

Table 5

Unit: µm

Value	Preload	Model No.				
		HA25	HA30	HA35	HA45	HA55
Permissible values of parallelism in two rails e_1	Z1	20	20	23	26	34
	Z3	15	14	17	19	25
Permissible values of parallelism (height) in two rails e_2	Z1,Z3	250 µm/500 mm				

(2) Shoulder height of the mounting surface and corner radius r

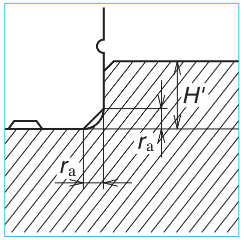


Fig. 10 Shoulder for the rail datum surface

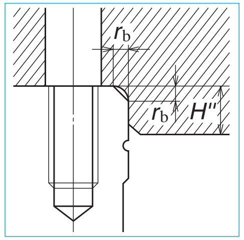


Fig. 11 Shoulder for the ball slide datum surface

Table 6

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
HA25	0.5	0.5	5	5
HA30	0.5	0.5	6	6
HA35	0.5	0.5	6	6
HA45	0.7	0.7	8	8
HA55	0.7	0.7	10	10

6. Lubrication components

Refer to pages A38 and D13 for linear guide lubrication.

(1) Types of lubrication accessories

Fig. 12 and **Table 7** show grease fittings and tube fittings.

We provide lubrication accessories with extended thread body length (L) for the addition of dust-proof accessories such as NSK K1 lubrication unit, double seal and protector.

We provide a suitable lubrication accessory for the special requirement on dust-proof accessories.

Consult NSK for a lubrication accessory with extended length of thread body for your convenience of replenishing lubricant.

When you require stainless lubrication accessories, please ask NSK.

(2) Mounting position of lubrication accessories

The standard position of grease fittings is the end face of ball slide. We mount them on the side of end cap for an option. (**Fig. 13**)

Please consult NSK for installation of grease or tube fittings to the ball slide body or the side of end cap.

When using a piping unit with thread of M6 × 1, you require a connector to connect to a grease fitting mounting hole with M6 × 0.75. The connector is available from NSK.

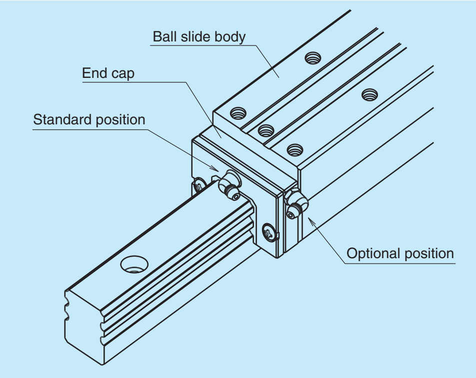


Fig. 13 Mounting position of lubrication accessories

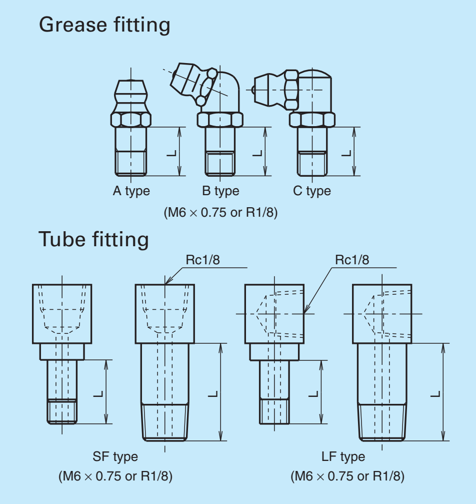


Fig. 12 Grease fitting and tube fitting

Table 7

Unit: mm

Model No.	Dust-proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
HA25	Standard	5	5
	With NSK K1	14	12
	Double seal	10	9
	Protector	10	9
HA30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
HA35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
HA45	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
HA55	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17

7. Dust-proof components

(1) Standard Specification

The HA Series can be readily used as they have a dust protection means for normal conditions. As the standard equipment, the ball slides have an end seal on both ends, bottom seals at the bottom, and an inner seal in inside.

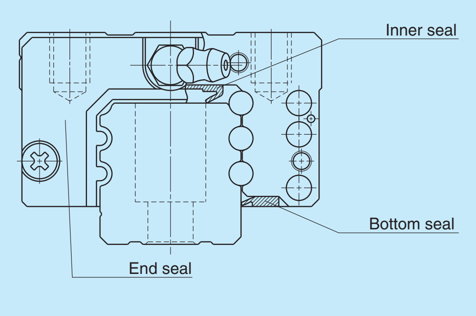


Fig. 14

Table 8 Seal friction per ball slide (maximum value)

Unit: N

Size Series	25	30	35	45	55
HA	17	17	19	21	22

(2) NSK K1™ lubrication unit

Table 9 shows the dimensions of linear guides equipped with the NSK K1 lubrication unit.

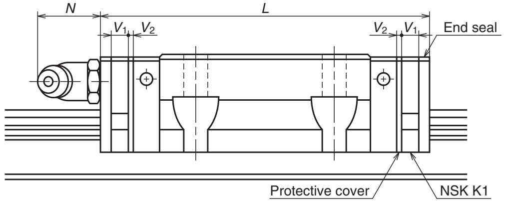


Table 9

Unit: mm

Model No.	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_1	Protective cover thickness V_2	Protruding area of the grease fitting N
HA25	AN, EM	147.8	159.8	5.0	1.0	(14)
HA30	AN, EM	177.2	190.2	5.5	1.0	(14)
HA35	AN, AL, EM	203.6	216.6	5.5	1.0	(14)
HA45	AN, AL, EM	233.4	248.4	6.5	1.0	(15)
HA55	AN,AL, EM	284.4	299.4	6.5	1.0	(15)

Note: Ball slide length equipped with NSK K1 =
(Standard ball slide length) + (Thickness of NSK K1, V_1 × Number of NSK K1) + (Thickness of the protective cover V_2 × 2)

(3) Double seal and protector

For the HA Series, double seal and protectors can be installed only before shipping from the factory. Please consult with NSK when you require dust tight protection.

Table 10 shows the increased thickness of V_3, and V_4 when the end seal and the protector are installed.

Table 10

Unit: mm

Model No.	Thickness of end seal: V_3	Thickness of protector: V_4
HA25	3.2	3.6
HA30	4.4	4.2
HA35	4.4	4.2
HA45	5.5	4.9
HA55	5.5	4.9

(4) Caps to plug the rail mounting bolt hole

Table 11 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
HA25	M6	LG-CAP/M6	20
HA30, HA35	M8	LG-CAP/M8	20
HA45	M12	LG-CAP/M12	20
HA55	M14	LG-CAP/M14	20

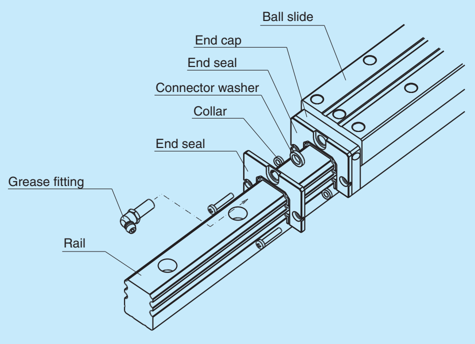


Fig. 15 Double seal

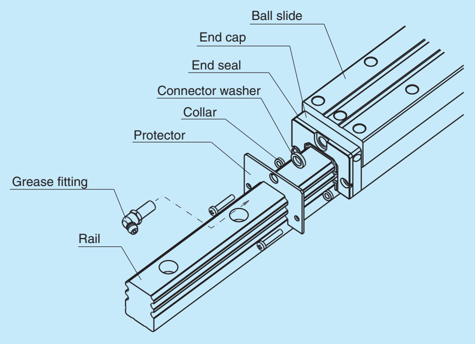


Fig. 16 Protector

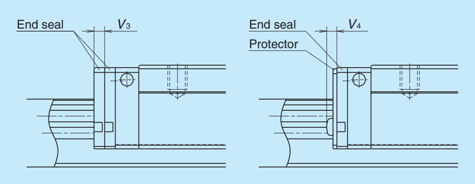


Fig. 17

8. Reference number

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

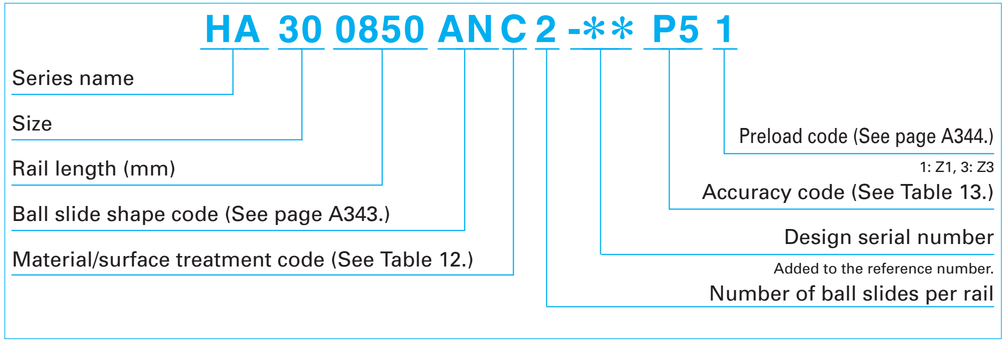


Table 12 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
Z	Other, special

Table 13 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5

Note: Refer to page A38 for NSK K1 lubrication unit.

9. Dimensions

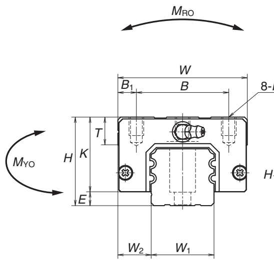
HA-AN

HA-AL

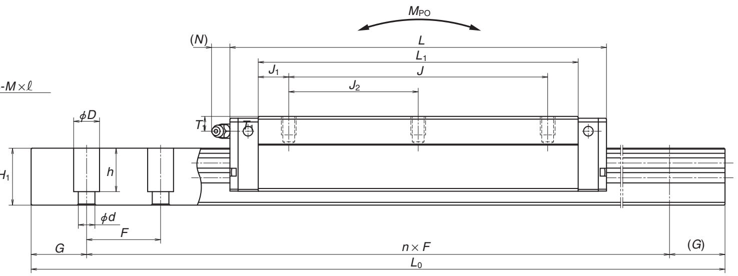
HA 30 0850 AN C 2 - P5 1**

Series name
Size
Rail length (mm)
Ball slide shape code (See page A343.)
Material/surface treatment code (See Table 12.)
Preload code (See page A344.)
1: Z1, 3: Z3
Accuracy code (See Table 13.)
Design serial number
Added to the reference number.
Number of ball slides per rail

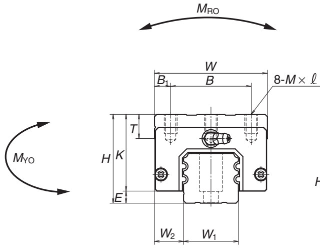
Front view of AL type



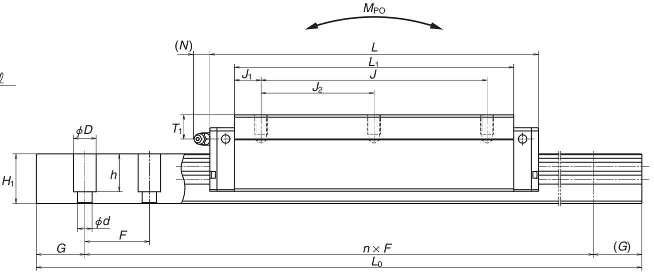
Side view of AL type



Front view of AN type



Side view of AN type



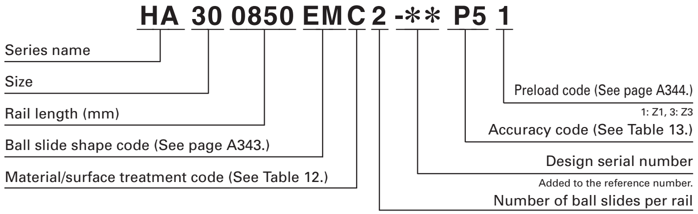
Unit: mm

Model No.	Assembly			Ball slide														Rail						Basic load rating							Weight	
	Height			Width	Length	Mounting hole									Grease fitting			Width	Height	Pitch	Mounting bolt hole	G	Maximum length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
															Hole size											M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	J_2	$M\times$ pitch $\times\ell$	B_1	L_1	J_1	K	T		T_1	N	W_1	H_1	F	$d\times D\times h$	(Reference)	L_{0max}	C (N)	C_0 (N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
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	23	22	30	7×11×16.5	20	3 960	54 000	115 000	670	2 060	10 100	2 060	10 100	1.2	3.7
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	28	28	40	9×14×21	20	4 000	79 500	166 000	1 140	3 550	17 400	3 550	17 400	1.8	5.8
HA35AN	55	7.5	18	70	203.6	50	140	70	M8×1.25×12	10	173	16.5	47.5	15	M6×0.75	15	11	34	30.8	40	9×14×23.5	20	4 000	111 000	226 000	1 950	5 650	27 100	5 650	27 100	3.0	7.7
HA35AL	48								M8×1.25×10				40.5			8															2.6	
HA45AN	70	10	20.5	86	233.4	60	160	80	M10×1.5×16	13	197	18.5	60	17	Rc1/8	20	13	45	36	52.5	14×20×27	22.5	3 990	147 000	295 000	3 700	8 450	40 500	8 450	40 500	6.0	12.0
HA45AL	60												50			10															5.0	
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	13	53	43.2	60	16×23×32.5	30	3 960	232 000	445 000	6 500	15 400	75 000	15 400	75 000	9.4	17.2
HA55AL	70												58			11															7.8	

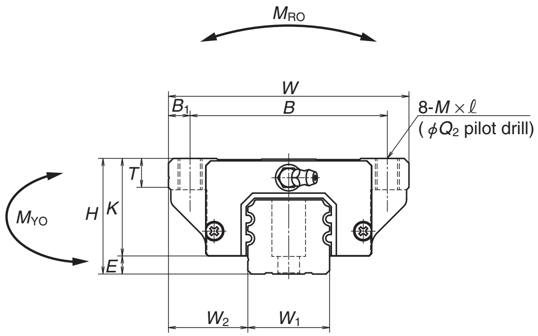
Notes: 1) The HA Series does not have a ball retainer. Be aware that the balls fall out when a ball slide is withdrawn from the rail.

2) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.

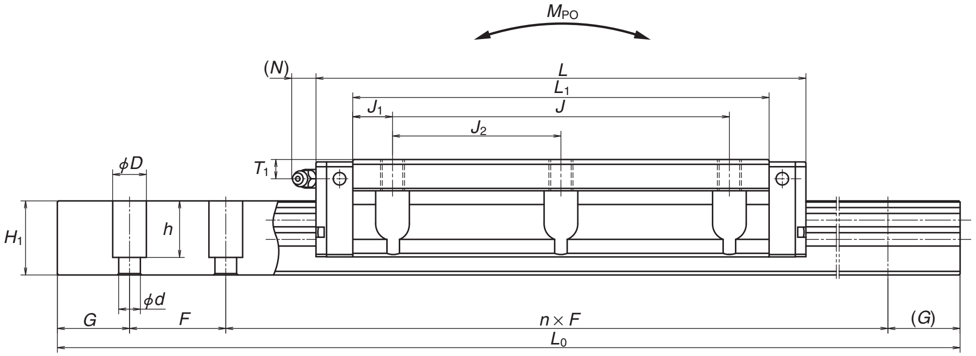
HA-EM



Front view of EM type



Side view of EM type



Unit: mm

Model No.	Assembly			Ball slide														
	Height			Width	Length	Mounting hole										Grease fitting		
	H	E	W_2	W	L	B	J	J_2	M × pitch × ℓ	Q_2	B_1	L_1	J_1	K	T	Hole size	T_1	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

Model No.	Rail						Basic load rating							Weight	
	Width	Height	Pitch	Mounting bolt hole	G	Maximum length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
							C	C_0	M_{RO}	M_{PO}		M_{YO}			
	W_1	H_1	F	d × D × h	(Reference)	L_{0max}	(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
HA25EM	23	22	30	7×11×16.5	20	3 960	54 000	115 000	670	2 060	10 100	2 060	10 100	1.6	3.7
HA30EM	28	28	40	9×14×21	20	4 000	79 500	166 000	1 140	3 550	17 400	3 550	17 400	2.6	5.8
HA35EM	34	30.8	40	9×14×23.5	20	4 000	111 000	226 000	1 950	5 650	27 100	5 650	27 100	3.8	7.7
HA45EM	45	36	52.5	14×20×27	22.5	3 990	147 000	295 000	3 700	8 450	40 500	8 450	40 500	6.6	12.0
HA55EM	53	43.2	60	16×23×32.5	30	3 960	232 000	445 000	6 500	15 400	75 000	15 400	75 000	11	17.2

Notes: 1) HA Series does not have a ball retainer. Be aware that the balls fall out when a ball slide is withdrawn from the rail.

2) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface.
To convert C to C_{100} for a 100-km rating fatigue life, divide 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 mounting base, to 50% or less. This feature restrains the pitching motion of ball slide whose frequency matches to the mounting hole pitch.

In addition, the mounting hole pitch has been reduced by one-half of the conventional models, so the rail can be more accurately installed in position.

(4) High rigidity and load capacity with lower friction

High rigidity, high load capacity and low friction are achieved by increasing the number of balls.

(5) Compact design

Reduced body size enables more compact machinery.

(6) High load carrying capacity to vertical direction

The contact angle is set at 50 degrees, increasing load carrying capacity as well as rigidity against the load in vertical direction.

(7) High resistance against impact load

The bottom ball groove is formed in Gothic arch and the center of the top and bottom grooves are offset as shown in **Fig. 2**. The vertical load is usually carried by top two ball rows at where balls are contacting at two points. Because of this design, the bottom ball rows will carry the load when a large impact load is applied as shown in **Fig. 3**. This assures high resistance to the impact load.

(8) High accuracy at manufacturing

As showing in **Fig. 4**, fixing the measuring rollers to the ball groove is easy thanks to the Gothic arch groove. This makes easy and accurate measuring of ball grooves.

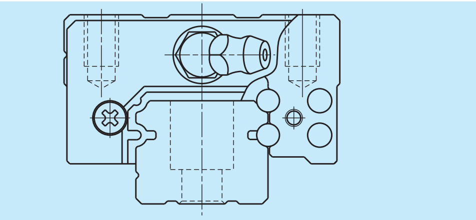


Fig. 1 HS Series

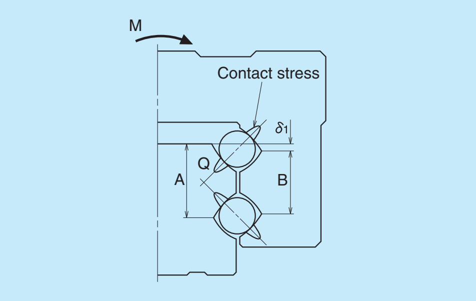


Fig. 2 Enlarged illustration: Offset Gothic arch

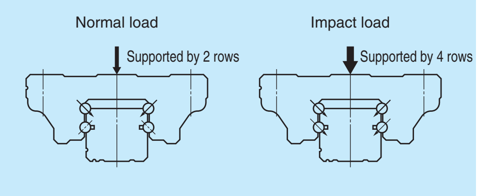
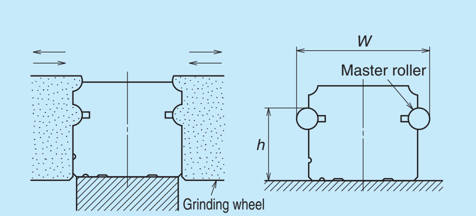


Fig. 3 When load is applied



Grinding of datum surface and ball grooves

Measuring accuracy and ball grooves

Fig. 4 Rail-grinding and measuring

Measurement results of ball passage vibration

Ball passage vibration can translate into posture changes in the ball slide which result from ball passage (circulation). In the HS Series, this vibration has been substantially reduced to one-third of conventional models.

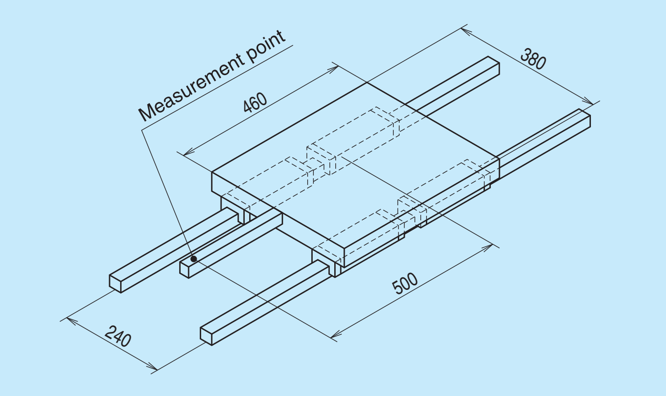


Fig. 5 Schematic view of measurement of ball passage vibration

HS Series

Model No.: HS30
Preload: Z1
Table dimensions: 460 mm × 380 mm

Conventional Series

Model No.: LS30
Preload: Z1
Table dimensions: 460 mm × 380 mm

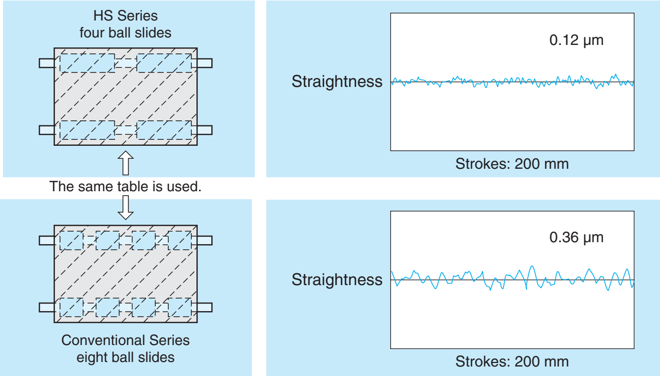
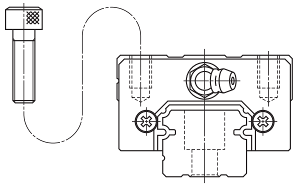
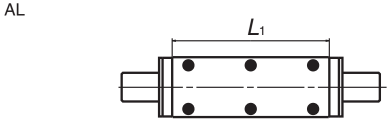
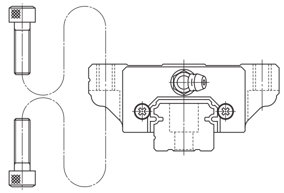
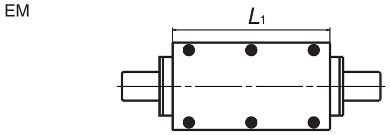


Fig. 6 Measurement results of HS Series and conventional Series

2. Ball slide shape

Ball slide Model	Shape/installation method	Type
AL		
EM		

3. Accuracy and preload

(1) Running parallelism of ball slide

Table 1

Unit: μm

Rail length (mm) over	Rail length (mm) or less	Preloaded assembly Ultra precision P3	Super precision P4	High precision P5
–	200	2	2	4
200	250	2	2.5	5
250	315	2	2.5	5
315	400	2	3	6
400	500	2	3	6
500	630	2	3.5	7
630	800	2	4.5	8
800	1 000	2.5	5	9
1 000	1 250	3	6	10
1 250	1 600	4	7	11
1 600	2 000	4.5	8	13
2 000	2 500	5	10	15
2 500	3 150	6	11	17
3 150	4 000	9	16	23

(2) Accuracy Standard

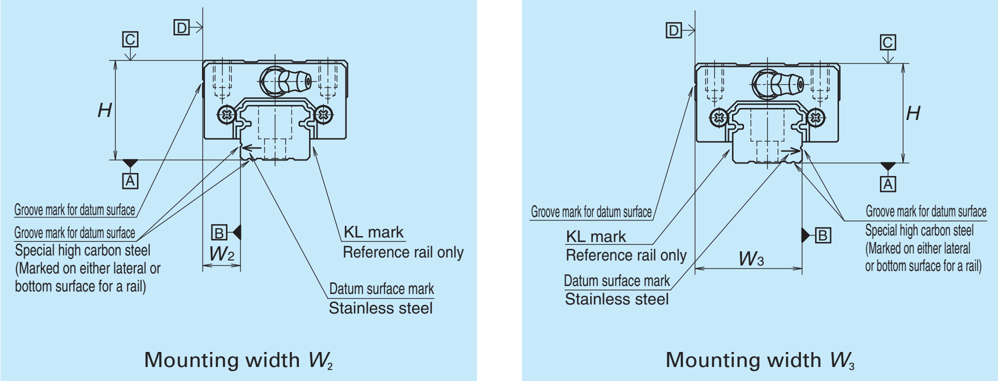
Three accuracy grades are available: Ultra precision P3, Super precision P4 and High precision P5.

Table 2

Unit: μm

Characteristics \ Accuracy grade	Ultra precision P3	Super precision P4	High precision P5
Mounting height H Variation of H (All ball slides on a set of rails)	±10 3	±10 5	±20 7
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±15 3	±15 7	±25 10
Running parallelism of surface C to surface A Running parallelism of surface D to surface B	Refer to **Table 1** and **Fig. 7**		

(3) Assembled accuracy



Mounting width W_2

Mounting width W_3

Fig. 7

(4) Preload and rigidity

Slight preload Z1 and Medium preload Z3 are available for preload, which can be selected for specific applications.

Table 3

Model No.	Preload (N)		Rigidity (N/μm)			
			Vertical direction		Lateral direction	
	Slight preload (Z1)	Medium preload (Z3)	Slight preload (Z1)	Medium preload (Z3)	Slight preload (Z1)	Medium preload (Z3)
HS15	98	785	260	530	173	355
HS20	147	1 030	305	600	212	415
HS25	245	1 620	385	735	263	505
HS30	390	2 550	505	965	345	665
HS35	590	3 550	610	1 140	415	780

4. Maximum rail length

Table 4 shows the limitation. The dimension in parenthesis is for stainless steel products. However, the limitations vary by accuracy grades.

Table 4 Length limitation of rails

Unit: mm

Series \ Size	15	20	25	30	35
HS	2 000 (1 700)	3 960 (3 500)	3 960 (3 500)	4 000 (3 500)	4 000 (3 500)

Note: Rails can be butted if user requirement exceeds the rail length shown in the table. Please consult NSK.

5. Installation

(1) Permissible values of mounting error

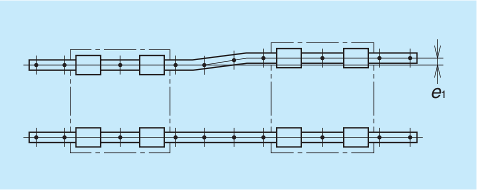


Fig. 8

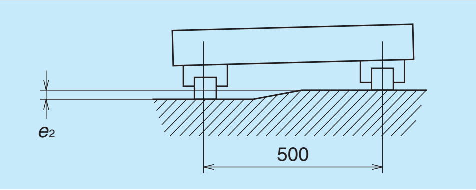


Fig. 9

Table 5

Unit: μm

Value	Preload	Model No.				
		HS15	HS20	HS25	HS30	HS35
Permissible values of parallelism in two rails e_1	Z1	18	20	26	31	37
	Z3	12	14	18	22	26
Permissible values of parallelism (height) in two rails e_2	Z1, Z3	330 μm/500 mm				

(2) Shoulder height of the mounting surface and corner radius r

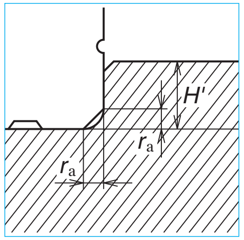


Fig. 10 Shoulder for the rail datum surface

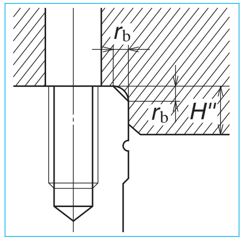


Fig. 11 Shoulder for the ball slide datum surface

Table 6

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
HS15	0.5	0.5	4	4
HS20	0.5	0.5	4.5	5
HS25	0.5	0.5	5	5
HS30	0.5	0.5	6	6
HS35	0.5	0.5	6	6

6. Lubrication components

Refer to pages A38 and D13 for linear guide lubrication.

(1) Types of lubrication accessories

Fig. 12 and **Table 7** show grease fittings and tube fittings.

We provide lubrication accessories with extended thread body length (L) for the addition of dust-proof accessories such as NSK K1 lubrication unit, double seal and protector.

We provide a suitable lubrication accessory for the special requirement on dust-proof accessories.

Consult NSK for a lubrication accessory with extended length of thread body for your convenience of replenishing lubricant.

When you require stainless lubrication accessories, please ask NSK.

(2) Mounting position of lubrication accessories

The standard position of grease fittings is the end face of ball slide. We mount them on the side of end cap for an option. (**Fig. 13**)

Please consult NSK for installation of grease or tube fittings to the ball slide body or the side of end cap.

When using a piping unit with thread of M6 × 1, you require a connector to connect to a grease fitting mounting hole with M6 × 0.75. The connector is available from NSK.

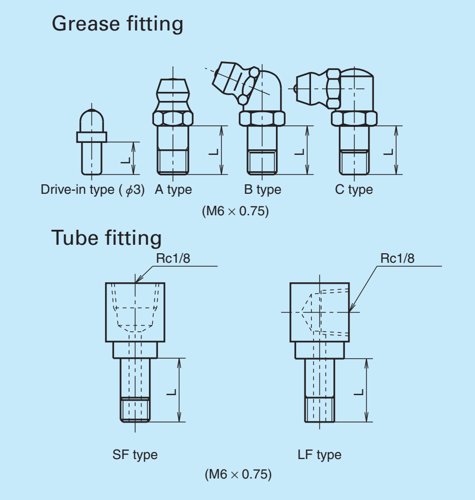


Fig. 12 Grease fitting and tube fitting

Table 7

Unit: mm

Model No.	Dust-proof specification	Grease fitting Drive-in	Tube fitting
		Thread body length L	Thread body length L
HS15	Standard	5	–
	With NSK K1	10	–
	Double seal	*	–
	Protector	*	–
HS20	Standard	5	–
	With NSK K1	10	–
	Double seal	8	–
	Protector	8	–
HS25	Standard	5	6
	With NSK K1	12	11
	Double seal	10	9
	Protector	10	9
HS30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
HS35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11

*) A connector is required for this model. Please contact NSK.

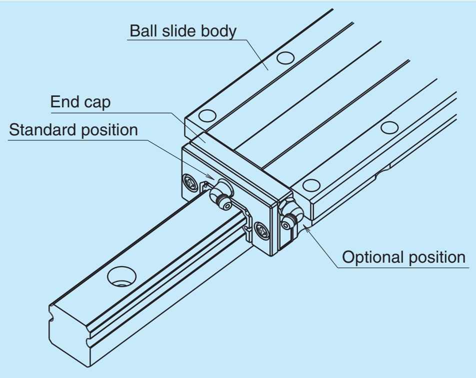


Fig. 13 Mounting position of lubrication accessories

7. Dust-proof components

(1) Standard Specification

The HS Series can be readily used as they have a dust protection means for normal conditions. As the standard equipment, the ball slides have an end seal on both ends.

Bottom seal is equipped on bottom as an option.

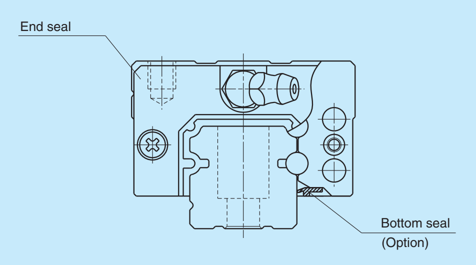


Fig. 14

Table 8 Seal friction per ball slide (maximum): end seal only

Unit: N

Size / Series	15	20	25	30	35
HS	3	3	3	3	4

(2) NSK K1™ lubrication unit

Refer to **Table 9** for dimension of linear guides equipped with the NSK K1 lubrication unit.

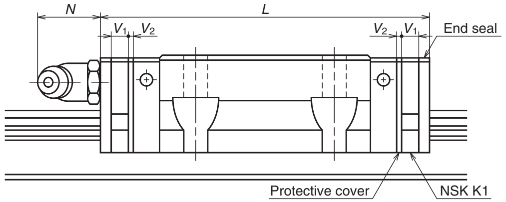


Table 9

Unit: mm

Model No.	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_1	Protective cover thickness V_2	Protruding area of the grease fitting N
HS15	AL, EM	106	115.6	4.0	0.8	(5)
HS20	AL, EM	119.7	130.3	4.5	0.8	(14)
HS25	AL, EM	148	158.6	4.5	0.8	(14)
HS30	AL, EM	176.1	188.1	5.0	1.0	(14)
HS35	AL, EM	203.6	216.6	5.5	1.0	(14)

Note: Ball slide length equipped with NSK K1 =
(Standard ball slide length) + (Thickness of NSK K1, V_1 × Number of NSK K1) + (Thickness of the protective cover V_2 × 2)

(3) Double seal and protector

For the HS Series, double seal and protectors can be installed only before shipping from the factory. Please consult with NSK when you require dust tight protection.

Table 10 shows the increased thickness of V_3 and V_4 when the end seal and the protector are installed.

Table 10

Unit: mm

Model No.	Thickness of end seal: V_3	Thickness of protector: V_4
HS15	2.8	3
HS20	2.5	2.7
HS25	2.8	3.2
HS30	3.6	4.2
HS35	3.6	4.2

(4) Caps to plug the rail mounting bolt hole

Table 11 Caps to plug rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
HS15	M3	LG-CAP/M3	20
HS15	M4	LG-CAP/M4	20
HS20	M5	LG-CAP/M5	20
HS25, HS30	M6	LG-CAP/M6	20
HS35	M8	LG-CAP/M8	20

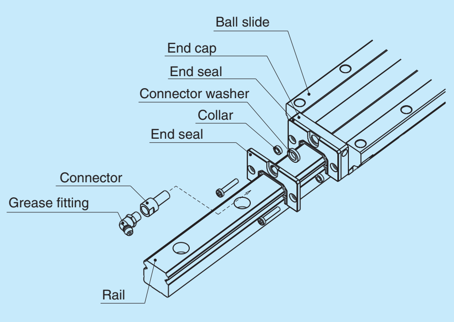


Fig. 15 Double seal

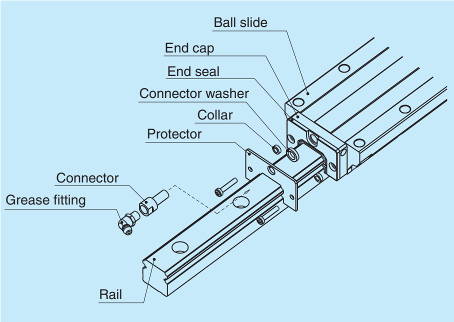


Fig. 16 Protector

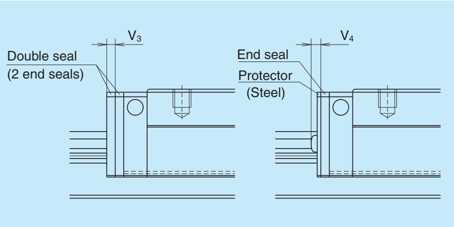


Fig. 17

8. Reference number

Reference numbers shall be set to individual NSK linear guide when its specifications are finalized, and it is indicated on its specification drawing.
Please specify the reference number, except design serial number, to identify the product when ordering, requiring estimates, or inquiring about specifications from NSK.

HS 30 1000 AL C 2 - P5 1**

- HS: Series name
- 30: Size
- 1000: Rail length (mm)
- AL: Ball slide shape code (See page A357.)
- C: Material/surface treatment code (See Table 12.)
- 2: Number of ball slides per rail
- -**: Design serial number
  Added to the reference number.
- P5: Accuracy code (See Table 13.)
- 1: Preload code (See page A358.)
  1: Z1, 3: Z3

Table 12 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
K	Stainless steel
D	Special high carbon steel with surface treatment
H	Stainless steel with surface treatment
Z	Other, special

Table 13 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5

Note: Refer to page A38 for NSK K1 lubrication unit.

9. Dimensions
HS-AL

HS 30 1000 AL C 2 -** P5 1

Series name

Size

Rail length (mm)

Ball slide shape code (See page A357.)

Material/surface treatment code (See Table 12.)

Preload code (See page A358.)

1: Z1, 3: Z3

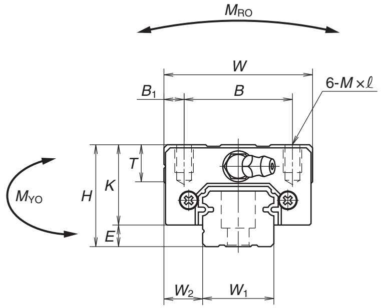
Accuracy code (See Table 13.)

Design serial number

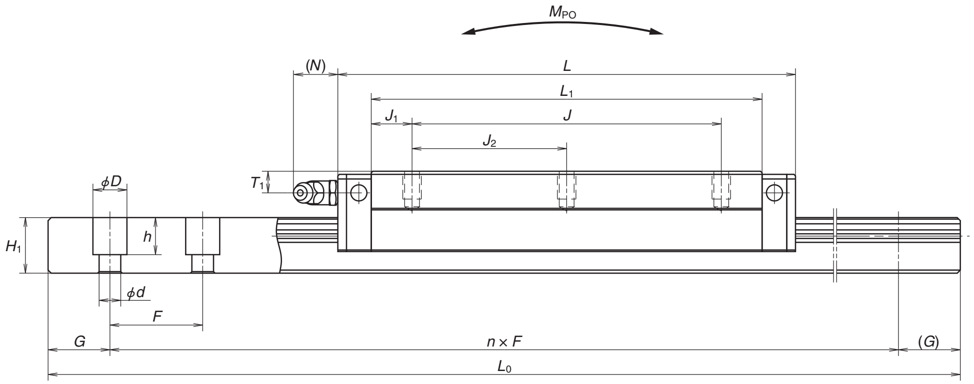
Added to the reference number.

Number of ball slides per rail

Front view of AL types



Side view of AL type



Unit: mm

Model No.	Assembly			Ball slide														Rail						Basic load rating							Weight	
	Height			Width	Length	Mounting hole									Grease fitting			Width	Height	Pitch	Mounting Bolt hole	G	Maximum length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
	H	E	W_2	W	L	B	J	J_2	M × pitch × ℓ	B_1	L_1	J_1	K	T	Hole size	T_1	N	W_1	H_1	F	d × D × h	(Reference)	L_{0max} ( ) for stainless	C (N)	C_0 (N)	M_{RO}	M_{PO} One slide	M_{PO} Two slides	M_{YO} One slide	M_{YO} Two slides	(g)	(kg/m)
HS15AL	24	4.6	9.5	34	106	26	60	30	M4×0.7×6	4	89.2	14.6	19.4	10	ϕ3	6	3	15	12.5	30	*3.5×6×8.5 4.5×7.5×8.5	20	2 000 (1 700)	15 300	40 000	199	395	1 990	335	1 670	0.34	1.4
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	20	15.5	30	6×9.5×10.5	20	3 960 (3 500)	20 400	52 000	350	590	2 930	495	2 460	0.52	2.3
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	23	18	30	7×11×12	20	3 960 (3 500)	32 000	78 000	605	1 090	5 450	910	4 600	0.85	3.1
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	28	23	40	7×11×16	20	4 000 (3 500)	51 500	127 000	1 190	2 120	10 600	1 780	8 850	1.7	4.8
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	34	27.5	40	9×14×20	20	4 000 (3 500)	71 500	172 000	1 980	3 350	16 600	2 820	13 900	2.5	7.0

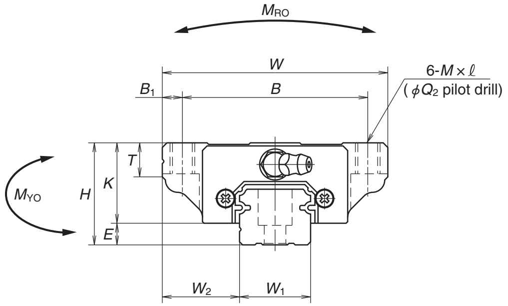
Notes: 1) The HS Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.
2) External appearance of stainless steel ball slides differ from those of carbon steel ball slide.
3) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load on the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.
4) Parenthesized dimensions are applicable to stainless steel products.
*) Standard rail mounting bolt hole for HS15 is specified as hole for M3 (3.5 × 6 × 8.5). Please contact us to request a different hole for M4 (4.5 × 7.5 × 8.5).

HS-EM

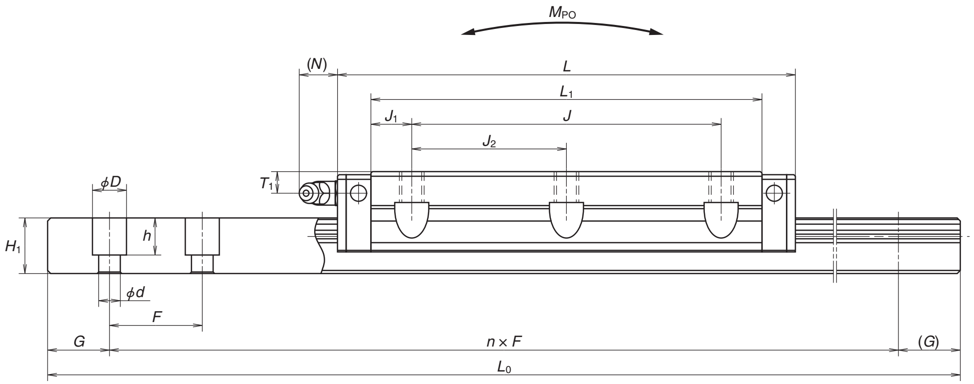
HS 30 1000 EM C 2 - P5 1**

Series name
Size
Rail length (mm)
Ball slide shape code (See page A357.)
Material/surface treatment code (See Table 12.)
Preload code (See page A358.)
1: Z1, 3: Z3
Accuracy code (See Table 13.)
Design serial number
Added to the reference number.
Number of ball slides per rail

Front view of EM type



Side view of EM type



Unit: mm

Model No.	Assembly			Ball slide															Rail						Basic load rating							Weight	
	Height			Width	Length	Mounting hole										Grease fitting			Width	Height	Pitch	Mounting Bolt hole	G	Maximum length	Dynamic	Static	Static moment (N·m)					Ball slide	Rail
																									C	C_0	M_{RO}	M_{PO}		M_{YO}			
	H	E	W_2	W	L	B	J	J_2	M × pitch × ℓ	Q_2	B_1	L_1	J_1	K	T	Hole size	T_1	N	W_1	H_1	F	d × D × h	(Reference)	L_{0max} ( ) for stainless	(N)	(N)		One slide	Two slides	One slide	Two slides	(kg)	(kg/m)
HS15EM	24	4.6	18.5	52	106	41	60	30	M5×0.8×7	4.4	5.5	89.2	14.6	19.4	8	ϕ 3	6	3	15	12.5	30	*3.5×6×8.5 4.5×7.5×8.5	20	2 000 (1 700)	15 300	40 000	199	395	1 990	335	1 670	0.45	1.4
HS20EM	28	6	19.5	59	119.7	49	80	40	M6×1×9 (M6×1×9.5)	5.3	5	102.5	11.25	22	10	M6×0.75	5.5	11	20	15.5	30	6×9.5×10.5	20	3 960 (3 500)	20 400	52 000	350	590	2 930	495	2 460	0.67	2.3
HS25EM	33	7	25	73	148	60	100	50	M8×1.25×10 (M8×1.25×11.5)	6.8	6.5	126.4	13.2	26	11 (12)	M6×0.75	7	11	23	18	30	7×11×12	20	3 960 (3 500)	32 000	78 000	605	1 090	5 450	910	4 600	1.3	3.1
HS30EM	42	9	31	90	176.1	72	120	60	M10×1.5×12 (M10×1.5×14.5)	8.6	9	150.7	15.35	33	11 (15)	M6×0.75	8	11	28	23	40	7×11×16	20	4 000 (3 500)	51 500	127 000	1 190	2 120	10 600	1 780	8 850	2.4	4.8
HS35EM	48	10.5	33	100	203.6	82	140	70	M10×1.5×13 (M10×1.5×14.5)	8.6	9	175.6	17.8	37.5	12 (15)	M6×0.75	8.5	11	34	27.5	40	9×14×20	20	4 000 (3 500)	71 500	172 000	1 980	3 350	16 600	2 820	13 900	3.4	7.0

Notes: 1) The HS Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.
2) External appearance of stainless steel ball slides differ from those of carbon steel ball slide.
3) Basic dynamic load rating is a load that allows for a 50-km rating fatigue life and is a vertical and constant load to the ball slide mounting surface. To convert C to C_{100} for a 100-km rating fatigue life, divide C by 1.26.
4) Parenthesized dimensions are applicable to stainless steel products.
*) Standard rail mounting bolt hole for HS15 is specified as hole for M3 (3.5 × 6 × 8.5). Please contact us to request a different hole for M4 (4.5 × 7.5 × 8.5).

A-6 Other Linear Rolling Guide Products

A-6-1 Linear Rolling Bushing

1. Features

(1) Low friction

Low friction owes to its design: Balls come into point contacts with raceway surface: the balls smoothly re-circulate. There is very little stick slip.

(2) Low noise

Noise level is low due to the ball retainer which is made of a synthetic resin.

(3) High precision

Due to NSK's superb quality control, precision is guaranteed.

(4) Dust prevention

Series with seal is available. The seal has small friction, and is highly durable. Highly dust-preventive double-lip system has been adopted.

(5) Superb durability

The material of outer sleeve is vacuum degassed, highly pure, and is heat-treated with good expertise.

2. Models

There are three models

(1) Standard type LB (Fig. 1)

This model is the most commonly used, and is the only model that comes with a seal and in super precision grade.

Fig. 1 Standard type LB

(2) Adjustable clearance type LB-T (Fig. 2)

A part of the outer sleeve is cut open toward the axial direction. Used with a housing which can adjust inside diameter, it makes minute adjustment of the clearance between the linear shaft and the inscribed circle (an imaginary circle that connects the summit of the ball) of linear rolling bushing.

Fig. 2 Adjustable Clearance type LB-T

(3) Open type LB-K (Fig. 3)

A cut is made in the outer sleeve and retainer, to a width equivalent to one row of the retainer, to the axial direction. The opening is used to hold this linear rolling bushing by a support or base to prevent a long linear shaft from bending.

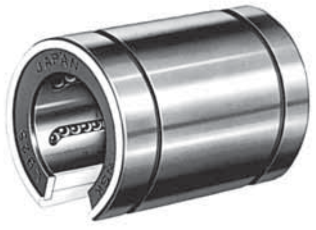


Fig. 3 Open type LB-K

3. Accuracy

(1) Accuracy grades

- Standard type LB························High precision grade S, and super precision grade SP are available.
- Space adjustment type LB-T········ } High precision grade S is available.
- Open type LB-K ······················

(2) Tolerance of rolling linear bushing, linear shaft and housing

Table 1 Tolerance for inscribed circle of the linear rolling bushing and shaft diameter

Unit: μm

Nominal dimension/ inscribed circle diameter /shaft diameter (mm)		Tolerance/inscribed circle diameter[*1]				Tolerance/width *B*		Tolerance/slot distance of retaining rings *B*n		Recommended tolerance/ shaft diameter			
		High precision grade S		Super high precision grade SP		High precision grade S Super high precision grade SP		High precision grade S Super high precision grade SP		High precision grade S		Super high precision grade SP	
over	or less	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower
2.5	6	0	-8	0	-5	0	-120	+240	-240	-6	-14	-4	-9
6	10									-6	-15	-4	-10
10	18									-6	-17	-4	-12
18	30	0	-10	0	-6					-6	-19	-4	-13
30	50	0	-12	0	-8					-7	-23	-5	-16

Table 2 Tolerance of linear rolling bush outside diameter, and housing inside diameter

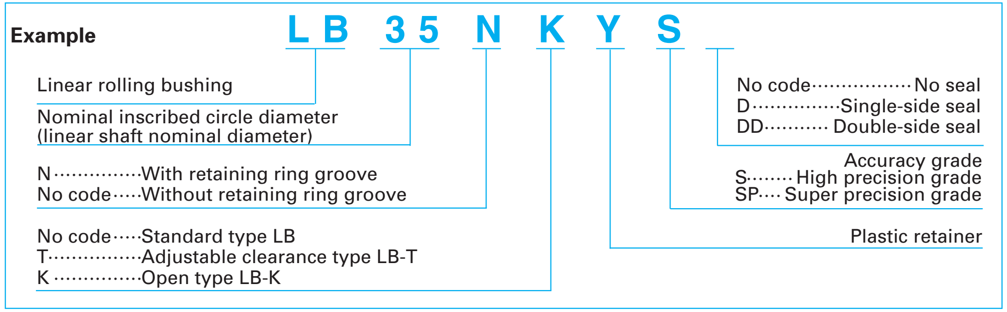
Unit: μm

Nominal dimension/ outside diameter/housing inside diameter (mm)		Tolerance/outside diameter D[*1]				Eccentricity[*2]	Tolerance/housing inside diameter			
		High precision grade S		Super high precision grade SP		Super high precision grade SP	High precision grade S		Super high precision grade SP	
over	or less	upper	lower	upper	lower	Maximum	upper	lower	upper	lower
2.5	6	0	-10	0	-7	8	+12	0	+8	0
6	10						+15	0	+9	0
10	18						+18	0	+11	0
18	30	0	-12	0	-8	9	+21	0	+13	0
30	50	0	-14	0	-9	10	+25	0	+16	0

*1) For adjustable clearance 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

Nominal inscribed circle diameter
(linear shaft nominal diameter)

N···············With retaining ring groove
No code·····Without retaining ring groove

No code·····Standard type LB
T················Adjustable clearance type LB-T
K ···············Open type LB-K

No code·················No seal
D···············Single-side seal
DD··········· Double-side seal

Accuracy grade
S········ High precision grade
SP···· Super precision grade

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, 1 000 km or no replenishing for a normal environment.

(2) Oil lubrication

It is not necessary to wash off the rust preventive agent applied before delivery.

Use an oil of ISO viscosity grade VG15-100. Drip the oil on the linear shaft by an oil supply system.

Temperature to use

–30°C to 50°C	Viscosity VG15 – 46
50°C to 80°C	Viscosity VG46 – 100

Lubricant is removed by the seal if the linear ball bearing has a seal. Therefore, the drip method cannot be used except for single-seal types.

(3) Friction coefficient

The linear rolling bushing has a small dynamic friction coefficient. This contributes to low power loss and temperature rise.

According to **Fig. 4**, dynamic friction coefficient is merely 0.001-0.004. Also, at the speed of under 60 m/min, there is no danger of the temperature rising.

Friction force can be obtained by the following formula.

$$F = \mu \cdot P \quad \cdots\cdots (1)$$

In this formula:

F : Friction force (N)

P : Load (vertical load to the shaft center line) (N)

μ : Friction coefficient (dynamic or static)

For a seal type, a seal resistance of 0.3 to 2.40 N is added to the above.

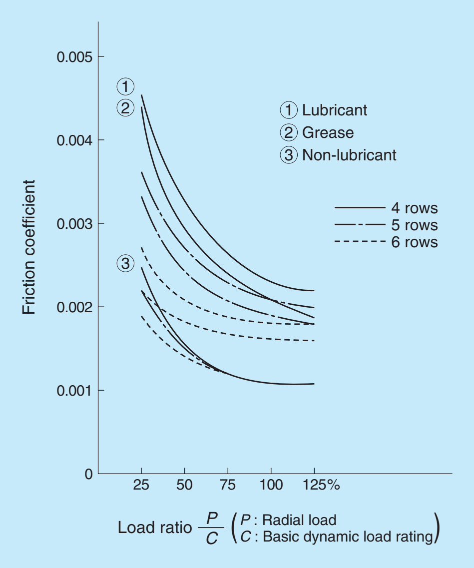


Fig. 4 Dynamic friction coefficient of linear rolling bushing

6. Range of Conditions to Use

Generally, use under the following conditions.

Please consult NSK when values exceed the ranges given below.

Temperature: – 30°C to 80°C

Speed: Up to 120 m/min

(excluding oscillation and short strokes)

7. Preload and Rigidity

The linear rolling bushing is normally used without applying preload. If high positioning accuracy is required, set the clearance between the linear rolling bush and the shaft at the range of 0 to 5 µm. Slight preload is a general rule (1% of basic dynamic load rating C -- see the dimension table).

The dimension table shows theoretical rigidity K when clearance with the shaft is zero, and a load of 0.1 C is applied to the summit of the ball.

Rigidity K_N, when load is not 0.1C, is obtained by the following formula.

$$K_N = K\,(P/0.1\mathrm{C})^{1/3} \quad \cdots\cdots (2)$$

In this formula:

K : Rigidity value in the dimension table (N/µm)

P : Radial load (N)

When the load is applied between the ball raws, the load becomes 1.122 times for 4 ball rows; 0.959 times for 5 ball rows; 0.98 times for 6 ball rows.

8. Basic Load Rating and Rated Life

(1) Basic dynamic load rating

Basic dynamic load rating C is: A radial load which allows 90% of a group of linear rolling bush to run a distance of 50 km without suffering damage when they are moved individually.

There is a relationship as below between C and the life

$$L = 50\, f_L^3 \quad \cdots\cdots (3)$$

$$f_L = C/P \quad \cdots\cdots (4)$$

In this formula:

L : Rated life (km)

P : Radial load (N)

f_L : Life factor (Refer to Fig. 5)

This formula is used provided that the shaft hardness is HRC58 or higher. Rated life is shorter if the shaft is softer. In this case, find the hardness factor f_H from Fig. 6, and multiply the value.

$$f_L = C \cdot f_H/P \quad \cdots\cdots (5)$$

Or

$$C = P \cdot f_L/f_H \quad \cdots\cdots (6)$$

Life in time can be obtained by the following formula, substituting for given stroke length, cycle numbers, and running distance:

$$L_h = (L/1.2 \cdot S \cdot n) \times 10^4 \quad \cdots\cdots (7)$$

In this formula:

L_h : Life hours (h)

L : Rated life (km)

S : Stroke (mm)

n : Cycles per minute (cpm)

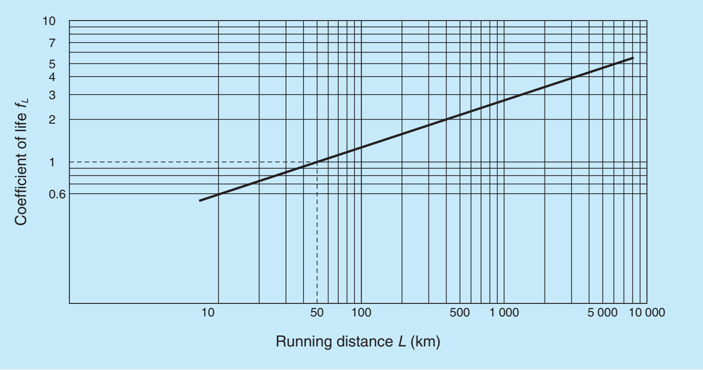


Fig. 5 Relationship between life factor and running distance

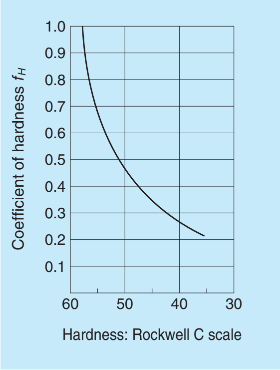


Fig. 6 Hardness factor

(2) Basic static load rating

It is a load that the total permanent deformation of outer sleeve, ball and shaft at the contact point, becomes 0.01% of the ball diameter when this load is applied to the rolling bushing. It is understood in general that this is the applicable load limit which causes this much permanent deformation without hampering operation.

(3) Calculation example

What is the appropriate rolling bushing size if required life is 5 000 hours?

Conditions are:

- Three linear rolling bushings are installed in two parallel shafts, and support a reciprocating table.
- Load 450 N is equally distributed to the three bushings.
- The table is required to reciprocate on the shafts at 200 times per minute at a stroke of 70 mm.
- Hardness of the shaft: HRC 55

$$450/3 = 150 \text{ (N)}$$

- 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),

$$C = P \times f_L / f_H$$

$$= 150 \times 5.6/0.65 = 1\,292 \text{ (N)}$$

Based on the above, select linear rolling bushing LB30NY with shaft diameter of 30 mm, basic dynamic load rating of 1 400 N.

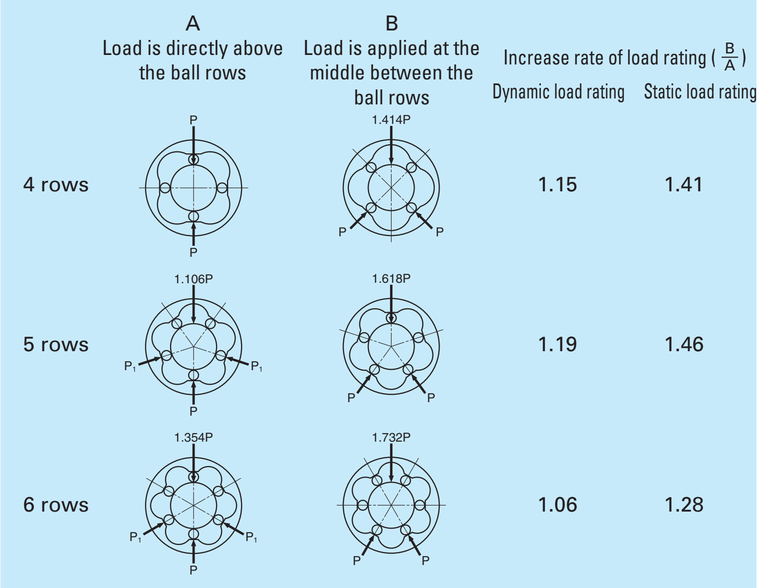
(4) Compensating load rating by ball row position

Load rating of the linear rolling bushing changes by the position of the ball circuit rows.

Permissible load is larger when it is applied to the middle of the ball circuit rows than when it is applied directly above the ball row (**Fig. 7**).

(Radial clearance set at zero in this case.)

Load ratings in the dimension table are in case "A" when it is applied directly above the ball circuit row. If used as in case "B," the load rating becomes larger (refer to **Fig. 7**).



	A Load is directly above the ball rows	B Load is applied at the middle between the ball rows	Increase rate of load rating ($\frac{B}{A}$)	
			Dynamic load rating	Static load rating
4 rows			1.15	1.41
5 rows			1.19	1.46
6 rows			1.06	1.28

Fig. 7 Increasing rate of load rating by position of ball row (B/A)

9. Shaft Specification

Harden the shaft surface where the balls run with heat treatment to provide the following values.

- Surface hardness: HRC58 or over
- Depth of core hardness at HRC50 or higher
    - Depth for LB3; 0.3 mm or deeper
    - Depth for LB50; 1.2 mm or deeper

Roughness of the surface should be:

- For SP grade, and "the clearance for fit" with the ball bushing less than 5 μm -
    - Less than 0.8 S
- For SP grade with "the clearance" of more than 5 μm, and for S grade -
    - Less than 1.2 S

Bending should be:

- LB3 -- 15 μm/100 mm
- LB50 -- 100 μm/1 000 mm

An appropriate clearance for normal use conditions can be obtained when the tolerance in shaft diameter remains within the recommended range (refer to **Table 1** on page A370). For operations which require particular accuracy, select the shaft diameter which creates a clearance in the range of 0 to 0.005 (mm) for example, when assembled with the rolling bushing.

10. Dust Proof

Select a linear rolling bushing with seals to prevent moisture or foreign matters which are floating in the air from entering.

11. Installation

(1) Combination of shaft and linear rolling bushing

When the linear rolling bushing is installed in a linear motion table for its reciprocating movement, it is necessary to prevent the table from rotating.

In general, for this reason, two shafts installed with two linear rolling bushings on each are used.

Fig. 8 is an installation example.

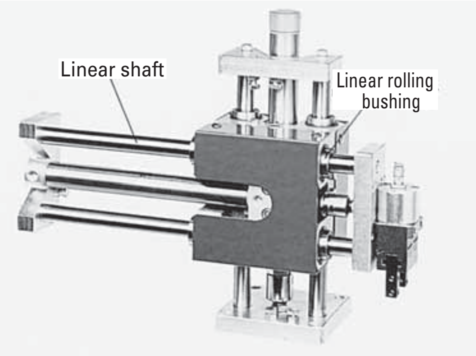


Fig. 8 Installation example

(2) Installation of linear rolling bushing

1) Standard type installation

Fig. 9 shows a method using a retainer ring. Linear rolling bushing can also be secured to the housing using a stop plate and/or screw.

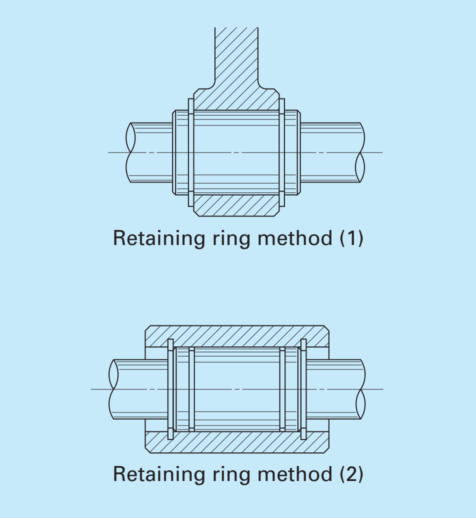


Fig. 9 Installation using retaining rings

a) Housing inside diameter should be of a recommended value (**Table 2**, page A370). The entire rolling bushing contracts and gives excessive preload if: the inside diameter is small; the roundness or cylindricity is excessive. This may result in an unexpected failure.

b) To install linear rolling bushing, use a tool (**Fig. 10**) and squeeze it in, or use a holder and lightly pound it.

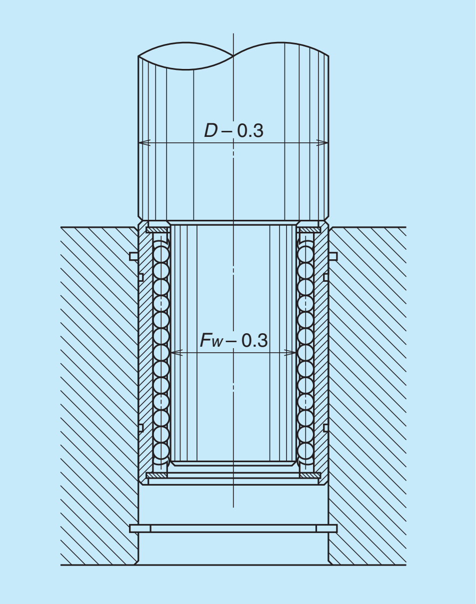


Fig. 10 Tool to install a linear rolling bushing

2) Installation of adjustable clearance type

Use a housing which can adjust the inside diameter of the rolling bushing. This way, the clearance between the rolling bushing and the linear shaft can be easily adjusted. Arrange the cut-open section of the rolling bushing at a 90-degree angle to the housing's cut-open section. This is the most effective way to evenly distribute deformation toward circumferential direction.

The tolerance of shaft diameter of the adjustable clearance type should be within the recommended range (refer to **Table 1** on page A370). As a general rule, set the preload at slight or light volume. (Do not provide excessive preload.) Use a dial gauge to measure and adjust clearance. However, here is an easy method to adjust .

First, loosen the housing until shaft turns freely. Then narrow the clearance gradually. Stop at the point when the shaft rotation becomes heavy. This creates a clearance zero or light preload.

3) Installation of open type

Use with clearance or with light preload.

Keep the tolerance in shaft diameter within the recommended range (refer to **Table 1** on page A370), so the preload shall not become excessive.

(Unlike the adjustable clearance type, clearance cannot be narrowed by rotating the shaft because the state of shaft rotation does not indicate how narrow the space has become. Narrowing clearance requires caution for open type.)

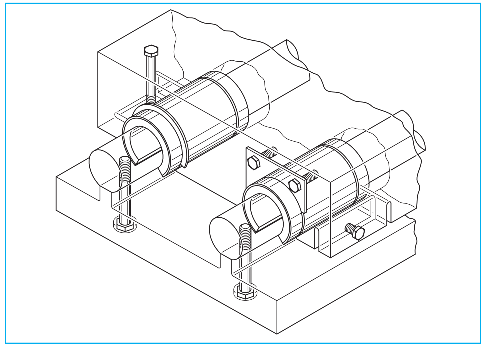


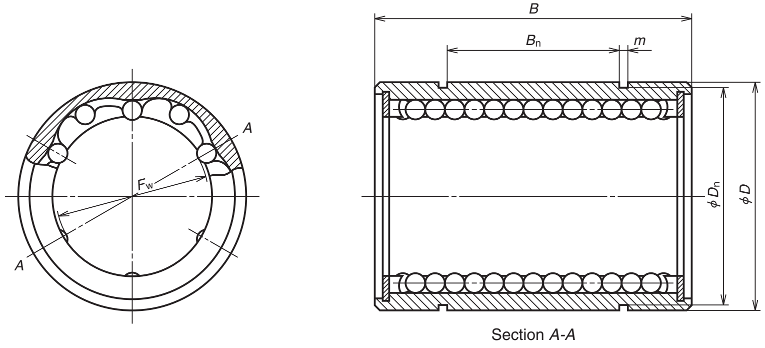
Fig. 11 Installation example of an open type

(3) Precaution for installing a shaft in the linear rolling bushing

1) To install two shafts parallel to each other, first install one shaft accurately. Use this as a reference, and install the other parallel to the first shaft. This makes installation easy.
2) Do not incline the shaft when inserting it into the linear rolling bushing. Do not force it to enter by twisting. This deforms the retainer, and causes the balls to fall out.
3) Do not use the shaft for rotating movement after inserting the shaft to the linear rolling bushing. The balls slip and damage the shaft.
4) Do not twist the shaft after it is inserted to the linear rolling bushing. The pressure scars the shaft.

12. Dimension tables

Model LB (standard type), no seal



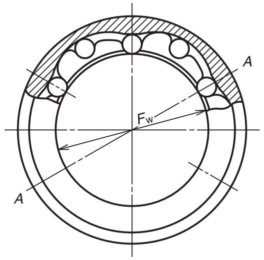
Unit: mm

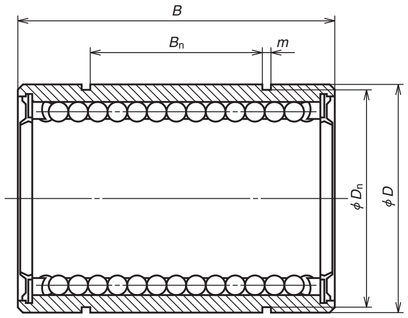
Model No.	Inscribed circle diameter F_w	Outside diameter D	Length B	Retaining ring groove			Stiffness[*1] (N/μm)	Number of ball circuit	Weight (kg) (Reference only)	Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
				Distance B_n	Width m	Bottom diameter D_n					
LB3Y	3	7	10	—	—	—	3	4	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
LB8ANY[*2]	8	15	17	9	1.15	14.3	5.5	4	0.0094	78	118
LB8NY	8	15	24	15	1.15	14.3	9.5	4	0.014	118	226
LB10NY	10	19	29	19	1.35	18	12	4	0.025	206	355
LB12NY	12	21	30	20	1.35	20	13	4	0.028	265	500
LB13NY	13	23	32	20	1.35	22	13	4	0.040	294	510
LB16NY	16	28	37	23	1.65	26.6	14	4	0.063	440	635
LB20NY	20	32	42	27	1.65	30.3	19	5	0.088	610	1 010
LB25NY	25	40	59	37	1.9	38	35	6	0.267	1 000	1 960
LB30NY	30	45	64	40	1.9	42.5	41	6	0.305	1 400	2 500
LB35NY	35	52	70	45	2.2	49	48	6	0.440	1 510	2 800
LB40NY	40	60	80	56	2.2	57	54	6	0.520	2 230	4 000
LB50NY	50	80	100	68	2.7	76.5	69	6	1.770	4 100	7 100

*1): Refer to Section (7).

*2): Semi-standard item of which length B is shorter than standard.

Model LB (standard type), with seal





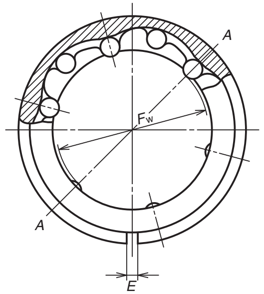
Section *A-A*

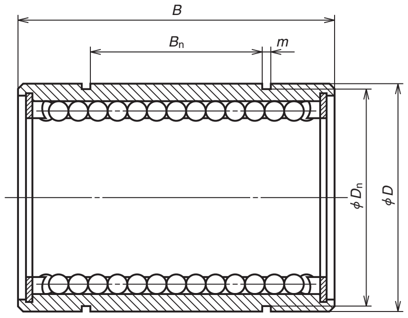
Unit: mm

*Model No.	Inscribed circle diameter F_w	Outside diameter D	Length B	Retaining ring groove Distance B_n	Retaining ring groove Width m	Retaining ring groove Bottom diameter D_n	Number of ball circuit	Weight (kg) (Reference only)	Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
LB6NYDD	6	12	19	11	1.15	11.5	4	0.0074	74	147
LB8ANYDD	8	15	17	9	1.15	14.3	4	0.0094	78	118
LB8NYDD	8	15	24	15	1.15	14.3	4	0.014	118	226
LB10NYDD	10	19	29	19	1.35	18	4	0.025	206	355
LB12NYDD	12	21	30	20	1.35	20	4	0.028	265	500
LB13NYDD	13	23	32	20	1.35	22	4	0.040	294	510
LB16NYDD	16	28	37	23	1.65	26.6	4	0.063	440	635
LB20NYDD	20	32	42	27	1.65	30.3	5	0.088	610	1 010
LB25NYDD	25	40	59	37	1.9	38	6	0.267	1 000	1 960
LB30NYDD	30	45	64	40	1.9	42.5	6	0.305	1 400	2 500
LB35NYDD	35	52	70	45	2.2	49	6	0.440	1 510	2 800
LB40NYDD	40	60	80	56	2.2	57	6	0.520	2 230	4 000
LB50NYDD	50	80	100	68	2.7	76.5	6	1.770	4 100	7 100

*) Single-seal type is indicated as LB-D.

Model LB-T (Adjustable clearance type)



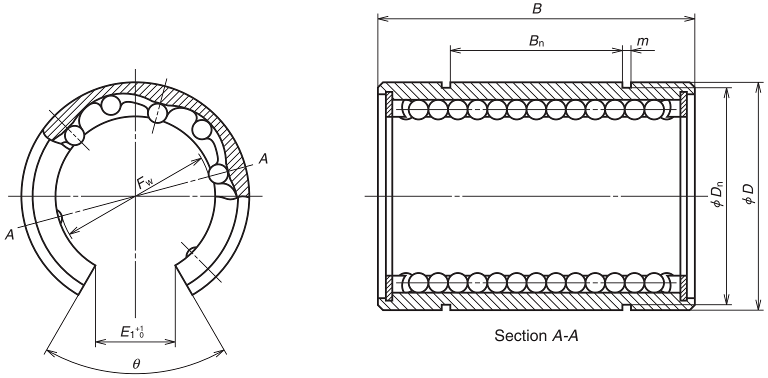


Section *A-A*

Unit: mm

Model No.	Inscribed circle diameter F_w	Outside diameter D	Length B	Opening width E	Retaining ring groove Distance B_n	Retaining ring groove Width m	Retaining ring groove Bottom diameter D_n	Number of ball circuit	Weight (kg) (Reference only)	Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
LB6NTY	6	12	19	0.8	11	1.15	11.5	4	0.0073	74	147
LB8ANTY	8	15	17	1	9	1.15	14.3	4	0.0093	78	118
LB8NTY	8	15	24	1	15	1.15	14.3	4	0.014	118	226
LB10NTY	10	19	29	1.5	19	1.35	18	4	0.025	206	355
LB12NTY	12	21	30	1.5	20	1.35	20	4	0.028	265	500
LB13NTY	13	23	32	1.5	20	1.35	22	4	0.040	294	510
LB16NTY	16	28	37	1.5	23	1.65	26.6	4	0.062	440	635
LB20NTY	20	32	42	2	27	1.65	30.3	5	0.087	610	1 010
LB25NTY	25	40	59	2	37	1.9	38	6	0.265	1 000	1 960
LB30NTY	30	45	64	2	40	1.9	42.5	6	0.302	1 400	2 500
LB35NTY	35	52	70	3	45	2.2	49	6	0.44	1 510	2 800
LB40NTY	40	60	80	3	56	2.2	57	6	0.52	2 230	4 000
LB50NTY	50	80	100	3	68	2.7	76.5	6	1.75	4 100	7 100

Model LB-K (Open type)



Section *A-A*

Unit: mm

Model No.	Inscribed circle diameter F_w	Outside diameter D	Length B	Opening width E_1	Opening angle θ	Retaining ring groove Distance B_n	Width m	Bottom diameter D_n	Number of ball circuit	Weight (kg) (Reference only)	Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
LB20NKY	20	32	42	11	60°	27	1.65	30.3	4	0.072	610	1 010
LB25NKY	25	40	59	13	50°	37	1.9	38	5	0.220	1 000	1 960
LB30NKY	30	45	64	15	50°	40	1.9	42.5	5	0.260	1 400	2 500
LB35NKY	35	52	70	17	50°	45	2.2	49	5	0.370	1 510	2 800
LB40NKY	40	60	80	20	50°	56	2.2	57	5	0.440	2 230	4 000
LB50NKY	50	80	100	25	50°	68	2.7	76.5	5	1.480	4 100	7 100

A-6-2 Crossed Roller Guide

1. Structure

Rollers with a retainer (hereinafter referred to as "retainer") are assembled in a pair of rails which have a V-shape groove. (The grooves form a 90-degree angle. Refer to **Figs. 1**, **2**.) Rollers are placed crisscrossed, and are able to support load in all directions, including moment loads.

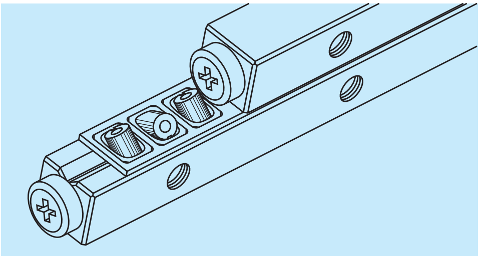


Fig. 1 Structure of crossed roller guide

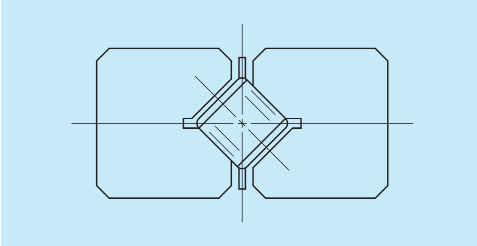


Fig. 2 Cross section of a crossed roller guide

2. Features

(1) High rigidity

This is attributable to the long contact area between the rollers and their accurately ground rolling surface.

(2) Superbly smooth movement, low noise

The window which directly embraces the roller is made of plastic for smooth and quiet operation, lowering clatter when the retainer and the rollers come into contact.

(3) Less micro-slip

Occasionally, a minute continuous slippage of the retainer to one direction, called "micro-slip," is caused due to installation error of the rail. After years of testing and research, NSK developed technology to minimize this.

(4) Easy installation

Installation is easy because the rail bending is minimal, and the bolt hole pitch for installation is precise.

(5) Long durability

The material is vacuum-degassed and highly pure, and is hardened by carburized heat treatment for superb resistance to wear and fatigue.

3. Accuracy

Accuracy grade P5 super precision and high precision grade P6 are available.

Fig. 3 shows parallelism of the roller's rolling surface to the mounting datum surface.

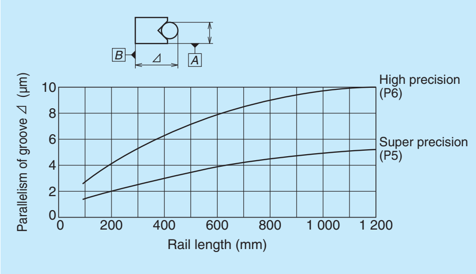


Fig. 3 Parallelism of the roller rolling surface

4. Rigidity

The number of the load rollers changes by the direction of the load. This is because the rollers are positioned crisscross.

That is, in case of **Fig. 4**:

The number of load rollers =1/2 × total roller number ·································(1)

In case of **Fig. 5**:

The number of load rollers = Total roller number ·································(2)

Fig. 6 shows changes in elastic deformation when there are 20 load rollers. If the total number of rollers is other than 20, use the graph in **Fig. 7**. Obtain the compensation factor which converts the elastic deformation value at time of 20 load rollers into the value when a specific number of rollers are loaded. That is, obtain a compensation factor on the ordinate that correspond to the number of load rollers on the abscissa. Then, multiply this factor by the elastic deformation value (on ordinates) which corresponds to the load (on abscissa) shown in **Fig. 6**.

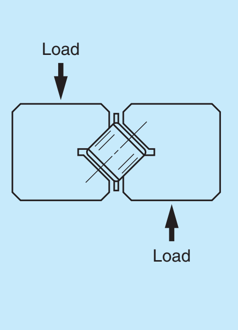


Fig. 4

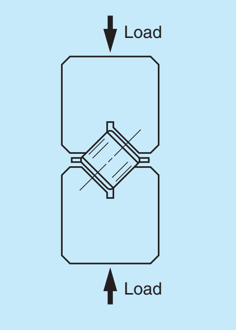


Fig. 5

[Calculation example: Elastic deformation]

A retainer which contains 30 rollers (roller diameter 6 mm) is installed on both right and left side (**Fig. 8**). How large is the elastic deformation of the crossed roller guide when a load of 4 kN is applied to the table center?

[Answer]

A load of 2 kN is applied to each side of the crossed roller guide. The elastic deformation value on the ordinate which corresponds to the load 2 kN on the abscissa (in **Fig. 6**) is:

4.5 μm

This application of load is the same as in **Fig. 4**. Therefore, the number of load rollers is one-half of 30, or 15. From **Fig. 7**, the compensation factor on the ordinate which corresponds to 15 rollers on abscissa is:

1.3

Multiply 1.3 by 4.5 μm obtained above. The answer is:

$4.5 \times 1.3 \fallingdotseq 6$ μm

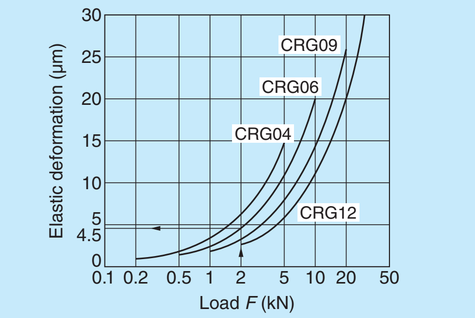


Fig. 6 Elastic deformation with 20 rollers

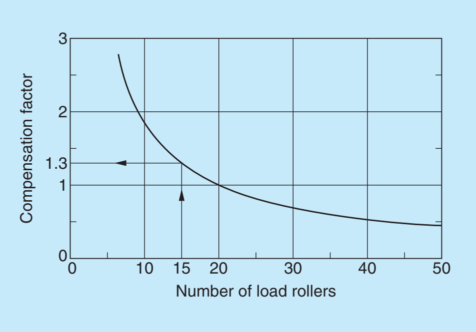


Fig. 7 Compensation factor to obtain elastic deformation

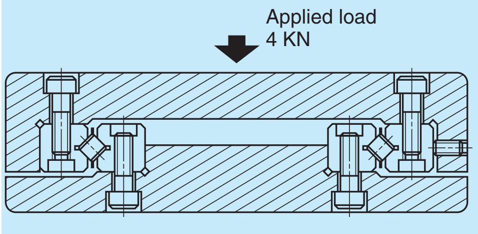


Fig. 8 Example calculation of elastic deformation (illustration)

5. Friction Force

If installation and lubrication are appropriate, the starting friction coefficient is markedly small as shown below:

$\mu = 0.005$

6. Lengths of Rail and Retainer

The relationship of rail length L with stroke S is as follows:

When $S \leq 400$ mm, $L \geq 1.5S$ ················ (3)

When $S > 400$ mm, $L \geq S$ ·················· (4)

Since the retainer travels a distance of half of the stroke, the retainer length K is:

$$K < L - \frac{S}{2} \quad \cdots\cdots (5)$$

The retainer does not detach from the rail when condition in Formula (5) is satisfied (Refer to **Fig. 9**).

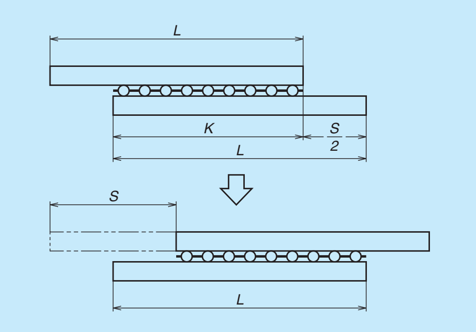


Fig. 9 Relationship of rail and retainer

7. Lubrication and Dust Proof

For grease lubrication, lithium soap based greases of consistency 1 or 2 are used.

For example; NSK Grease LR 3,
NSK Grease PS 2,
NSK Grease AS 2

For oil lubrication, JIS viscosity 32 to 150 is recommended.

When necessary, install a bellows on the rail, or install a seal on the side of the rail to arrest foreign matters and dust as shown in Fig. 10.

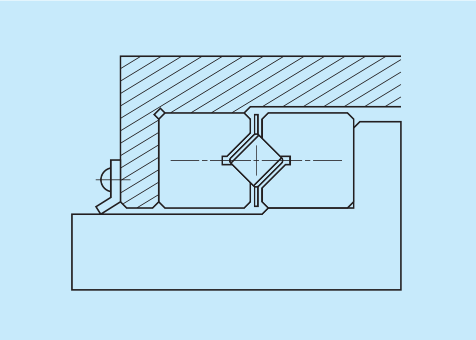


Fig. 10 Dust prevention (example)

8. Installation

Fig. 11 shows the standard installation procedures.

(1) Secure Rail 1 and 2 to the machine base using the fixing bolts. Secure Rail 3 to the table with the bolts. Temporarily secure Rail 4 and loosen the side bolt.

(2) Match the machine base and the table. Insert the retainer in the roller space. At this time, measure the distance from the rail end to the retainer end with a depth gauge to determine its position.
If the roller space is too narrow and the retainer does not go inside, slide Rail 4 toward the side bolt, then insert the retainer.

(3) Follow the reading of dial gauge which is previously set, and squeeze in all side bolts until they stop rattling. Do not apply excessive force.
When the side bolts are tightened, the rollers should be in the vicinity of the bolt position.
Then, secure Rail 4 with the fixing bolts.
Finally, install a stopper to the rail end.

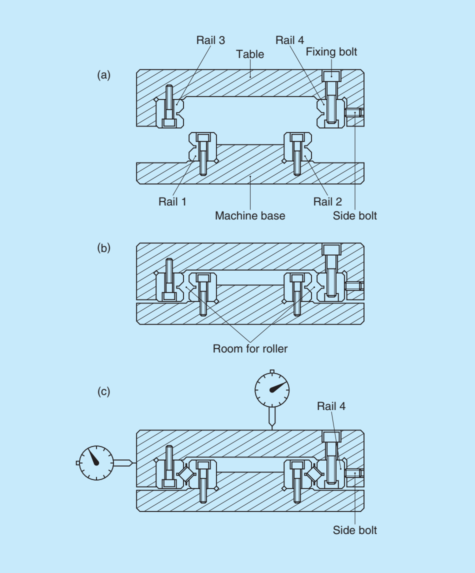


Fig. 11 Standard installation procedures

[Regarding preload]

As crossed roller guide has higher rigidity than other linear rolling guides, it does not need preload. It is also difficult to apply preload accurately. Crossed roller guide is usually used without clearance. For highly accurate applications, it is desirable to press the crossed roller guide by means of a bolt over the gib as shown in **Fig. 12**.

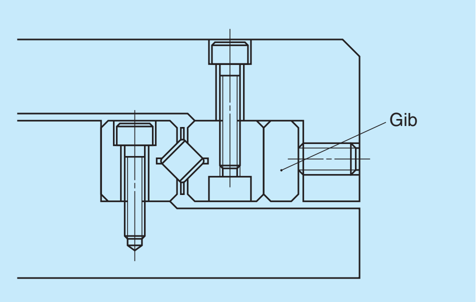


Fig. 12 Tightening using a gib

9. Basic Static Load Rating

Basic static load rating becomes larger in proportion to the number of the load rollers "n." Obtain basic static load rating per roller C_{01}. Then the basic static load rating C_{0n}, when the number of rollers is n, can be obtained as follows.

$$C_{0n} = n \times C_{01} \cdots\cdots\cdots\cdots (6)$$

Values of C_{01} are shown in the dimension table.

10. Basic Dynamic Load Rating and Rated Life

Basic static load rating is based on a rated traveled distance of 50 km. The dimension table shows the value with 20 load rollers. When the number of load rollers is other than 20, a basic dynamic load rating C_n can be obtained by multiplying a compensation factor (obtained from **Fig. 13**.) by C in the dimension table.

(Suffix 'n' is to refer the number of load rollers.)

As an example; Number of load rollers: n = 15.

The compensation factor from **Fig. 13** is 0.8.

$$C_{15} = 0.8 \times C$$

Therefore, C_{15} is obtained from the following formula.

Rated life (km) is shown in the formula below.

In this formula:

$$L = 50\left(\frac{C_n}{f_w \cdot F_c}\right)^{\frac{10}{3}} \cdots\cdots\cdots\cdots (7)$$

f_w: Load factor. 1.0 to 1.2 under smooth operation

F_c: Computed load which applies to the guide (kN)

Please refer to NSK Linear Guide Technical Description for details.

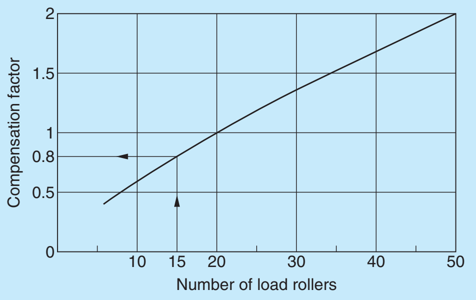
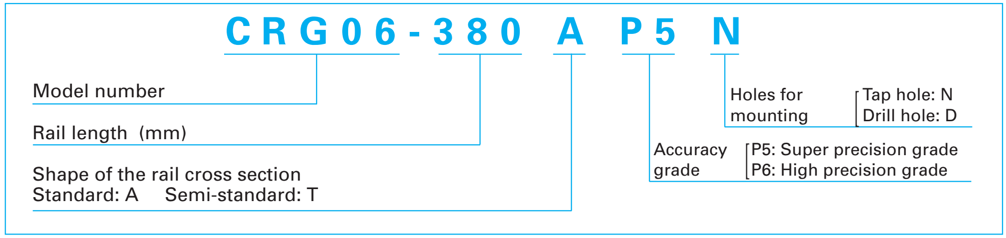


Fig. 13 Compensation factor for basic dynamic load rating

11. Reference Number and Standard Set for "One-Axis"

Specifications are indicated as a reference number as shown below.

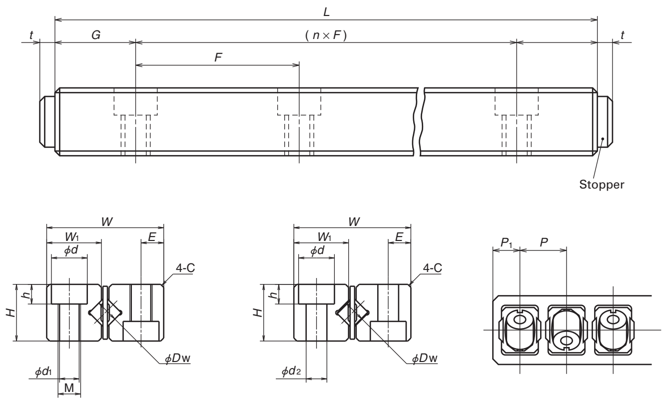


Notes : 1) Semi-standard T, a shape of rail cross section, is available only for CRG04. It is lower in H dimension, and wider in W dimension compared with A.

2) Standard set for "one axis" of the guide refers to 4 rails and 2 retainers which usually comprise the guide way for one axis.

12. Dimension Table

Crossed roller guide: Model CRG



When mounting bolt hole code is N

When mounting bolt hole code is D

Unit: mm

Model No.	D_w	W	H	w	C	E	d	h	d_1	d_2	M	G	F	t	P	P_1	Dynamic load rating C when rollers are 20 (N)	Static load rating C_{01} when roller is one (N)	L Max length	
																			High precision P5	Super high precision P6
CRG04…A	4	24	12	11.3	0.5	5	8	4.2	4.3	5	M 5×0.8	20	40	2.3	6.5	3.8	9 800	665	200	300
CRG04…T	4	26	10	12.3	0.5	5	8	4.2	4.3	5	M 5×0.8	12/15	38/40	2.3	6.5	3.8	9 800	665	200	300
CRG06…A	6	31	15	14.5	0.8	6	9.5	5.2	5.2	5.5	M 6×1	25	50	3.2	9.5	5.8	26 700	1 510	400	600
CRG09…A	9	44	22	20.7	1	9	11	6.2	6.8	7	M 8×1.25	50	100	4	14	8	72 500	3 400	600	900
CRG12…A	12	58	28	27.6	1.5	12	14	8.2	8.5	9	M10×1.5	50	100	5	20	12	130 000	6 050	900	1 200

Note: The area which embraces the roller is plastic for the standard retainer. A solid type made of steel plate is available for high temperature resistance.

A-6-3 Roller Pack

1. Structure

A roller pack comprises a main body which supports load from the guide way block via two rows of rollers; an end cap which changes the direction of the re-circulation of rollers at the end of the main body; a side plate which guides the rollers (**Fig. 1**). Roller pack is one of the linear rolling guides, where rollers are allowed to re-circulate infinitely.

There is a plate spring attached to a side of roller pack to prevent roller pack from falling out when it is turned upside down after assembly.

Other component of the roller pack is spring pin. Spring pin is on the top surface of the roller pack, and makes installation of wedge block and fitting plate easier.

Wedge block is a unit to provide preload (**Fig. 3**) to roller pack; a fitting plate (**Fig. 2**), functioning like a pivot, adjusts misalignment of roller pack automatically. Wedge of wedge block moves up and down to apply preload by turning the adjust screw.

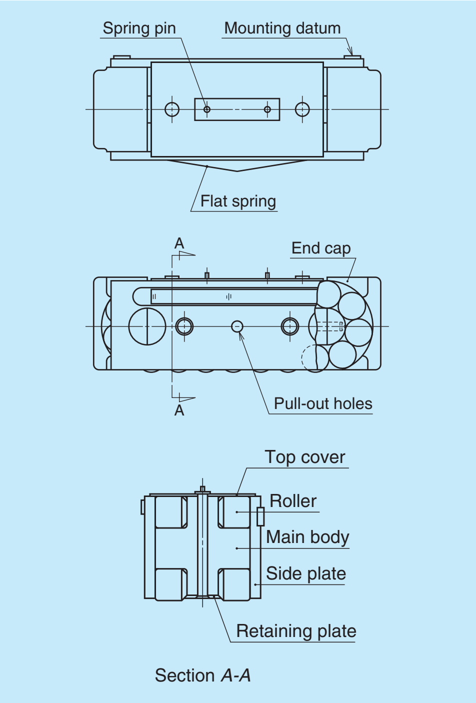


Fig. 1 Roller pack

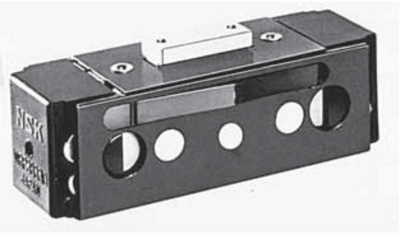


Photo 1 Roller pack

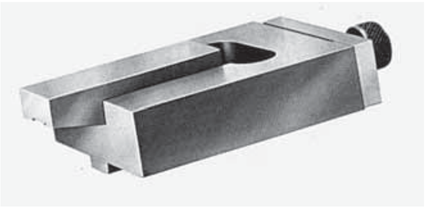


Photo 2 Wedge block

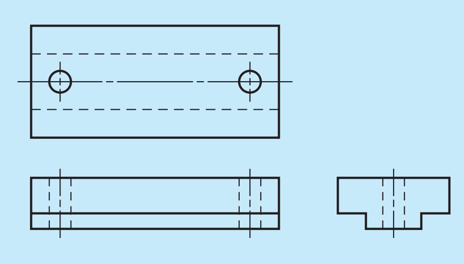


Fig. 2 Fitting plate

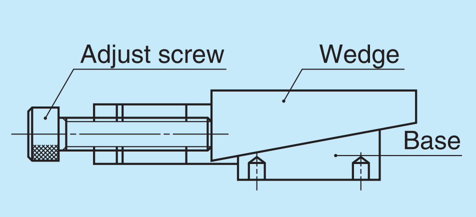


Fig. 3 Wedge block

2. Features

Roller pack has two remarkable characteristics other linear roller guide bearings do not have.

(1) No roller skewing

If the roller is long relative to its diameter, the roller inclines during operation. This phenomenon is called skewing. Skewing causes problems such as sudden rise in friction force. However, a short roller lacks large load carrying capacity. The roller introduced here solved the skewing problem, yet has a large load carrying capacity:
short rollers are combined into double rows.

(2) Load is applied equally.

This is due to a "fitting plate," a result of "changed way of conceiving." Installation is quite easy: Merely place the fitting plate through the two holes to spring pins. The stop pins are inserted to holes on the top surface of the roller pack. The contact area between the fitting plate and the main body is made small. This way, the self-alignment is automatically accomplished by elastic contact of both parts.

This distributes an equal load to the rollers, far extending the life, compared to conventional roller linear guides.

Other characteristics include: Easy to provide preload by the wedge block; can be installed to vertical shaft; and reduction in noise level.

3. Accuracy

The height tolerance of roller pack is 10 μm. Roller packs are grouped into a size difference of every 2 μm (corded by A to E) before delivery (**Table 1**).

Table 1 Height Classification

Unit: μm

Category	Code
over or less	
+3 – +5	A
+1 – +3	B
-1 – +1	C
-3 – -1	D
-5 – -3	E

4. Rigidity

Fig. 4 shows the relationship between load and deformation. This includes deformation caused by contact between: the rollers and main body; the rollers and guide way surface; the main body and fitting plate.

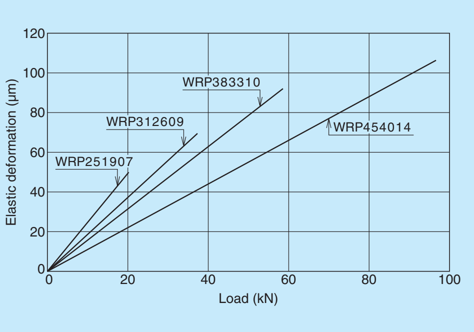


Fig. 4 Elastic deformation of the roller pack

5. Preload

Fig. 5 shows conversions of tightening torque of the wedge block adjust screw into preload volume. Use a dial gauge for accurate measurement.

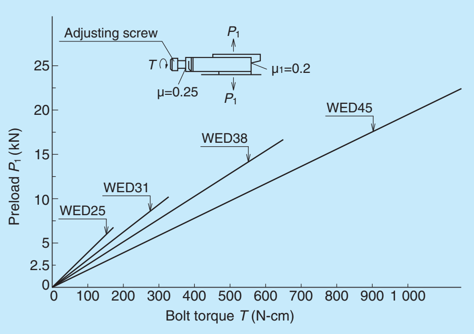


Fig. 5 Tightening torque of the adjust screw, and preload volume

6. Friction and Lubrication

(1) Lubricants and volume

Mineral oils are commonly used. Since roller pack is used under a relatively heavy load, the oil should, ideally, have high viscosity and provide a strong film. Select from JIS viscosity 32-150.

Criteria of oil supply per roller pack Q (cc/h) can be calculated by the following formula.

$$Q \geq S \times 1/4 \quad \cdots\cdots (1)$$

In this formula, S (stroke) is shown in meters. The oil volume, when the stroke is 1 m, per roller pack is more than 0.25 (cc/h). It is more desirable to supply a small amount of oil at short intervals than supplying a large amount at one time. In case of grease lubrication, use a grease of consistency 2. Albania EP2 is widely used.

(2) Friction coefficient

Starting friction coefficient is significantly small at under 0.005.

(3) Seal

It is necessary to install a wiper seal to the guide way surface to prevent foreign matters (swarf from cutting, and other dust) from entering the roller pack to enjoy the full benefit of the designed life of it. The material of the seal should have strong resistance to oil and wear. Felt and synthetic rubber (acrylonitril butadiene rubber) are some of the suitable materials. **Fig. 6** shows a general method to install the seals.

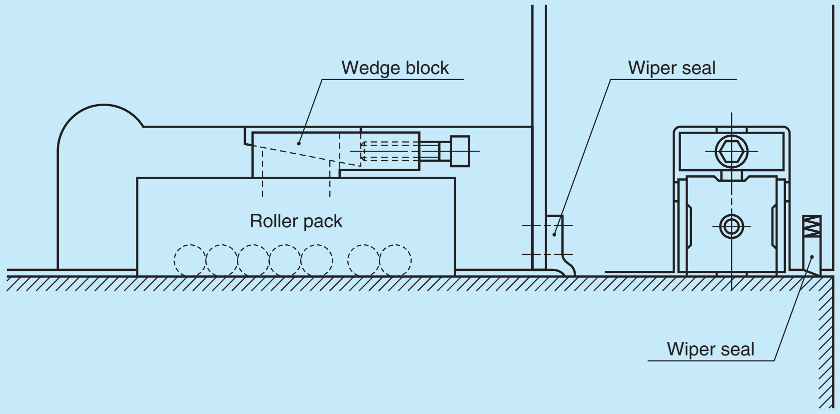


Fig. 6 Installation of seal

7. Installation

(1) Installation and applying preload

As shown in **Fig. 7**, it is basic that a fitting plate is installed on the roller pack which receives load, and a wedge block is installed on the roller pack which receives no load, but is only used for preload. All components should be secured with a stop pin, facing toward the direction of movement. To cut costs for processing, it is recommended to divide the pocket (which contains roller pack) into some blocks and secure them with bolts (**Fig. 7**). Preload is provided by the wedge block. Estimate the actual load beforehand, so the preload shall not be lost when a load is applied. A load variation equivalent to up to two times of the preload volume can be absorbed in this case.

(Take into consideration the rated life in 8. in determining preload volume.)

(2) Accuracy of way block

The following is the ideal accuracy specification and installation accuracy of way block as a guide surface.

Hardness by heat treatment

: More than HRC58 hardened depth 2 mm or more

Surface roughness

: Less than 1.6 S

Parallelism as a single unit: Less than 0.010 mm per meter

Parallelism after installation

: Less than 0.020 mm per meter

Please consult NSK when using cast iron or cast steel guide face.

(3) Pocket accuracy

Accuracy of the pocket in which the roller pack is mounted should satisfy the following conditions.

Pocket width

: Roller pack width + 0.10 to 0.20 mm

Parallelism of the pocket side faces to the guide way face

: Less than 0.010 mm per 100 mm.

Parallelism of the fitting plate (pocket bottom) mounting surface to the guide way face and parallelism of the wedge block mounting surface to the guide way surface :

: Less than 0.040 mm per 100 mm.

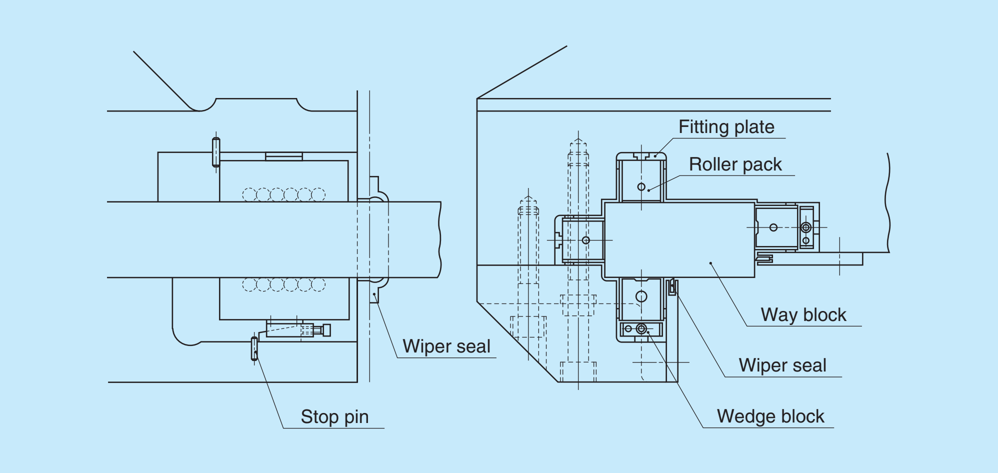


Fig. 7 Design of the roller pack pocket (example)

8. Rated life

Rated life L (km) is shown in the following formula.
In this formula:

$$L = 50\left(\frac{C}{f_w \cdot F_c}\right)^{\frac{10}{3}} \cdots\cdots\cdots\cdots\cdots\cdots (2)$$

C: Basic dynamic load rating (N)

f_w: Load factors. 1.0 to 1.2 at time of smooth operation

F_c: Calculated load (N) applied to the roller pack

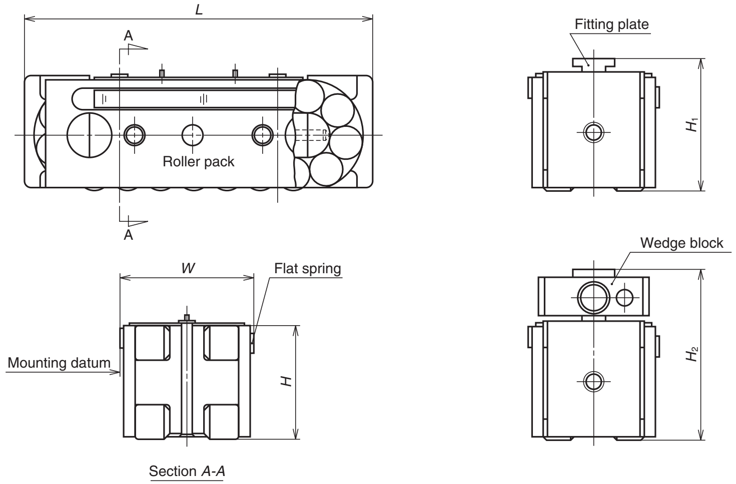
9. Disassembly

Remove the roller pack preloaded by the wedge block in the following manner.

- Loosen the adjust screw of the wedge block. Lightly tap the wedge. In case of light preload, the wedge loosens, and the roller pack can be pulled out.
- When pulling, put the bolt in the tap hole at the end of the end cap, and tug the bolt.
- In case of heavy load, the roller pack could not be pulled out by the above method. Hook a tool to the pull-out hole (**Fig. 1**) on the side plate of the roller pack, and pull out the roller pack.

10. Dimension Table

Roller pack: Model WRP

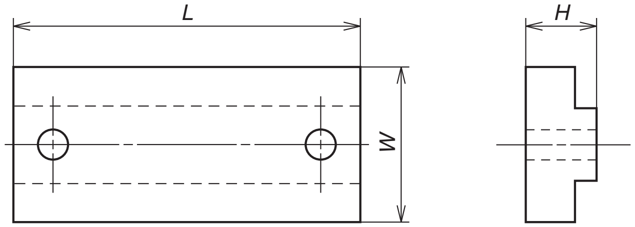


Unit: mm

Model No.	Width W	Height ±0.005 H	Length L	Applicable fitting plate reference No.	Assembled height H_1	Applicable wedge reference No.	Assembled height H_2	Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
WRP 251907	25	19	65.5	WFT 25	24	WED 25	31 (30.4 – 31.6)	31 000	40 500
WRP 312609	31	26	85	WFT 31	31	WED 31	40 (39.4 – 40.6)	57 000	73 000
WRP 383310	38.1	33.31	104.4	WFT 38	38.91	WED 38	50.8 (50 – 51.5)	91 000	113 000
WRP 454014	45	40	138	WFT 45	45	WED 45	60 (59.2 – 60.8)	151 000	191 000

Note : Numbers in the parentheses in column H_2 show the adjustable height range of the wedge block.

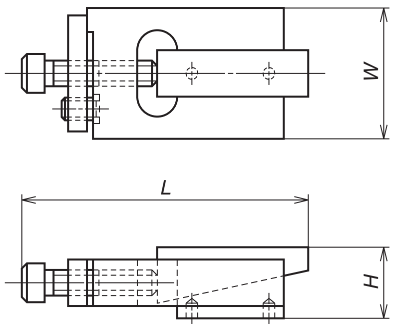
Fitting plate: Model WFT



Unit: mm

Model No.	Width W	Height (±0.01) H	Length L	Applicable roller pack
WFT 25	10	5	20	WRP 251907
WFT 31	12	5	26	WRP 312609
WFT 38	12.8	5.6	29	WRP 383310
WFT 45	16	5	40	WRP 454014

Wedge block: Model WED



Unit: mm

Model No.	Width W	Height H	Length L	Applicable roller pack
WED 25	23	12 (11.5 – 12.5)	47	WRP 251907
WED 31	28	14 (13.5 – 14.5)	63	WRP 312609
WED 38	35	17.47 (16.9 – 18.1)	76	WRP 383310
WED 45	40	20 (19.2 – 20.8)	95	WRP 454014

Note : Numbers in the parentheses in column H_2 show adjustable height range of the wedge block.

A-6-4 Linear Roller Bearings

1. Structure

Linear roller bearing comprises: A single row of rollers; the main body which supports load via rollers; the end cap which turns the roller re-circulating direction at the end of the main body from the loaded zone to the unloaded zone; a retaining wire which prevents rollers from falling out (**Fig. 1**). The main body, as the cylindrical roller bearing, has a rib at both sides. The rib guides the rollers to travel correctly, and assists the rollers to circulate infinitely in the bearing in a stable manner. This contributes to the bearing's linear movement without the restriction of travel range.

NSK also developed a highly functional preload pad (Photo 2) to provide a slight preload to the bearing. The preload pad basically comprises parallel plates and sandwiched bellevile springs, having adjusted its spring rate.

Preloaded pad can be used in a machine tool in the following manner.

When two bearings are installed with one on the top and the other under the way block (the bearings comprise a set), a preloaded pad is used at the bottom bearing. This provides an equal preload to the top and bottom bearings. This way, to a certain extent, the variation in the load and the uneven thickness of the way block can be absorbed.

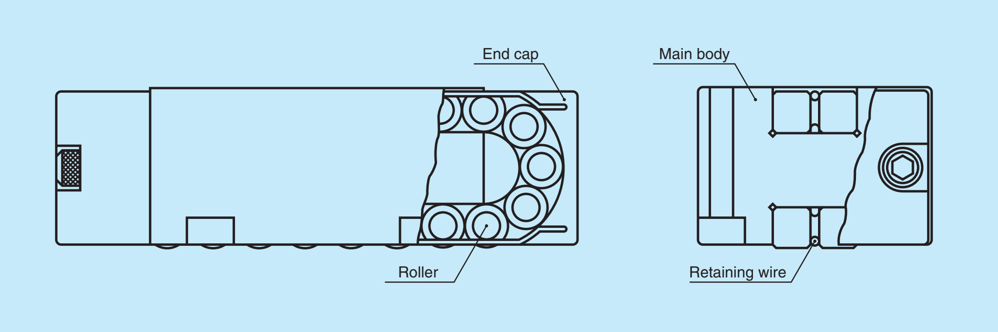


Fig. 1 Linear roller bearing

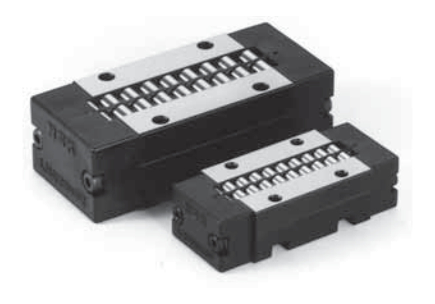


Photo 1 Linear roller bearing

Photo 2 Preload pad

2. Features

In addition to the general features of a roller bearing guide such as no-stick slip, small friction resistance, and easy maintenance, the linear roller bearing has several more advantages.

(1) No trouble by roller skewing

Skewing is the inclination of the rollers during operation. It causes friction force to suddenly soar. Skewing is apt to occur when the roller is long relative to its diameter. The proportion of the length and diameter is 1:2 for the products in this series. This is superior to the commonly used 1:3 ratio.

(2) Highly reliable

Retaining the rollers without allowing them to fall out of the bearing is a crucial function of the linear guide bearing. The simple and highly effective retaining wire has solved the problem for this product series.

(3) Compact design

Despite the load carrying capacity, this series is smaller in size than any other models. This contributes to the application which requires compact design.

(4) High rigidity

The contact area between the bearing and the mounting surface is large to increase rigidity.

3. Accuracy

The nominal height difference between bearings is 10 μm. The bearings are grouped into every 2 μm, and are coded before delivery (**Table 1**).

Table 1 Classification of height

Unit: μm

Category			Code
over		or less	
0	–	–2	A
–2	–	–4	B
–4	–	–6	C
–6	–	–8	D
–8	–	–10	E

4. Rigidity

Fig. 2 shows elastic deformation.

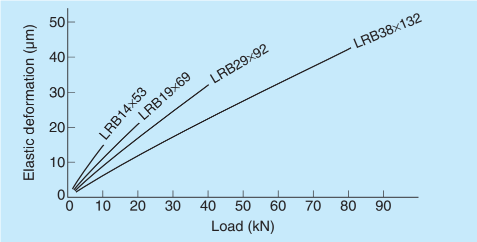


Fig. 2 Elastic deformation

5. Friction and Lubrication

(1) Lubricants and volume

Mineral oils are used in general. The linear roller bearing is used under relatively heavy load. An oil which has high viscosity and creates a strong oil film is ideal for linear roller guides. Select from JIS viscosity 32 to 150.

General oil supply for a linear roller bearing Q (cc/h) can be calculated by the following formula.

$$Q \geq S \times 1/4 \cdots\cdots (1)$$

In this formula, S (stroke) is shown in meters. Therefore, when the stroke is 1 m, the volume of lubricant per roller bearing is more than 0.25 (cc/h). It is recommended to supply a small amount of oil at short intervals rather than supplying a large amount at one time. In case of grease lubrication, a grease of consistency degree 2, such as Albania EP2, is generally used.

(2) Friction coefficient

Starting friction coefficient is significantly small at under 0.005.

(3) Seal

Install a wiper seal on the way block surface to prevent foreign matters (cutting chip and other contaminant from entering) to realize a full life of the linear roller bearing. The material of the seal should have strong resistance against oil and wear. Felt and synthetic rubber (acrylonitril-butadien rubber) are some of the suitable materials.

6. Installation

Secure the linear roller bearing using four bolts. The bearing main body has four holes for mounting.

Accuracy of way block
The ideal accuracy specification and mounting accuracy of a way block as a guide way surface are as follows.
Hardness by heat treatment
: More than HRC58 hardened depth 2 mm or more
Surface roughness
: Less than 1.6 S
Parallelism as a single unit
: Less than 0.010 mm per 1 m
Parallelism after installation
: Less than 0.020 mm per 1 m
Please consult NSK when using cast iron or cast steel guide way.

7. Rated life

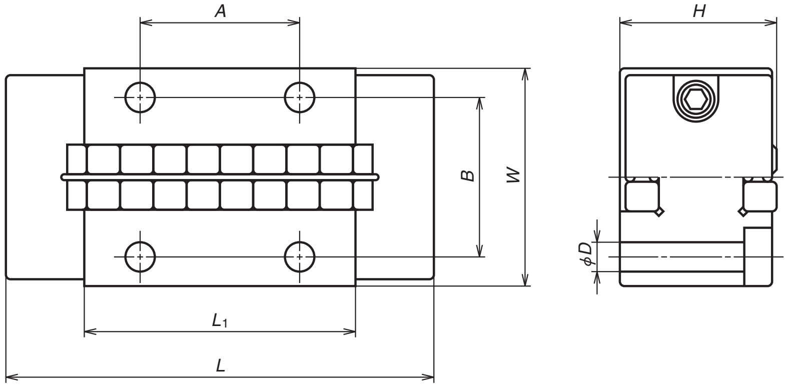
Rated life L (km) is shown in the following formula.
In this formula:

$$L = 50\left(\frac{C}{f_w \cdot F_c}\right)^{\frac{10}{3}} \cdots\cdots\cdots\cdots (2)$$

C : Basic dynamic load rating (N)
f_w : Load factor. 1.0 to 1.2 at time of smooth operation
F_c : Calculated load applied on the bearing (N)

8. Dimension Table

Linear roller bearing Model: LRB

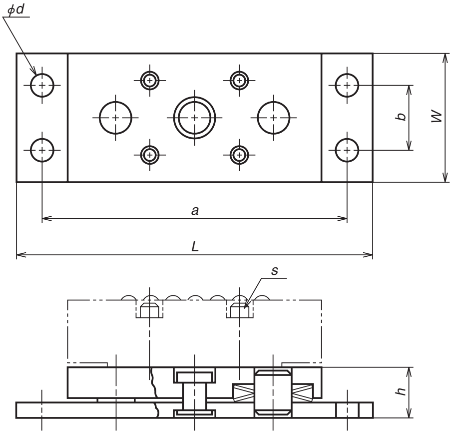


Unit: mm

Model No.	Width W	Height $H^{0}_{-0.010}$	Length L	L_1	Roller diameter × length	Mounting bolt hole D	Bolt hole distance		Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
							A	B		
LRB 14×53	26.5	14.29	52.8	32.8	φ 4×8	3.4	19	19.3	15 400	21 900
LRB 19×69	30.5	19.05	68.6	44.6	φ 5×10	3.4	25.4	23.3	27 000	39 000
LRB 29×92	41.5	28.58	92.0	59	φ 7.5×15	4.5	38.1	32.7	57 500	76 500
LRB 38×132	51.4	38.10	132.0	88	φ 10×20	5.5	50.8	41.5	119 000	159 000

Note: Bearings are grouped into heights of every 2 μm before delivery.

Preload pad Model: PRP



Unit: mm

Model No.	Applicable linear roller bearing	Height (no-load) *h* max.	Compressed height *h* min.	h min. Load when fully compressed (N)	*W*	*L*	*d*	*a*	*b*	*s* Hex. Socket cap screw
PRP 14×53	LRB 14×53	10.23	9.53	1 570	26	72	4.5	62	14	M3×16
PRP 19×69	LRB 19×69	11.53	11.10	2 650	30	96	4.5	86	18	M3×19
PRP 29×92	LRB 29×92	13.13	12.70	6 450	41	120	4.5	110	27	M3×25
PRP 38×132	LRB 38×132	16.28	15.88	12 000	51	157	4.5	147	35	M5×38

B BLOCK

Ball Screw

B-1 Selection Guide to NSK Ball Screw

B-2 Technical Description of Ball Screws

B-3 Ball Screw Dimension Table

B1 -B36

B37 -B100

B103 -B544

B-1 Selection Guide to NSK Ball Screw

B-1-1 Features of NSK Ball Screws

(1) Quick delivery

Standard ball screws are for short lead time.

- Precision ball screws with finished shaft end
  Compact FA Series, 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 with finished shaft end
  VFA Type, RMA Type
- Ball screws for transfer equipment with 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** to minimize the clearance between the balls and grooves. Further, an application of preload makes no backlash possible. As providing controlled preload is easy, appropriate rigidity is obtained.

As the Gothic arch also minimizes the clearance between the balls and the grooves, the backlash is minimized without applying preload.

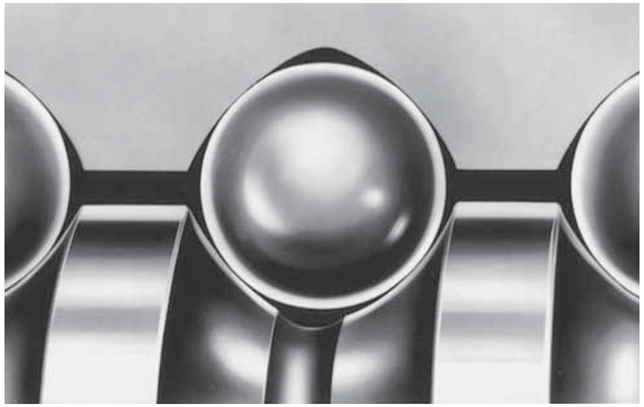


Fig. 1.1 Ball groove profile of NSK ball screw

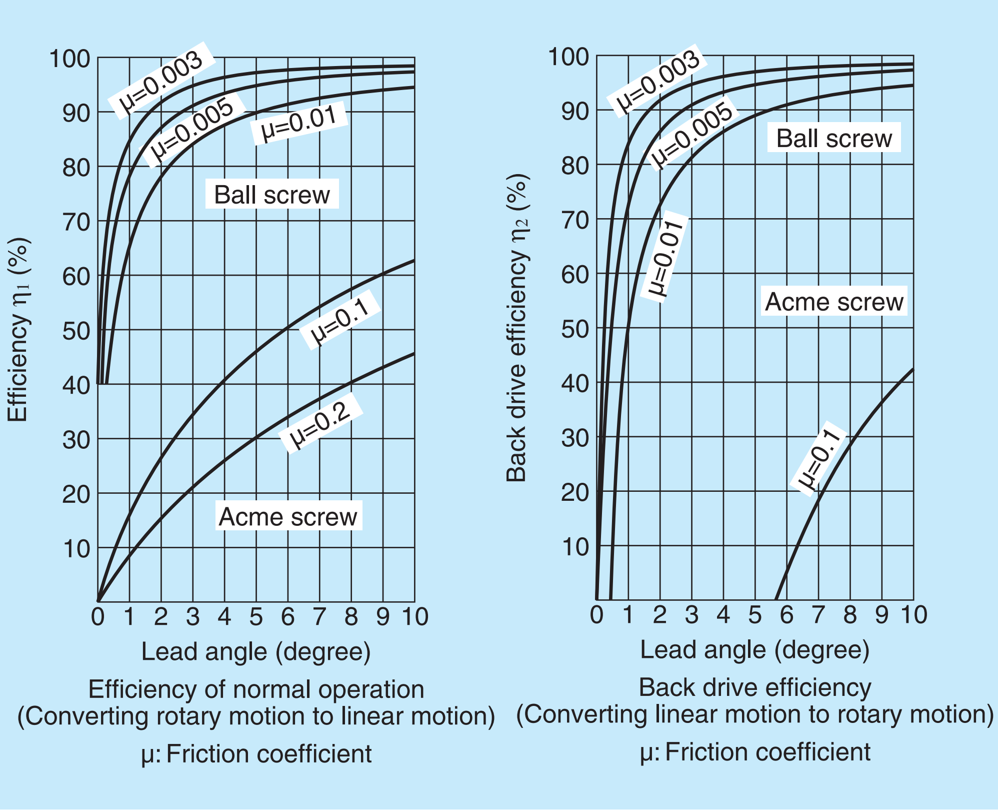
(6) Smooth movement assures high efficiency

When the circular-arc groove is used for the ball screws, balls are wedging into the grooves of ball nut and ball screw shaft. But this phenomenon does not happen in the Gothic arc groove. The Gothic arc groove, along with the low friction that is inherent nature of ball screw, is accountable for 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.

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.



Efficiency of normal operation
(Converting rotary motion to linear motion)
μ: Friction coefficient

Back drive efficiency
(Converting linear motion to rotary motion)
μ: Friction coefficient

Fig. 1.2 Mechanical efficiency of ball screws

B-1-2 Structure of a Ball Screw

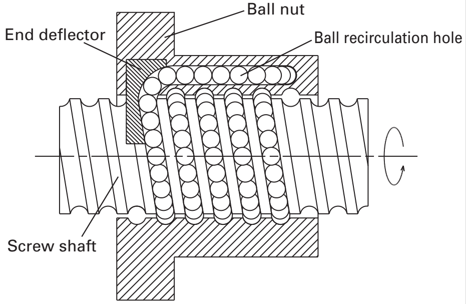
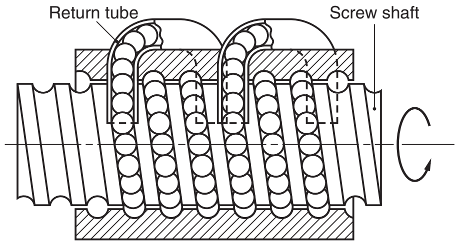
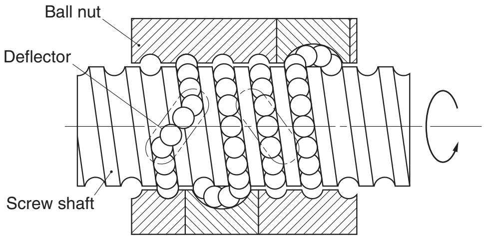
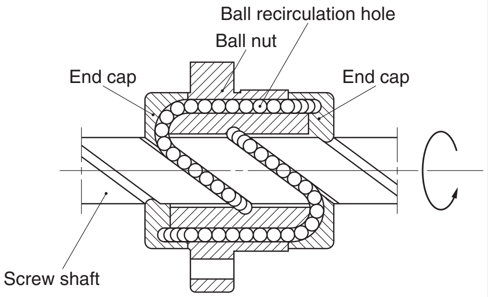
Balls are placed between the screw shaft and nut, and roll. This system is called a "ball screw." To keep the balls recirculating continually, this system requires a screw shaft, a nut, balls, and recirculation components as basic items. A ball screw has the following functions.

(1) Converting motion: Changing rotary motion to linear motion (normal operation); Changing linear motion to rotary motion efficiently (back-drive operation).
(2) Increasing power: A small torque is converted to a large thrust force.
(3) Positioning: Sets accurate position in linear motion.

B-1-2.1 Ball Recirculation System

A ball 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 the NSK ball screws.

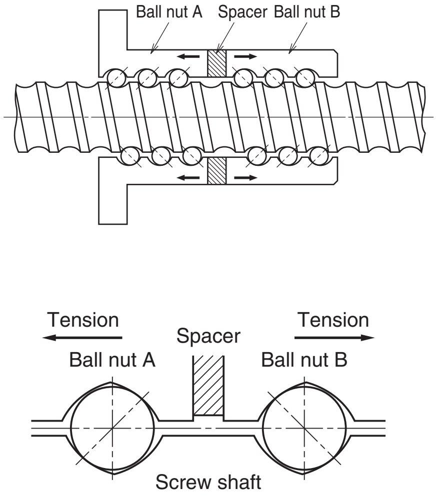
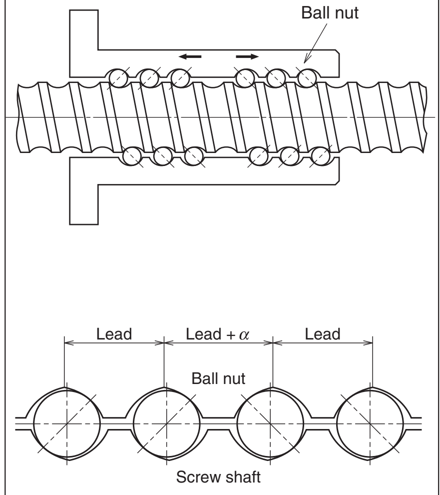
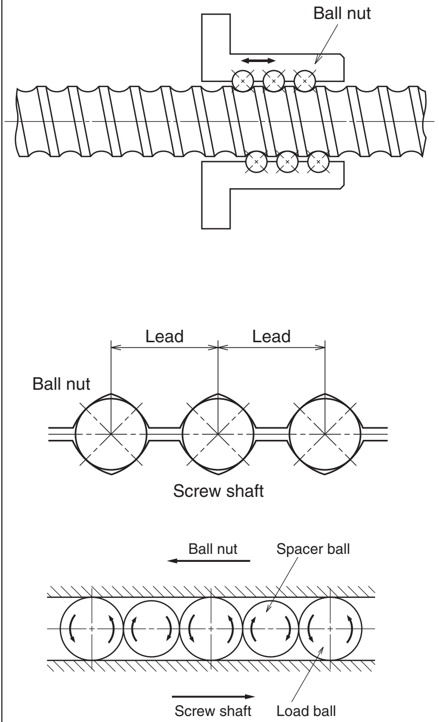
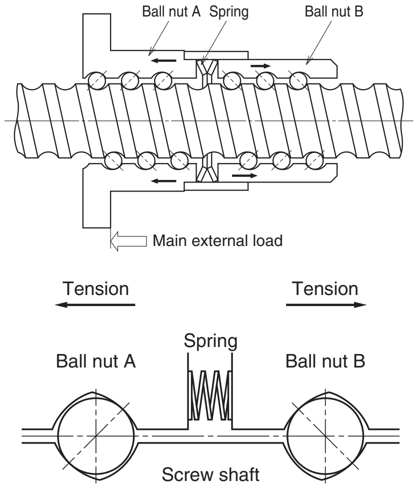
Table 2.1 Ball screw recirculation system

End deflector type	Ball return tube type	Deflector type	End cap type
			
[Structure] Balls are smoothly picked up in the tangential direction at the end of nut, and recirculated via a hole in the nut. If the balls are picked up at the middle of the nut, it is called middle deflector type.	[Structure] Balls are recalculating through a pipe (ball return tube) of optimized size, bridging the start and end of recirculation.	[Structure] Balls are recirculated by a horseshoe shaped deflector bridging the adjacent ball thread grooves.	[Structure] Balls are picked up by an end cap placed at both ends of the nut, and recirculated via a hole through the nut.
[Features] · Small nut outside diameter allows compact nut design. · Low noise, high speed.	[Features] · Adapt to various specifications. (screw shaft diameter, lead)	[Features] · Suitable for fine lead ball screws. · Small nut outside diameter, allows compact nut design.	[Features] · Suitable for large lead ball screws. · Not universal due to complex recirculation structure.

B-1-2.2 Preload system

There are four systems to apply preload to NSK ball screws depending on the application.

Table 2.2 Preload system for ball screws

Preload system	Double nut preload (D-Preload)	Offset preload (Z-Preload)	Oversize ball preload (P-Preload)	Spring preloaded double nut (J-Preload)
Structure				
Description	Uses two nuts, and inserts a spacer between them to apply the preload. In general, a spacer is thicker (by the deformation equivalent to the preload) than the actual space between two nuts. However, a thin spacer is inserted in some cases.	To apply preload, the lead near the center of the nut is offset by the volume equivalent to preload (α). This method is like to creating a preload system similar to the double nut preload (D-preload) by a single ball nut, thus enabling a compact nut design.	Balls slightly larger than the ball groove space (over-size balls) are inserted to allow them to contact at four points. Provides better torque characteristics in the low torque range.	A spring is used as a spacer of D-Preload. Must be used with discretion in its varied rigidity by load direction.
Nut length	Long	Medium	Short	Long
Torque characteristics	○	○	○	◎
Rigidity	◎	◎	○	△

B-1-3 Ball Screw Series

B-1-3.1 Ball Screw Classification

- Ball screws
  - Standard ball screws
    - Finished shaft end
      - Compact FA Series **Page B103**
      - MA Type, Miniature, fine lead ball screws **Page B145**
      - FA Type for small equipment **Page B167**
      - SA Type for machine tools **Page B203**
      - KA Type, Stainless steel product **Page B259**
      - VFA Type, RMA Type for transfer equipment **Page B339**
    - Blank shaft end
      - MS Type, Miniature, fine lead ball screws **Page B287**
      - FS Type for small equipment **Page B295**
      - SS Type for machine tools **Page B307**
      - RMS Type, R Series for transfer equipment **Page B357**
  - Standard nut ball screws
    - End deflector type **Page B409**
      High-speed and low-noise operation, and compact nut outside diameter
      A wide variety of combinations of screw diameters and leads
    - Tube type **Page B415**
      Standard ball recirculation system for ball screws
      A wide variety of combinations of screw diameters and leads
    - Deflector type **Page B449**
      A ball recirculation system that facilitates the most compact nut diameter
      Suitable for fine lead ball screws
    - End cap type **Page B463**
      Ball screws with high helix lead and multiple start threads
      High-speed, high-load capacity
  - Application-oriented ball screws
    Features and application examples are shown on page B471.
    - For high-speed machine tools
      - HMD Type **Page B473**
      - HMC Type **Page B477**
    - BSL™ Type for miniature lathes **Page B483**
    - For high-load drives
      - HTF-SRC Type **Page B487**
      - HTF-SRD Type **Page B491**
      - HTF Type **Page B495**
    - VSS Type for contaminated environment **Page B507**
    - TW Series for twin drives **Page B511**
    - Hollow shaft ball screws for high precision machine tools **Page B512**
    - ND Series for nut rotatable drives **Page B517**
    - ∑ Series for robots **Page B525**
    - Ball screws equipped with NSK K1™ Lubrication Units **Page B537**

- Ball screw accessories
  - Support units (Support bearing units for ball screw)
    - For small equipment, light load **Page B381**
    - For machine tools, high load **Page B391**
  - Lock nuts **Page B395**
  - Grease units **Page B397**
  - Travel stoppers (available on request) **Page B398**
  - Thrust angular contact ball bearings for ball screw support **Page B399**

Lead classification

Classification	Lead ratio K = lead *l* / shaft diameterd
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

●Standard ball screws

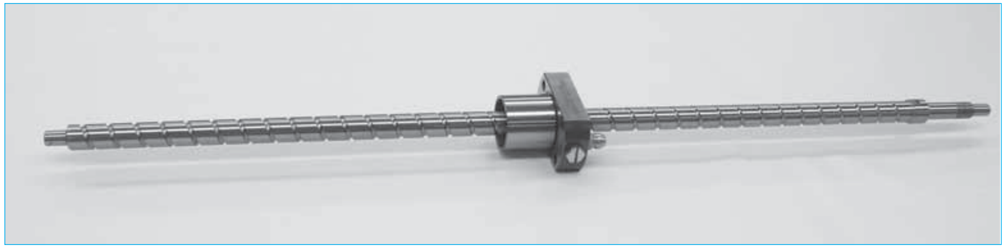


Fig. 3.1 Finished shaft end compact FA Series Page B103

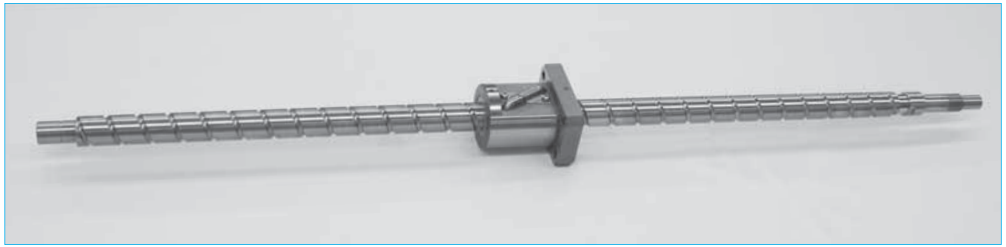


Fig. 3.2 Finished shaft end MA type, FA type and SA type Page B143

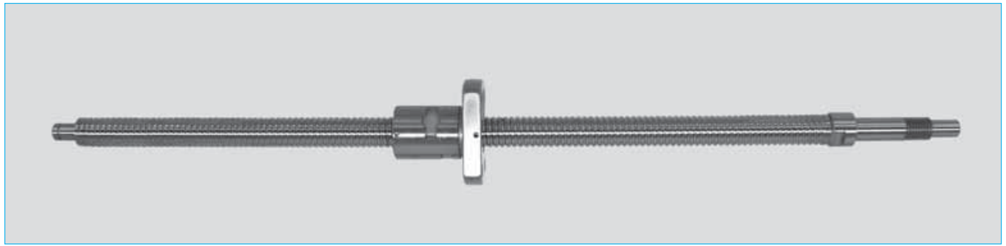


Fig. 3.3 Finished shaft end KA type Page B259

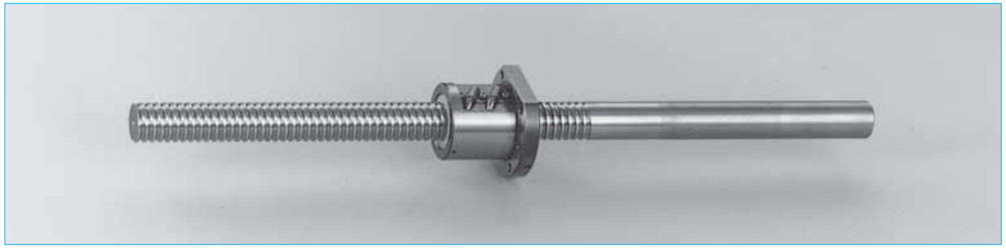


Fig. 3.4 Blank shaft end MS type, FS type and SS type Page B287

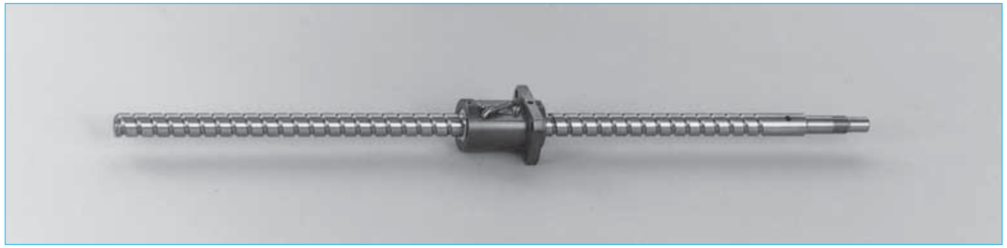


Fig. 3.5 Finished shaft end VFA type for transfer equipment Page B335

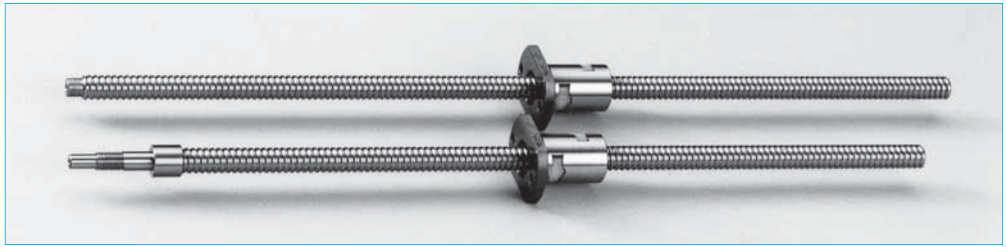


Fig. 3.6 Finished shaft end RMA type and blank shaft end RMS type for transfer equipment Page B335


Fig. 3.7 Blank shaft end R series for transfer equipment Page B335

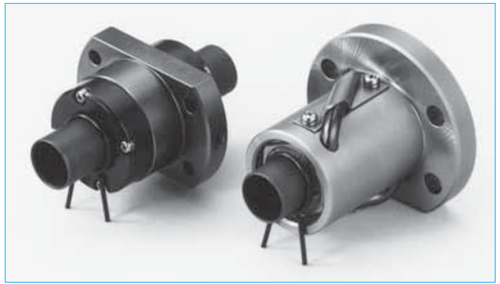


Fig. 3.8 R series nut assembly for transfer equipment Page B335

●Standard nut ball screws

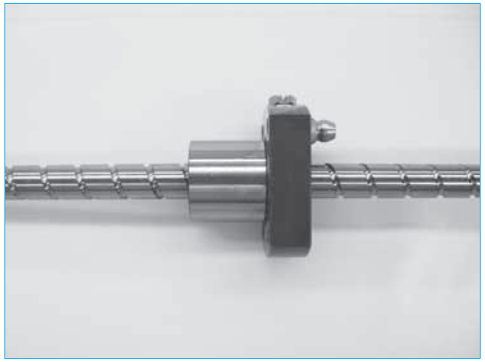


Fig. 3.9 End deflector type Page B409

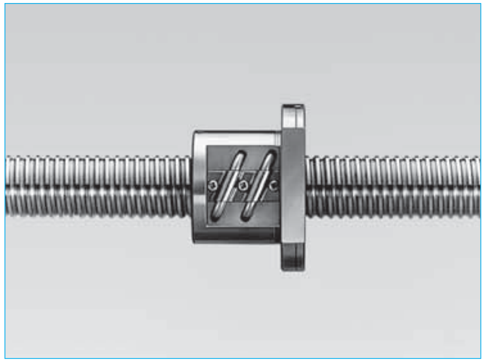


Fig. 3.10 Tube type Page B415

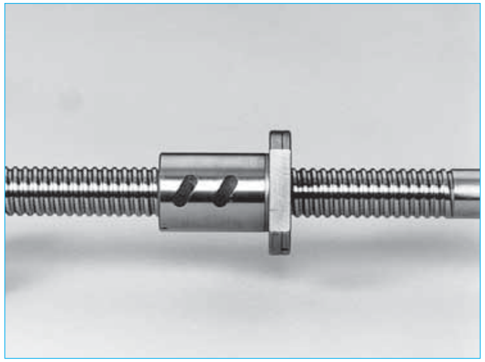


Fig. 3.11 Deflector type Page B449

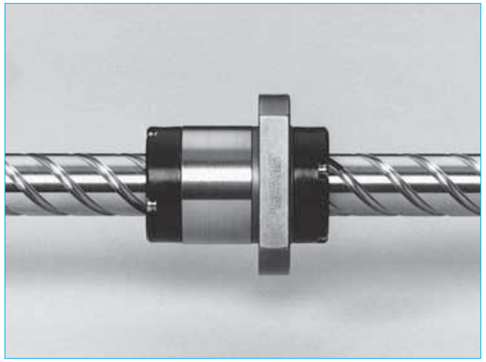


Fig. 3.12 End cap type Page B463

●Application-oriented ball screws

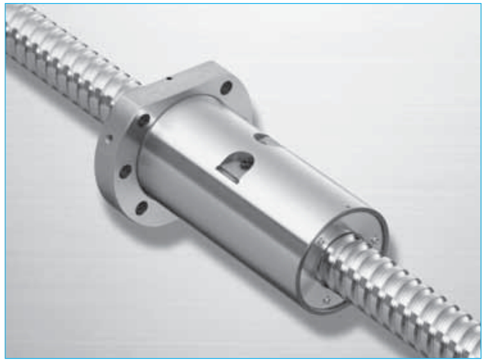


Fig. 3.13 HMD type for high-speed machine tools Page B473

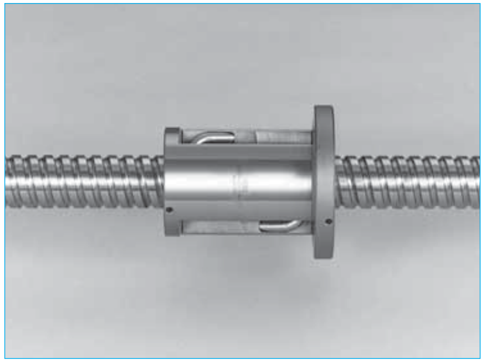


Fig. 3.14 HMC type for high-speed machine tools Page B477

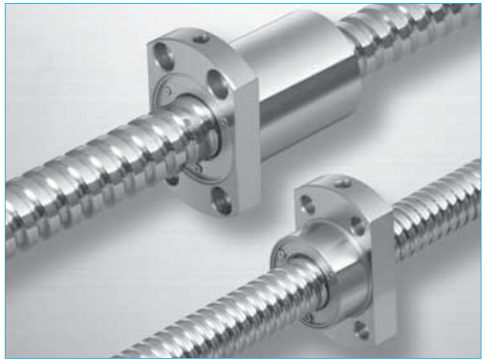


Fig. 3.15 BSL™ type for miniature lathes Page B483

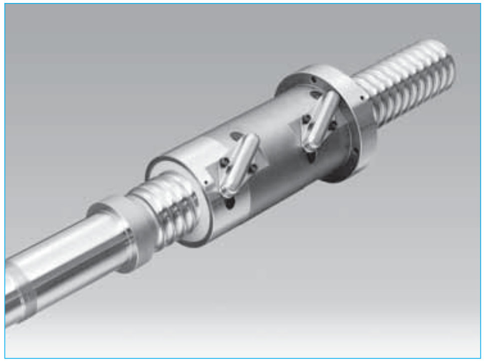


Fig. 3.16 HTF-SRC type for high-load drives Page B487

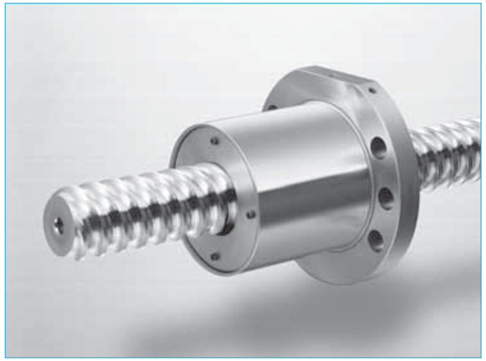


Fig. 3.17 HTF-SRD type for high-load drives Page B491

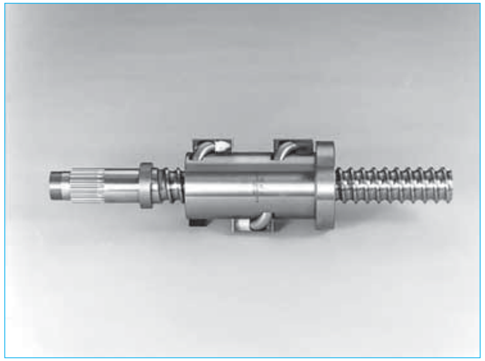


Fig. 3.18 HTF type for high-load drives Page B495

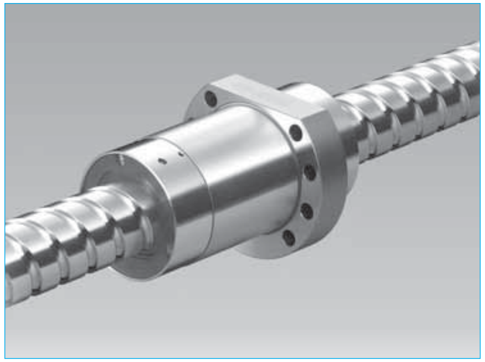


Fig. 3.19 VSS type for contaminated environments Page B507

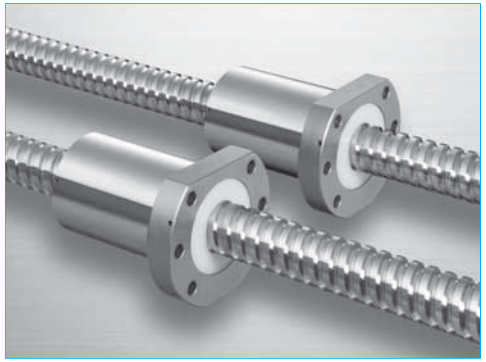


Fig. 3.20 TW series for twin-drive systems Page B511

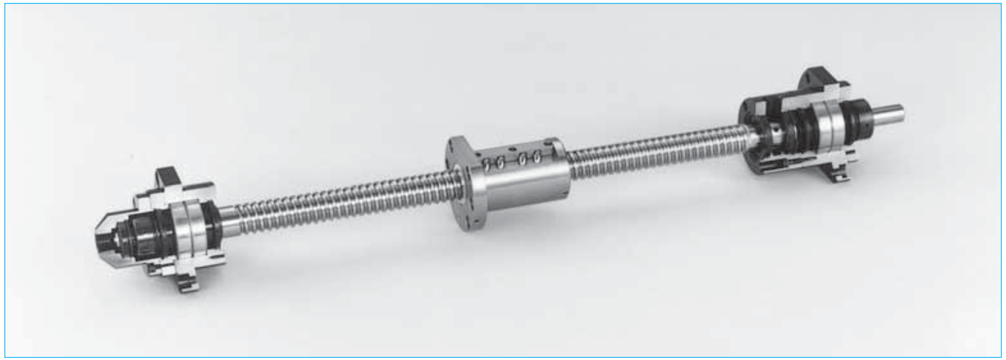


Fig. 3.21 Hollow shaft ball screws for high-precision machine tools Page B512

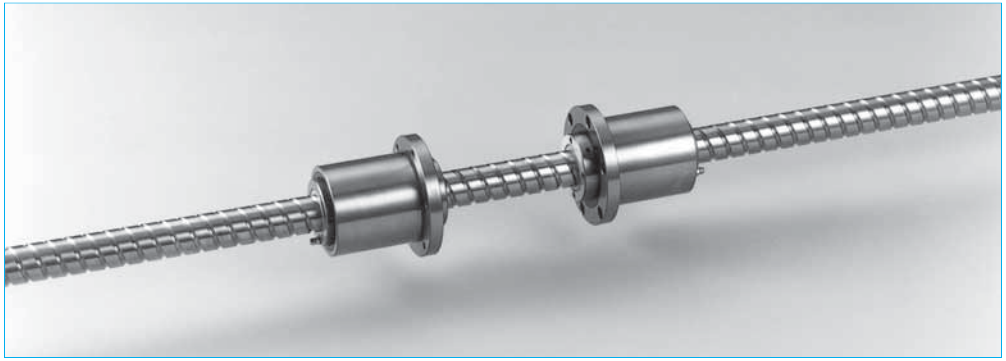


Fig. 3.22 ND series for nut-rotatable drives Page B517

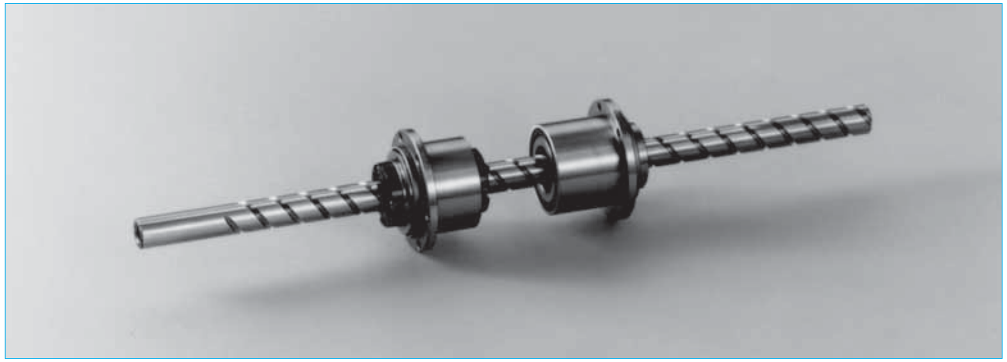


Fig. 3.23 ∑ series for robots Page B525

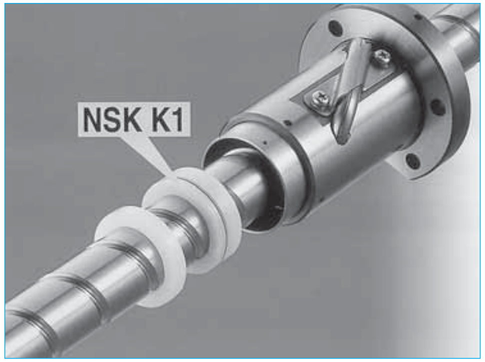


Fig. 3.24 Ball screws equipped with NSK K1™ lubrication units Page B537

(2) Standard accessories

Fig. 3.25 Support units **Page B381**
(for small equipment, light load)

Fig. 3.26 Support units **Page B381**
(for small equipment, light load, low-profile)

Fig. 3.27 Support units **Page B391**
(for machine tools, heavy load)

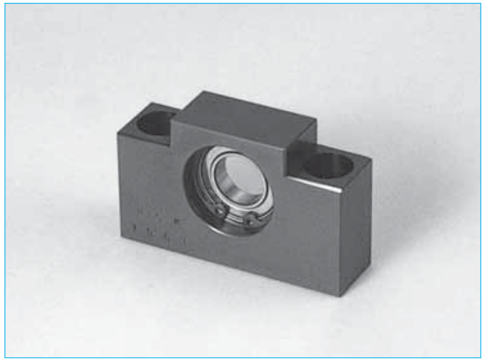


Fig. 3.28 Support unit for VFA type **Page B396**
(simple support side)

Fig. 3.29 Support kits for RMA and RMS types
Page B397

Fig. 3.30 Lock nuts A type **Page B395**

Fig. 3.31 Lock nuts S type **Page B396**

Fig. 3.32 NSK hand grease pump unit **Page D19**

Fig. 3.33 NSK grease **Page B397, D19**

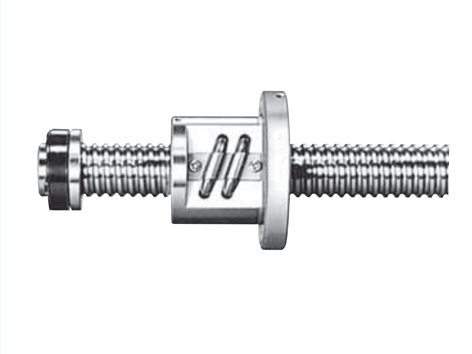


Fig. 3.34 Travel stoppers **Page B398**
(by order)

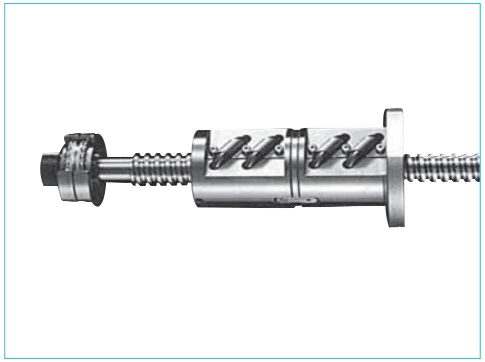


Fig. 3.35 Thrust angular contact ball bearings for ball screw support **Page B399**

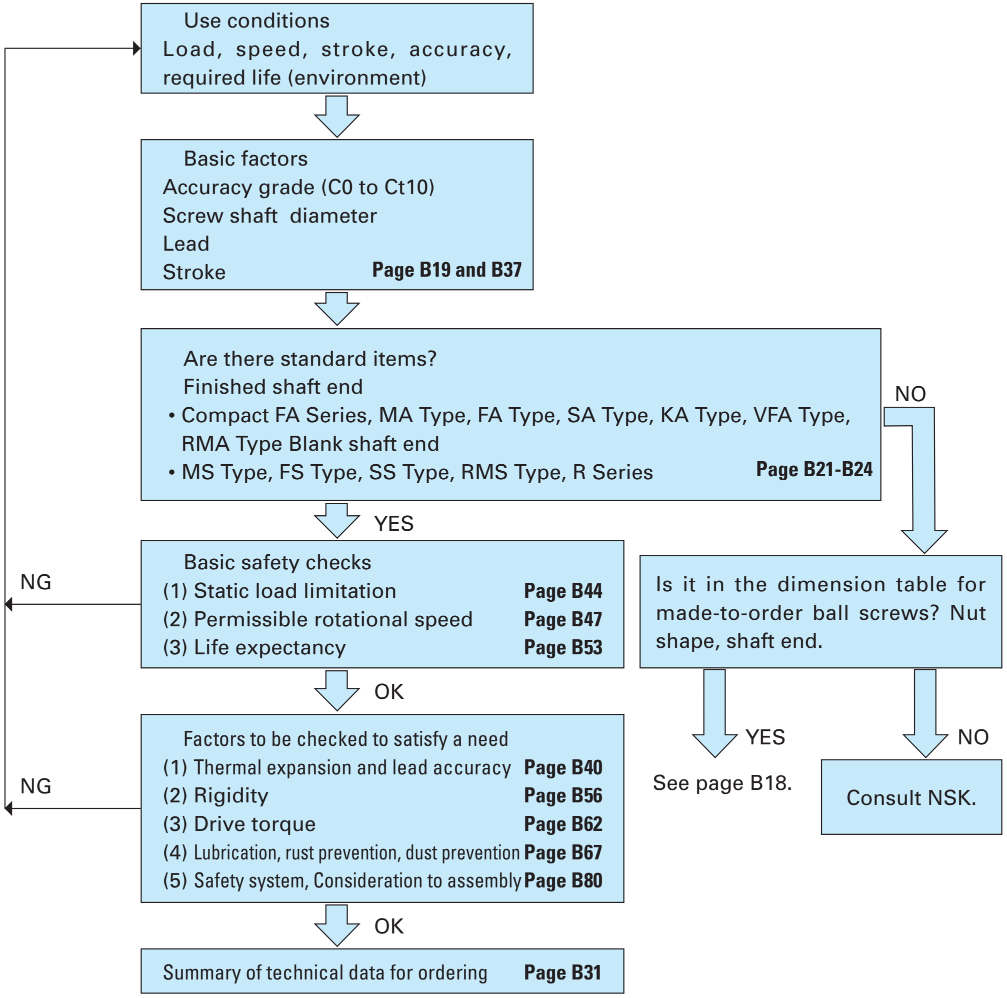
B-1-4 Procedures to Select Ball Screw

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.

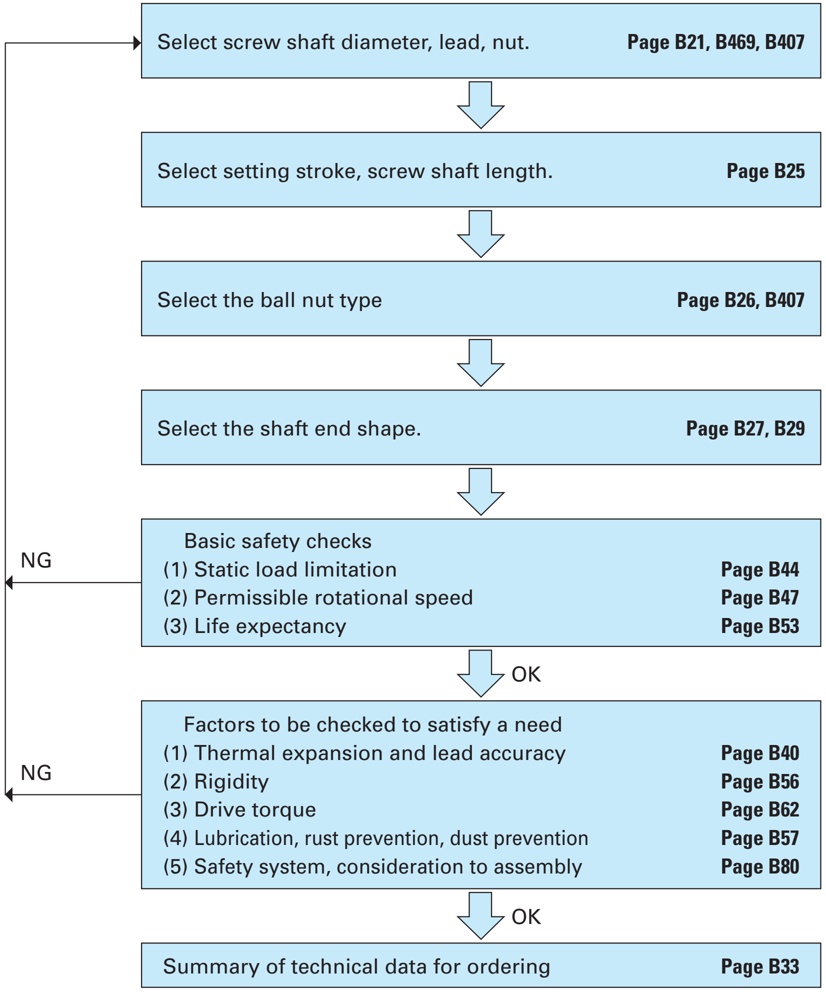
(1) Standard ball screw

The chart below is one of the selection procedures. To take advantage of prompt delivery and reasonable prices, this procedure focuses on the standardized ball screws.
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 B83.
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. The circles indicate the range of the accuracy grade in actual use. The double circles indicate accuracy grades most frequently used among the cases marked with the single circle. These symbols help to select the accuracy grade of ball screws temporarily. To confirm whether a specific ball screw accuracy grade satisfies requirements in positioning accuracy in actual use, refer to "Technical Description" and "Mean travel deviation and travel variation." (page B38)

Table 4.1 Accuracy grades of ball screw and their application

Application		NC machine tools																			
		Lathes		Milling machines Boring machines		Machining centers		Drilling machines		Jig boring machines		Grinders		Electric discharge machines		Wire cuttings Electric discharge machines		Punch presss	Laser cutting machines		Woodworking machines
Axis		X	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	XY	Z	
Accuracy grade	C0	○								○	○	○									
	C1	○		○		○				◎	◎	○	○	○		○	○				
	C2	○		○	○	○	○					◎	○	○	○	◎	○				
	C3	◎	○	◎	○	○	○	○					◎	◎	◎	◎	◎	○	○	○	
	C5	◎	◎	◎	◎	◎	◎	◎	◎						◎		○	◎	◎	◎	◎
	Ct7								○												◎
	Ct10																				○

Application		General industrial machines, Machines for specific use	Semiconductor/associated industry						Industrial robots					Steel mills equipment	Plastic injection molding machines	Three-dimensional coordinate measuring machines	Office machines	Image processing equipment	Nuclear power		Aircrafts
			Lithographic machines	Chemical processing equipment	Wire bonders	Probers	Electric component mounted devices	Printed circuit board drilling machines	Cartesian type		Articulate type		SCARA type						Fuel rod controls	Mechanical snubbers	
									Assembly	other purposes	Assembly	other purposes									
Accuracy grade	C0		○			○										○		○			
	C1		◎		◎	◎		○								◎		◎			
	C2				○	◎	○	○	○							○					
	C3	○		○			○	◎	○		○		○						○		○
	C5	◎		○			◎	○	◎	○	◎	○	○		○		○		◎		◎
	Ct7	◎		◎					○	◎	○	◎	◎	○	◎		◎		○	◎	
	Ct10	○		○						○				◎	○		○			○	

B-1-4.3 Axial Play

Table 4.2 indicates the combinations of NSK ball screw accuracy grades and axial play. Select an axial play which satisfies the required accuracy in backlash, positioning and repeatability. Ranges of available ball thread effective 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 the 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 Accuracy grade	*Z*	*T*	*S*	*N*	*L*
	0 mm (Preload)	0.005 mm or less	0.020 mm or less	0.050 mm or less	0.3 mm or less
C0	C0Z	C0T	—	—	—
C1	C1Z	C1T	—	—	—
C2	C2Z	C2T	—	—	—
C3	C3Z	C3T	C3S	—	—
C5	C5Z	C5T	C5S	C5N	—
Ct7	—	—	C7S	C7N	—

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	1 000	1 000	1 000
32 – 40	1 000	800	2 000	1 500	1 500
50 – 63	1 200	1 000	2 500	2 000	2 000
80 – 125	—	—	4 000	3 000	3 000

Note: Refer to **Table 4.8** (page B25) for the available length of screw shaft (maximum length). Also, axial play of code N does not become 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. A lead should be set based on the required running speed, and should give some allowance to the maximum rotational speed of the motor.

(1) Standard ball screw

Tables 4.4 and **4.5** show the combinations of ball screw shaft diameter and leads, and range of stroke. From these tables, select the 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 B101).

Table 4.4 Screw shaft diameter, lead and stroke of standard ball screw

Unit: mm

Shaft dia.	Lead	Stroke																										
		– 50	– 100	– 150	– 200	– 250	– 300	– 350	– 400	– 450	– 500	– 550	– 600	– 650	– 700	– 750	– 800	– 850	– 900	– 950	– 1 100	– 1 200	– 1 300	– 1 400	– 1 500	– 1 700	– 2 100	– 3 000
4	1	○	○△																									
6	1	○	○	○△■	○△	■□																						
	8		●																									
	12		●																									
8	1		○△	○■	○△	■□																						
	1.5		○△	○■	○△	■□																						
	2		○△	○■		■□																						
	10		●																									
	15		●																									
10	2		○	○△	○■	○△	■□																					
	2.5		○	○△	○	○△																						
	4		○	○△	○	○△	○	○△																				
	5		●	●		●		●		●																		
	10			●		●		●		●																		
12	2		○	○	○△■	○	○△■□																					
	2.5		○	○	○△	○	○△																					
	5		●○	●○△	○	●○△	○	●	○	●△	○	●																
	10			●○	○△	●	○✓	●	○△	●	○✓	●																
	20				●		●		●		●		●															
	30			●		●		●		●		●																
14	5			○	○		○	△	○		○		△	○														
	8			○	○	○	○	○	○	○	○△	○	○	○		○	△											
15	5			●	●		●		●		●		●		●													
	10			●○	○	●○	○	●○△✓	○	●○	○	●○△✓	○	●○		●○		●○△✓			●○△							
	20			●○	○	●○	○	●○✓	○△	●○	○	●○✓	○△	●○		●○		●○✓	△		●○△							
	30				●		●		●		●		●		●		●		●		●							
16	2		○	○	○	○△		○	△																			
	2.5		○	○	○	○△		○	△																			
	5			○		○		○		○	△			○				○	△									
	16			○	○	○	○	○	○	○	○	○△	○	○		○		○			○△							
	32							○				○						○	△				○△					
20	4				○	○	△	○		○	△	○		○			△											
	5				●○	●○△		●○		●○△		●○		●△		●○		●		△								
	10					●○		●○		●○		●○		●○		●○		●○△		○	●○	○	●○△					
	20					○		○	●	○	●	○	●	○	●	○	●	○	●	○△	●○	○	●		○△	●		
	30					●		●		●		●		●		●		●			●		●					
	40										●○		●		●○		●		●○		●○△		●○			●○△	●	
	60										●		●		●		●				●		●			●	●	
25	4				○	○	△	○		○		○	△			○					△							
	5				●○△	●○△		●○△		●○△		●○△		○		●○△		●△		○	●	○△						
	6							○△				○				○△						○△						
	10						○	△	●		●○	△	●	△	●○	△	●		●○	△	●○△			○	△	●		
	20											●		●	○	●		●	○		●○		●○△		○	●○	●○△	
	25												●		●○		●		●○		●○		●○△		○	●○	●○△	
	30												●		●		●		●		●		●			●	●	
	50												●		●		●○		●		●○		●		△	●○	●○△	
28	5				○	○	○	○△	○	○	○	○△			○	○△			○	○	○	○△						
	6						○	○△			○	○△			○	△			○		○	△						
32	5				○	○	○	○△	○	○	○	○△	○	○	○	○△		△	○	○	○	○△		○	○△	△		
	6						○	○			○	○△			○	○			○	○△	○	○		○	○△			
	8						○				○	△			○				○	△				○	△			
	10				○		○	△	○△		○	△	○△		○		○	△	○△		○		○△	○		○△		
	25																				○					○△	○	○△
	32																				○					○△	○	○△
36	10						○		○		○	△	○△				○		○		△	○	○			○△	△	
40	5						○				○	△			○				○	△	○				○	△		
	8					○				○			△	○				○			○△				○	△		
	10						○		○		○	△	○△		○		○	△	○△		○	○	○△	○	○	○△		○△
	12										○		○				○△	△	○△			○	○	△	△	○		○△
45	10												○						○△				○		△	○		○△
50	10									○	○		△	○	○			○△	○△		○			○△			○△	○△

●mark; PSS type, USS type, FSS type: ○mark; MA type, FA type, SA type: △mark; MS type, FS type, SS type
✓mark; VFA type: ■mark; RMA type: □mark; RMS type

Note: See **Table 4.5** for KA Type in stainless steel product.

Table 4.5 Screw shaft diameter, lead and stroke of KA type in stainless steel product

Unit: mm

Shaft dia.	Lead	Stroke								
		– 150	– 200	– 250	– 300	– 350	– 450	– 500	– 650	– 1 050
6	1	●								
8	1		●							
	2		●							
10	2			●						
	4	●				●				
12	2	●			●					
	5			●				●		
	10				●			●		
15	10						●		●	●
	20						●		●	●
16	2	●				●				
20	20						●		●	●

Ball Screw

Table 4.6 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	1 000	1 500	2 000	2 500	3 000	4 000	5 000
10	3	●		●							
	6	●		●							
12	8	●		●							
	12	●		●							
14	4		●		●						
	5		●		●						
15	20		●		●	●					
16	10		●		●	●					
	16		●		●	●					
	32		●		●	●					
18	8		●		●	●					
20	5		●		●		●				
	10		●		●		●				
	20		●		●		●				
	40		●		●	●	●				
25	5				●		●	●			
	10				●		●	●			
	25				●		●	●			
	50				●		●	●			
28	6				●		●	●			
32	10				●		●		●		
	32				●		●		●		
	64				●		●		●	●	
36	10				●		●		●		
40	10						●		●	●	
	40						●		●	●	
	80						●		●	●	●
45	12						●		●	●	
50	10						●		●	●	
	16						●		●	●	
	50						●		●	●	

(2) Made-to-order ball screws

Table 4.7 shows the combinations of screw shaft diameter and leads for made-to-order ball screws. For details, refer to the dimension tables from pages B407 and B469.

Table 4.7 Combinations of screw shaft diameter and leads for typical ball screw

Unit: mm

Lead Screw shaft diameter	0.5	1	1.5	2	2.5	3	4	5	6	8	10	12	14	15	16	20	25	30	32	36	40	50	60	64	80	100
4	D	D																								
6	D	D		D						S		S														
8	D	D	D	D							S			S												
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	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

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	1 000	1 000	1 000
15	600	700	800	900	1 250	1 250	1 500
16	600	750	900	1 000	1 500	1 500	1 500
18	—	—	—	—	—	—	1 500
20	850	1 000	1 200	1 400	1 900	1 900	2 000
25	1 100	1 400	1 600	1 900	2 500	2 500	2 500
28	1 100	1 400	1 600	1 900	2 500	2 500	2 500
32	1 500	1 750	2 250	2 500	3 200	3 200	3 000 (4 000)
36	1 500	1 750	2 250	2 500	3 200	3 500	3 000
40	2 000	2 400	3 000	3 400	3 800	4 300	4 000 (5 000)
45	2 000	2 400	3 000	3 400	4 000	4 500	4 000
50	2 000	3 200	4 000	4 500	5 000	5 750	4 000
63	2 000	4 000	5 000	6 000	6 800	7 700	—
80	—	4 000	6 300	8 200	9 200	10 000	—
100	—	4 000	6 300	10 000	12 500	13 500	—
∗120	—	—	—	—	—	13 500	—
∗125	—	—	—	10 000	13 500	13 500	—
∗140	—	—	—	—	—	10 000	—
∗160	—	—	—	—	—	8 000	—
∗200	—	—	—	—	—	5 000	—

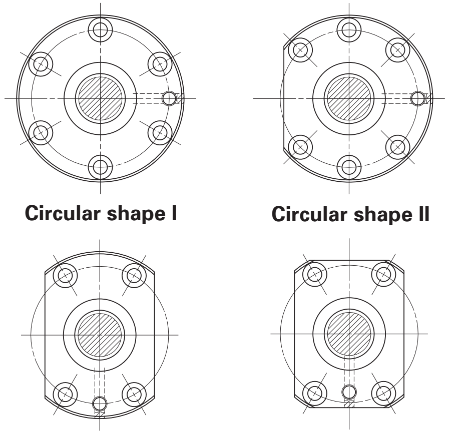
Notes: 1. Values in parentheses of Ct10 are applicable to the ultra high helix lead (l/d≥2). Refer to dimension tables on B371 and following pages for details.

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**)



Circular shape I

Circular shape II

Circular shape III

Rectangular shape

Fig. 4.1 Flange shape

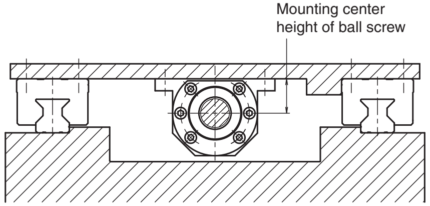


Fig. 4.2 Installation example

(2) Shapes of nut cross section

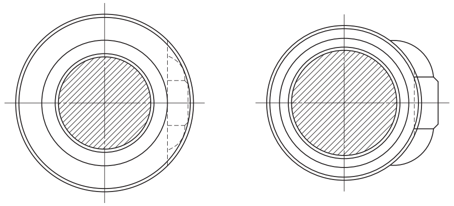
Cross-section of nuts are shown in **Fig. 4.3**. For detailed dimensions, refer to dimension table of nut.

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.



Circular (round)

Tube-projecting type

Fig. 4.3 Shape of the cross section of nut

B-1-4.7 Shaft End Configuration

(1) Standard shaft end dimensions

Tables 4.9 and **4.10** show shaft end types for NSK standard support units.

Refer to the dimension tables below when designing shaft ends of standard ball screw.

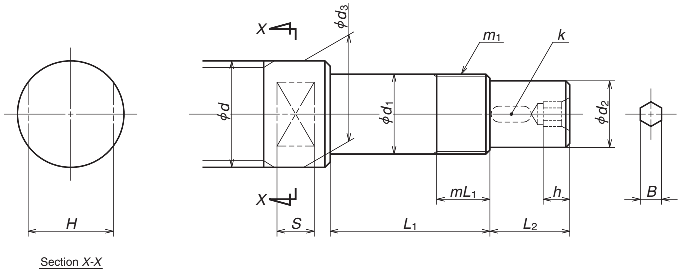


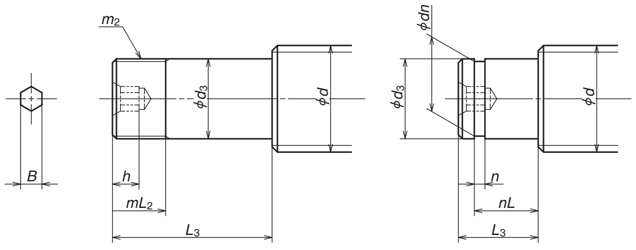
Fig. 4.4 Configuration of standard shaft end (drive side)

Table 4.9 Dimensions of shaft ends (drive side)

Unit: mm

Screw shaft diameter	Bearing journal		Thread		Drive section			Seal section	Hexagon hole		Wrench flats		Support unit	
	Outside diameter	Length	Nominal spec.	Length	Outside diameter	Length	Key width	Outside diameter	Width across flats	Depth	Width across flats	Length		
d	d_1	L_1	m_1	mL_1	d_2	L_2	k	d_3	B	h	H	S	Reference No.	
4	6	22.5	M6×0.75	7	4.5	7.5	—	9.5	—	—	8	4.5	WBK06-01A	WBK06-11
6	6	22.5	M6×0.75	7	4.5	7.5	—	9.5	—	—	8	4.5	WBK06-01A	WBK06-11
8	8	27	M8×1	9	6	10	—	11.5	—	—	10	5.5	WBK08-01A	WBK08-11
10	8	27	M8×1	9	6	10	—	11.5	—	—	10	5.5	WBK08-01A	WBK08-11
12	10	30	M10×1	10	8	15	—	14	—	—	12	6.5	WBK10-01A	WBK10-11
14	12	30	M12×1	10	10	15	3	15	4	6	12	6.5	WBK12-01A	WBK12-11
15	12	30	M12×1	10	10	15	3	15	4	6	12	6.5	WBK12-01A	WBK12-11
16	12	30	M12×1	10	10	15	3	15	4	6	12	6.5	WBK12-01A	WBK12-11
20	15	40	M15×1	15	12	20	4	19.5	5	7	17	8.5	WBK15-01A	WBK15-11
	17	81	M17×1	23	12	29	4	20	5	7	22	10	WBK17DF-31	
25	20	53	M20×1	16	15	27	5	25	6	8	22	10	WBK20-01	WBK20-11
	20	81	M20×1	23	15	39	5	25	6	8	22	10	WBK20DF-31	
28	20	53	M20×1	16	15	27	5	25	6	8	22	10	WBK20-01	WBK20-11
	20	81	M20×1	23	15	39	5	28	6	8	24	12	WBK20DF-31	
32	25	62	M25×1.5	20	20	33	6	32	8	10	27	12	WBK25-01W	WBK25-11
	25	89	M25×1.5	26	20	51	6	32	8	10	27	12	WBK25DF-31	
	25	104	M25×1.5	26	20	51	6	32	8	10	27	12	WBK25DFD-31	
36	30	89	M30×1.5	26	25	61	8	36	10	12	30	13	WBK30DF-31	
	30	104	M30×1.5	26	25	61	8	36	10	12	30	13	WBK30DFD-31	
40	30	89	M30×1.5	26	25	61	8	40	10	12	—	—	WBK30DF-31	
	30	104	M30×1.5	26	25	61	8	40	10	12	—	—	WBK30DFD-31	
45	35	92	M35×1.5	30	30	63	8	45	12	14	—	—	WBK35DF-31	
	35	107	M35×1.5	30	30	63	8	45	12	14	—	—	WBK35DFD-31	
50	40	92	M40×1.5	30	35	78	10	50	14	18	—	—	WBK40DF-31	
	40	107	M40×1.5	30	35	78	10	50	14	18	—	—	WBK40DFD-31	

Note: Low-profile support unit is available for compact FA Series.



Shape Ⅰ Shape Ⅱ

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	Shape	Bearing journal		Thread for lock nut		Retainer ring groove			Hexagonal hole		Support unit Reference No. Numbers in parentheses are bearing reference number.	
		Outside diameter	Length	Nominal spec.	Length	Width	Groove diameter	Groove position	Width across flats	Depth		
d		d_3	L_3	m_2	mL_2	n	dn	nL	B	h		
8	Ⅱ	6	9	—	—	0.8	5.7	6.8	—	—	WBK08S-01	
10	Ⅱ	6	9	—	—	0.8	5.7	6.8	—	—	WBK08S-01	
12	Ⅱ	8	10	—	—	0.9	7.6	7.9	—	—	WBK10S-01	
14	Ⅱ	10	22(12)	—	—	1.15	9.6	9.15	4	6	WBK12S-01	
15	Ⅱ	10	22(12)	—	—	1.15	9.6	9.15	4	6	WBK12S-01	
16	Ⅱ	10	22(12)	—	—	1.15	9.6	9.15	4	6	WBK12S-01	
20	Ⅱ	15	25(13)	—	—	1.15	14.3	10.15	5	7	WBK15S-01	
25	Ⅱ	20	19	—	—	1.35	19	15.35	6	8	WBK20S-01	
	Ⅰ	20	53	M20×1	16	—	—	—	6	8	WBK20-01	WBK20-11
	Ⅰ	20	81	M20×1	23	—	—	—	6	8	WBK20DF-31	
28	Ⅱ	20	19	—	—	1.35	19	15.35	6	8	WBK20S-01	
	Ⅰ	20	53	M20×1	16	—	—	—	6	8	WBK20-01	WBK20-11
	Ⅰ	20	81	M20×1	23	—	—	—	6	8	WBK20DF-31	
32	Ⅱ	25	20	—	—	1.35	23.9	16.35	8	10	WBK25S-01W	
	Ⅰ	25	62	M25×1.5	20	—	—	—	8	10	WBK25-01W	WBK25-11
	Ⅰ	25	89	M25×1.5	26	—	—	—	8	10	WBK25DF-31	
36	Ⅱ	25	20	—	—	1.35	23.9	16.35	10	12	(6205)	
	Ⅰ	25	89	M25×1.5	26	—	—	—	10	12	WBK30DF-31	
40	Ⅱ	30	22	—	—	1.75	28.6	17.75	10	12	(6206)	
	Ⅰ	30	89	M30×1.5	26	—	—	—	10	12	WBK30DF-31	
45	Ⅱ	35	25	—	—	1.75	33	18.75	12	14	(6207)	
	Ⅰ	35	92	M35×1.5	30	—	—	—	12	14	WBK35DF-31	
50	Ⅱ	40	25	—	—	1.95	38	19.95	14	18	(6208)	
	Ⅰ	40	92	M40×1.5	30	—	—	—	14	18	WBK40DF-31	

(2) Shaft end configuration of R series ball screws for transfer equipment

Tables 4.11 and **4.12** show shaft end types for R Series.

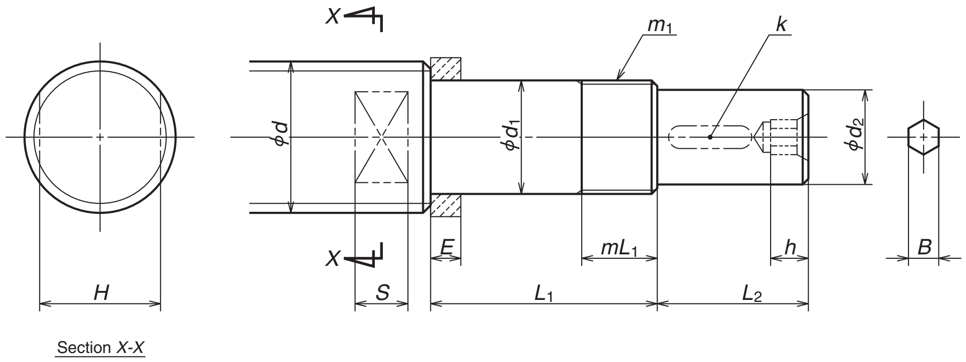


Fig. 4.6 R Series shaft end (drive side)

Table 4.11 Dimensions of R Series shaft ends (drive side)

Unit: mm

Screw shaft diameter	Bearing journal		Thread for lock nut		Spacer	Drive section			Hexagonal hole		Wrench flat		Support unit	
	Outside diameter	Length	Nominal spec	Length	Width	Outside diameter	Length	Key width	Width across flats	Depth	Width across flats	Length		
d	d_1	L_1	m_1	mL_1	E	d_2	L_2	k	B	h	H	S	Reference No.	
10	6	27	M6×0.75	7	5.0	4.5	7.5	—	—	—	8	4.5	WBK06-01A	WBK06-11
12	8	32	M8×1	9	5.5	6	10	—	—	—	10	5.5	WBK08-01A	WBK08-11
14	10	35	M10×1	10	5.5	8	15	—	—	—	12	6.5	WBK10-01A	WBK10-11
15	10	35	M10×1	10	5.5	8	15	—	—	—	12	6.5	WBK10-01A	WBK10-11
16	12	35	M12×1	10	5.6	10	15	3	4	6	12	6.5	WBK12-01A	WBK12-11
18	12	35	M12×1	10	5.6	10	15	3	4	6	12	6.5	WBK12-01A	WBK12-11
20	15	50	M15×1	15	10	12	20	4	5	7	17	8.5	WBK15-01A	WBK15-11
25	17	53	M17×1	17	7	15	27	5	6	8	22	10	WBK17-01A	—
	20	64	M20×1	16	11	15	27	5	6	8	22	10	WBK20-01	WBK20-11
28	20	64	M20×1	16	11	15	27	5	6	8	22	10	WBK20-01	WBK20-11
32	25	76	M25×1.5	20	14	20	33	6	8	10	27	12	WBK25-01W	WBK25-11
36	25	76	M25×1.5	20	14	20	33	6	8	10	27	12	WBK25-01W	WBK25-11
40	30	89	M30×1.5	26	—	25	61	8	10	12	—	—	WBK30DF-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 "Precautions for Designing Ball Screw (page B80)".

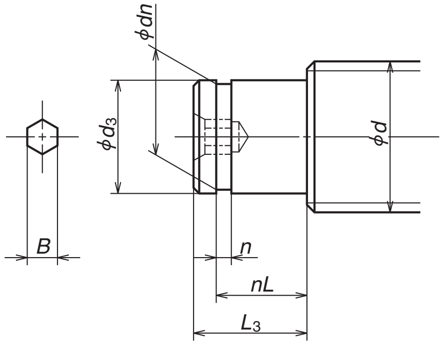


Fig. 4.7 Shaft end configuration of R Series (opposite to the drive side)

Table 4.12 Dimensions of R Series shaft ends (opposite to the drive side)

Unit: mm

Screw shaft diameter	Bearing journal		Retaining ring groove			Hexagonal hole		Support unit
	Outside diameter	Length	Width	Groove diameter	Groove position	Width across flats	Depth	Numbers in parentheses are bearing reference numbers.
d	d_3	L_3	n	dn	nL	B	h	
10	6	9	0.8	5.7	6.8	—	—	WBK08S-01(606)
12	8	10	0.9	7.6	7.9	—	—	WBK10S-01(608)
14	10	12	1.15	9.6	9.15	4	6	WBK12S-01(6000)
15	10	12	1.15	9.6	9.15	4	6	WBK12S-01(6000)
16	10	12	1.15	9.6	9.15	4	6	WBK12S-01(6000)
18	10	12	1.15	9.6	9.15	4	6	WBK12S-01(6000)
20	15	13	1.15	14.3	10.15	5	7	WBK15S-01(6002)
25	17	16	1.15	16.2	13.15	6	8	WBK17S-01(6203)
	20	19	1.35	19	15.35	6	8	WBK20S-01(6204)
28	20	19	1.35	19	15.35	6	8	WBK20S-01(6204)
32	25	20	1.35	23.9	16.35	8	10	WBK25S-01W(6205)
36	25	20	1.35	23.9	16.35	8	10	WBK25S-01W(6205)
40	30	22	1.75	28.6	17.75	10	12	(6206)
45	35	23	1.75	33	18.75	12	14	(6207)
50	35	23	1.75	33	18.75	12	14	(6207)

B-1-5 When Placing Orders

To avoid confusion, please use "reference 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.

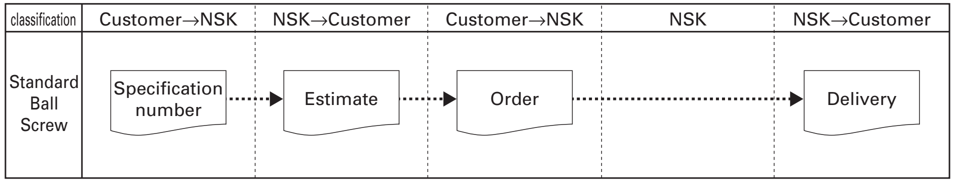
◇ **Specification number:**

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.)

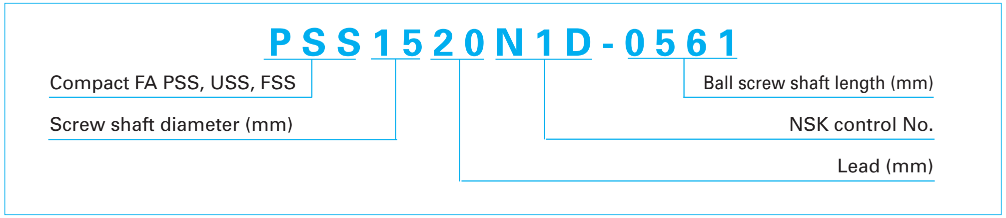
B-1-5.1 When Ordering Standard Ball Screws

Find the reference number from the dimension table. Enter the reference number in the "Order Form by Fax" (page B34). Send the fax to your local NSK agency (branch office, sales office, or your local representative.).

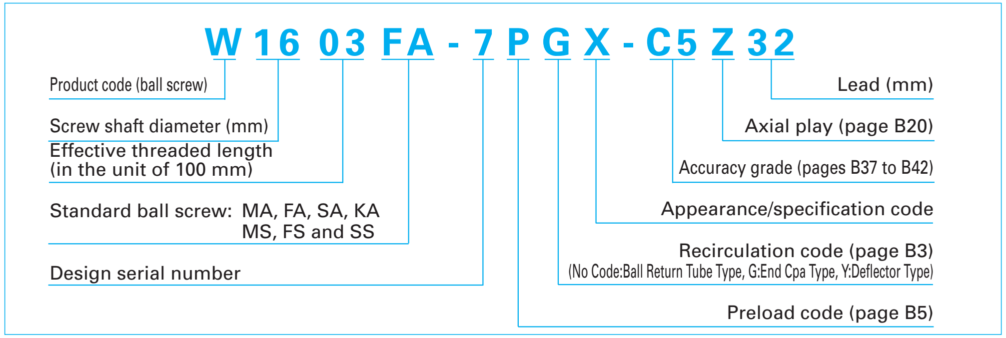
The following is the flow chart for ordering standard ball screws.



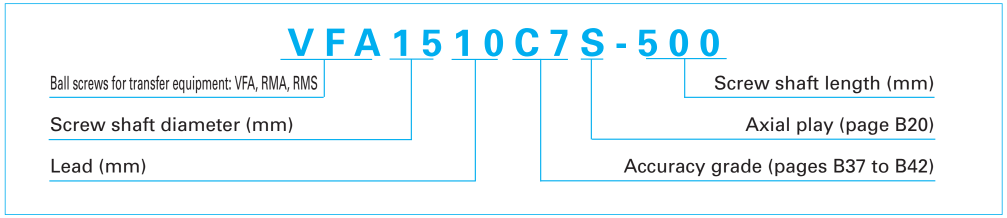
(1) Example of reference number for Standard ball screws Compact FA Series



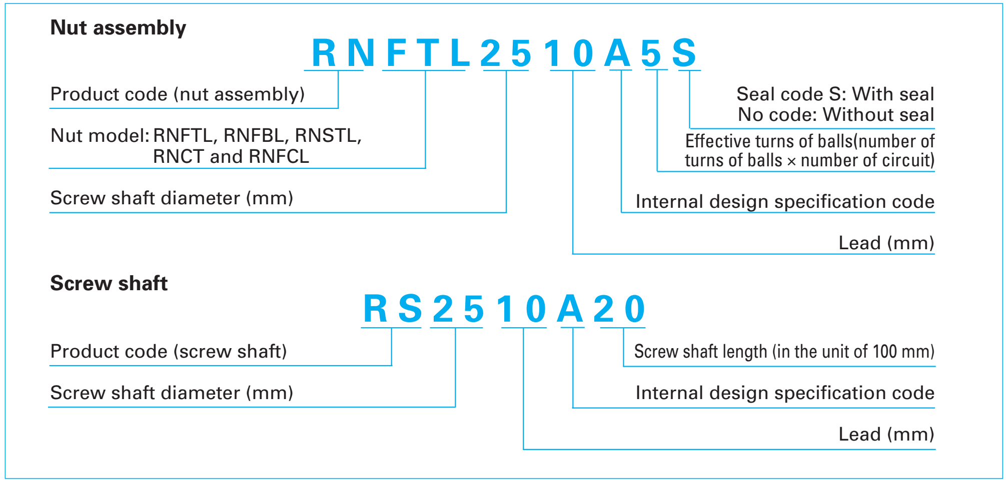
(2) Example of reference number of Standard ball screws



(3) Example of reference number of ball screws for transfer equipment with finished shaft end and blank shaft end



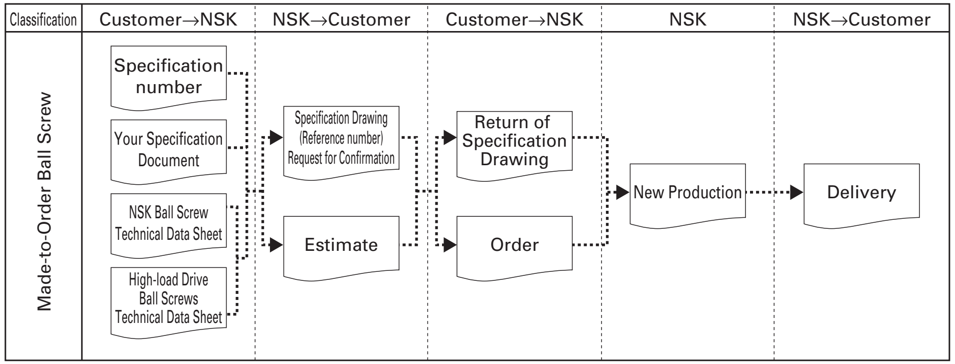
(4) Example of reference number of R series ball screws for transfer equipment



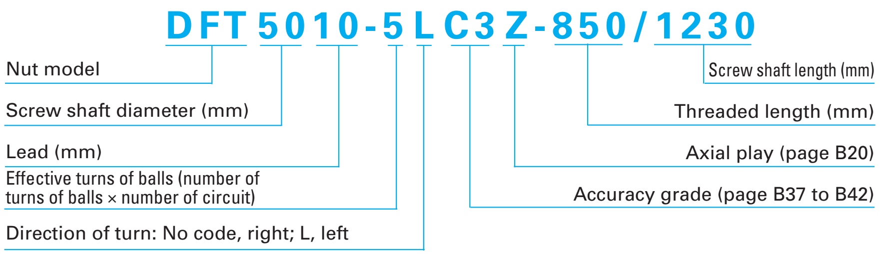
B-1-5.2 When Ordering Made-to-Order Ball Screws

If you would like to discuss technical points regarding specifications, use the NSK ball screw technical data sheet as an aid (page B36). For high-load drive ball screws, use the technical sheet on page B505 for NSK high-load drive ball screw.

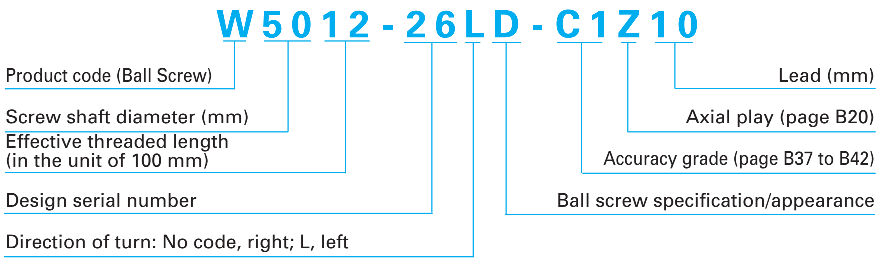
The following is the flow chart for ordering made-to-order ball screws.



(1) Example of specification number of made-to-order ball screw



(2) Example of reference number of made-to-order 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 pages B27 to B30 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

Address

Person in charge

Machine which uses the ball screw *Machining center Model MC-*

Drawing/rough sketch attached? Yes [✓ No]

Date: Day Month Year

Telephone

Section

Application *Table left/right movement (X axis)*

Use conditions

	Axial load	Rotational speed	Operating hours	Operating conditions	[✓ Shaft rotation - Moving nut] [✓ Normal operation] Shaft rotation - Moving shaft Back drive operation Nut rotation - Moving nut Nut rotation - Moving shaft Oscillation
Maximum load	*9 000* N	*20* min^{-1}	*15* %		
Load in normal use	*4 000* N	*360* min^{-1}	*60* %		
Minimum load	*2 000* N	*1 000* min^{-1}	*25* %	Degree of vibration shock	*Normal*
Maximum rotational speed	*1 000* min^{-1}			Required life	*20 000h*
Lubricant	Grease/oil (Brand name: *NSK GRS AS2* Maker:)			Motor in use	*Company A, Model 1*
Seal	Yes	No		Control system	*Company B, Model 2* (resolution: *1μm*)
Support bearing	Drive side *35TAC62DF*			Opposite to drive side	*35TAC62DF*
Guide way	[✓ Rolling] Sliding (*RA451500GM2-P4Z3-Ⅱ*)				
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 per machine	Piece
Date, going in production/Quantity	/Month	/Year	/Lot		

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	*1 335 mm*	Required torque	
Nut model	ZFT5010-10		Flange type	*Circular I*	Nut orientation	Same as shown in the dimension table		Opposite	

Supplemental explanation/requests

NSK Ball Screw Technical Data Sheet (example)

(2) Made-to-order ball screw

Company name

Address

Person in charge

Machine which uses the ball screw

Drawing/rough sketch attached? Yes No

Date: Day Month Year

Telephone

Section

Application

Use conditions

	Axial load	Rotational speed	Operating hours	Operating conditions	Shaft rotation - Moving nut Normal operation Shaft rotation - Moving shaft Back drive operation Nut rotation - Moving nut Nut rotation - Moving shaft Oscillation
Maximum load	N	min^{-1}	%		
Load in normal use	N	min^{-1}	%		
Minimum load	N	min^{-1}	%	Degree of vibration shock	
Maximum rotational speed	min^{-1}			Required life	
Lubricant	Grease/oil (Brand name: Maker:)			Motor in use	
Seal	Yes	No		Control system	(resolution:)
Support bearing	Drive side			Opposite 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 per machine	Piece
Date, going in production/Quantity	/Month	/Year	/Lot		

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

B-2 Technical Description of Ball Screws

B-2-1 Accuracy

B-2-1.1 Lead Accuracy

The lead accuracy of NSK precision ball screws (C0 to C5 grades) conforms to the four characteristics specified in JIS Standards. These characteristics are expressed by codes *ep*, υ_u, υ_{300}, and $\upsilon_{2\pi}$.
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. **Tables 1.2**, **1.3** and **1.4** show tolerance of each characteristic.
JIS B1192 sets C type and Cp type standards for positioning ball screws. NSK uses the specification of C type only. JIS B1192 specifies Ct1, 3, and 5 grade. NSK standards are integrated by C type only. Refer to **Table 1.2** for C type standard tolerance.

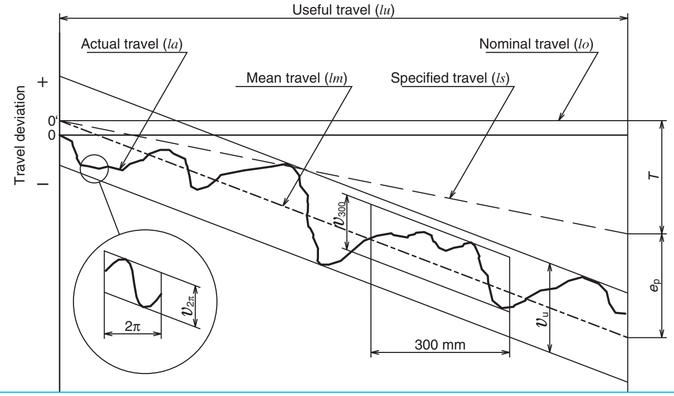


Fig. 1.1 Definition of lead accuracy

Table 1.1 Terminology in lead accuracy

Term	Code	Description	Tolerance
Specified travel	*ls*	The travel 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 B39).	
Actual travel	*la*	Actually measured travel	
Actual mean travel	*lm*	A straight line that demonstrates the direction of actual travel. This straight line is obtained from the curve that shows actual travel volume by 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	υ_u υ_{300} $\upsilon_{2\pi}$	Maximum range of the actual travel which is between the two straight lines drawn parallel to the actual mean travel. There are three categories as shown below. • Maximum range relative to the effective length of thread. • Maximum range relative to the length of 300 mm anywhere within the effective length of thread. • Maximum range which corresponds to any single rotation (2π *rad.*) within the effective length of thread.	**Table 1.2** **Table 1.3, 1.4** **Table 1.3**

Table 1.2 Tolerance on specified travel (±*ep*) and travel variation (υ_u) of the positioning (*C* type) ball screws

Unit: μm

Accuracy grade			C0		C1		C2		C3		C5	
	over	or less	±*ep*	υ_u	±*ep*	υ_u	±*ep*	υ_u	±*ep*	υ_u	±*ep*	υ_u
Effective thread length, mm	–	100	3	3	3.5	5	5	7	8	8	18	18
	100	200	3.5	3	4.5	5	7	7	10	8	20	18
	200	315	4	3.5	6	5	8	7	12	8	23	18
	315	400	5	3.5	7	5	9	7	13	10	25	20
	400	500	6	4	8	5	10	7	15	10	27	20
	500	630	6	4	9	6	11	8	16	12	30	23
	630	800	7	5	10	7	13	9	18	13	35	25
	800	1 000	8	6	11	8	15	10	21	15	40	27
	1 000	1 250	9	6	13	9	18	11	24	16	46	30
	1 250	1 600	11	7	15	10	21	13	29	18	54	35
	1 600	2 000			18	11	25	15	35	21	65	40
	2 000	2 500			22	13	30	18	41	24	77	46
	2 500	3 150			26	15	36	21	50	29	93	54
	3 150	4 000			30	18	44	25	60	35	115	65
	4 000	5 000					52	30	72	41	140	77
	5 000	6 300					65	36	90	50	170	93
	6 300	8 000							110	60	210	115
	8 000	10 000									260	140
	10 000	12 500									320	170

Table 1.3 Tolerance of travel variation relative to 300 mm (υ_{300}) and one revolution ($\upsilon_{2\pi}$) of the positioning (*C* type) ball screws

Unit: μm

Accuracy grade	C0	C1	C2	C3	C5
υ_{300}	3.5	5	7	8	18
$\upsilon_{2\pi}$	2.5	4	5	6	8

Note: ▨ to JIS B1192 standards. Values in other areas are NSK standards.

Table 1.4 Travel variation (υ_{300}) relative to 300 mm of the transportation (*Ct* type) ball screws

Unit: μm

Accuracy grade	Ct7	Ct10
υ_{300}	52	210

Note: Tolerance on specified travel (*ep*) of the transportation (*Ct* type) ball screws is calculated as follows.

$$ep = \frac{2 \cdot lu}{300} \cdot \upsilon_{300}$$

Example of specifying lead accuracy

<Use Conditions>

Nut model: DFT4010-5

Stroke: 1 000 mm

Positioning accuracy: ±0.035 mm/1 000 mm

<Calculation>

Obtain required lead accuracy of a ball screw under these conditions.

(1) Calculate the length of the thread

Stroke + nut length + margin =1 000 + 193 + 100

=1 293 (mm)···→1 300 mm

(2) Calculate lead accuracy

From **Table 1.2**, obtain the tolerance on specified travel relative to the length of thread (1 300 mm).

C5 ··· ±0.054/1 250 – 1 600

C3 ··· ±0.029/1 250 – 1 600

(3) Determine lead accuracy

Positioning accuracy is: ±ep $<$±0.035/1 000 mm

Accuracy grade: C3 grade ±*ep* = 0.029/length of thread (1 300 mm)

υ_u = 0.018

B-2-1.2 Thermal Expansion and Target Value of Specified Travel

(1) Thermal expansion

Thermal expansion of screw shaft induces the degradation of positioning accuracy of the ball screws. Thermal expansion of a screw shaft is calculated as follows.

$\Delta L_\theta = \rho \bullet \theta \bullet L$ (mm) ····· 1)

In this formula:

ΔL_θ : Thermal expansion (mm)

ρ : Thermal expansion coefficient (12.0×10^{-6} °C^{-1})

θ : Average temperature rise of screw shaft (Celsius)

L : Length of screw shaft (mm)

The above formula indicates that when the temperature rises one degree Celsius, the screw shaft stretches 12 μm per meter. Ball 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.

(a) Suppress heat generation.

- Do not apply excessive preload to the ball screw and support bearing.
- Select appropriate lubricant and use it properly.
- Use higher helix ball screw lead to lower rotational speed.

(b) Use forced cooling.

- Use hollow screw shaft, and flow liquid coolant through it. - Refer to hollow ball screws in the section for application-oriented ball screws (page B512).
- Cool screw shaft surface with lubricant oil or air.

(c) Avoid effects of temperature rise on positioning.

- Warm up the machine by high speed until the temperature rise of ball screw shaft saturates, then maintain it properly.
- Set pre-tension. (**Fig. 1.2**)
- Set the negative (minus) target value of specified travel.
- Employ 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 lathes	X	– 0.02 — – 0.05
	Z	– 0.02 — – 0.03
Machining centers	X, Y	– 0.03 — – 0.04
	Z	Differs by structure

(4) How to determine pre-tension force

In order to absorb thermal expansion, pre-tension can be provided to the screw shaft at the time of installation. In this case, the pre-tension is usually equivalent to the expansion brought about by the temperature rise of 2 to 3°C.

Fig. 1.2 shows the bearing support structure in such occasion.

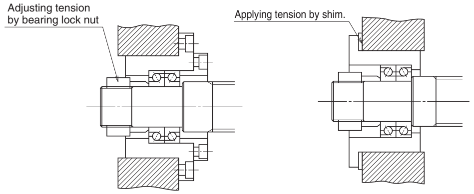


Fig. 1.2 Bearing structure to provide pre-tension

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 B73).

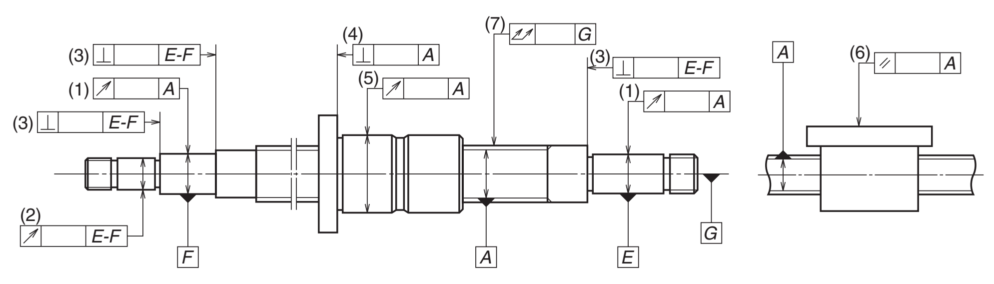


Fig. 1.3 Mounting accuracy of ball screw

(1) Radial run-out of the support bearing seat relative to the axis of the ball thread of screw shaft.
(2) Radial run-out of the other shaft ends section relative to the axis of the support bearing seat.
(3) Perpendicularity of the shoulder of support bearing seat relative to the axis of support bearing seat.
(4) Perpendicularity of the nut flange surface, or of the nut end datum surface, 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: μm

Accuracy grade			C0						C1						
Nominal diameter (mm)		over	–	8	12	20	32	50	–	8	12	20	32	50	80
	over	or less	8	12	20	32	50	80	8	12	20	32	50	80	125
Overall length of screw shaft (mm)	–	125	15	15	15				20	20	15				
	125	200	25	20	20	15			30	25	20				
	200	315	35	25	20	20			40	30	25	20			
	315	400		35	25	20	15		45	40	30	25	20		
	400	500		45	35	25	20			50	40	30	25		
	500	630		50	40	30	20	15		60	45	35	25	20	
	630	800			50	35	25	20			60	40	30	25	
	800	1 000			65	45	30	25			75	55	40	30	25
	1 000	1 250			85	55	40	30			95	65	45	35	30
	1 250	1 600			110	70	50	40			130	85	60	45	35
	1 600	2 000				95	65	45				120	80	55	40
	2 000	2 500											100	70	50
	2 500	3 150												130	90
	3 150	4 000													120

Unit: μm

Accuracy grade			C3							C5						
Nominal diameter (mm)		over	–	8	12	20	32	50	80	–	8	12	20	32	50	80
	over	or less	8	12	20	32	50	80	125	8	12	20	32	50	80	125
Overall length of screw shaft (mm)	–	125	25	25	20					35	35	35				
	125	200	35	35	25	20				50	40	40	35			
	200	315	50	40	30	30				65	55	45	40			
	315	400	60	50	40	35	25			75	65	55	45	35		
	400	500		65	50	40	30				80	60	50	45		
	500	630		70	55	45	35	30			90	75	60	50	40	
	630	800			70	55	40	35				90	70	55	45	
	800	1 000			95	65	50	40	30			120	85	65	50	45
	1 000	1 250			120	85	60	45	35			150	100	75	60	50
	1 250	1 600			160	110	75	55	40			190	130	95	70	55
	1 600	2 000				140	95	70	50				170	120	85	65
	2 000	2 500					120	85	60					150	110	80
	2 500	3 150					160	110	75					200	140	95
	3 150	4 000					220	150	100					260	180	120
	4 000	5 000						200	130						240	160
	5 000	6 300													310	210
	6 300	8 000														280
	8 000	10 000														370

B-2-1.4 Automatic Lead Accuracy Measuring System of NSK

In response to the demand for high precision in production technology, NSK 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 B37.)

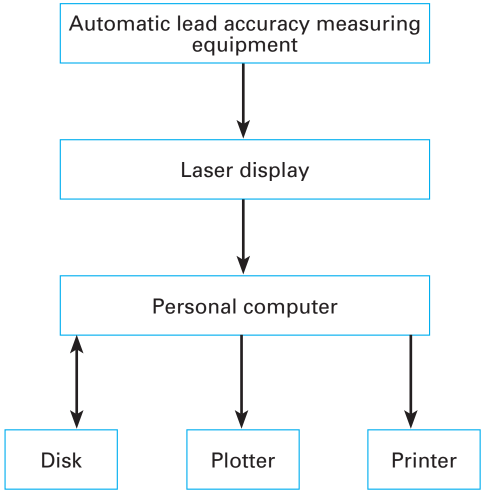
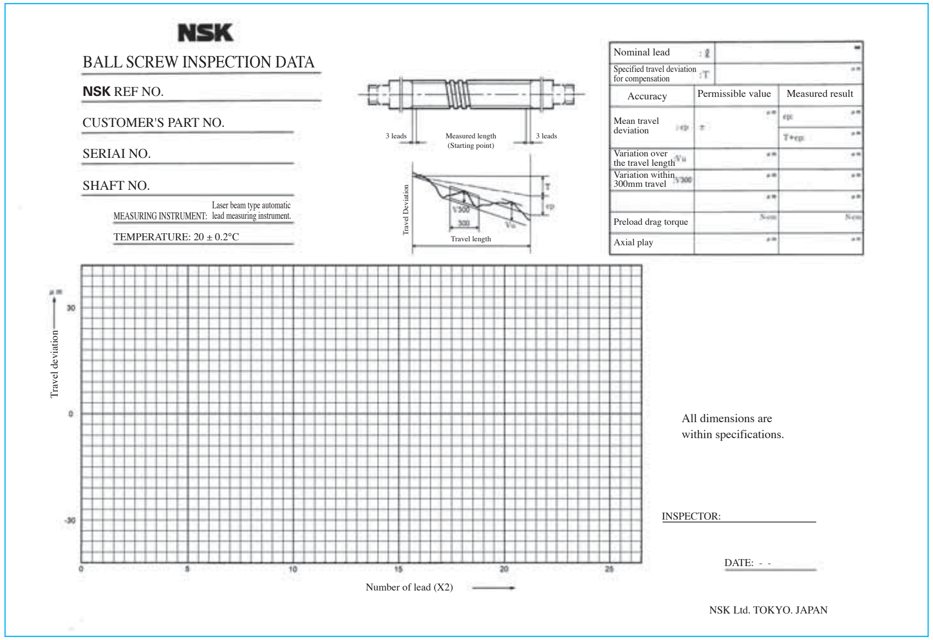


Fig. 1.4 Lead accuracy measuring system



NSK

BALL SCREW INSPECTION DATA

NSK REF NO.

CUSTOMER'S PART NO.

SERIAI NO.

SHAFT NO.

MEASURING INSTRUMENT: Laser beam type automatic lead measuring instrument.

TEMPERATURE: 20 ± 0.2°C

Nominal lead : ℓ	mm	
Specified travel deviation for compensation : T	μm	
Accuracy	Permissible value	Measured result
Mean travel deviation : ep	± μm	ep μm T+ep μm
Variation over the travel length : Vu	μm	μm
Variation within 300mm travel : V300	μm	μm
	μm	μm
Preload drag torque	N·cm	N·cm
Axial play	μm	μm

All dimensions are within specifications.

INSPECTOR:

DATE: - -

NSK Ltd. TOKYO. JAPAN

Fig. 1.5 Ball screw Inspection data

B-2-2 Static Load Limitation

Ball screws, based on their function, will generally receive axial load only. Ball screw shafts in general are long, so it is necessary to consider 3 items below:

- Buckling load of the screw shaft
- Yielding of the screw shaft by tensional or compressive stress
- Permanent deformation at the ball contact points

B-2-2.1 Buckling Load

It is necessary to calculate whether the ball screw shaft is safe against buckling.

Buckling load, i.e. permissible compressive load "P" to axial direction, is calculated as follows.

$$P = \alpha \times \frac{N \bullet \pi^2 \bullet E \bullet I}{L^2} = m \frac{d_r^4}{L^2} \times 10^4 \quad \text{(N)} \cdots\cdots 2)$$

In this formula:

α : Safety factor ($\alpha = 0.5$)

E : Elastic modulus ($E = 2.06 \times 10^5$ MPa)

I : Moment of inertia

$$I = \frac{\pi}{64} d_r^4 \qquad (\text{mm}^4) \cdots\cdots 3)$$

d_r : Screw shaft root diameter (mm) (See the dimension table.)

L : Unsupported length (mm) (See **Figs. 4.1** and **4.2** 'Supporting conditions of screw shaft and nut' on page B51.)

m, N : Factors determined by the supporting condition of the ball screw shaft

Table 2.1 Factors of bucking load

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

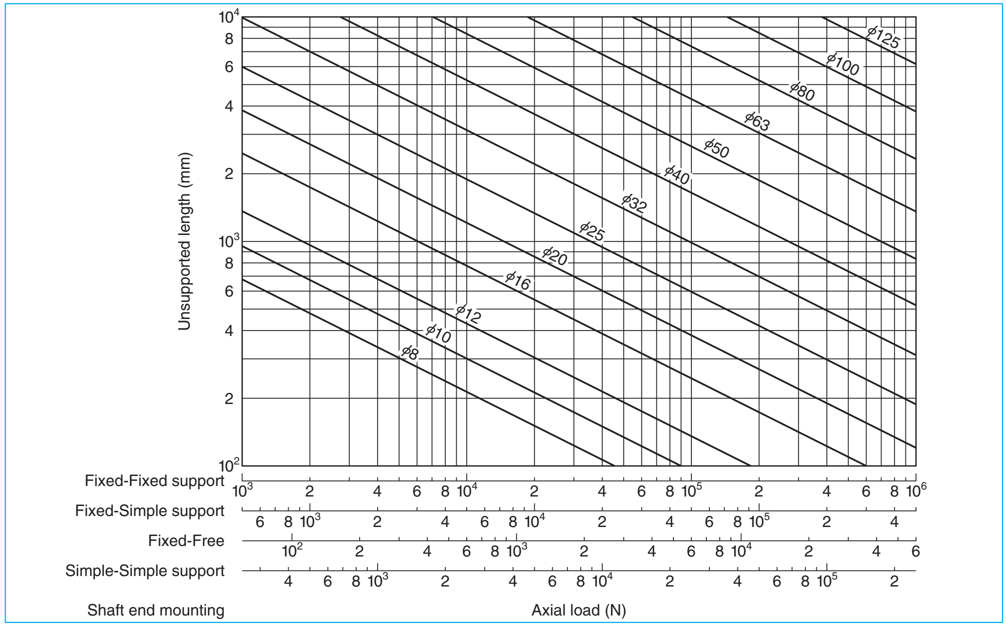


Fig. 2.1 Buckling load

<<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' on page B51.)

Unsupported length $L = 2\ 000$ 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** on page B44

N = 4

$m = 19.9$

By formula 2) on page B44

$$P = m\frac{d_r^4}{L^2} \cdot 10^4 = 19.9 \times \frac{34.4^4}{2\ 000^2} \times 10^4 = 69\ 667 \text{ (N)}$$

Therefore,

Permissible buckling load $P = 69\ 600$ N

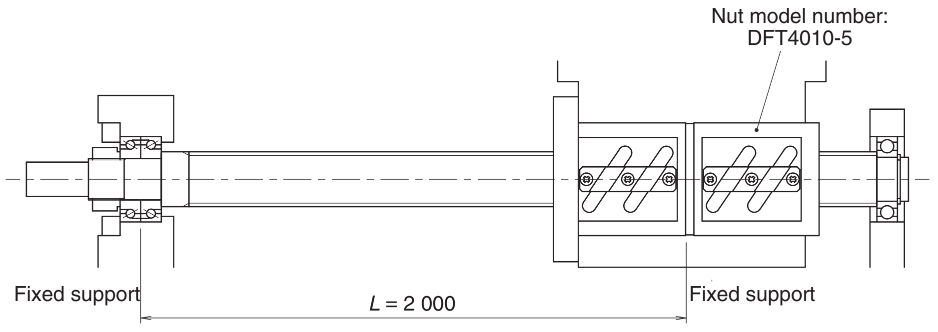


Fig. 2.2 Calculation example of buckling load

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

$$P = \sigma \cdot A = 1.15 d_r^2 \times 10^2 \text{ (N)} \quad \cdots 4)$$

In this formula:

σ : Allowable stress (= 147 MPa)

A : Cross section area of a screw shaft using root diameter (mm^2)

$$A = \frac{\pi}{4} \cdot d_r^2 \text{ (mm}^2\text{)} \quad \cdots 5)$$

d_r : Screw shaft root diameter (mm)

<<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 4)

$P = 1.15 d_r^2 \times 10^2 = 1.15 \times 34.4^2 \times 10^2$

$= 136\ 086$ (N)

Therefore,

Permissible load $P = 136\ 000$ N

B-2-2.3 Permanent Deformation at the Ball Contact Point

Exposed to an excessively heavy load in axial direction, the balls are squashed, and the ball rolling surface is dented. The deformations on these points do not perfectly restore to original shape after the load is removed. They are permanently disfigured. It is necessary to determine the 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_o (allowable axial direction load to limit the permanent deformation) is calculated using C_{0a}.

$$P_0 = \frac{C_{0a}}{f_s} \text{ (N)} \quad \cdots 6)$$

In this formula, f_s: Static permissible load factor

Table 2.2 Static permissible load factor

At time of normal operation	1 – 2
With vibration impact	1.5 – 3

<<Calculation example of the maximum allowable load>>

Obtain the maximum allowable load to the ball groove section under conditions in **Fig. 2.2**.

<Use conditions>

Nut model: DFT4010-5

Basic static load rating $C_{0a} = 137\ 000$ (N)

(From the dimension table)

Static permissible load factor $f_s = 2$

(normal operation, no vibration impact)

<Calculation>

By formula 6), the maximum allowable load of the ball groove section

$$P_0 = \frac{C_{0a}}{f_s} = \frac{137\ 000}{2} = 68\ 500 \text{ (N)}$$

B-2-3 Permissible Rotational Speed

Permissible rotational speed is determined by the feeding speed and ball screw lead. When selecting a ball screw, it is important to know the permissible rotational speed.

It is necessary to calculate two items below, and 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 B50, 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 80% of the critical speed is defined as the permissible rotational speed.

Calculate the critical speed of the screw shaft whether you use shaft rotation or nut rotation. Critical speed varies by the nut traveling position. Please consult NSK for detailed 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" on page B517.)

Calculate the permissible rotational speed based on critical speed n_c as follows, taking in account "B-2-4 Supporting Conditions for Calculation of Buckling Load and Critical Speed" on page B51.

Fig. 3.1 shows the permissible rotational speeds against critical speed for each shaft diameter.

$$n_c = \alpha \times \frac{60\lambda^2}{2\pi L^2}\sqrt{\frac{E \bullet I \bullet g}{\gamma \bullet A}}$$

$$= f\frac{d_r}{L^2} \times 10^7 \text{ (min}^{-1}\text{)} \qquad \cdots 7)$$

In this formula:

α : Safety factor ($\alpha = 0.8$)

E : Elastic modulus ($E = 2.06 \times 10^5$ MPa)

I : Moment of inertia of area of screw shaft

$$I = \frac{\pi}{64} d_r^4 \text{ (mm}^4\text{)} \qquad \cdots 3)$$

d_r : Screw shaft root diameter (mm) (See the dimension table.)

g : Acceleration of gravity ($= 9.8 \times 10^3$ mm/s^2)

γ : Specific weight ($\gamma = 7.65 \times 10^{-5}$ N/mm^3)

A : Cross section area of the screw shaft root diameter (mm^2)

$$A = \frac{\pi}{4} \times d_r^2 \text{ (mm}^2\text{)} \qquad \cdots 5)$$

L : Unsupported length (mm) (See **Figs. 4.1**, and **4.2** "Supporting conditions of screw shaft and ball nut" on page B51)

f, λ : Factors determined by the supporting condition

Table 3.1 Coefficients of critical speed

Supporting condition	f	λ
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	π

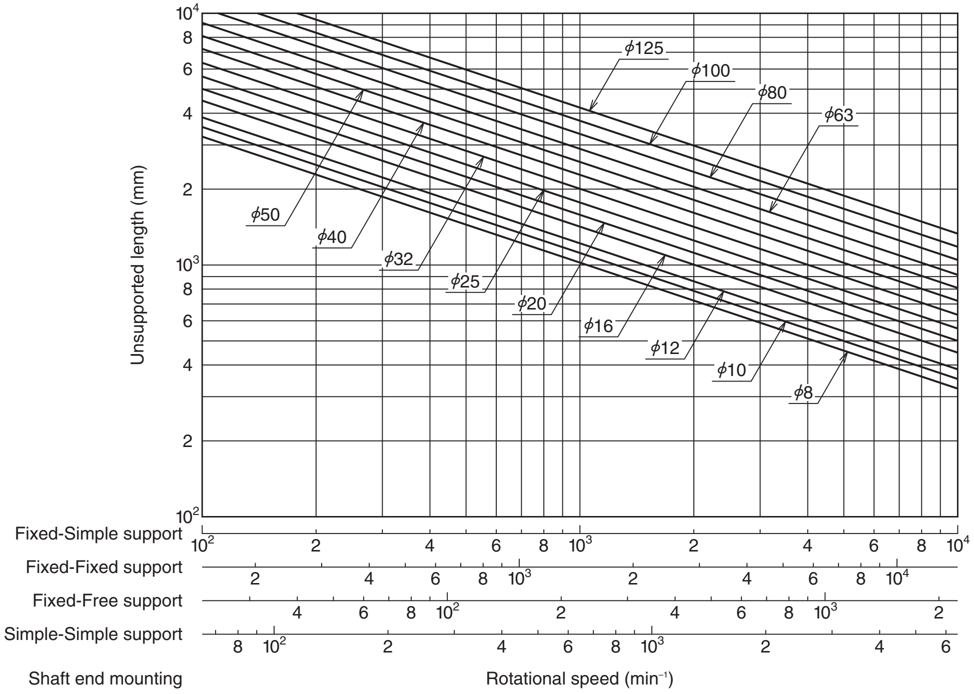


Fig. 3.1 Permissible rotational speeds vs. critical speeds

<<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" on page B51.)

Unsupported length $L = 2\ 000$ 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** on page B47

$\lambda = 3.927$

$f = 15.1$

By formula 7) on page B47, permissible rotational speed to critical speed is

$$n_c = f\frac{d_r}{L^2} \times 10^7 = 15.1 \times \frac{34.4}{2\ 000^2} \times 10^7 = 1\ 298.6\ (\text{min}^{-1})$$

$$n_c = 1\ 290\ \text{min}^{-1} \text{ or under}$$

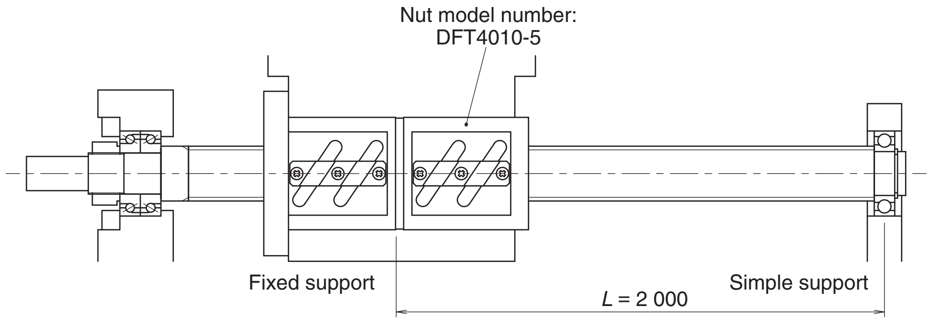


Fig. 3.2 Calculation example of permissible rotational speed to the critical speed

B-2-3.2 d·n Value

An increase of ball orbital speed increases the collision impact of balls to ball recirculation parts, and thus resulting in damage to them. For this reason, the permissible rotational speed is also limited by the d·n value (d, shaft diameter in millimeters; n, rotational speed per minutes). **Table 3.2** shows the allowable d·n value and the maximum rotational speed of ball screws.

Notes: 1. Special measure must be taken for high-speed specification products. Please consult NSK.

2. Please consult NSK if the maximum rotational speed or the d·n value exceed the values 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^{-1}]
		Standard	High-speed	
Standard ball screw	Ball screw for transfer equipment R series	50 000 or less	–	3 000
Standard nut ball screws	End-deflector type	180 000 or less	–	5 000
	Return tube type	70 000 or less	100 000 or less	3 000
	Deflector type	84 000 or less	100 000 or less	3 000
	End cap type	80 000 or less	100 000 or less	3 000
Application-oriented ball screws	HMD type for high-speed machine tools	160 000 or less	–	4 000
	HMC type for high-speed machine tools	100 000 or less, 135 000 or less*1	–	3 750
	BSL type for miniature lathes	(180 000 or less)	–	4 000
	HTF-SRC type for high-load drives	140 000 or less, 160 000 or less*1	–	3 225
	HTF-SRD type for high-load drives	120 000 or less	–	2 400
	HTF type for high-load drives	50 000 or less, 70 000 or less*1	100 000 or less	3 125
	VSS type for contaminated environment	150 000 or less	–	3 000
	ND series nut-rotatable ball screws	70 000 or less	100 000 or less	3 000
	∑ series for robots	70 000 or less	–	3 000
	R series for transfer equipment	50 000 or less	–	3 000

∗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 B477
- HTF-SRC type for high-load drives: page B487
- HTF type for high-load drives: page B495

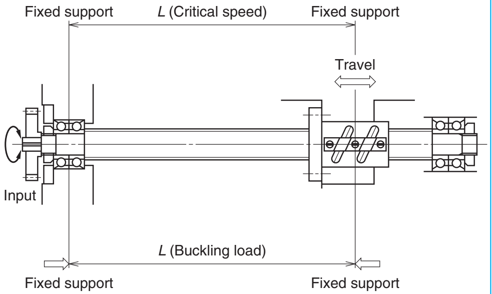
B-2-4 Supporting Conditions for Calculation of Buckling Load and Critical Speed

Figs. 4.1 and **4.2** are typical conditions in supporting ball screws. Use them as reference to calculate the buckling load and the 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: A 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 the maximum stroke for each side. Calculate by applying support bearing conditions.

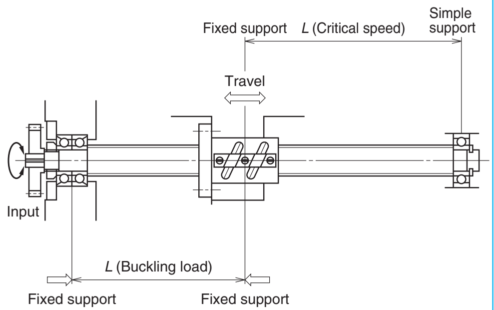
i

Buckling load: Fixed - Fixed support
Critical speed: Fixed - Fixed support



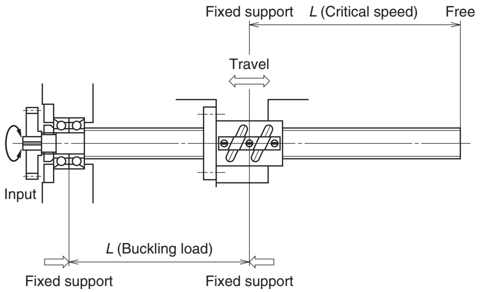
ii

Buckling load: Fixed - Fixed support
Critical speed: Fixed - Simple support



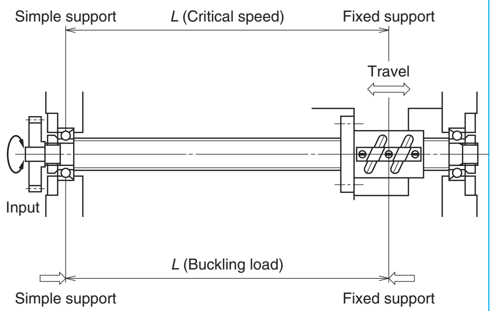
iii

Buckling load: Fixed - Fixed support
Critical speed: Fixed - Free support



iv

Buckling load: Fixed - Simple support
Critical speed: Fixed - Simple support



v

Buckling load: Fixed - Fixed support
Critical speed: Fixed - Fixed

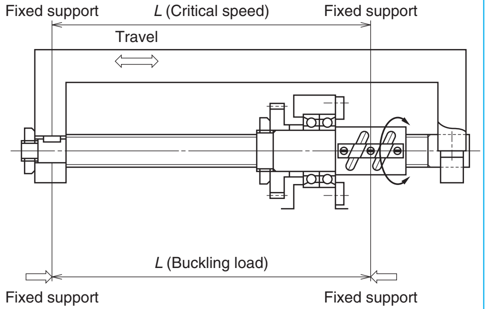
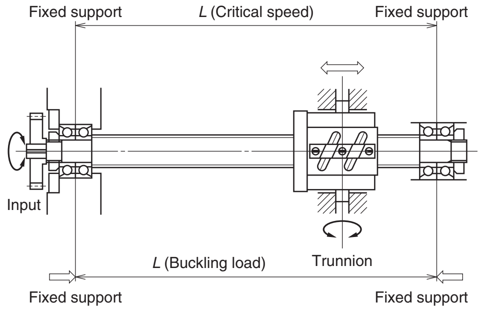


Fig. 4.1 Supporting conditions for screw shaft and ball nut

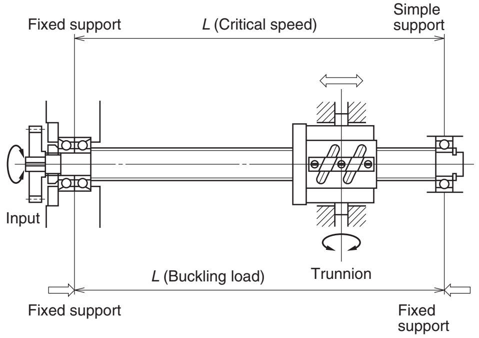
vi

Buckling load: Fixed - Fixed support
Critical speed: Fixed - Fixed support
} Minimum value (estimate) is obtained in the state as shown in the figure.



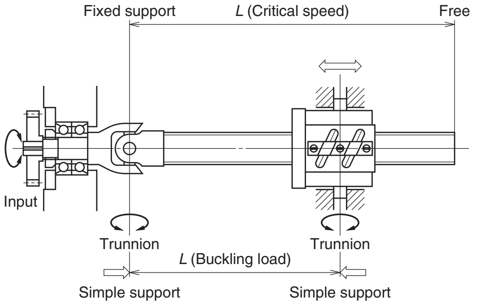
vii

Buckling load: Fixed - Fixed support
Critical speed: Fixed - Simple support
} Minimum value (estimate) is obtained in the state as shown in the figure.



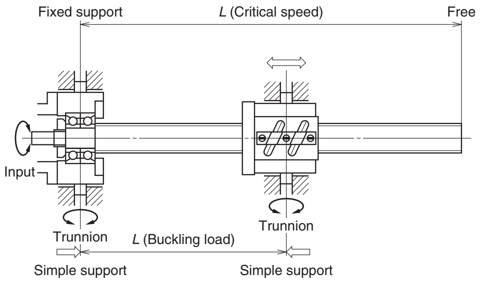
viii

Buckling load: Simple support - Simple support
Critical speed: Fixed - Free support→ Minimum value (estimate) is obtained in the state as shown in the figure.



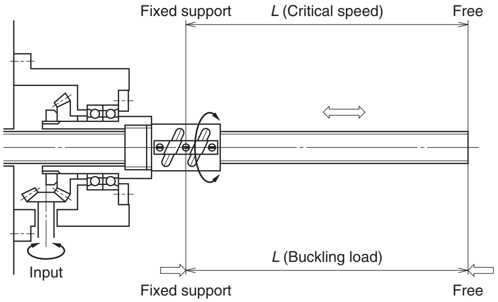
ix

Buckling load: Simple support - Simple support
Critical speed: Fixed - Free support→ Minimum value (estimate) is obtained in the state as shown in the figure.



x

Buckling load: Fixed - Free support
Critical speed: Fixed - Free support



xi

Buckling load: Fixed - Fixed support
Critical speed: Fixed - Free support

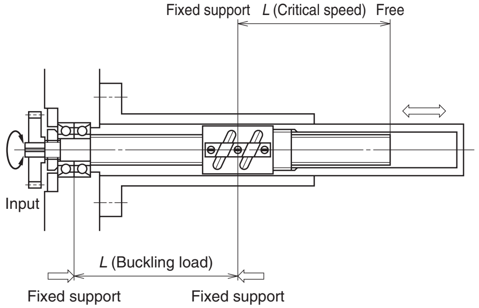


Fig. 4.2 Supporting conditions of screw shaft and ball nut

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.

B-2-5.2 Fatigue Life

Fatigue life of a ball screw can be estimated by basic dynamic load rating (C_a) as is for the rolling bearings.

(1) Basic dynamic load rating C_a

Basic dynamic load rating is the axial load that 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.

$$L = \left(\frac{C_a}{F_a \bullet f_w}\right)^3 \bullet 10^6 \qquad \cdots 8)$$

$$L_t = \frac{L}{60n} \qquad \cdots 9)$$

$$L_s = \frac{L \bullet l}{10^6} \qquad \cdots 10)$$

In this formula:

L : Rating fatigue life (rev)

L_t : Life in hours (h)

L_s : Life by running distance (km)

C_a : Basic dynamic load rating (N)

F_a : Axial load (N)

n : Rotational speed (min^{-1})

l : Lead (mm)

f_w : Load factor (Coefficient by operating condition)

Load factor f_w for operating conditions is shown in **Table 5.1**.

Table 5.1 Load coefficient f_w

Smooth operation without 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	20 000 hours
Industrial machines	10 000 hours
Automatic control system	15 000 hours
Measuring equipment	15 000 hours

(3) Mean load

If the axial load often varies, calculate life by obtaining the mean load, which gives the equivalent fatigue life under this varying load conditions.

(a) When the load and the rotational speed shift stepwise

Obtain the mean load F_m by the formula below.

Obtain mean rotational speed N_m by the formula below as **Table 5.3** and **Fig. 5.1**.

$$F_m = \left(\frac{F_1^3 \bullet n_1 \bullet t_1 + F_2^3 \bullet n_2 \bullet t_2 + \cdots F_n^3 \bullet n_n \bullet t_n}{n_1 \bullet t_1 + n_2 \bullet t_2 + \cdots + n_n \bullet t_n}\right)^{\frac{1}{3}} \qquad \cdots 11)$$

$$N_m = \frac{n_1 \bullet t_1 + n_2 \bullet t_2 + \cdots + n_n \bullet t_n}{t_1 + t_2 + \cdots + t_n} \qquad \cdots 12)$$

Table 5.3 Stepwise operation condition

Axial load (N)	Rotational speed (min^{-1})	Hours of use, or ratio of hours of use
F_1	n_1	t_1
F_2	n_2	t_2
:	:	:
F_n	n_n	t_n

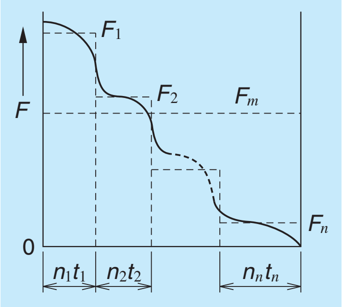


Fig. 5.1 Stepwise load variation

(b) When the rotational speed is constant, and the load changes linearly, obtain approximate value of the mean load F_m by the formula below.

$$F_m = \frac{1}{3}(F_{min} + 2F_{max}) \qquad \cdots 13)$$

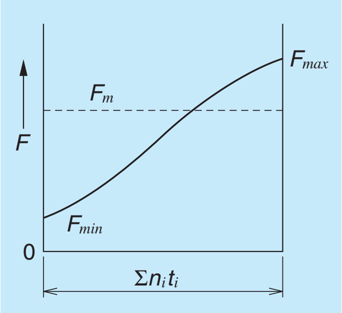


Fig. 5.2 Linear load change

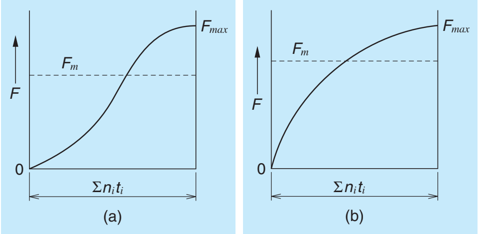
(c) When the rotational speed is constant, and the load changes in a sinusoidal pattern, obtain approximate value of the mean load F_m by the formula below.

When the sine curve is Fig. (a)

$$F_m \fallingdotseq 0.65\ F_{max} \qquad \cdots 14)$$

When the sine curve is Fig. (b)

$$F_m \fallingdotseq 0.75\ F_{max} \qquad \cdots 15)$$



(a) (b)

Fig. 5.3 Load changes in sinusoidal pattern

(4) 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 ··1/2 000 or less

Eccentricity·························20 μm or less

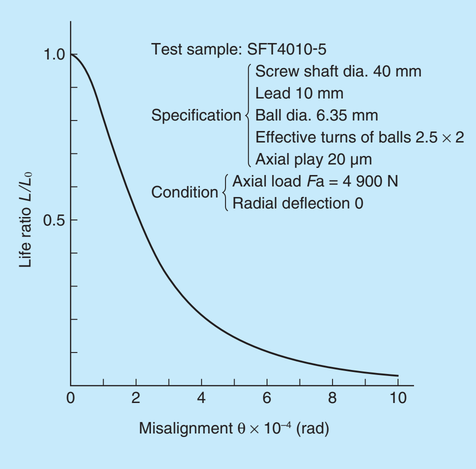


Fig. 5.4 Affects of misalignment

(5) Effects of heavy load and short stroke

If the ball screw is used under heavy load and short strokes, such as for the 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 points of balls and ball grooves of the screw shaft and the nut, adversely affecting the life.

The axial load F_{amax}[*1] during operation and the size of strokes, which affect fatigue life, can be obtained by the following formula.

In such 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.

$$F_{\text{amax}} \geq 0.10C_{0\text{a}} \qquad \cdots\ 16)$$

$$S \leq 4$$

In this formula:

F_{amax} : Maximum load to axial direction during drive (N)

$C_{0\text{a}}$: Basic static load rating (N)

S : Stroke (rev)

$$S = \frac{L_\text{s}}{l}$$

L_s : Stroke distance (mm)

l : Lead (mm)

*1) Axial load : The load 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 the hardness of NSK standard ball screw.

Table 5.4 Ball screw materials and their hardness

Component	Heat treatment method	Hardness (HRC)
Screw shaft	Carburizing	58 or over
	Induction hardening	58 or over
Nut	Carburizing	58 or over

Note: NSK manufactures special material ball screws for special environments (stainless steel: SUS440C, SUS630). NSK also furnishes protective surface 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.

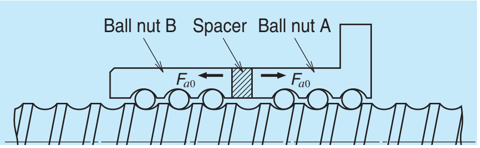
NSK has the data of wear accumulated through abundant experience. Please contact NSK for inquiry pertaining to the wear.

B-2-6 Preload and Rigidity

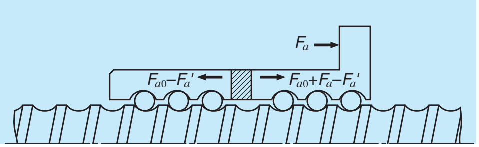
B-2-6.1 Elastic Deformation of Preloaded Ball Screw

(1) Position preload (D, Z, and P preload)

The concept of double nut preload ball screw is shown in **Fig. 6.1**.



(a) Extemal load : 0



(b) Extemal load : F_a

Fig. 6.1 Position preload (double-nut)

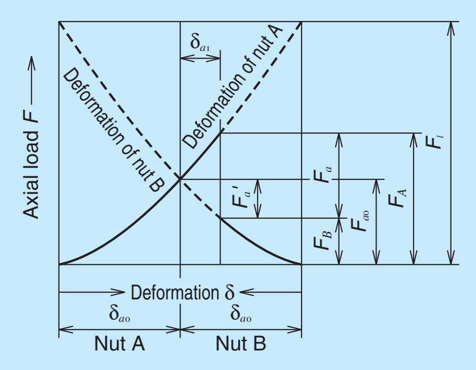


Fig. 6.2 Deformation of A and B nut (position preload)

Elastic deformation of Nut A and B is already given at time of assembly by the amount of δ*a*o by preload F_{ao}. When the external load F_a is added to Nut A, the elastic deformation δ_a and δ_b of each Nut A and B change as shown in **Fig. 6.2**,

$$\delta_a = \delta_{ao} + \delta_{a1} \qquad \delta_\text{b} = \delta_{ao} - \delta_{a1}$$

At this time, the load to each Nut A and B are:

$$F_\text{A} = F_{ao} + F_a - F_a'$$

$$F_\text{B} = F_{ao} - F_a'$$

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 δ_{ao}, 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 (refer to **Fig. 6.2**).

$$\delta_{ao} = K \bullet F_{ao}^{2/3} \qquad 2\delta_{ao} = K \bullet F_l^{2/3}$$

(K : Invariable number)

$$\left[\frac{F_l}{F_{ao}}\right]^{2/3} = \frac{2\delta_{ao}}{\delta_{ao}} = 2$$

$$F_l = 2^{3/2} \times F_{ao} \fallingdotseq 3F_{ao}$$

For this reason, the preload should be about 1/3 of the maximum axial load. However, please note that if the preload of about 1/3 of the maximum axial load exceeds 10% of C_a, which is the criterion of the maximum preload, the ball screw may adversely increases heat generation and / or may shortens its lifetime.

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.

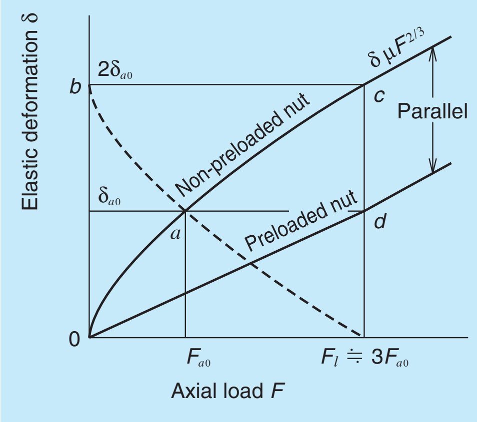


Fig. 6.3 Deformation of preloaded ball nut (position preload)

(2) Constant pressure preload (J preload: preloaded by spring)

Fig. 6.5 shows an elastic deformation of a ball screw which is preloaded with "constant pressure." The rigidity of the preload spring is sufficiently smaller than the nut rigidity. Therefore, the deformation of the spring becomes nearly parallel to the abscissa axis. For this reason, 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 an arrow in **Fig. 6.4**.

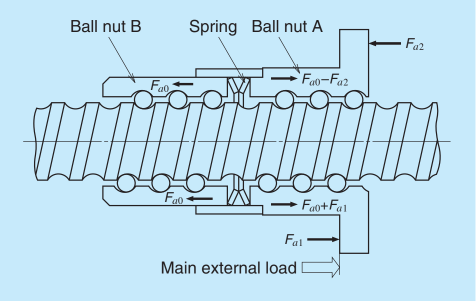


Fig. 6.4 Constant pressure preload (double nut)

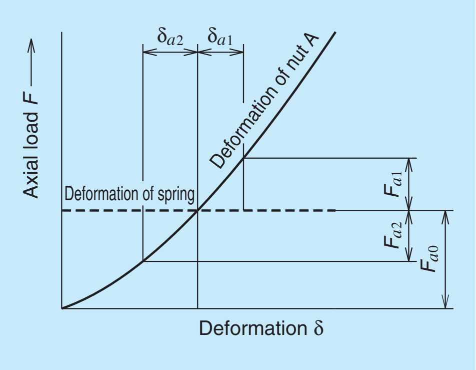


Fig. 6.5 Deformation curve of constant pressure preloaded nut

B-2-6.2 Rigidity of the Feed Screw System

A low rigidity around the feed screw mounting area causes lost motion. To improve the positioning accuracy of precision machines such as NC machine tools, 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.

$$\delta = \frac{F_a}{K_T} \text{ ……………………………………………… 17)}$$

$$\frac{1}{K_T} = \frac{1}{K_S} + \frac{1}{K_N} + \frac{1}{K_B} + \frac{1}{K_H} \text{ ……………… 18)}$$

In this formula:

δ : Volume of axial elastic deformation of the feed screw system (μm)
F_a : Axial load to the feed screw system (N)
K_T : Axial rigidity of the feed system (N/μm)
K_S : Axial rigidity of the screw shaft (N/μm)
K_N : Axial rigidity of the nut (N/μm)
K_B : Axial rigidity of the support bearing (N/μm)
K_H : Axial rigidity of the nut and bearing mounting section (N/μm)

(2) Axial rigidity of the screw shaft: K_S

(a) In case of: Fixed support - Free (axial direction)

$$K_S = \frac{A \cdot E}{x} \times 10^{-3} \text{ ………………………………… 19)}$$

In this formula:

K_S : Axial rigidity of the screw shaft (N/μm)
A : Cross section area of the screw shaft (mm²)

$$A = \frac{\pi}{4} dr^2$$

dr : Screw shaft root diameter (mm)
E : Elastic modulus ($E = 2.06 \times 10^5$ MPa)
x : Distance between points of load application (mm)

(b) In case of: Fixed – Fixed support (axial direction)

$$K_S = \frac{A \cdot E \cdot L}{x\,(L-x)} \times 10^{-3} \text{ ……………………………… 20)}$$

In this formula:

K_S : Axial rigidity of the screw shaft (N/μm)
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.

$$K_S = \frac{4A \cdot E}{L} \times 10^{-3} \text{ ……………………………… 21)}$$

<<Calculation example of axial rigidity (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
$x = 1\,200$ mm
Screw shaft root diameter (from the dimension table)
$d_r = 34.4$ mm

<Calculation>

By formula 19), axial rigidity K_S is :

$$A = \frac{\pi}{4} d_r^2 = \frac{3.14}{4} \times 34.4^2 = 929.4 \text{ (mm}^2\text{)}$$

$$K_S = \frac{A \cdot E}{x} \times 10^{-3} = \frac{929.4 \times 2.06 \times 10^5}{1\,200} \times 10^{-3} = 159 \text{ (N/μm)}$$

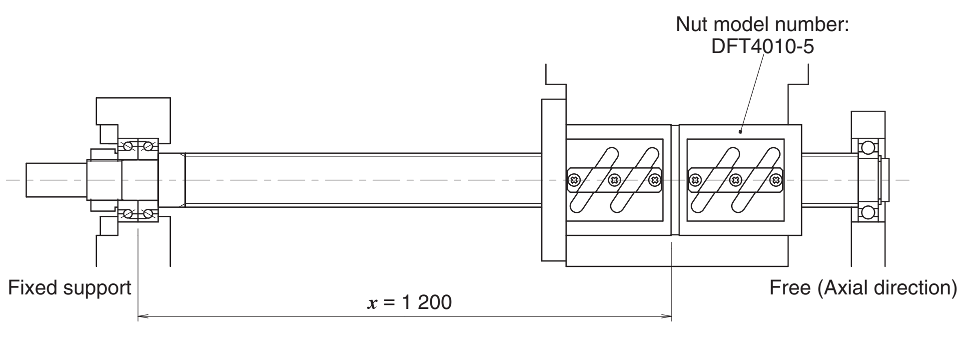


Fig. 6.6 Calculation example of axial rigidity of the screw shaft (1)

<<Calculation example of axial rigidity (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)

$L = 1\ 200$ mm

Distance between points of load application:

Screw shaft root diameter (from the dimension table)

$dr = 34.4$ mm

<Calculation>

By formula 21), axial rigidity K_S is :

$$A = \frac{\pi}{4}\ dr^2 = \frac{3.14}{4} \times 34.4^2 = 929.4\ (\text{mm}^2)$$

$$K_S = \frac{4A \cdot E}{L} \times 10^{-3} = \frac{4 \times 929.4 \times 2.06 \times 10^5}{1\ 200} \times 10^{-3} = 638\ (\text{N/μm})$$

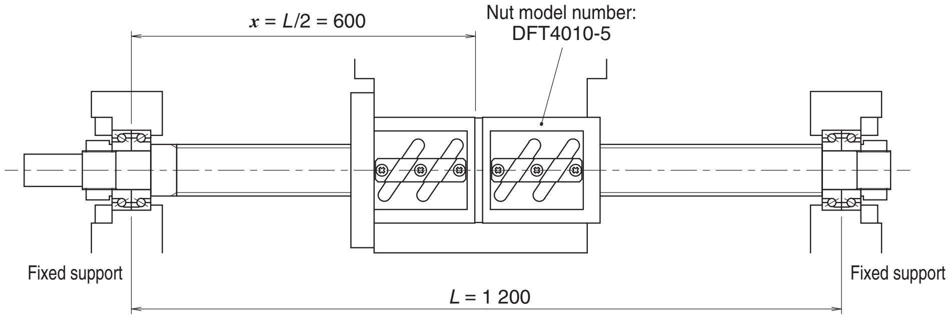


Fig. 6.7 Calculation example of axial rigidity of the screw shaft (2)

(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. The value K is obtained from the elastic deformation between screw grooves and balls when an axial load equivalent to 30% of the basic dynamic load rating C_a is applied. The criterion for the ball nut rigidity is 80% of the value listed in the table taking into consideration of deformation of the ball nut, etc. The rigidity value K_N is obtained by the following formula when the axial load "F_a" is not 30% of "C_a."

$$K_N = 0.8 \times K \left(\frac{F_a}{0.3\ C_a} \right)^{1/3} \ (\text{N/μm}) \qquad \cdots 22)$$

In this formula:

K : Rigidity value in dimension tables (N/μm)

F_a : Axial load (N)

C_a : Basic dynamic load rating (N)

<<Calculation example of axial rigidity (3)>>

Obtain axial rigidity of the nut under the following conditions.

<Use conditions>

Nut model: SFT 4010-5

Axial load: $F_a = 6\ 000$ N

F_a = Rigidity at 0.3 C_a $K = 706$ N/μm

(from the dimension table)

<Calculation>

By formula 22), axial rigidity K_N is :

$$K_N = 0.8 \times K \left(\frac{F_a}{0.3 \cdot C_a} \right)^{1/3}$$

$$= 0.8 \times 706 \times \left(\frac{6\ 000}{0.3 \times 52\ 000} \right)^{1/3}$$

$$= 410\ (\text{N/μm})$$

(b) Rigidity of preloaded ball nut

Theoretical rigidity K of preloaded ball nut under an axial load is shown in each dimension table. The 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 (5% in case of the P-preload [single-nut oversize ball preload system]) is applied. The criterion for calculation of nut rigidity is 80% of the value listed in the table taking into consideration 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".

$$K_N = 0.8 \times K \left(\frac{F_{a0}}{\varepsilon \cdot C_a} \right)^{1/3} \ (\text{N/μm}) \qquad \cdots 23)$$

In this formula:

K : Rigidity in the dimension tables (N/μm)

F_{a0} : Preload (N)

ε : Basic factor to calculate rigidity ($\varepsilon = 0.1$. For P-preload use percentage of the preload to basic dynamic load rating. e.g. 0.03 for BSS and 0.015 for VSS.)

<<Calculation example of axial rigidity of the screw shaft (4)>>

Obtain axial rigidity of the nut under the following conditions.

<Use conditions>

Nut model : DFT 4010-5

Preload : $F_{a0} = 4\ 000$ N

Rigidity K when $F_{a0} = \varepsilon\ C_a$: $K = 1\ 376$ N/μm

(from the dimension table on page B435)

Basic factor to calculate rigidity when

D Preload: $\varepsilon = 0.1$

<Calculation>

By formula 23)

$$K_N = 0.8 \times K \left(\frac{F_{a0}}{\varepsilon \cdot C_a} \right)^{1/3}$$

$$= 0.8 \times 1\ 376 \times \left(\frac{4\ 000}{0.1 \times 52\ 000} \right)^{1/3}$$

$$= 1\ 008\ (\text{N/μm})$$

The criterion of the preload to ball screw

Nut rigidity increases by a larger preload volume. But an 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 applications.

Table 6.1 Criteria of preload

Ball screw application	Preload (relative to dynamic load rating C_a)
Robots,material handling systems, etc.	Axial play or under 0.01 C_a
Semiconductor manufacturing systems, etc. That require highly accurate positioning	0.01 C_a – 0.04 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.

$$K_B \doteqdot \frac{3F_{a0}}{\delta_{a0}}\ (\text{N/μm}) \qquad \cdots 24)$$

In this formula:

K_B : Rigidity of the combined thrust angular contact ball bearings (N/μm)

F_{ao} : Preload of the bearings (N)

δ_{ao} : Axial elastic deformation by preload (μm)

$$\delta_{a0} \doteqdot \frac{0.44}{\sin\alpha}\left(\frac{Q^2}{D_W}\right)^{1/3}\ (\text{μm}) \qquad \cdots 25)$$

$$Q = \frac{F_{a0}}{Z}\cdot \sin\alpha$$

α : Contact angle

D_W : Ball diameter (mm)

Z : Number of balls

Refer to page B399 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_H

As the rigidity of mounting section has a profound effect on positioning accuracy, 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 B40.

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 following two:

- Friction torque, i.e. the friction of the ball screw itself
- Drive torque which is required for operation

B-2-7.1 Friction Torque

(1) Starting friction torque (Break away torque)

A high torque is necessary to start a ball screw. This is called "starting friction torque" or "brakeaway torque." This torque is 2 to 2.5 times larger than the dynamic (friction) torque due to preload which is described below. The starting friction torque quickly diminishes once the ball screw begins to move.

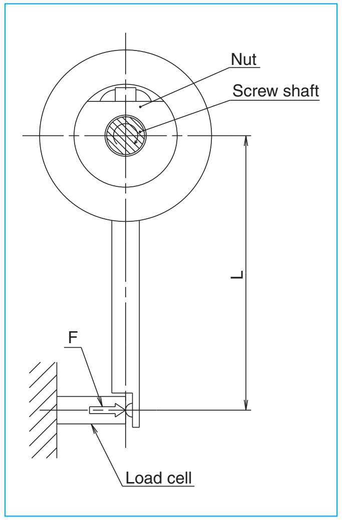


Fig. 7.1 Preload dynamic torque measuring method

(2) Dynamic friction torque (dynamic friction torque due to preload)

When a ball screw is moving, two types of torque generate: the dynamic friction torque due to preload and the friction torque associated with ball recirculation. JIS B1192 sets the standard of dynamic friction torque due to preload, which is the total of these two torque types. They are defined in **Fig. 7.2**.

The dynamic friction torque due to preload is calculated by the following formula. When the screw shaft is rotated as **Fig. 7.1** in the following measuring conditions, measure the nut holding power *F* and then multiple the distance of action line *L* which is perpendicular to the direction of the power *F*.

$$T_p = F \cdot L \qquad \cdots 26)$$

- Measuring rotational speed 100 min^{-1}
- Viscosity of lubrication is ISO VG 68 as prescribed in JIS K 2009.
- Remove Seals.

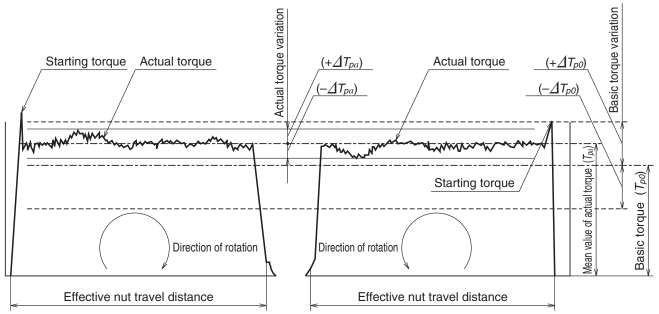


Fig. 7.2 Definitions of dynamic preloaded drag torque

(3) Calculation of basic torque

The basic torque of preloaded ball screw T_{p0} can be obtained by the following formula.

$$T_{p0} = K\frac{F_{a0} \bullet l}{2\pi} \fallingdotseq 0.014 F_{a0}\sqrt{d_m \bullet l} \quad (\mathrm{N \cdot cm}) \qquad \cdots 27)$$

In this formula:

F_{a0} : Preload (N)

l : Lead (cm)

K : Torque coefficient of ball screw

$$K = \frac{0.05}{\sqrt{tan\beta}}$$

β : Lead angle (deg.)

d_m : Ball pitch circle diameter (cm)

Allowable values of torque variation rate relative to basic torque are regulated as shown in **Table 7.1**.

B-2-7.2 Drive Torque

(1) Operating torque of a ball screw

(a) Normal drive

The torque when converting rotational motion to linear motion (normal operation) is obtained by the following formula.

$$T_a = \frac{F_a \bullet l}{2\pi \bullet \eta_1} \quad (\mathrm{N \cdot cm}) \qquad \cdots 28)$$

In this formula:

T_a : Normal operation torque (N · cm)

F_a : Axial load (N)

l : Lead (cm)

η_1 : Normal efficiency (η_1 = 0.9 to 0.95)

(b) Back-drive operation

The torque when converting linear motion to rotational motion (back-drive operation) is obtained by the following formula.

$$T_b = \frac{F_a \bullet l \bullet \eta_2}{2\pi} \quad (\mathrm{N \cdot cm}) \qquad \cdots 29)$$

In this formula:

T_b : Reverse operation torque (N · cm)

η_2 : Reverse efficiency (η_2 = 0.9 to 0.95)

(c) Dynamic drag torque of the preloaded ball screw

the operation torque of preloaded ball screw can be obtained by Formula 27).

Table 7.1 Range of allowable values of torque variation rates (Source: JIS B 1192)

Basic torque (N · cm)		Effective length of the screw thread (mm)										
		4 000 or under								Over 4 000 and 10 000 or under		
		Slenderness ratio(1): 40 or less				Slenderness ratio(1): More than 40 and 60 or less				—		
		Accuracy grade				Accuracy grade				Accuracy grade		
Over	Incl.	C0	C1	C2, 3	C5	C0	C1	C2, 3	C5	C1	C2, 3	C5
20	40	±30%	±35%	±40%	±50%	±40%	±40%	±50%	±60%	—	—	—
40	60	±25%	±30%	±35%	±40%	±35%	±35%	±40%	±45%	—	—	—
60	100	±20%	±25%	±30%	±35%	±30%	±30%	±35%	±40%	—	±40%	±45%
100	250	±15%	±20%	±25%	±30%	±25%	±25%	±30%	±35%	—	±35%	±40%
250	630	±10%	±15%	±20%	±25%	±20%	±20%	±25%	±30%	—	±30%	±35%
630	1 000	—	±15%	±15%	±20%	—	—	±20%	±25%	—	±25%	±30%

Notes: 1. Slenderness ratio: The value obtained by dividing the length of the screw thread section of screw shaft (mm) by diameter of the screw shaft (mm).
2. NSK independently sets torque standards which are under 20 N ·cm.

(2) Drive torque of the motor

(a) Drive torque at constant speed

The torque which is necessary to drive a ball screw at constant speed resisting to external loads can be obtained by the following formula.

$$T_1 = (T_a + T_{pmax} + T_u) \times \frac{N_1}{N_2} \qquad \cdots 30)$$

In this formula:

T_a : Drive torque at constant speed

$$T_a = \frac{F_a \bullet l}{2\pi \bullet \eta_1} \qquad \cdots 28)$$

F_a : Axial load (N)

The value of F_a in **Fig. 7.3** is:

$F_a = F + \mu \bullet m \bullet g$

F : Such as cutting force to axial direction (N)

μ : Friction coefficient of the guide way

m : Volume of the traveling section (table mass plus work mass kg)

g : Gravitational acceleration (9.80665 m/s^2)

T_{pmax} : Upper limit of the dynamic friction torque of ball screw (N · cm)

T_u : Friction torque of the support bearing (N · cm)

N_1 : Number of teeth in Gear 1

N_2 : Number of teeth in Gear 2

Generally, though it depends on the type of motor, T_1 shall be kept under 30% of the motor rating torque.

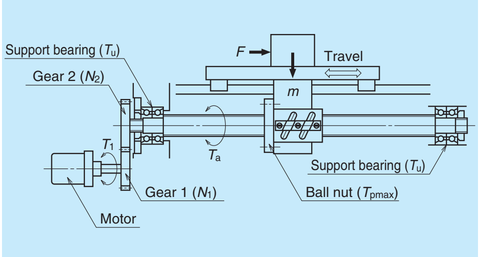


Fig. 7.3 Driving mechanism of ball screw

(b) Drive torque at acceleration

Accelerating the ball screw resisting axial load requires the maximum torque in an operation. Drive torque necessary for this occasion can be obtained by the following formula.

$$T_2 = T_1 + J \bullet \dot{\omega} \qquad \cdots 31)$$

$$J = J_M + J_{G1}\left(\frac{N_1}{N_2}\right)^2\left[J_{G2} + J_S + m\left(\frac{l}{2\pi}\right)^2\right] \quad (\mathrm{kg \cdot m^2}) \qquad \cdots 32)$$

In this formula:

T_2 : Maximum drive torque at time of acceleration (N · m)

$\dot{\omega}$: Motor's angular acceleration (rad/s^2)

J : Moment of inertia applied to the motor (kg · m^2)

J_M : Moment of inertia of the motor (kg · m^2)

J_{G1} : Moment of inertia of Gear 1 (kg · m^2)

J_{G2} : Moment of inertia of Gear 2 (kg · m^2)

J_S : Moment of inertia of the screw shaft (kg · m^2)

When selecting a motor, it is necessary to examine the maximum torque of the motor relative to the drive torque T_2 at the time of acceleration of ball screw.

For the calculation of the moment of inertia of a cylindrical object (ball screw, gear, etc.), please refer to the formula below.

Formula for the moment of inertia of a cylindrical object

$$J = \frac{\pi \bullet \gamma}{32} D^4 \bullet L \ (\mathrm{kg \cdot cm^2}) \qquad \cdots 33)$$

In this formula:

γ : Material density (kg/cm^3)

D : Diameter of the cylindrical object (cm)

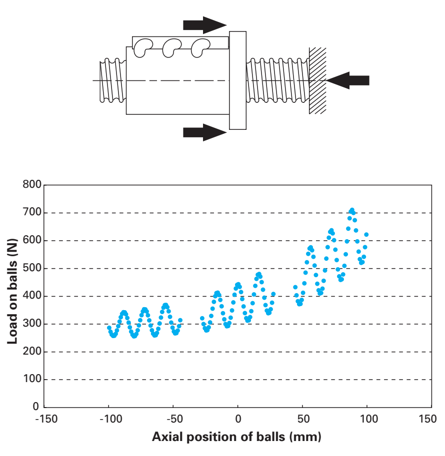
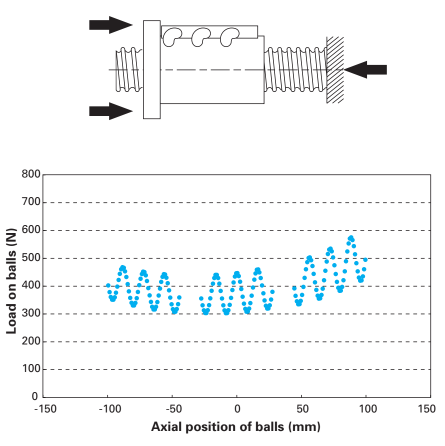
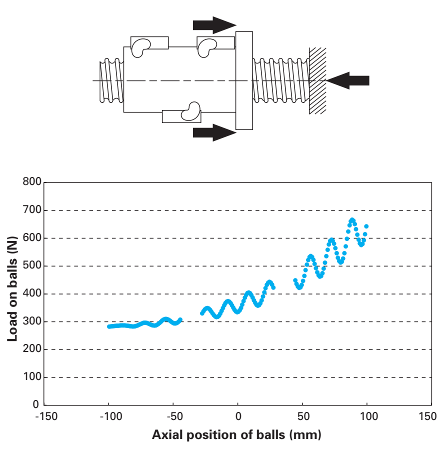
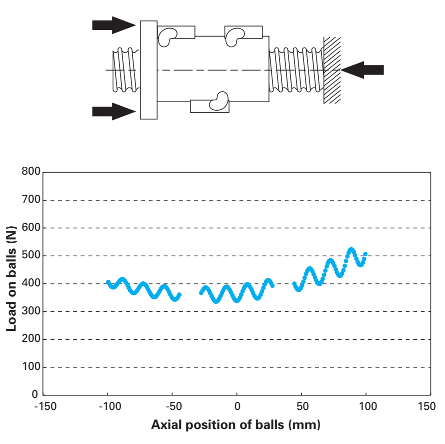
L : Length of the cylindrical object (cm)

B-2-8 Even Load Distribution in Ball Nut (In Case of Ball Screws for High-Load Drive)

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. 8.1**, while **Table. 8.1** shows the result of load distribution analysis.

Table. 8.1 The result of equalization of load distribution

	NSK recommended mounting direction	Conventional mounting direction
Conventional design		
HTF design		

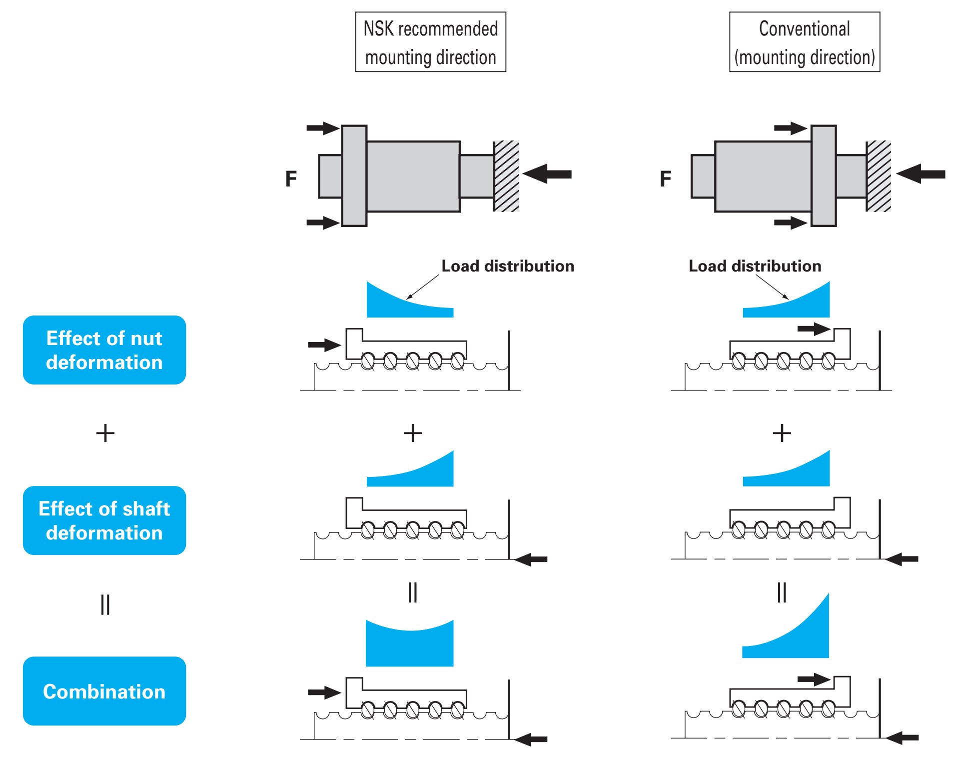


Fig. 8.1 The relationship between acting point of load and load distribution

B-2-9 Lubrication of Ball Screw

Lithium soap-based grease with base oil viscosity of 30 to 140 mm^2/s (40°C) is recommended for grease lubrication and oil of ISO VG 32 to 100 for oil lubrication.

In general, a lubricant with low base oil viscosity is recommended where a ball screw is used for high-speed operation, and thus requires reducing thermal elongation of the screw shaft. On the other hand, a lubricant with high base oil viscosity is recommended for a low-speed, high-temperature operation, or a high-load and oscillating operation.

Please consult NSK about greases for high-load drives and high-temperature applications.

NSK markets "NSK Grease Unit" as the standard series products for a variety of 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^2/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 LG2	Lithium base	Mineral oil combined with Synthetic hydrocarbon oil	30	–20 – 70	For clean environment
NSK Grease NF2	Urea composite type	Synthetic hydrocarbon oil	27	–40 – 100	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 grooves and balls wear rapidly, or the ball screw may malfunction due to the damage of groove and/or ball recirculation system. Use bellows or telescopic pipes (**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 seals on the ball nut as shown in **Figs. 10.2** to **10.6**. We provide seals in **Table 10.1**.

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.)

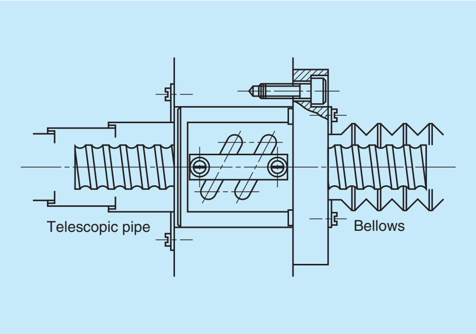


Fig. 10.1 Dust prevention by telescopic pipe and bellows

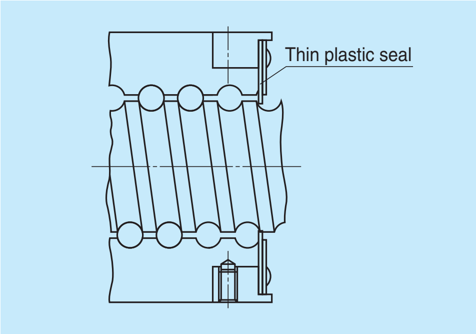


Fig. 10.2 Thin plastic seal

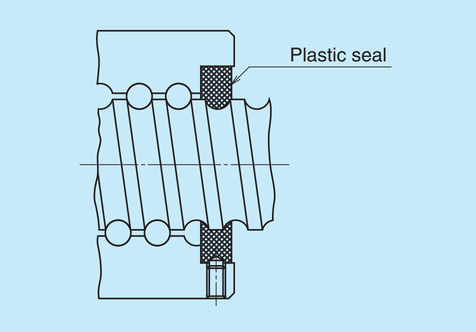


Fig. 10.3 Plastic seal

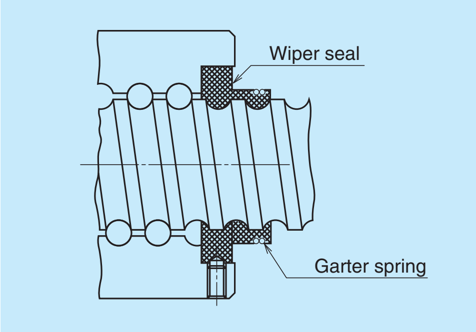


Fig. 10.4 Wiper seal

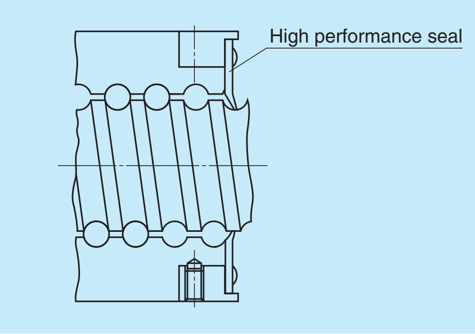


Fig. 10.5 High performance seal

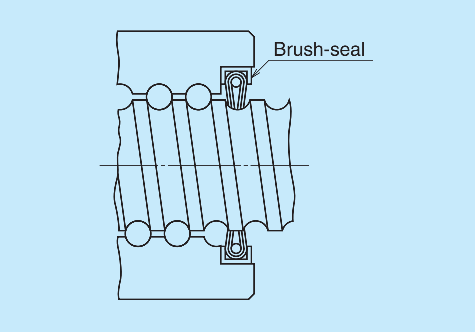


Fig. 10.6 Brush-seal for R Series

B-2-11 Rust Prevention and Surface Treatment of Ball Screws

(1) Stainless steel ball screw

KA type ball screws made of stainless steel are available. Please consult NSK for a custom made stainless steel ball screw.

(2) Types of surface treatment

The following are common types of treatment.

○Low temperature chrome plating
- Used to prevent corrosion and light reflection, and for cosmetic 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
- Very hard coating provides high resistance to both wear and corrosion.

○Electroless nickel plating
- Creates a film of consistent thickness on complex shaped items.
- For corrosion prevention.

(3) Recommended surface treatment

Among the surface treatments mentioned above, we recommend "Low temperature chrome plating" and "fluoride low temperature chrome plating" for rust prevention because of 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.

B-2-12 Ball Screw Specifications for Special Environments

B-2-12.1 Clean Environments

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.

The 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. The LG2 and LGU also have a sufficient durability and dust prevention capability.

Features of "LG2" and "LGU"

(a) Generates less dust than prevailing vacuum greases and general greases. Cleanliness is enhanced by simply switching the grease to the LG2 or the LGU.

(b) Has extremely low and stable torque characteristics. It is ideal for high-speeds operation.

(c) Unlike prevailing vacuum greases, the 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.

(d) They have an equal capability in rust prevention as general grease, and also are reliable.

When using NSK linear guides, ball screws, or Monocarriers in a clean environment, request the LG2 or LGU as a packed lubricant prior to delivery. NSK also makes bellows-tubes which contain 80 grams of the LG2 or LGU. The tube is easy to use, and is ideal for maintenance (refer to pages B397 and D19). Wash to remove adipose substances prior to use.

Refer to page D8 for their detailed nature, functions and characteristics of LG2 and LGU.

B-2-12.2 Measures for Use Under Vacuum

NSK developed MoS_2 / WS_2 spattering and dry-filmed ball screws for equipment to be used in space. NSK also makes soft-metal film (gold and silver) ball screws to be used in a vacuum environment for semiconductor and 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_2, WS_2 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 manufacturing equipment, the oil of the vacuum grease evaporates and causes environmental contamination. Also, it hinders creation of a super high vacuum. MoS_2 in the state of solid lubricant generates a large volume of dust, and Mo is unsuitable for semiconductors and reformed 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 the test data of ball screws for vacuum.

For ball screw specifications for special environments, 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.

(a) Use as a large lead as possible to reduce rotational speed.

(b) Use a ball screw with smaller outer diameter as possible.

(It often requires designing for critical dimensions, mandating special specification. Please consult NSK.)

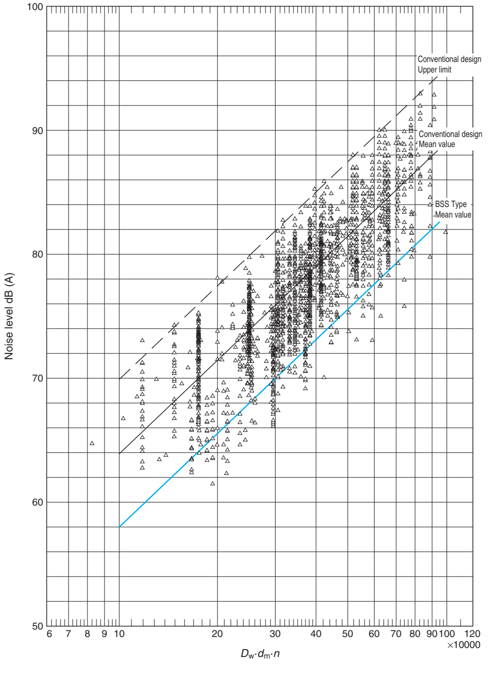


Fig. 13.1 Noise levels of ball screws

For reference, noise levels by ball screws alone are plotted below. The formula for calculation is also shown below.

(a) Average value at measuring distance of 400 mm

$$\text{dB (A)} = 25.2 \{\log_{10} (D_w \bullet d_m \bullet n \times 10^{-5})\} + 63.9 \quad \cdots 34)$$

(b) Upper limit at measuring distance of 400 mm

Average value + 6 dB (A)

D_w : Ball diameter (mm)

d_m : Ball pitch circle dia. (mm)

n : Rotational speed (min^{-1})

If measuring distance is 1 m, the average noise level is: Various noise levels minus 8 dB (A).

<<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: 2 000 min^{-1}

<Calculation>

By formula 34):

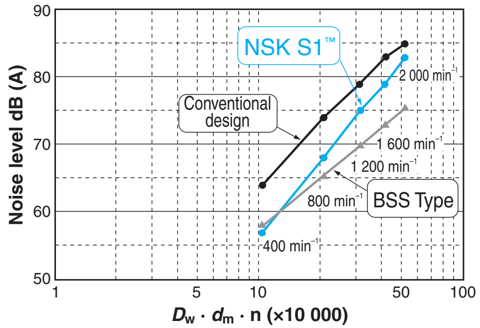
$$\text{dB (A)} = 25.2 \{\log_{10} (D_w \bullet d_m \bullet n \times 10^{-5})\} + 63.9$$
$$= 25.2 \{\log_{10} (6.350 \times 41 \times 2\,000 \times 10^{-5})\} + 63.9$$
$$= 82 \text{ dB (A)}$$

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.

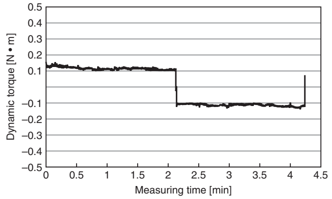
By using NSK S1, the noise is reduced and softened compared to conventional ball screws. The BSS type will furthermore reduce and soften the noise.



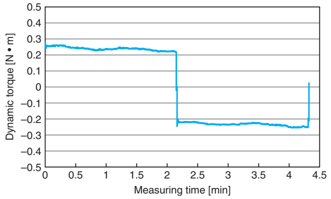
$D_w \cdot d_m \cdot$ n (×10 000)
Ball diameter × Peripheral speed

B-2-13.2 Consideration to Operational Characteristics

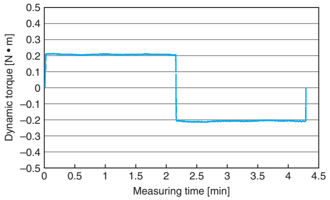
Smooth motion is achieved by using spacer balls on conventional ball return tube type ball screws. By using NSK S1 the smoothness is further improved. The BSS type will achieve the smoothness equivalent to ball screws with NSK S1.



Spacer balls



NSK S1 Inserting type



BSS Type, PSS Type

B-2-13.3 Consideration to Ball Screw Support System

A 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.

A simplified support bearing system to cut costs invites noise and vibration problems. Therefore, the necessity of consideration to the ball screw support system of both shaft ends is increasingly becoming important as the speed of machines is ever-increasing.

If one shaft end must be left unfixed without support bearing due to structural reasons, noise and vibration problems may occur. These problems are related to the natural vibration frequency of the screw shaft on the unsecured end. This problem can be averted by installing an impact damper to the shaft end (**Fig. 13.2**). Please consult NSK for details.

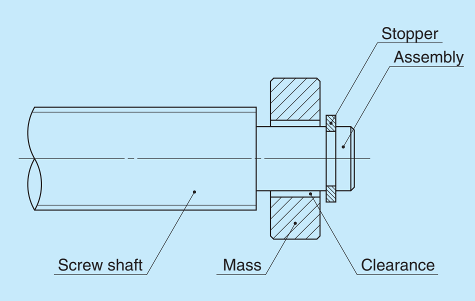


Fig. 13.2 Impact damper (Applied for patent)

B-2-14 Installation of Ball Screw

B-2-14.1 Installation

Follow the flowchart in **Fig. 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

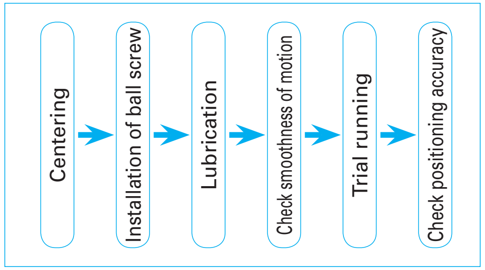


Fig. 14.1 Flowchart of ball screw installation

(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.

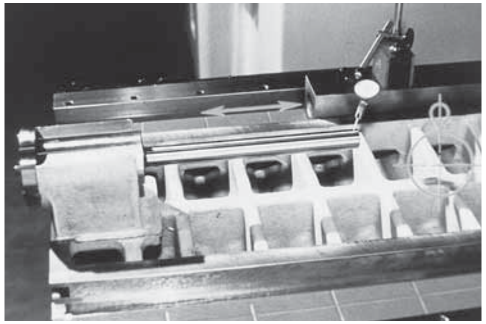


Photo 14.1 Centering of ball nut housing

(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.

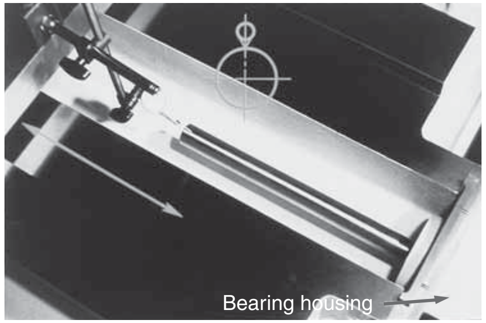


Photo 14.2 Centering of the housing of support bearing

(4) Eccentricity of the housings

Measuring way of eccentricity between the two housings is shown in **Photo 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.

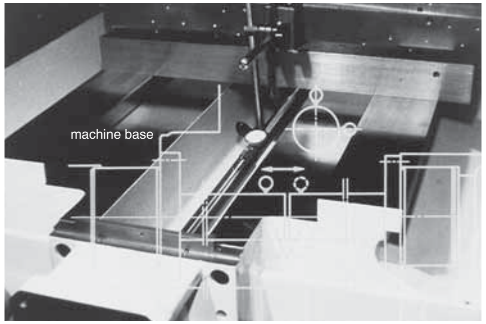


Photo 14.3 Eccentricity of the housings

(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.

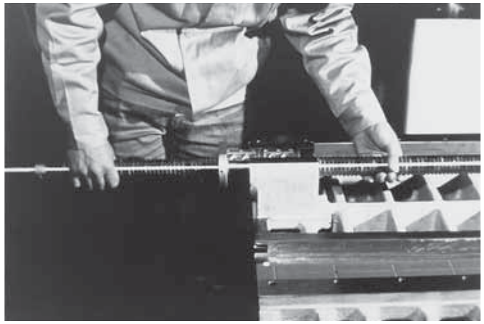


Photo 14.4 Installation of ball nut

(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.

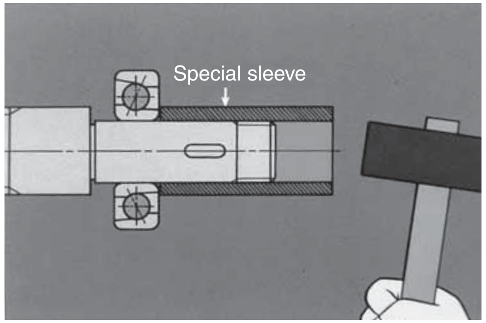


Photo 14.5 Installation of support bearings in ball screw

(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 on page B77.)

For easy installation work of ball screws, NSK provides Support Unit (page B375 to B394) that consists of bearings and Bearing Lock Nuts (page B395) of which surface run-out is made to a specification.

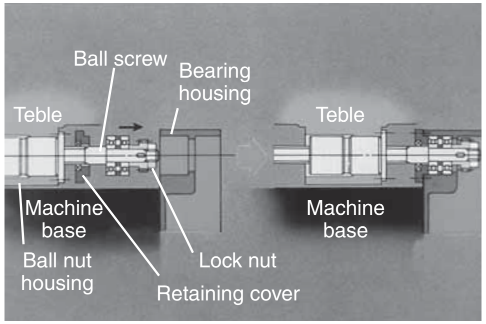


Photo 14.6 Installation of bearings

(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.

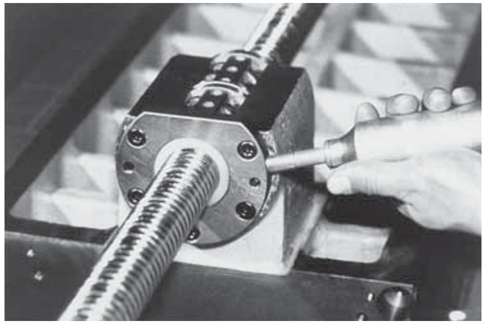


Photo 14.7 Replenish lubrication grease

(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.

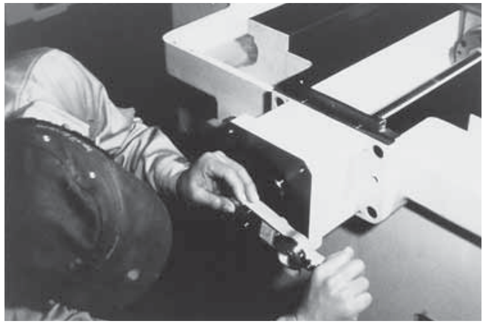


Photo 14.8 Check motion smoothness

(10) Trial operation

Photo 14.9 shows a scene 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.

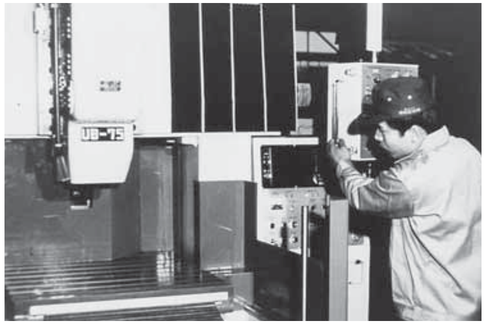


Photo 14.9 Trial operation

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.

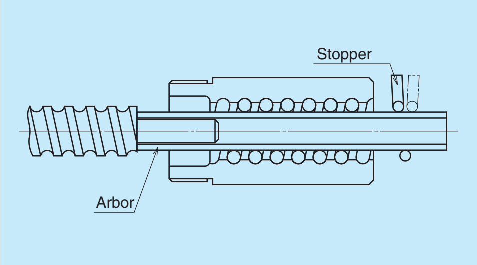


Fig. 14.2 Inserting nut into screwshaft

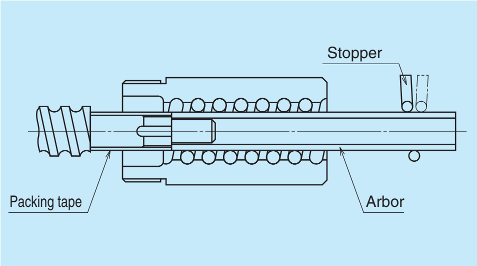


Fig. 14.3 Arbor and shaft end configuration

(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.

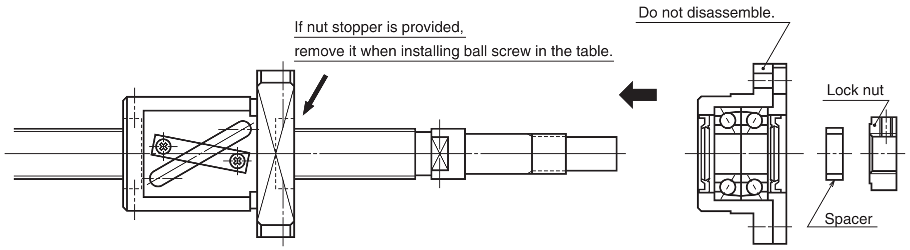
(3) Moving the nut

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.

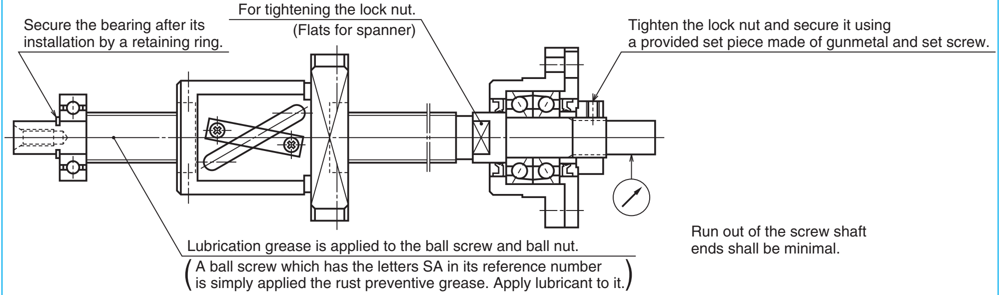
B-2-14.3 Installation of Ball Screw and Support Unit

The illustrations below show typical installation procedures for a standard ball screw and a support unit.

(1) Assembly of support unit

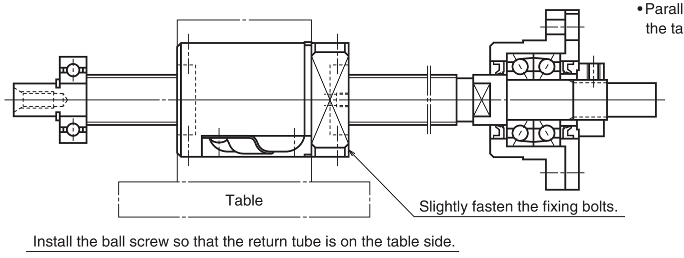


- Pay attention to turnup of seal lip.
- Apply grease to the oil seal,then install in the screw shaft.



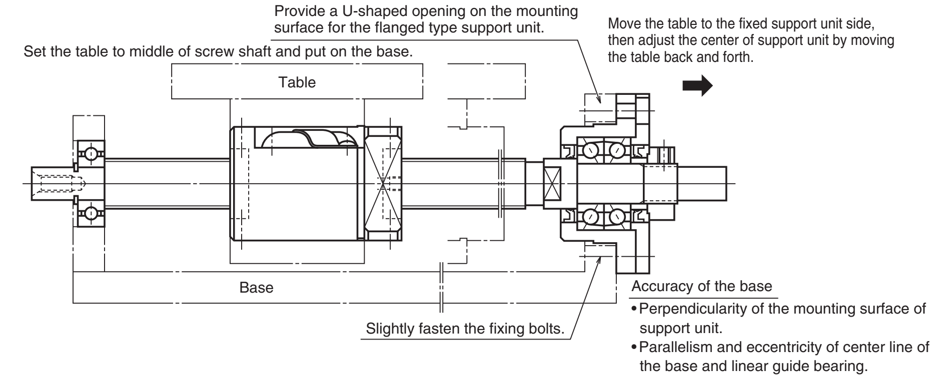
(2) Installation of ball nut to the table

Installation example: Turn the table upside down, and install the ball screw.

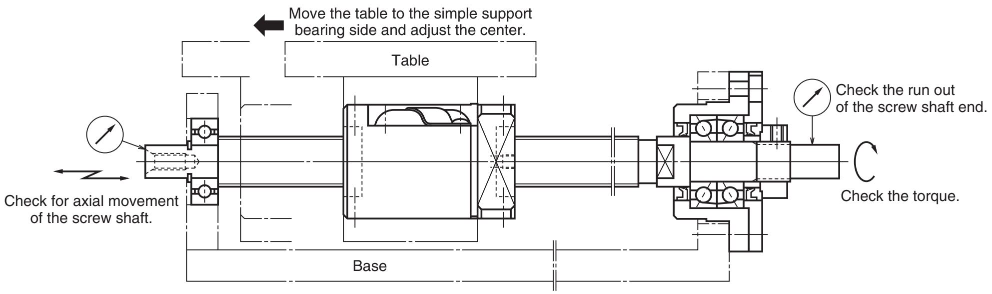


Accuracy of table
- Perpendicularity of nut housing
- Parallelism and center height deviation between the table center and the guide way bearings.

(3) Base and the support unit installation on the fixed support side

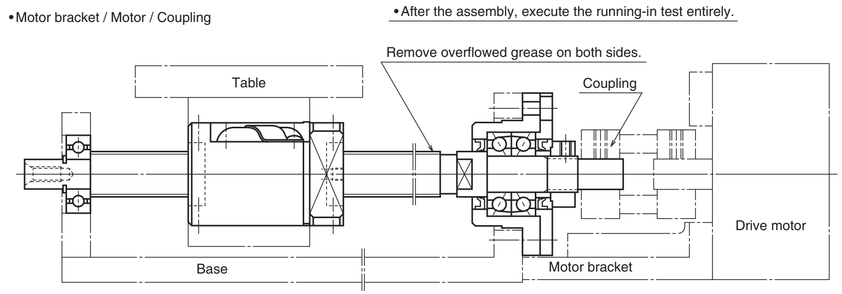


(4) Base and bearing installation on simple support side, and confirming assembling accuracy.



Adjust the center line by moving the table back and forth. Check for smooth operation of the table.
Repeat the same procedures described above if the table is not moving smoothly.
Tighten the fixing bolts checking the assembly accuracy.

(5) Assembly completed.



Assembling accuracy of the motor bracket and coupling affects the positioning accuracy of the table.
Pay great attention to it in the same manner as assembling ball screw.

B-2-14.4 Shaft End Machining

You require to machine shaft ends 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 the summaries of machining of these shaft ends. For details, please contact NSK.

(1) Machining of blank shaft ends of precision ball screws

(a) Cutting screw shaft

Use a cutting whetstone or the like to cut the shaft, leaving stock for turning. Keep the nut 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, and then cut the screw shaft. This prevents foreign matters from entering to the ball screw section. Do the same for other machining.

(b) Precautions in cutting shaft end

Outside of the screw shaft is ground with precision (excluding R Series). 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).

(c) 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 the shaft end accuracy.

(d) 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.

(e) Milling processing

Process keyways and tooth seats for lock washers.

(f) Deburring, washing, and rust prevention

Wash with clean white kerosene after processing. Apply lubricant for immediate use. For later use, apply rust preventive agent.

Note: Contact NSK if nut is accidentally removed.

(2) Additional machining of R Series ball screw shaft end

(a) Cutting screw shaft

Carry out the same process as "(1) Machining of blank shaft ends of precision ball screws" above.

(b) 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 may shorten the all screw life. Cool with water the areas where should not be heated to avoid heat conduction.

(c) The following process is the same as "(1) Machining of blank shaft ends of precision ball screws" 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 B398) is available at NSK.

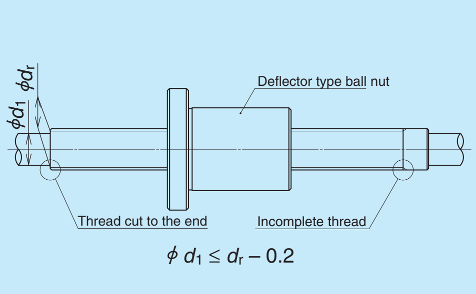


Fig. 15.1 **Shaft end of a deflector recirculation system ball screw**

B-2-15.2 Design Cautions to Assembling Ball Screw

(1) Cutting through the thread screw to the end

For some recirculation system, such as the deflector type, end cap type, S1 speficication (High-Load drive ball screws etc.) and a part of end deflector type, one end of the thread screw should be cut through to the end of the major diameter. This is necessary to assemble the ball nut to the screw shaft (**Fig. 15.1**).

In this case, the shaft end diameter, to where this "cut-through thread" is made, should be 0.2 mm or smaller than the ball groove root diameter "d_r". (See the dimension 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 perpendicularly to the bearing seat. (**Fig. 15.2**)

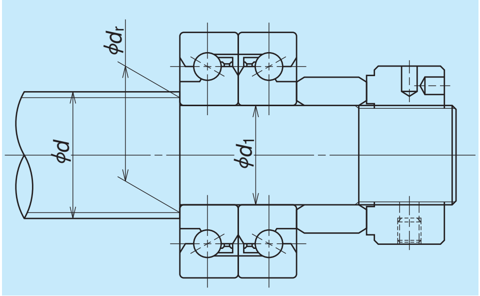


Fig. 15.2 **Support bearing and end face (shoulder) for installation**

(2) Designing the screw shaft end and the nut mounting area

When installing a ball screw to the machine, avoid a design which makes it necessary to separate the nut from the screw shaft as shown in **Fig. 15.3**. If separated, the balls may fall out. The separation may also deteriorate the ball screw accuracy, or 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.

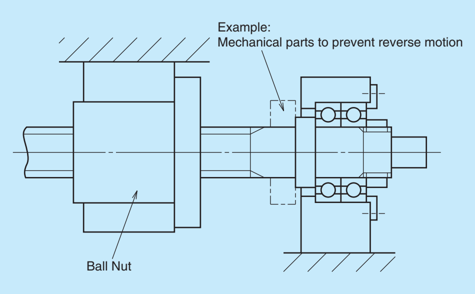


Fig. 15.3 **Nut and ball screw are required to be separated when installing in this structure.**

(3) Removing the nut from the screw shaft at the 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 mm to 0.4 mm smaller than the ball groove root diameter "d_r."

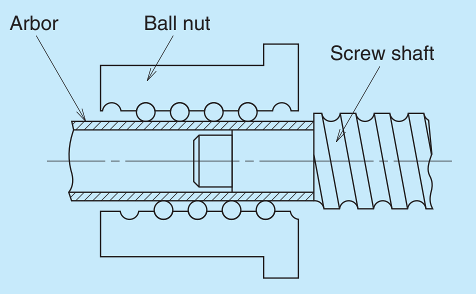


Fig. 15.4 Arbor to install and remove nut

(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.

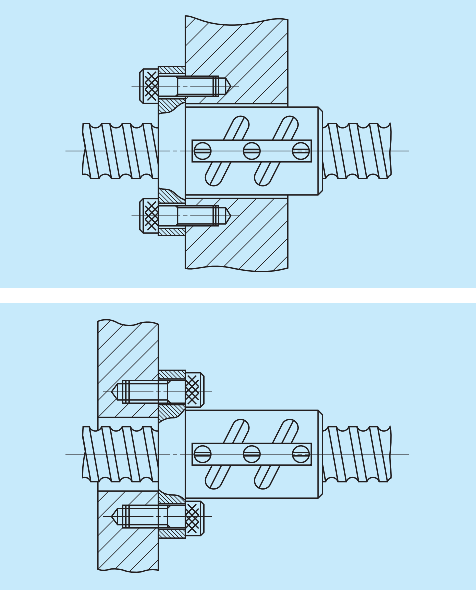


Fig. 15.5 Fixing a ball nut by flange

(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 type of R Series ball screws, apply an agent which prevents the nut from loosening.

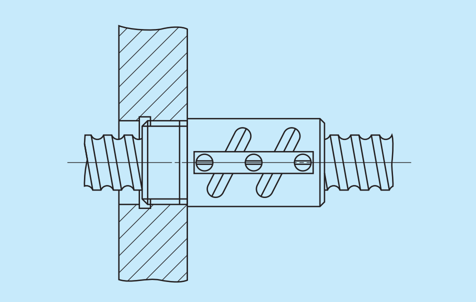


Fig. 15.6 Fixing a ball nut with thread screw

(6) Installation of brush-seal to the nut

If a brush-seal is installed at the thread screw side of the nut similar to the RNCT type which comes with a thread screw, the brush-seal should be secured as shown in **Fig. 15.7**.

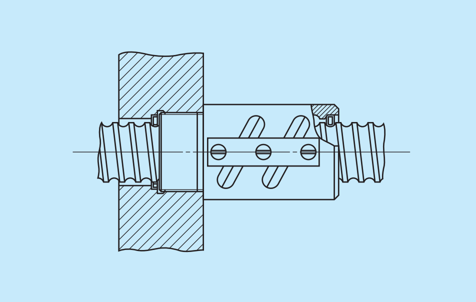


Fig. 15.7 Installation of brush-seal to a ball nut with thread screw

B-2-15.3 Effective Stroke of Ball Screw

When hardened by the induction hardening, the hardness of a ball screw may be slightly low at both ends of the screw section. Consider this low hardness prior to determining the length of effective stroke. Please consult NSK for details.

B-2-15.4 Matching after Delivery

When, after the delivery of a ball screw, you require drill knock pin hole on the screw shaft end, or at the nut mounting area, please inform NSK on the position and size of the hole.

NSK will take a measure and protect designated spots from heat treatment prior to delivery to make subsequent machining easy.

B-2-15.5 "NSK K1™" Lubrication Unit

When using the NSK K1 lubrication unit, be aware of the operating temperature and chemicals that come to contact the unit for keeping the K1's best performance.

Temperature range for use:

Maximum temperature; 50°C

Momentary maximum temperature; 80°C

Chemicals that should not come to contact:

Do not leave the K1 unit 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 the K1 unit.

B-2-16 Ball Screw Selection Exercise

Drill 1: High-speed transporting system

1. Design conditions

Table mass : $m_1 = 40$ kg
Mass of the transporting item : $m_2 = 20$ kg
Maximum stroke : $S_{\text{max}} = 700$ mm
Rapid traverse speed : $V_{\text{max}} = 1\,000$ mm/sec (60 m/min)
Positioning accuracy : ±0.05/700 mm (0.005 mm/pulse)
Repeatability : ±0.005 mm
Required life : $L_t = 25\,000$ h (5 years)
Guide way (rolling) : $\mu = 0.01$ (friction coefficient)
Drive motor : AC servo motor ($N_{\text{max}} = 3\,000$ min^{-1})

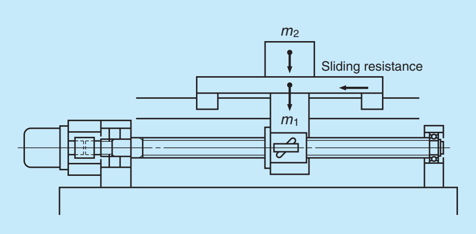


Fig. 16.1 System appearance

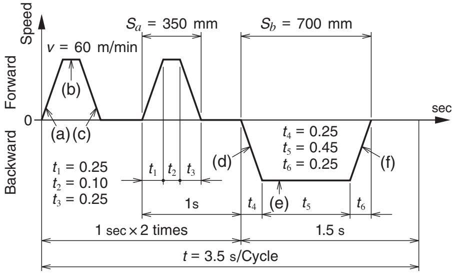


Fig. 16.2 Operating condition

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" on page B19, the accuracy grade of ball screws for Cartesian type industrial robots is C5 to Ct10.

From the following conditions in design, the axial play should be 0.005 mm or less.

Repeatability : ±0.005 (mm)
Resolution : 0.005 mm/pulse

According to **Table 4.2** "Combinations of accuracy grades and axial play" on page B20, you will require the accuracy grade C5 to satisfy the axial play of 0.005 mm or less. Therefore select the accuracy grade C5, and the axial play of 0 mm (Z-preload).

(2) Selection of lead

Calculate the lead l based on maximum speed of AC servo motor and the rapid traverse speed V$_{\text{max}}$.

$$l \geq \frac{V_{\text{max}}}{N_{\text{max}}} = \frac{1\,000 \times 60}{3\,000} = 20 \text{ (mm)}$$

Select a lead l of 20 mm or larger.

(3) Selection of screw shaft diameter

According to the **Table 4.4** "Shaft diameter, lead and stroke of standard ball screw" on page B21, the screw shaft diameter d which has a lead l larger than 20 mm should be in the range of 15 mm to 32 mm. Select the smallest 15 mm.

(4) Selection of stroke

From the **Table 4.4** "Screw shaft diameter, lead, and stroke of standard ball screw" on page B21, a ball screw with shaft diameter (d) of 15 mm and lead (l) of 20 mm meets maximum stroke of 700 mm, therefore it is possible to select from the standard ball screws. The primary selection is as follows:

Primary selection:

Shaft diameter :	15 (mm)
Lead :	20 (mm)
Stroke :	700 (mm)
Accuracy grade :	C5
Axial play :	Z

3. Confirmation of standard ball screw

In consideration of delivery time and price, select from the standard ball screws with finished shaft ends.

Primary candidate: W1507FA-3PG-C5Z20

4. Basic safety check

Let's examine the primary candidate.

(1) Allowable axial load

[1] Calculation of allowable axial load

From **Fig. 16.2**: Acceleration α_1 at accelerating / decelerating is:

$$\alpha_1 = \frac{V_{\text{max}}}{t_1} = \frac{1\,000}{0.25} = 4\,000 \text{ (mm/s}^2\text{)} = 4 \text{ (m/s}^2\text{)}$$

Axial load F_i is:

(At the time of acceleration (a)(d))

$$F_1 = \mu\,(m_1 + m_2) \times g + (m_1 + m_2) \times \alpha_1$$
$$= 0.01 \times (40 + 20) \times 9.80665 + (40 + 20) \times 4$$
$$= 246 \text{ (N)}$$

(At the time of constant speed (b)(e))

$$F_2 = \mu\,(m_1 + m_2) \times g = 0.01 \times (40 + 20) \times 9.80665$$
$$= 6 \text{ (N)}$$

(At the time of deceleration (c)(f))

$$F_3 = -\mu\,(m_1 + m_2) \times g + (m_1 + m_2) \times \alpha_1$$
$$= -0.01 \times (40 + 20) \times 9.80665 + (40 + 20) \times 4$$
$$= 234 \text{ (N)}$$

Thus, the maximum axial load P is 246 N.

[2] Buckling load

W1507FA-3PG-C5Z20 has the support length of 804 mm ("La" as per the dimension table on page B179), and must support maximum axial load (P) of 246 (N). The supporting condition of screw shaft is "Fixed – Simple", and the supporting condition of ball nut is "Fixed". Due to the direction of the load, the whole ball screw supporting condition is "Fixed – Fixed" support (Factor m = 19.9).

From fomula 2) on page B44:

$$d_r \geq \left(\frac{P \bullet L_a^2}{m} \times 10^{-4} \right)^{1/4} = \left(\frac{246 \times 804^2}{19.9} \times 10^{-4} \right)^{1/4}$$
$$= 5.3 \text{ (mm)}$$

W1507FA-3PG-C5Z20 has the dimension (dr) of 12.2 mm as per the dimension chart (page B179) and therefore meets the condition.

Result: Acceptable

(2) Allowable rotational speed

The permissible rotational speed listed in the dimension table is 3 000 min^{-1}. Since the motor maximum rotational speed is 3 000 min^{-1}, the operation is in the range of permissible rotational speed.

Result: Acceptable

(3) Checking life expectation

[1] Mean load F_m and mean rotational speed N_m

From the calculation of axial load, rotational speed N_i and the operating time t_i is:

(At the time of acceleration (a)(d))

$$F_1 = 246 \text{ (N)}$$

$$N_1 = \frac{n}{2} = \frac{3\,000}{2} = 1\,500 \text{ (min}^{-1}\text{)}$$

$$t_a = 2 \times t_1 + t_4 = 0.75 \text{ (s)}$$

(At the time of constant speed (b)(e))

$$F_2 = 6 \text{ (N)}$$
$$N_2 = 3\,000 \text{ (min}^{-1}\text{)}$$
$$t_b = 2 \times t_2 + t_5 = 0.65 \text{ (s)}$$

(At the time of deceleration (c)(f))

$$F_3 = 234 \text{ (N)}$$
$$N_3 = 1\,500 \text{ (min}^{-1}\text{)}$$
$$t_c = 2 \times t_3 + t_6 = 0.75 \text{ (s)}$$

Calculation result is shown in **Table 16.1**

Table 16.1 Axial load and rotational speed

Operating condition	Axial load (N)	Rotational speed (mean) (min^{-1})	Operating time (s)
(a) (d)	$F_1 = 246$	$N_1 = 1\,500$	$t_a = 0.75$
(b) (e)	$F_2 = 6$	$N_2 = 3\,000$	$t_b = 0.65$
(c) (f)	$F_3 = 234$	$N_3 = 1\,500$	$t_c = 0.75$

From the formulas 11) and 12) on page B53:

$$F_m = \left(\frac{F_1^3 \bullet N_1 \bullet t_a + F_2^3 \bullet N_2 \bullet t_b + F_3^3 \bullet N_3 \bullet t_c}{N_1 \bullet t_a + N_2 \bullet t_b + N_3 \bullet t_c} \right)^{1/3}$$
$$= 195 \text{ (N)}$$

$$N_m = \frac{N_1 \bullet t_a + N_2 \bullet t_b + N_3 \bullet t_c}{t}$$
$$= 1\,200 \text{ (min}^{-1}\text{)}$$

[2] Calculation of life expectancy

At the basic dynamic load rating C_a of W1507FA-3PG-C5Z20 (Clearance Z) is 3 870 N (as per the dimension table on page B179), from the formulas 8) and 9) on page B53:

$$L_t = \left(\frac{C_a}{F_m \bullet f_w}\right)^3 \times \frac{1}{60N_m} \times 10^6$$

$$= \left(\frac{3\,870}{195 \times 1.2}\right)^3 \times \frac{1}{60 \times 1\,200} \times 10^6$$

$$\fallingdotseq 62\,800$$

The ball screw satisfies the required life.

<u>Result: Acceptable</u>

5. Check for other requirements

(1) Accuracy and axial play

As per the dimension table on page B180 and **Table 1.2** for the permissible value of lead accuracy on page B38:

According to **Table 1.2**:

Accuracy grade: C5

$e_p = \pm 0.035/800$ (mm)

$\upsilon_u = 0.025$ (mm)

This grade satisfies the required positioning accuracy of ±0.05/700 mm.

The checking of axial play is omitted here since it is explained in "2. Selection of basic factors."

(2) Drive torque

Required specifications are as follows.

Motor rotational speed: 3 000 min^{-1}

Time to reach maximum speed: Less than 0.25 sec

[1] Load (converted to the motor axis)

Using the formula 32) and 33) on page B64, calculate the moment of inertia whereas γ is the material density of the ball screw.

(Screw shaft)

$$J_B = \frac{\pi \bullet \gamma}{32} D^4 \bullet L = \frac{\pi \times 7.8 \times 10^{-3}}{32} \times 1.5^4 \times 80$$

$$= 0.31\ (\text{kg} \cdot \text{cm}^2)$$

(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)

$J_c = 0.25\ (\text{kg} \cdot \text{cm}^2)$···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

We assume that WBK12-01 compact light load type is used as recommended for W1507FA-3PG-C5Z20, and the moment of inertia of motor (J_M) is 3.1 ($\text{kg} \cdot \text{cm}^2$) ($3.1 \times 10^{-4}$ $\text{kg} \cdot \text{m}^2$).

(At the time of constant speed)

The torque which is necessary to drive the ball screw at a constant speed resisting to external loads is: per formula 30) on page B64

$$T_1 = T_a + T_{pmax} + T_u$$

In this formula, T_a is the drive torque at constant speed, T_{pmax} is the upper limit of the dynamic friction torque of ball screw, and T_u is the friction torque of the support bearings.

From the chart on pages B179 and B386, (T_{pmax}) is 7.8 (N · cm) and (T_u) is 2.1 (N · cm) respectively.

$$T_a = \frac{F_a \bullet l}{2\pi\eta_1}$$

Using formula 28) on page B63, the drive torque at a constant speed T_1 is:

$$T_1 = \frac{F_a \bullet l}{2\pi \bullet \eta_1} + T_{pmax} + T_u$$

$$= \frac{6 \times 2}{2\pi \times 0.9} + 7.8 + 2.1$$

$$= 12\ (\text{N} \cdot \text{cm}) = 0.12\ (\text{N} \cdot \text{m})$$

(At the time of acceleration)

The drive torque necessary for accelerating the ball screw resisting axial load can be calculated by the formula 31) on page 64.

$$T_2 = T_1 + J \bullet \frac{2\pi \bullet n}{60t_1}$$

$$= T_1 + (J_L + J_M) \bullet \frac{2\pi \bullet n}{60t_1}$$

$$= 0.12 + (6.7 \times 10^{-4} + 3.1 \times 10^{-4}) \frac{2\pi \times 3\,000}{60 \times 0.25}$$

$$= 1.35\ (\text{N} \cdot \text{m})$$

(At the time of deceleration)

Similarly at the time of acceleration.

$$T_3 = T_1 - J \bullet \frac{2\pi \bullet n}{60t_3}$$

$$= T_1 - (J_L + J_M) \bullet \frac{2\pi \bullet n}{60t_3}$$

$$= 0.12 - (6.7 \times 10^{-4} + 3.1 \times 10^{-4}) \frac{2\pi \times 3\,000}{60 \times 0.25}$$

$$= -1.11\ (\text{N} \cdot \text{m})$$

[3] Selection of motor

Selection conditions are as follows.

Maximum rotational speed: $N_M \geq 3\,000\ (\text{min}^{-1})$

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:

$N_M = 3\,000\ (\text{min}^{-1})$

Rating torque: $T_M = 1\ (\text{N} \cdot \text{m}) = 1 \times 10^2\ (\text{N} \cdot \text{cm})$

Rotor inertia: $J_M = 3.1 \times 10^{-4}\ (\text{kg} \cdot \text{m}^2)$

$= 3.1\ (\text{kg} \cdot \text{cm}^2)$

[4] Check on effective torque

Effective torque T_{rms} can be calculated as follows:

$$T_{rms} = \sqrt{\frac{T_2^2 \times t_a + T_1^2 \times t_b + T_3^2 \times t_c}{t}}$$

$$= \sqrt{\frac{1.35^2 \times 0.75 + 0.12^2 \times 0.55 + 1.11^2 \times 0.75}{3.5}}$$

$$= 0.81$$

Thus the condition of "$T_M \geq T_{rms}$" is cleared.

[5] Check on time to reach maximum speed

The time required to reach the rapid traverse speed can be calculated as follows. Whereas $T_M' = 2 \times T_M$:

$$t_a = \frac{(J_L + J_M) \times 2\pi \times n}{(T_M' - T_1)} \times 1.4$$

$$= \frac{(6.7 \times 10^{-4} + 3.1 \times 10^{-4}) \times 2\pi \times 3\,000}{(2 \times 1 - 0.12) \times 60} \times 1.4$$

$$= 0.23$$

Thus the ball screw meets the requirement of "0.25 sec or less".

<u>From the above, use W1507FA-3PG-C5Z20</u>

Drill 2: Processing table for special machines

1. Design conditions

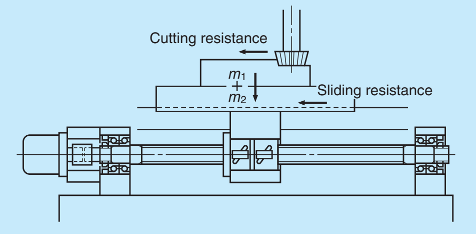


Fig. 16.3 System appearance

Table mass: m_1 = 1 000 kg
Mass of the work: m_2 = 600 kg
Maximum stroke: S_{max} = 1 000 mm
Maximum speed: V_{max} = 15 000 mm/min
Positioning accuracy: ±0.035/1 000 mm (no load)

∗ Attitude accuracy of the table and thermal displacement are not included in the accuracy requirement of the ball screw.

Repeatability: ±0.005 mm (no load)
Lost motion: 0.020 mm (no load)
Required life expectancy: L_t = 20 000 h
(16 $^{\text{h}}$ × 250 $^{\text{days}}$ × 10 $^{\text{years}}$ × 0.5 $^{\text{rate of operation}}$)
Guide way (sliding): μ = 0.15
(friction coefficient)
Processing: Milling and drilling
Drive motor: AC servo motor
(N_{max} = 2 000 min^{-1})

Table 16.2 Operating conditions

Operation	Axial load (N)		Feed speed (mm/min)	Use time ratio (%)
	Cutting resistance	Sliding resistance		
Rapid traverse	0	2 354	15 000	30
Light/medium cutting	4 000	2 354	500	50
Heavy cutting	8 000	2 354	100	20

∗ Sliding resistance: $F_r = \mu\,(m_1 + m_2)\,g = 0.15 \times (1\,000 + 600) \times 9.80665 = 2\,354$ (N)

∗ Ignore the inertia force at the time of acceleration/deceleration because their time rate is negligibly short.

2. Selection of basic factors

(1) Selection of accuracy grade and axial play

The proper accuracy grade for machining centers should be in the range from C1 to C5 according to "**Table 4.1** Accuracy grades of ball screws and their applications" on page B19. Assuming the nut length is 200 mm and margin stroke is 100 mm, the shaft length L_0 is obtained as follows:

L_0 = Maximum stroke + nut length + margin
= 1 000 = (200) + (100) = 1 300

From "**Table 1.2** Tolerance on specified travel and travel variation of the positioning ball screws" on page B38, the accuracy factors which satisfy the required function are:

Accuracy C3 grade
e_p = ±0.029/1 600 (mm)
υ_u = 0.018 (mm)

Considering the importance of lost motion, select the Z code (axial play 0 mm and less) for the axial play.

(2) Selection of lead

From the maximum rotational speed of AC servo motor N_{max} and rapid traverse speed of table V_{max} , lead l is :

$$l \geq \frac{V_{\text{max}}}{N_{\text{max}}} = \frac{15\,000}{2\,000} = 7.5 \text{ (mm)}$$

A larger lead l would be beneficial for a higher feed speed. But from the view of the control system (resolution), the lead l is limited to 8 mm or 10 mm.

(3) Selection of screw shaft diameter

According to **Table 4.4** "Screw shaft diameter, lead and stroke of standard ball screw" on page B21, the screw shaft diameter with the lead of 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 1 000 mm, the maximum stroke as specified in the design condition.

Primary selection:
Standard ball screw
Shaft diameter: 32, 36, 40, 45, 50 mm
Lead: 8, 10 mm
Stroke: 1 000 mm
grade: C3
Axial play code: Z

3. Confirmation of standard ball screw

Giving consideration to delivery time and price, select a standard ball screw.
At the primary selection of C3 grade is not found in the standard ball screws. Let us check for application-oriented ball screws whether there is a C3 grade among ball screw.

4. Confirmation of made-to-order ball screw

Because standard ball screws do not meet the accuracy grade requirement, we will consider made-to-order ball screws which are based on standard ball screws but with accuracy grade of C3.

Second selection:
Made-to-order ball screw
Shaft diameter : 32, 36, 40, 45, 50 mm
Lead : 8, 10 mm
Stroke : 1 000 mm
Accuracy grade : C3
Axial play : Z

5. Selection of screw shaft diameter, lead, and nut

(1) Dynamic load rating

Obtain required load carrying capacity for each lead through load conditions. From **Table 16.2** "Operating conditions" on page B91, calculate the rotation speed N_i as shown in **Table 16.3**.

$$N_i \geq \frac{V_i}{l}$$

Table 16.3 Load conditions

Operating condition	Axial load (N)	Rotations per minute (min^{-1})		Use time ratio (%)
		$l = 8$	$l = 10$	
Rapid traverse	$F_1 = 2\,354$	$N_1 = 1\,875$	$N_1 = 1\,500$	$t_1 = 30$
Light/medium cutting	$F_2 = 6\,354$	$N_2 = 62.5$	$N_2 = 50$	$t_2 = 50$
Heavy cutting	$F_3 = 10\,354$	$N_3 = 12.5$	$N_3 = 10$	$t_3 = 20$

By using the formulas 11) and 12) on page B53, calculate the mean load F_m and the mean rotational speed N_m as shown below.

$$F_m = \left(\frac{F_1^3 \bullet N_1 \bullet t_1 + F_2^3 \bullet N_2 \bullet t_2 + F_3^3 \bullet N_3 \bullet t_3}{N_1 \bullet t_1 + N_2 \bullet t_2 + N_3 \bullet t_3} \right)^{1/3}$$

$$N_m = \frac{N_1 \bullet t_a + N_2 \bullet t_b + N_3 \bullet t_c}{t}$$

Table 16.4 Mean load and mean rotational speed

Lead (mm)	8	10
Mean load F_m (N)	3 122	3 122
Mean rotational speed N_m (min^{-1})	596	477

Required dynamic load rating C_a is:

Using the formulas 8) and 9) on page B53, calculate the required dynamic load rating.

$$C_a \geq (60 N_m \bullet L_t)^{1/3} \bullet F_m \bullet f_w \times 10^{-2}\ (N)$$

Whereas required life expectancy L_1 = 20 000 (h), load coefficient f_w = 1.2 (refer to page B53),

l = 8 (mm)············$C_a \geq$ 33 500 (N)

l = 10 (mm)··········$C_a \geq$ 31 100 (N)

(2) Selection of the nut

Due to the requirement on the lost motion, the nut will be selected as follows emphasizing the importance of system rigidity.

Table 16.5 shows the dynamic load rating of each specification.

- Standard nut ball screw, tube type
- Model: ZFT or DFT (pages B417 to B436)
- 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 *Ca*: (N)			
	Lead 8 mm		Lead 10 mm	
	2.5 turns 2 circuits	2.5 turns 3 circuits	2.5 turns 2 circuits	2.5 turns 3 circuits
32	31 700	–	46 300	–
36	–	–	49 300	–
40	34 900	–	52 000	–
45	–	–	54 200	76 800
50	38 700	54 900	57 700	81 800

(3) Permissible rotational speed

[1] Critical speed

Check if the rapid traverse speed of 15 000 mm/min (V_{max}) clears the critical speed. Ball screw rotational speed at each lead N is:

l = 8 (mm)·······N = 1 875 (min^{-1})

l = 10 (mm)·····N = 1 500 (min^{-1})

From the formula 7) on page B47, screw shaft root diameter to meet critical speed requirement is:

$$d_r \geq \frac{n \bullet L_2}{f} \times 10^{-7}\ (\text{mm})$$

In this formula, unsupported length L_a is:

L_a = Maximum stroke + nut length/2 + shaft end extra length

= 1 000 + 100 + 200 = 1 300 (mm)

Supporting condition of the screw shaft is Fixed - Fixed support, and that of the ball nut is Fixed. Therefore, supporting condition is Fixed - Fixed support (Factor f = 21.9)

l = 8 (mm)······$d_r \geq$ 14.5 (mm)

l = 10 (mm)····$d_r \geq$ 11.6 (mm)

[2] $d \bullet n$ value

From **Table 3.2** on page B50, as the d·n is 70 000 or less, screw shaft diameters to meet the d·n are:

$$d \leq \frac{70\ 000}{N}\ (\text{mm})$$

l = 8 (mm)············$d \leq$ 37.3 (mm)

l = 10 (mm)··········$d \leq$ 46.7 (mm)

Based on nut specifications (pages B417 to B436) select an item that meets screw shaft root diameter (d_r) and screw shaft diameter (d).

＊Please consult NSK if the d • n value is necessary to exceed 70 000.

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 bearings) at 80% of the specified value. Then calculate the system rigidity. The criterion lost motion is:

20 (μm) × 0.8 = 16 (μm)

At this time, the one-way elastic deformation $\varDelta L$ of the major factors of ball screw system shall be less than the half of above criterion.

$$\varDelta L \leq 8\ (\mu\text{m})$$

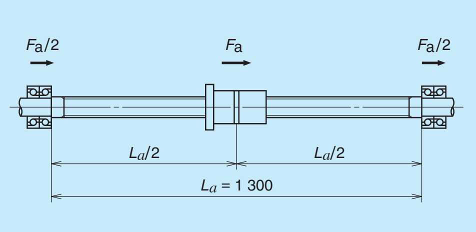


Fig. 16.3 Unsupported length

[1] Rigidity of the screw shaft K_S

Calculate the rigidity at the center of screw shaft where the axial deformation becomes the largest. Because the supporting condition of screw shaft is Fixed - Fixed support, the rigidity as per the formula 21) on page B58:

$$K_s = \frac{\pi \bullet d_r^2 \bullet E}{L_a} \times 10^{-3}\ (\text{N/mm})$$

At here E is the elastic modulus. From the formula 17) on page B57, the elastic deformation of the screw shaft $\varDelta L_S$ is:

$$\varDelta L_s = \frac{F_a}{K_s} = \frac{F_a \bullet L_a}{\pi \bullet d_r^2 \bullet E} \times 10^3\ (\mu\text{m})$$

The sliding resistance F_a is:

F_a = μ (m_1 + m_2) = 0.15 × (1 000 + 600)

= 2 354 (N)

Table 16.7 shows the rigidity of screw shaft K_S and the elastic deformation $\varDelta L_S$.

[2] Rigidity of the ball nut K_N

Set about 1/3 of the maximum axial load as the preload value F_{a0}.

$$F_{a0} = \frac{F_{max}}{3} = \frac{10\ 354}{3} = 3\ 452 \rightarrow 3\ 500\ (\text{N})$$

From the formula 23) on page B60, the rigidity of the ball nut K_N is:

$$K_N = 0.8 \times K \left(\frac{F_{a0}}{\varepsilon \bullet C_a}\right)^{1/3} = 0.8 \times K \left(\frac{3\ 500}{0.1 \bullet C_a}\right)^{1/3}\ (\text{N/}\mu\text{m})$$

K : Theoretical rigidity

From the formula 17) on page B58, elastic deformation of the ball nut $\varDelta L_N$ is:

$$\varDelta L_N = \frac{F_a}{K_N} = \frac{2\ 354}{K_N}$$

Table 16.7 shows the rigidity of ball nut K_N and the elastic deformation $\varDelta L_N$.

[3] Rigidity of the support bearing K_B

The bearings are thrust angular contact ball bearings for ball screw support (TAC Series). We specify the model number of support bearing unit for each shaft diameter as shown in **Table 16.6** (refer to page B399).

Table 16.6 Bearing code

Screw shaft diameter (mm)	Bearing code
32	25TAC62BDF
36	25TAC62BDF
40	30TAC62BDF
45	35TAC72BDF

Refer to page B403 for the rigidity K_B of each bearing unit (axial spring modulus). Elastic deformation of bearing $\varDelta L_B$ is:

$$\varDelta L_B = \frac{F_a}{2K_B}$$

Table 16.7 shows the rigidity of support bearing K_B and the elastic deformation $\varDelta L_B$.

Table 16.7 Rigidity and elestic deformation

Nut model number	Screw shaft		Nut		Support bearing		Total
	K_S	$\varDelta L_S$	K_N	$\varDelta L_N$	K_B	$\varDelta L_B$	$\varDelta L$
DFT3210-5	347	6.8	839	2.8	1 000	1.2	10.8
DFT3610-5	460	5.1	907	2.6			8.9
DFT4010-5	589	4.0	973	2.4	1 030	1.1	7.5
DFT4510-5	772	3.0	1 050	2.2	1 180	1.0	6.2
DFT4510-7.5			1 375	1.7			5.7

Choose the most economical ball screw system which meets the requirement of one-way deformation ($\varDelta L$) of 8 μm or less.

The selected ball screw:

Nut model number:	DFT4010-5
Shaft diameter:	40 (mm)
Lead:	10 (mm)
Dynamic load rating:	52 000 (N)

6. Decision of screw shaft length

DFT4010 ball nut has the length of 193 mm, and thus the unsupported length of screw shaft L_a should be:

L_a = Maximum stroke + nut length + margin

= 1 000 + 193 + 100 = 1 293 → 1 300 mm

7. Checking basic safety

(1) Permissible axial load

Calculate the buckling load for conditions shown in **Fig. 16.4** with P of 10 354 (N) and L_1 of 1 210 (mm).

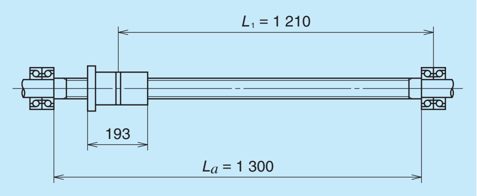


Fig. 16.4 Examination of bucking load

Supporting condition is Fixed - Fixed support, and from the calculation formula 2) on page B44, the screw shaft diameter d_r to prevent buckling is

$$d_r \geq \left(\frac{P \bullet L_1^2}{m} \times 10^{-4} \right)^{1/4}$$

$$= \left(\frac{10\ 354 \times 1210^2}{19.9} \times 10^{-4} \right)^{1/4} = 16.6\ (\text{mm})$$

From the specification of DFT4010-5 ball nut (page B435), the root diameter of screw shaft d_r is 34.4 mm and thus meets the above condition.

Result: Acceptable

(2) Permissible rotational speed

[1] Critical speed *n*

From the critical speed calculation formula 7) on page B47:

$$n = f \bullet \frac{d_r}{L_1^2} \times 10^7 = 21.9 \times \frac{34.4}{1\ 210^2} \times 10^7$$

$$\fallingdotseq 5\ 140$$

The maximum rotational speed (N_{max}) of 1 500 min^{-1} is less than the critical speed, and thus meets the requirement.

Result: Acceptable

[2] *d* • *n* value

The *d* • *n* value is:

$$d \bullet n = 40 \times 1\ 500 = 60\ 000$$

From **Table 3.2** on page B50, the d·n of tube type ball nut is 70 000 or less, and meets the requirement.

Result: Acceptable

(3) Life L_t

The dynamic load rating C_a is 52 000 N (see dimension table on page B435), and from the formulas 8) and 9) on page B53 the life expectancy is:

$$L_t = \left(\frac{C_a}{f_w \bullet F_m} \right)^3 \times 10^6 \times \frac{1}{60 \bullet N_m}$$

$$\fallingdotseq 95\ 000$$

The above result satisfies the required life of 20 000 (h).

Result: Acceptable

8. Check whether the following factors satisfy requirements

(1) Checking accuracy

[1] Positioning accuracy

The positioning accuracy of ±0.035/1 000 mm, and therefore, from **Table 1.2** "Tolerance of specified travel and travel variation" on page B38 the positioning accuracy is:

Accuracy grade : C3

$e_p = \pm 0.029/1\ 600$ (mm)

$\upsilon_u = 0.018$ (mm)

and thus meets the 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 bearings. Also, adjust the travel compensation for the specified travel equivalent to 3°C temperature rise (refer to page B40).

(a) Thermal elongation : $\varDelta L_\theta$

From the formula 1) on page B40:

$$\varDelta L_\theta = \rho \bullet \theta \bullet L_a = 12.0 \times 10^{-6} \times 3 \times 1\ 300$$

$$= 0.047\ (\text{mm})$$

(b) Pre-tension force : F_θ

$$F_\theta = \varDelta L_\theta \bullet Ks = \frac{\varDelta L_\theta \bullet E \bullet \pi \bullet d_r^2}{4 L_a}$$

$$= \frac{0.047 \times 2.06 \times 10^5 \times \pi \times 34.4^2}{4 \times 1\ 300}$$

$$\fallingdotseq 6\ 922 \rightarrow 6\ 900\ (\text{N})$$

Travel compensation :	–0.047/1 300 (mm)
Pre-tension force :	6 900 (N)
Tension (elongation) volume :	0.047 (mm)

[3] Selection of support bearing

Assuming that the ratio of basic dynamic load rating of support bearing (C_a) and pre-tension force (F_θ) is ε, select a bearing which generally satisfies the following:

$$\varepsilon = F_\theta / C_B < 0.20$$

Design the bearing supporting configuration to which pre-tension force is applied in such way that the axial load is supported by the duplex combination or a more multiple condition. Please consult 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)	ε
30TAC62BDF	29 200	0.23
30TAC62BDFD	47 500	0.14

Selected support bearing: 30TAC62BDFD

(2) Checking drive torque of motor

‹Required specifications›

- Motor rotational speed: 1 500 min^{-1}
- Time to reach maximum speed: 0.16 sec or less (At the time of rapid traverse)

[1] Load (converted to the motor load)

Calculate the moment of inertia of ball screw. From the formulas 32) and 33) on page B64, moment of inertia of ball screw parts J are calculated the load as follows, whereas γ is material density and ball screw shaft length L_o is 1 550 mm.

(Screw shaft)

$$J_B = \frac{\pi \bullet \gamma}{32} D^4 \bullet L_o = \frac{\pi \times 7.8 \times 10^{-3}}{32} \times 4^4 \times 155$$

$$= 30\ (\text{kg} \cdot \text{cm}^2)$$

(Moving part)

$$J_w = m \times \left(\frac{l}{2\pi} \right)^2 = 1\ 600 \times \left(\frac{1}{2\pi} \right)^2$$

$$= 40\ (\text{kg} \cdot \text{cm}^2)$$

(Coupling)

$$J_c = 10\ (\text{kg} \cdot \text{cm}^2) \cdots \text{assumed}$$

(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

The required torque to drive a ball screw resisting to external loads T_1 can be obtained by the formula 30) on page 63:

$$T_1 = T_A + T_P + T_U$$

In this formula, T_A is drive torque at constant speed, T_P is dynamic friction torque, and, T_U is friction torque of the support bearings. From the formula 26) on page B62 and the formula 27) on page B63, T_A and T_P are:

$$T_A = \frac{Fa \bullet l}{2\pi \eta_1}$$

$$T_P = 0.014 F_{a0} \sqrt{\text{d}_m \bullet l}$$

$$\eta_1 = 0.9$$

Refer to the starting torque value in **Table 3** on page B403:

T_U is:

$$T_U = 33 + 33 = 66\ (\text{N} \cdot \text{cm})$$

So, the required drive torque during rapid traverse T_{11} and heavy cutting T_{13} are:

(At the time of rapid traverse)

$$T_{11} = T_{A1} + T_{P1} + T_{U1}$$

$$= \frac{2\ 354 \times 1}{2\pi \times 0.9} + 0.014 \times 3\ 500 \sqrt{4.1 \times 1} + 66$$

$$= 580\ (\text{N} \cdot \text{cm}) \rightarrow 580 \times 10^{-2}\ (\text{N} \cdot \text{m})$$

(At the time of heavy cutting)

$$T_{12} = T_{A2} + T_{P2} + T_{U2}$$

$$= \frac{10\ 354 \times 1}{2\pi \times 0.9} + 0.014 \times 3\ 500 \sqrt{4.1 \times 1} + 66$$

$$= 1\ 995\ (\text{N} \cdot \text{cm}) \rightarrow 1\ 995 \times 10^{-2}\ (\text{N} \cdot \text{m})$$

[3] Selection of the motor

‹Selection conditions›

Maximum rotational speed: $N_M \geq 1\ 500\ (\text{min}^{-1})$

Motor rating torque: $T_M > T_1$ (N · m)

Motor's rotor inertia: $J_M > J_L / 3$ (kg · m²)

Based on the above, select AC servo motor as follows.

Motor specifications

Rating power output: $W_M = 1.8$ (kW)

Maximum rotational speed:

$N_M = 1\,500$ (min^{-1})

Rating torque: $T_M = 22.5$ (N · m)

$= 22.5 \times 10^2$ (N · cm)

Rotor inertia: $J_M = 190 \times 10^{-4}$ (kg · m^2)

$= 190$ (kg · cm^2)

[4] Checking the time to reach maximum speed:
Required time to reach rapid traverse speed can be calculated as follows (whereas $T_M' = 2 \times T_M$):

$$t_a = \frac{(J_L + J_M) \times 2\pi \times N}{(T_M' - T_1) \times 60} \times 1.4$$

$$= \frac{(80 \times 10^{-4} + 190 \times 10^{-4}) \times 2\pi \times 1\,500}{(2 \times 22.5 - 580 \times 10^{-2}) \times 60} \times 1.4$$

$$= 0.15 \text{ (sec)}$$

Thus the time meets the requirement 0.16 sec or less.

Drill 3: Cartesian type robot Z axis (vertical axis)

1. Design conditions

Mass of the traveling item : $m = 300$ kg

Maximum travel : $S_{max} = 1\,500$ mm

Rapid traverse speed : $V_{max} = 10\,000$ mm/min

Repeatability : 0.3 mm

Required life : $L_t = 24\,000$ h

($16^{\text{ hours}} \times 300^{\text{ days}} \times 5^{\text{ years}}$)

Screw shaft supporting condition :

Fixed -- Simple support

Nut: Flanged single nut

Guide way (rolling) : $\mu = 0.01$ (friction coefficient)

Drive motor : AC servo motor ($N_{max} = 1\,000\ \text{min}^{-1}$)

Environment : Slightly dusty

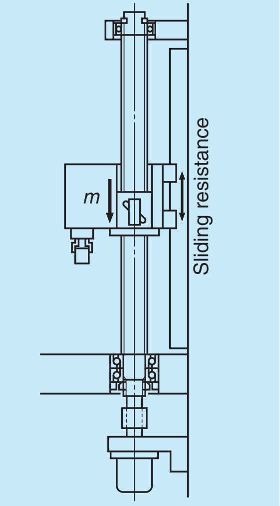


Fig. 16.5 System appearance

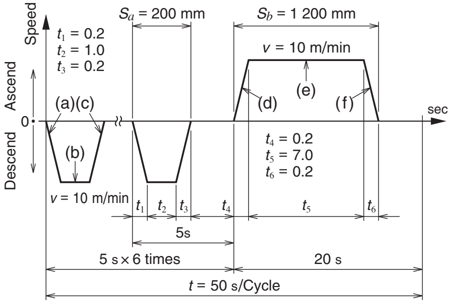


Fig. 16.6 Operating condition

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, the possibility is to use a 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:

$$l \geq \frac{V_{max}}{N_{max}} = \frac{10\,000}{1\,000} = 10 \text{ (mm)}$$

Select a lead 10 mm or over.

(3) Selection of screw shaft diameter

According to the **Table 4.6** "Shaft diameter, lead and standard screw length of R Series" on page B23, the shaft diameters whose lead is 10 mm or over are in the range of 12 mm to 50 mm.

(4) Selection of stroke

From the **Table 4.6** "Screw shaft diameter, lead and standard screw shaft length of R series" on page B23, it is possible to select from R series because the diameter d of 15 mm to 50 mm and lead l of 10 mm will meet the required maximum stroke of 1500 mm.

Primary selection : R Series ball screw for transfer equipment

Screw shaft diameter : 15 – 50 (mm)

Lead : 10 (mm)

Stroke : 1 500 (mm)

3. Confirmation of standard ball screw

Select from a flanged single nuts of R Series ball screws 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 : 1 500 (mm)

4. Decision of screw length

Screw length L_o is:

L_o = Stroke + nut length + margin + shaft end length

= 1 500 + 100 + 100 + 200 = 1 900 (mm)

Normally, the overall screw shaft length L_o less than or equal to 70 times of screw shaft diameter d is recommended.

Therefore, screw shaft diameter d is:

$$d \geq \frac{L_s}{70} = \frac{1\,900}{70} = 27.1 \text{ (mm)}$$

Third selection : R Series ball screw for transfer equipment

Shaft diameter: 32, 36, 40, 45, 50 (mm)

Lead: 10 (mm)

Stroke: 1 500 (mm)

5. Checking basic safety

(1) Allowable axial load

[1] Calculation of allowable axial load

Accelerating/decelerating time is:

$$\alpha = \frac{V}{60\,t} = \frac{10 \times 10^3}{60 \times 0.2} = 833 \text{ (mm/s}^2\text{)}$$

$$= 0.833 \text{ (m/s}^2\text{)}$$

$$t = t_1 = t_3 = t_4 = t_6$$

(a), (f) $\cdots\cdots F_1 = mg - m\alpha$

$= 300 \times 9.80665 - 300 \times 0.833$

$= 2\,690$ (N)

(b), (e) $\cdots\cdots F_2 = mg = 2\,940$ (N)

(c), (d) $\cdots\cdots F_3 = mg + m\alpha = 3\,190$ (N)

[2] Buckling load

For condition in **Fig. 16.7**, use values below.

$P = 3\,190$ N, $L_1 = 1\,600$ mm

Bearing supporting condition is common Fixed -- Simple support.

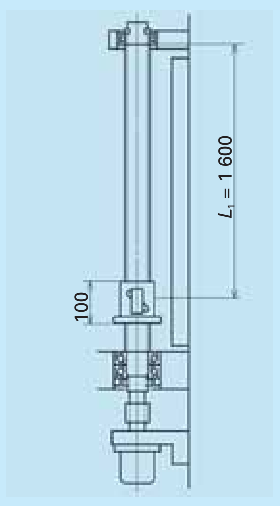


Fig. 16.7 Checking the buckling load

From the formula 2) on page B44:

$$d_r \geq \left(\frac{P \bullet L_1^{\,2}}{m} \times 10^{-4} \right)^{1/4}$$

$$= \left(\frac{3\,190 \times 1\,600^2}{10.0} \times 10^{-4} \right)^{1/4} = 16.8 \text{ (mm)}$$

(2) Checking permissible rotational speed

[1] Critical speed

Use values below.

$n = 1\,000$ (min^{-1}), $L_1 = 1\,600$ (mm)

From the formula 7) on page B47:

$$d_r \geq \frac{n \bullet L_1^{\,2}}{f} \times 10^{-7} = \frac{1\,000 \times 1\,600^2}{15.1} \times 10^{-7}$$

$$= 17 \text{ (mm)}$$

[2] $d \bullet n$ value

From **Table 3.2** on page B50:

$$d \leq \frac{50\,000}{n} = \frac{50\,000}{1\,000}$$

$$= 50 \text{ (mm)}$$

＊ Please consult NSK when the d • n value exceeds 50 000.

(3) Checking life (dynamic load rating)

Determine the 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^{-1})	Use time (s)
(a)$_{\times 6}$(f)	F_1 = 2 690	N_1 = 500	t_a = 1.4
(b)$_{\times 6}$(e)	F_2 = 2 940	N_2 = 1 000	t_b = 13.0
(c)$_{\times 6}$(d)	F_3 = 3 190	N_3 = 500	t_c = 1.4

Calculate mean load F_m and mean rotational speed N_m from the formulas 11) and 12) on page B53:

Required load carrying capacity is:

$$F_m = \left(\frac{F_1^{\,3} \bullet N_1 \bullet t_a + F_2^{\,3} \bullet N_2 \bullet t_b + F_3^{\,3} \bullet N_3 \bullet t_c}{N_1 \bullet t_a + N_2 \bullet t_b + N_3 \bullet t_c} \right)^{1/3}$$

$$= \quad 2\,940 \text{ (N)}$$

$$N_m = \frac{N_1 \bullet t_a + N_2 \bullet t_b + N_3 \bullet t_c}{t}$$

$$= 288 \text{ (min}^{-1}\text{)}$$

From the formulas 8) and 9) on page B53:

$$C_a \geq (60 N_m \bullet L_t)^{1/3} \bullet F_m \bullet f_w \times 10^{-2} \; (N)$$

$$= (60 \times 288 \times 24\,000)^{1/3} \times 2\,940 \times 1.2 \times 10^{-2}$$

$$= 26\,300 \text{ (N)}$$

(4) Checking static load rating

$$C_{0a} = F_{max} \times f_s = 3\,190 \times 2$$

$$= 6\,380 \text{ (N)}$$

In consideration of expense, select a ball screw shaft as follows.

Fourth selection : R 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 : 2 000 (mm)

Basic dynamic load rating : 35 700 (N)

6. Selection of nut

Select a "standard nut with a flange and a built-in brush seals" based 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
No.21	Dec. 2007	V1 Series of Ball Screws for Contaminated Environments HTF-SRC Series of Ball Screws for High-Speed and High-Load Applications
No.22	Mar. 2011	Technological Trends of Ball Screws for Industrial Machinery BSL Series of Ball Screws for Small Lathes HTF-SRD Series of Long-Lead Ball Screws for High-Speed and Heavy-Load Applications

B-2-18 Guide to Technical Services

(1) CAD data

■Web page

http://www.jp.nsk.com/app01/en/ctrg/

■CD-ROM

CAT. No. 7110

(3D data: Intermediate format or native,
2D date: DXF)

Catalog No.7110 (CD-ROM) contains precision machine components and rolling bearings.

Standard Ball Screws
- •Finished shaft end (Compact FA series, MA type, FA type, SA type, KA type, and RMA type)
- •Blank shaft end (MS type, FS type, and SS type)

Standard nut ball screws
- • End deflector type

Standard support units

(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) Do not apply any lubrication if grease is already applied to the ball screws. Remove dust or swarf if they stuck to the greased surface during handling. Wipe the surface with clean white kerosene, and then apply the same type of new lubricant before use. Avoid using different types of grease at the same time.

Consult NSK for special oil lubricant if it is required to your application.

(3) Check the grease after two to three months of operation. Wipe off the old grease if it is excessively contaminated, and apply sufficient volume of a fresh coat of grease. After the initial check, check and replenish the grease approximately every year. Check more often if environment requires.

Note: Refer to pages B67 and D13 for lubrication.

Do not disassemble

Do not reassemble

Watch out for falling objects

Handle with care

Do not apply shock

Handling

(1) Never disassemble the ball screw. It invites dust to enter, and lowers precision, or may cause an accident.

(2) Once the ball screw is disassembled for some reason, the user should never reassemble the ball screw by himself. Loss of ball screw function is apt to occur if a mistake is made. Please send the ball screw to NSK for repair or re-assembly. It will be reworked at the minimum service charge.

(3) The ball screw shaft or nut may fall off 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 their function might be lost. Make certain to return such item to NSK for check. There will be the minimum charge for this service.

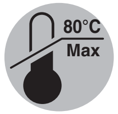
(4) If the recirculation component, the shaft outside, or the ball groove is scratched or damaged by impact, recirculation operation becomes deficient, and may cause a loss of function.

Note: Refer to page B73 for assembling components.

Prevent dust

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 catalog 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)

Note: Please read page B80 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

B-3-1 Dimension Table and Reference Number of Standard Ball Screws

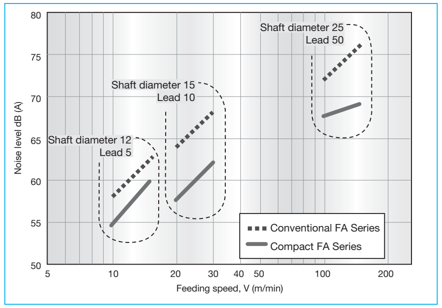
B-3- 1.1 Compact FA Series PSS Type, USS Type, and FSS Type

1. 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 inventories 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, food and medical equipment, and automotive manufacturing equipment.

●Quieter sound

The operating noise level of ball screws has been reduced by 6 dB, about half of what is sensed by the ear.



(Microphone was positioned at a distance of 400 mm for all noise levels)

Fig. 1 Comparison of noise level

●Compact

The outside diameter of the ball nut is as much as 30% smaller than those of existing NSK products. This contributes to more compact design of all sorts of equipment and devices such as low-profile positioning stages.

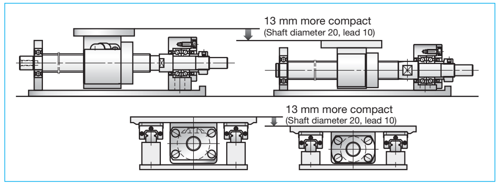


Fig. 2 Comparison of FA Type and Compact FA Series PSS Type

●High speed

The permissible rotational speed up to 5 000 min^{-1}. This capability dramatically expands the range of service conditions.

Please refer to the dimension tables for details of the permissible rotational speed.

●A grease fitting is provided as a standard equipment

The new ball screw type is equipped with a grease fitting (M5 × 0.8) as a standard equipment. Two lubrication ports are provided to facilitate easy maintenance.

●Storage seal

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 Series are available for a superb space-saving design.

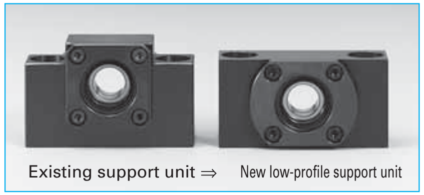


Fig. 3 Comparison of support units

●Low dust generation LG2 grease (USS Type)

The dust count is approximately 1/100 that of the existing FA series. It is suitable for applications in clean environments.

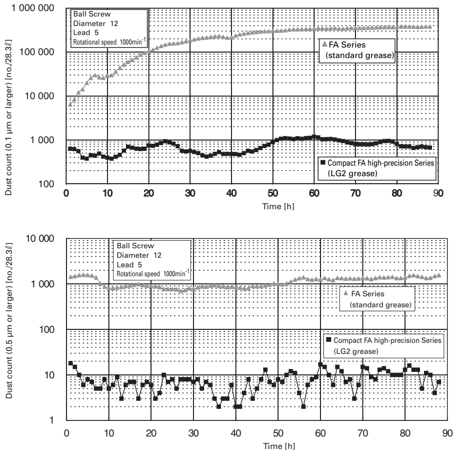


Fig.4 Comparison of dust count

●Easy stroke setting (FSS Type)

Flexible stroke setting with fixed-simple support by means of mounting support unit (simple support side) directly onto ball screw thread outside diameter. Proprietary support unit (simple support side) is available from NSK.

2. Order of the dimension table

For each type, it is arranged in order from small diameter to large.

3. 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_1).

●Lead accuracy

PSS Type, C5 grade; USS Type, C3 grade; FSS Type, Ct7 grade

T : Travel compensation

e_p : Tolerance on specified travel

υ_u : Travel variation

See "Technical Description: Lead Accuracy" (page B37) for the details of the codes.

Fig.5 Flexible stroke setting

●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, the d·n and critical speed, will determine the overall permissible rotational speed of the ball screw. For details, see "Technical Description: Permissible Rotational Speed" (page B47).

4. Other

The seal of the ball screw and end deflector are made of synthetic resin. Consult NSK when using our ball screws under extreme environments or in special environments, or if using special lubricant or oil.

The NSK K1 cannot be mounted to the compact FA Series.

For special environments, see pages B70 and D2. For lubrications, see pages B67 and D13.

Note: For details of standard stock products, contact NSK.

Table 1 Combinations of screw shaft diameter and lead

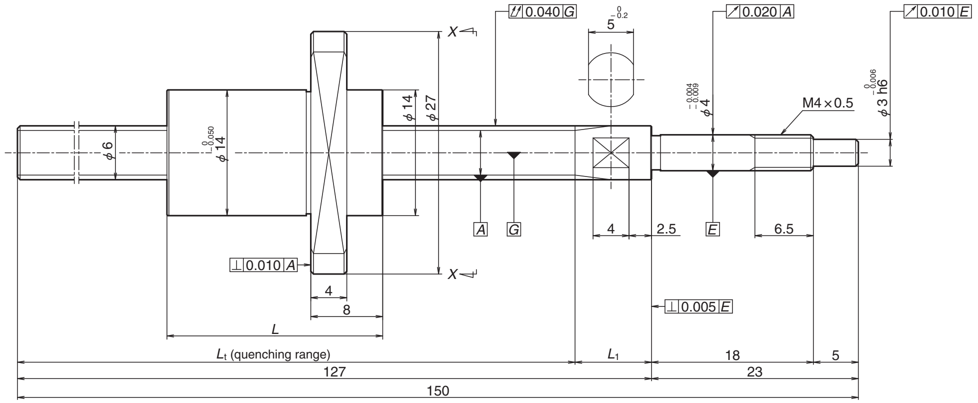
Lead Screw shaft diameter	5	8	10	12	15	20	25	30	40	50	60
6		B105		B105							
8			B107		B107						
10	B109 B129		B109								
12	B111 B131		B111 B135			B111		B111			
15	B113 B133		B113 B137			B115 B137		B115			
20	B117		B117 B139			B119 B139		B119	B121		B121
25	B123		B123 B141			B125 B141	B125 B141	B127		B127	

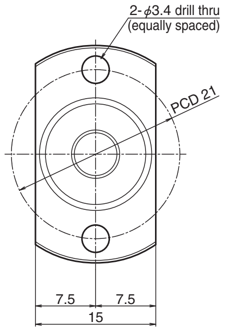
Compact FA PSS Type

Screw shaft ø6

Lead 8, 12

Unit: mm





Cross-section *X-X*

Ball screw specification	
Ball diameter/screw shaft root diameter	1.2 / 4.9
Ball circle dia.	6.2
Accuracy grade/axial play	C5 / 0.005 or less
Factory-packed grease	NSK grease PS2

Recommended

For drive side (Fixed)
WBK04-01M (square)
WBK04-11M (round)

Unit: mm

Ball screw No.	Screw shaft diameter	Lead	Effective turns of balls	Basic load ratings (N)		Maximum stroke	Nut length	Screw shaft dimensions		Lead accuracy			Dynamic preload torque	Mass	Permissible rotational speed	Internal spatial volume of nut	Standard volume of grease replenishing
				Dynamic	Static					Target value	Error	Variation					
	d	*l*		C_a	C_{0a}		*L*	L_t	L_1	*T*	e_p	υ_u	(N·cm)	(kg)	(min^{-1}) *1	(cm^3)	(cm^3)
PSS0608NAD0150	6	8	2	550	715	97.5	16	118.5	8.5	0	20	18	~0.5	0.06	5 000	0.2	0.1
PSS0608NBD0150			4	1 180	1 760	89.5	24	118.5	8.5					0.06		0.3	0.2
PSS0612NAD0150		12	2	550	715	92	20	117	10					0.06		0.2	0.1
PSS0612NBD0150			4	1 180	1 760	80	32	117	10					0.07		0.3	0.2

Notes: 1. Contact NSK if permissible rotational speed is to be exceeded.

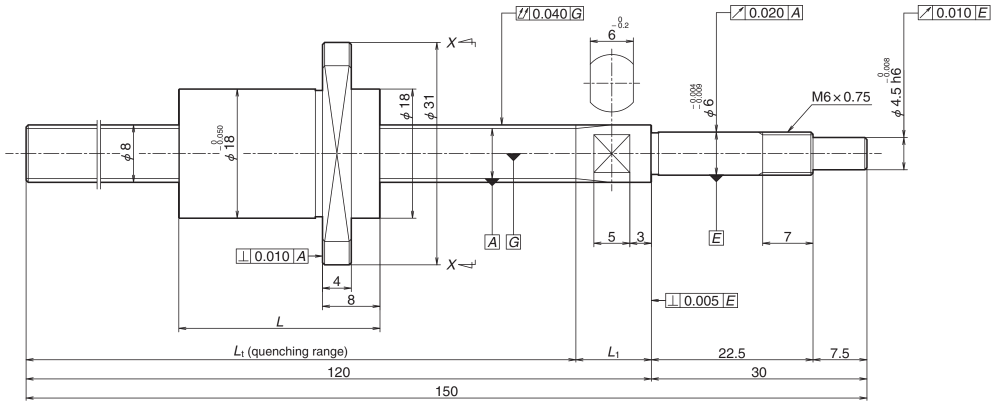
2. Service temperature range is 0 to 80˚C.

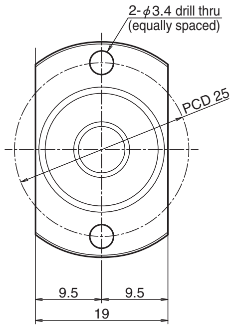
3. Use of NSK support unit is recommended. Refer to page B375 for details.

Screw shaft ø8

Lead 10, 15

Unit: mm





Cross-section *X-X*

Ball screw specification	
Ball diameter/screw shaft root diameter	1.588 / 6.6
Ball circle dia.	8.3
Accuracy grade/axial play	C5 / 0.005 or less
Factory-packed grease	NSK grease PS2

Recommended

For drive side (Fixed)
WBK06-01M (square)
WBK06-11M (round)

Unit: mm

Ball screw No.	Screw shaft diameter	Lead	Effective turns of balls	Basic load ratings (N)		Maximum stroke	Nut length	Screw shaft dimensions		Lead accuracy			Dynamic preload torque	Mass	Permissible rotational speed	Internal spatial volume of nut	Standard volume of grease replenishing
				Dynamic	Static					Target value	Error	Variation					
	d	*l*		C_a	C_{0a}		*L*	L_t	L_1	*T*	e_p	υ_u	(N·cm)	(kg)	(min^{-1}) *1	(cm^3)	(cm^3)
PSS0810NAD0150	8	10	2	910	1 260	86.5	18	109.5	10.5	0	20	18	~0.5	0.09	5 000	0.4	0.2
PSS0810NBD0150			4	1 950	3 080	76.5	28	109.5	10.5					0.11		0.5	0.3
PSS0815NAD0150		15	2	910	1 260	80	22	107	13					0.1		0.4	0.2
PSS0815NBD0150			4	1 950	3 080	65	37	107	13					0.12		0.6	0.3

Notes: 1. Contact NSK if permissible rotational speed is to be exceeded.

2. Service temperature range is 0 to 80˚C.

3. Use of NSK support unit is recommended. Refer to page B375 for details.

Compact FA PSS Type (Medium, High helix lead)

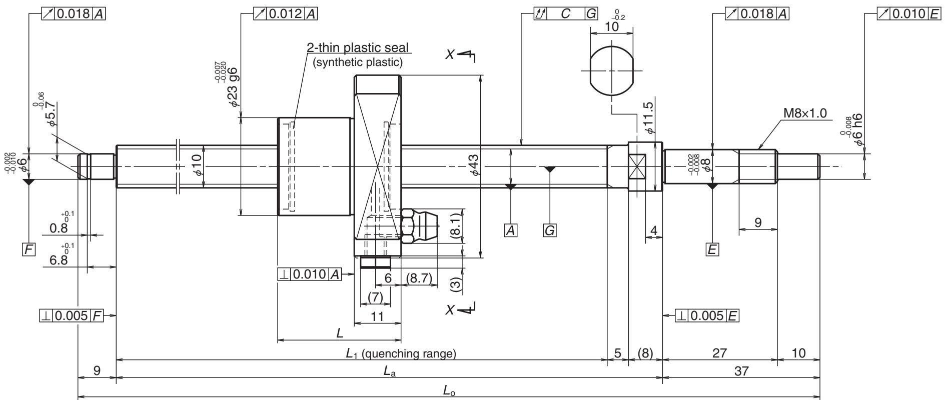
Nut model: BSS

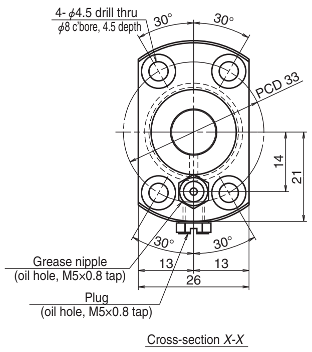
NSK

Screw shaft ø10

Lead 5, 10

Unit: mm





Cross-section X-X

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-packed grease	NSK grease PS2

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK08-01B (low-profile, square)	WBK08S-01B (low-profile, square)
WBK08-11B (round, high load)	

Unit: mm

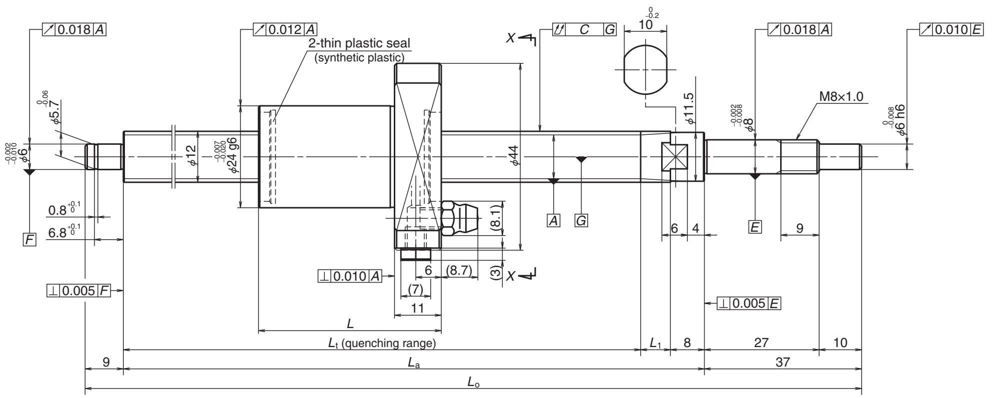
Ball screw No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions			Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *2	Internal spatial volume of nut	Standard volume of grease replenishing
			Dynamic	Static	Nominal	Max.	length				Target value	Error	Variation				Fixed-Simple		
	d	l	C_a	C_{0a}		L_t-L	L	L_t	L_a	L_o	T	e_p	υ_u	C	(N·cm) *1	(kg)		(cm^3)	(cm^3)
PSS1005N1D0171	10	5	2 930	4 790	50	83	29	112	125	171	0	0.020	0.018	0.030	0.7 – 3.3	0.3	5 000	0.8	0.4
PSS1005N1D0221					100	133		162	175	221		0.020	0.018	0.045	0.7 – 3.3	0.3			
PSS1005N1D0321					200	233		262	275	321		0.023	0.018	0.060	0.6 – 4.3	0.3			
PSS1005N1D0421					300	333		362	375	421		0.025	0.020	0.070	0.6 – 4.3	0.4			
PSS1005N1D0521					400	433		462	475	521		0.027	0.020	0.085	0.4 – 4.9	0.5			
PSS1010N1D0221		10	1 970	3 010	100	130	32	162	175	221		0.020	0.018	0.045	0.7 – 3.3	0.3	5 000	0.7	0.4
PSS1010N1D0321					200	230		262	275	321		0.023	0.018	0.060	0.6 – 4.3	0.4			
PSS1010N1D0421					300	330		362	375	421		0.025	0.020	0.070	0.6 – 4.3	0.4			
PSS1010N1D0521					400	430		462	475	521		0.027	0.020	0.085	0.4 – 4.9	0.5			

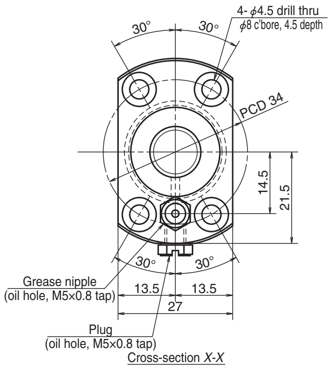
Notes:
1. Indicates ball screw preload control value. Approximately 2.0 N·cm of torque is added due to thin plastic seals.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0 to 80˚C.
4. Use of NSK support unit is recommended. Refer to page B375 for details.
5. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.

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-packed grease	NSK grease PS2

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK08-01B (low-profile, square)	WBK08S-01B (low-profile, square)
WBK08-11B (round, high load)	

Unit: mm

Ball screw No.	Screw shaft diameter *d*	Lead *l*	Basic load ratings (N) Dynamic C_a	Static C_{0a}	Stroke Nominal	Max. L_t-L	Nut length *L*	Screw shaft dimensions L_t	L_a	L_o	L_1
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	50	208	225	271	9
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	271	14
PSS1230N1D0371					200	233		303	325	371	
PSS1230N1D0471					300	333		403	425	471	
PSS1230N1D0571					400	433		503	525	571	
PSS1230N1D0671					500	533		603	625	671	

Ball screw No.	Lead accuracy Target value *T*	Error e_p	Variation υ_u	Shaft run-out *C*	Dynamic preload torque (N·cm) *1	Mass (kg)	Permissible rotational speed (min⁻¹) *2 Fixed-Simple	Internal spatial volume of nut (cm³)	Standard volume of grease replenishing (cm³)
PSS1205N1D0171	0	0.020	0.018	0.030	0.7 – 3.3	0.3	5 000	1.0	0.5
PSS1205N1D0221		0.020	0.018	0.045	0.7 – 3.3	0.3			
PSS1205N1D0321		0.023	0.018	0.060	0.6 – 4.3	0.4			
PSS1205N1D0421		0.025	0.020	0.070	0.6 – 4.3	0.5			
PSS1205N1D0521		0.027	0.020	0.085	0.6 – 4.3	0.6			
PSS1205N1D0621		0.030	0.023	0.085	0.4 – 4.9	0.7			
PSS1210N1D0221		0.020	0.018	0.045	0.7 – 3.3	0.4	5 000	1.0	0.5
PSS1210N1D0321		0.023	0.018	0.060	0.6 – 4.3	0.5			
PSS1210N1D0421		0.025	0.020	0.070	0.6 – 4.3	0.5			
PSS1210N1D0521		0.027	0.020	0.085	0.6 – 4.3	0.6			
PSS1210N1D0621		0.030	0.023	0.085	0.4 – 4.9	0.7			
PSS1220N1D0271		0.023	0.018	0.045	1.4 – 4.5	0.4	5 000	1.2	0.6
PSS1220N1D0371		0.023	0.018	0.060	0.9 – 4.9	0.5	5 000		
PSS1220N1D0471		0.027	0.020	0.070	0.9 – 4.9	0.6	5 000		
PSS1220N1D0571		0.030	0.023	0.085	0.6 – 5.9	0.7	5 000		
PSS1220N1D0671		0.030	0.023	0.110	0.6 – 5.9	0.8	4 200		
PSS1230N1D0271		0.023	0.018	0.045	1.4 – 4.5	0.5	5 000	1.5	0.8
PSS1230N1D0371		0.023	0.018	0.060	0.9 – 4.9	0.6	5 000		
PSS1230N1D0471		0.027	0.020	0.070	0.9 – 4.9	0.7	5 000		
PSS1230N1D0571		0.030	0.023	0.085	0.6 – 5.9	0.7	5 000		
PSS1230N1D0671		0.030	0.023	0.110	0.6 – 5.9	0.8	4 300		

Notes:
1. Indicates ball screw preload control value. Approximately 2.0 N·cm of torque is added due to thin plastic seals.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0 to 80˚C.
4. Use of NSK support unit is recommended. Refer to page B375 for details.
5. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.

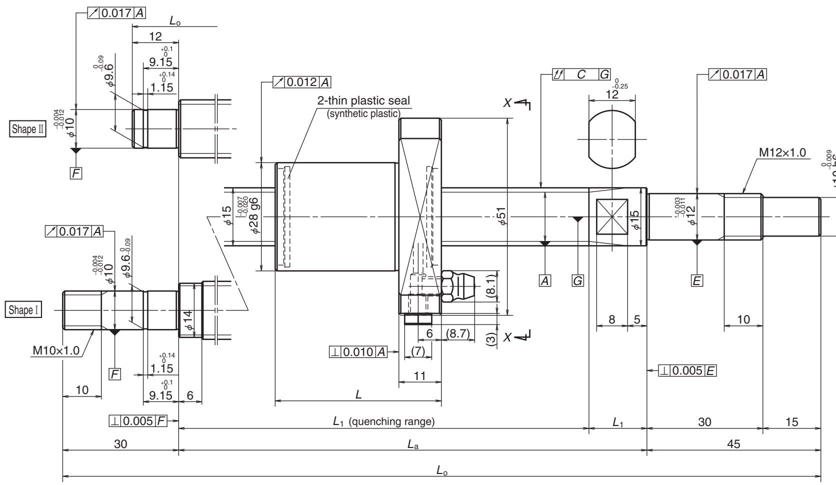
Compact FA PSS Type (Fine, Medium lead)

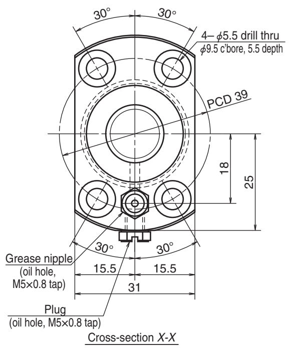
Nut model: BSS

Screw shaft ø15

Lead 5, 10

Unit: mm





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-packed grease	NSK grease LR3

Recommended support unit

For drive side	For opposite to drive side	
(Fixed)	(Fixed)	(Simple)
WBK12-01B (low-profile, square)	WBK10-01B (low-profile, square)	WBK12S-01B (low-profile, square)
WBK12-11 (round)	WBK10-11 (round)	

Unit: mm

Ball screw No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions			
			Dynamic	Static	Nominal	Max.					
	d	l	C_a	C_{0a}		L_t-L	L	L_t	L_a	L_o	L_1
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	43	189	204	261	15
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	

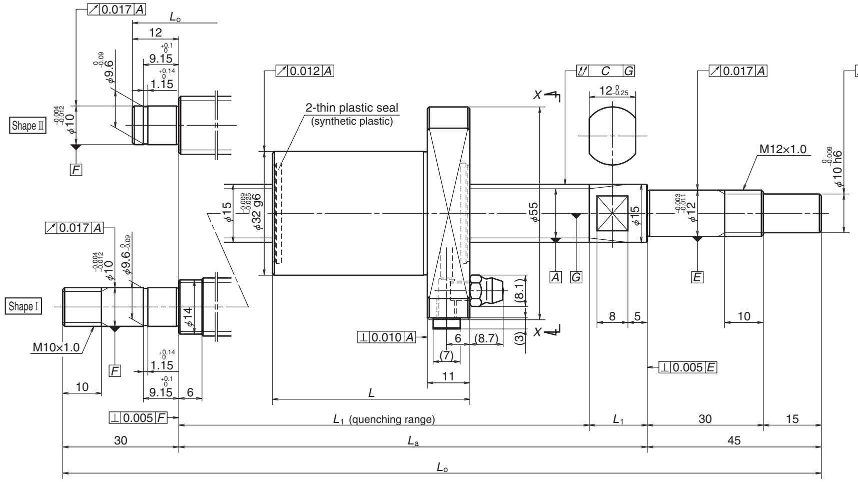
Ball screw No.	Left shaft end (opposite driven side)	Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min⁻¹) *2		Internal spatial volume of nut	Standard volume of grease replenishing
		Target value	Error	Variation				Fixed-Simple	Fixed-Fixed		
		T	e_p	υ_u	C	(N·cm) *1	(kg)			(cm³)	(cm³)
PSS1505N1D0211	II	0	0.020	0.018	0.035	0.2 – 6.9	0.5	5 000	—	2.0	1.0
PSS1505N1D0261			0.020	0.018	0.035	0.2 – 6.9	0.5	5 000			
PSS1505N1D0361			0.023	0.018	0.045	0.2 – 6.9	0.6	5 000			
PSS1505N1D0461			0.025	0.020	0.050	0.4 – 9.8	0.8	5 000			
PSS1505N1D0561			0.027	0.020	0.060	0.4 – 9.8	0.9	5 000			
PSS1505N1D0661			0.030	0.023	0.075	0.4 – 9.8	1.0	5 000			
PSS1505N1D0761			0.035	0.025	0.075	0.4 – 11.8	1.1	3 600			
PSS1510N1D0261	II		0.020	0.018	0.035	0.6 – 7.4	0.6	5 000	—	2.0	1.0
PSS1510N1D0361	II		0.023	0.018	0.045	0.6 – 7.4	0.7	5 000	—		
PSS1510N1D0461	II		0.025	0.020	0.050	0.4 – 9.8	0.8	5 000	—		
PSS1510N1D0561	II		0.027	0.020	0.060	0.4 – 9.8	1.0	5 000	—		
PSS1510N1D0661	II		0.030	0.023	0.075	0.4 – 9.8	1.1	5 000	—		
PSS1510N1D0761	II		0.035	0.025	0.075	0.4 – 11.8	1.2	3 600	—		
PSS1510N1D0879	I		0.035	0.025	0.095	0.4 – 11.8	1.4	2 700	3 400		
PSS1510N1D0979	I		0.040	0.027	0.095	0.4 – 11.8	1.5	2 200	3 400		
PSS1510N1D1179	I		0.046	0.030	0.120	0.4 – 11.8	1.7	1 400	2 300		

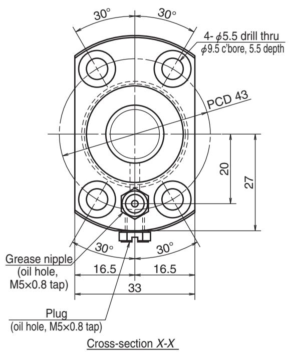
Notes: 1. Indicates ball screw preload control value. Approximately 2.0 N·cm of torque is added due to thin plastic seals.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0 to 80˚C.
4. Use of NSK support unit is recommended. Refer to page B375 for details.
5. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.

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-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Fixed)	For opposite to drive side (Simple)
WBK12-01B (low-profile, square)	WBK10-01B (low-profile, square)	WBK12S-01B (low-profile, square)
WBK12-11 (round)	WBK10-11 (round)	

Unit: mm

Ball screw No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions				Left shaft end (opposite driven side)	Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min⁻¹) *2		Internal spatial volume of nut	Standard volume of grease replenishing
			Dynamic	Static	Nominal	Max.							Target value	Error	Variation				Fixed-Simple	Fixed-Fixed		
	d	l	C_a	C_{0a}		L_t-L	L	L_t	L_a	L_o	L_1		T	e_p	υ_u	C	(N·cm) *1	(kg)			(cm³)	(cm³)
PSS1520N1D0261	15	20	5 070	8 730	100	135	51	186	204	261	18	Ⅱ	0	0.020	0.018	0.035	0.8 – 8.8	0.7	5 000	—	2.8	1.4
PSS1520N1D0361					200	235		286	304	361		Ⅱ		0.023	0.018	0.045	0.8 – 8.8	0.8	5 000	—		
PSS1520N1D0461					300	335		386	404	461		Ⅱ		0.025	0.020	0.050	0.8 – 10.8	0.9	5 000	—		
PSS1520N1D0561					400	435		486	504	561		Ⅱ		0.027	0.020	0.060	0.8 – 10.8	1.1	5 000	—		
PSS1520N1D0661					500	535		586	604	661		Ⅱ		0.030	0.023	0.075	0.8 – 10.8	1.2	5 000	—		
PSS1520N1D0761					600	635		686	704	761		Ⅱ		0.035	0.025	0.075	0.8 – 13.8	1.3	3 700	—		
PSS1520N1D0879					700	735		786	804	879		Ⅰ		0.035	0.025	0.095	0.8 – 13.8	1.5	2 900	4 200		
PSS1520N1D0979					800	835		886	904	979		Ⅰ		0.040	0.027	0.095	0.8 – 13.8	1.6	2 200	3 300		
PSS1520N1D1179					1 000	1 035		1 086	1 104	1 179		Ⅰ		0.046	0.030	0.120	0.8 – 13.8	1.9	1 500	2 200		
PSS1530N1D0311		30	5 070	8 730	100	159	71	230	254	311	24	Ⅱ		0.023	0.018	0.035	1.2 – 9.3	0.8	5 000	—	3.4	1.7
PSS1530N1D0411					200	259		330	354	411		Ⅱ		0.025	0.020	0.050	0.8 – 10.8	1.0	5 000	—		
PSS1530N1D0511					300	359		430	454	511		Ⅱ		0.027	0.020	0.060	0.8 – 10.8	1.1	5 000	—		
PSS1530N1D0611					400	459		530	554	611		Ⅱ		0.030	0.023	0.060	0.8 – 10.8	1.2	5 000	—		
PSS1530N1D0711					500	559		630	654	711		Ⅱ		0.030	0.023	0.075	0.8 – 13.8	1.4	4 500	—		
PSS1530N1D0811					600	659		730	754	811		Ⅱ		0.035	0.025	0.095	0.8 – 13.8	1.5	3 300	—		
PSS1530N1D0929					700	759		830	854	929		Ⅰ		0.040	0.027	0.095	0.8 – 13.8	1.6	2 600	3 800		
PSS1530N1D1029					800	859		930	954	1 029		Ⅰ		0.040	0.027	0.120	0.8 – 13.8	1.8	2 000	3 000		
PSS1530N1D1229					1 000	1 059		1 130	1 154	1 229		Ⅰ		0.046	0.030	0.120	0.8 – 13.8	2.0	1 400	2 000		

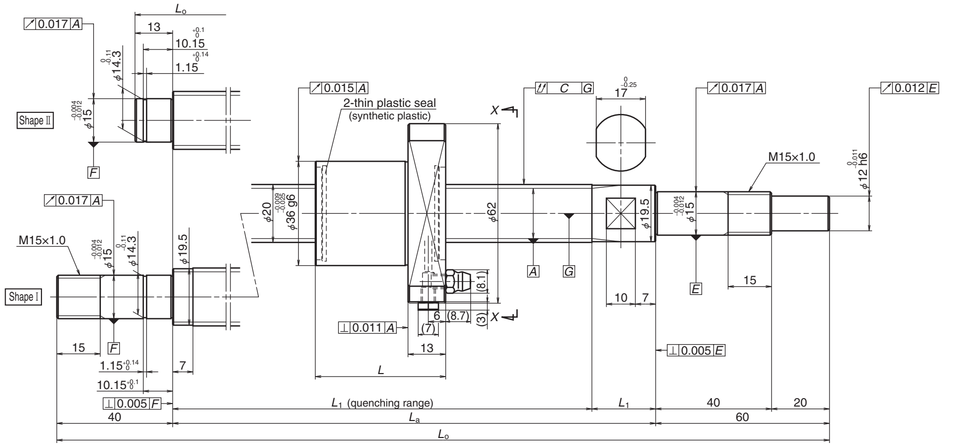
Notes: 1. Indicates ball screw preload control value. Approximately 2.0 N·cm of torque is added due to thin plastic seals.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0 to 80˚C.
4. Use of NSK support unit is recommended. Refer to page B375 for details.
5. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.

Compact FA PSS Type (Fine, Medium lead)

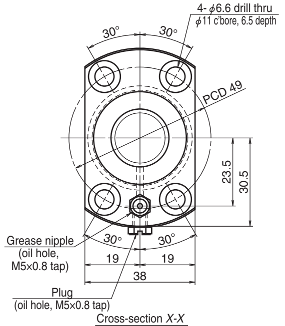
Nut model: BSS

Screw shaft ø20

Lead 5, 10



Unit: mm



Cross-section X-X

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-packed grease	NSK grease LR3

Recommended support unit

For drive side	For opposite to drive side	
(Fixed)	(Fixed)	(Simple)
WBK15-01B (low-profile, square)	WBK15-01B (low-profile, square)	WBK15S-01B (low-profile, square)
WBK15-11 (round)	WBK15-11 (round)	

Unit: mm

Ball screw No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions				Left shaft end (opposite driven side)	Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *2		Internal spatial volume of nut	Standard volume of grease replenishing
			Dynamic	Static	Nominal	Max.							Target value	Error	Variation				Fixed-Simple	Fixed-Fixed		
	d	l	C_a	C_{0a}		L_t-L	L	L_t	L_a	L_o	L_1		T	e_p	υ_u	C	(N·cm) *1	(kg)			(cm^3)	(cm^3)
PSS2005N1D0323	20	5	8 790	18 500	150	197	31	228	250	323	22	Ⅱ	0	0.023	0.018	0.045	0.6 – 7.4	1.0	5 000	—	3.4	1.7
PSS2005N1D0373					200	247		278	300	373		Ⅱ		0.023	0.018	0.045	0.6 – 7.4	1.1	5 000	—		
PSS2005N1D0473					300	347		378	400	473		Ⅱ		0.025	0.020	0.050	0.6 – 7.4	1.3	5 000	—		
PSS2005N1D0573					400	447		478	500	573		Ⅱ		0.027	0.020	0.060	0.4 – 9.8	1.5	5 000	—		
PSS2005N1D0673					500	547		578	600	673		Ⅱ		0.030	0.023	0.075	0.4 – 9.8	1.7	5 000	—		
PSS2005N1D0773					600	647		678	700	773		Ⅱ		0.035	0.025	0.075	0.4 – 9.8	1.9	5 000	—		
PSS2005N1D0873					700	747		778	800	873		Ⅱ		0.035	0.025	0.095	0.4 – 9.8	2.2	4 000	—		
PSS2005N1D1000					800	847		878	900	1000		Ⅰ		0.040	0.027	0.095	0.4 – 11.8	2.4	3 200	4 700		
PSS2010N1D0387		10	8 790	18 500	200	247	45	292	314	387	22	Ⅱ		0.023	0.018	0.045	1.2 – 9.3	1.2	5 000	—	3.2	1.6
PSS2010N1D0487					300	347		392	414	487		Ⅱ		0.025	0.020	0.050	1.2 – 9.3	1.4	5 000	—		
PSS2010N1D0587					400	447		492	514	587		Ⅱ		0.027	0.020	0.060	0.8 – 10.8	1.7	5 000	—		
PSS2010N1D0687					500	547		592	614	687		Ⅱ		0.030	0.023	0.075	0.8 – 10.8	1.9	5 000	—		
PSS2010N1D0787					600	647		692	714	787		Ⅱ		0.035	0.025	0.075	0.8 – 10.8	2.1	5 000	—		
PSS2010N1D0887					700	747		792	814	887		Ⅱ		0.035	0.025	0.095	0.8 – 10.8	2.4	4 000	—		
PSS2010N1D1014					800	847		892	914	1014		Ⅰ		0.040	0.027	0.120	0.8 – 13.8	2.6	3 100	4 600		
PSS2010N1D1214					1 000	1047		1092	1 114	1214		Ⅰ		0.046	0.030	0.120	0.8 – 13.8	3.1	2 100	3 100		
PSS2010N1D1414					1 200	1247		1292	1 314	1414		Ⅰ		0.054	0.035	0.160	0.8 – 13.8	3.6	1 500	2 200		

Notes:
1. Indicates ball screw preload control value. Approximately 2.0 N·cm of torque is added due to thin plastic seals.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0 to 80˚C.
4. Use of NSK support unit is recommended. Refer to page B375 for details.
5. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.

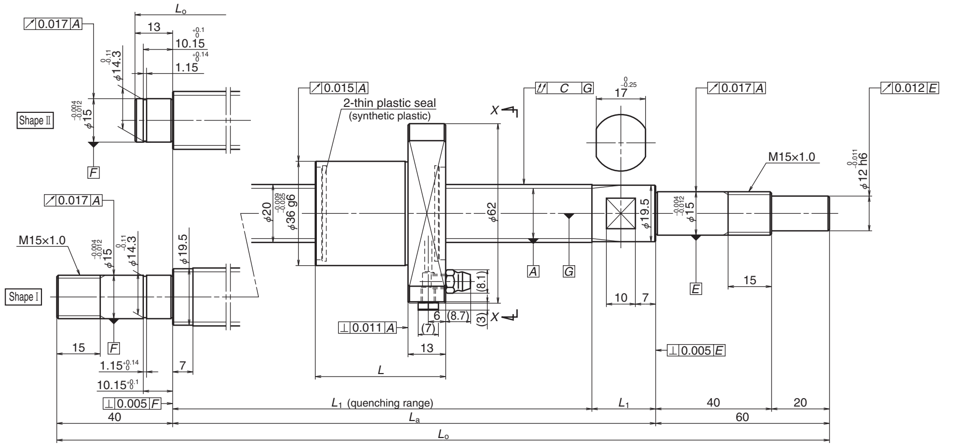
Compact FA PSS Type (High helix lead)

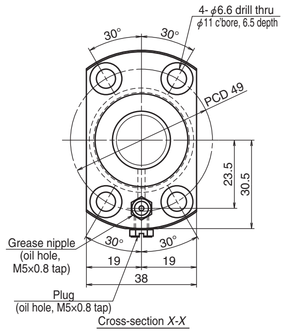
Nut model: BSS

NSK

Screw shaft ø20
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-packed grease	NSK grease LR3

Recommended support unit

For drive side	For opposite to drive side	
(Fixed)	(Fixed)	(Simple)
WBK15-01B (low-profile, square)	WBK15-01B (low-profile, square)	WBK15S-01B (low-profile, square)
WBK15-11 (round)	WBK15-11 (round)	

Unit: mm

Ball screw No.	Screw shaft diameter d	Lead l	Basic load ratings (N) Dynamic C_a	Basic load ratings (N) Static C_{0a}	Stroke Nominal	Stroke Max. L_t-L	Nut length L	Screw shaft dimensions L_t	L_a	L_o	L_1
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	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	

Notes: 1. Indicates ball screw preload control value. Approximately 2.0 N·cm of torque is added due to thin plastic seals.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0 to 80˚C.

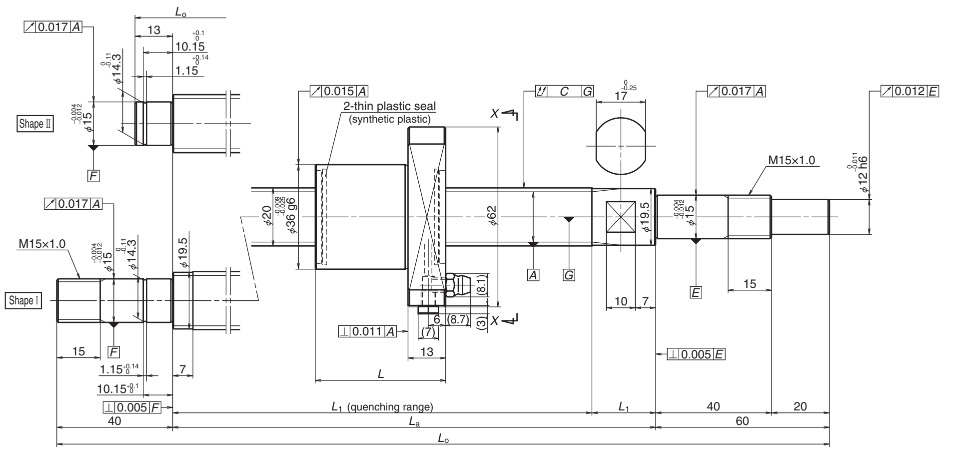
Unit: mm

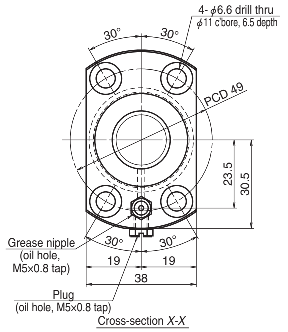
Ball screw No.	Left shaft end (opposite driven side)	Lead accuracy Target value T	Lead accuracy Error e_p	Lead accuracy Variation υ_u	Shaft run-out C	Dynamic preload torque (N·cm) *1	Mass (kg)	Permissible rotational speed (min^{-1}) *2 Fixed-Simple	Permissible rotational speed Fixed-Fixed	Internal spatial volume of nut (cm^3)	Standard volume of grease replenishing (cm^3)
PSS2020N1D0508	II	0	0.027	0.020	0.060	1.4 – 11.8	1.6	5 000	—	3.2	1.6
PSS2020N1D0608	II		0.030	0.023	0.060	1.4 – 11.8	1.8	5 000	—		
PSS2020N1D0708	II		0.030	0.023	0.075	1.4 – 11.8	2.0	5 000	—		
PSS2020N1D0808	II		0.035	0.025	0.095	1.4 – 11.8	2.3	5 000	—		
PSS2020N1D0908	II		0.040	0.027	0.095	0.8 – 13.8	2.5	3 700	—		
PSS2020N1D1035	I		0.040	0.027	0.120	0.8 – 13.8	2.8	3 000	4 500		
PSS2020N1D1235	I		0.046	0.030	0.120	0.8 – 13.8	3.3	2 000	3 000		
PSS2020N1D1435	I		0.054	0.035	0.160	0.8 – 13.8	3.8	1 400	2 100		
PSS2020N1D1835	I		0.065	0.040	0.200	0.8 – 13.8	4.7	800	1 200		
PSS2030N1D0408	II		0.023	0.018	0.050	1.6 – 9.8	1.4	5 000	—	4.6	2.3
PSS2030N1D0508	II		0.027	0.020	0.060	1.4 – 11.8	1.7	5 000	—		
PSS2030N1D0608	II		0.030	0.023	0.060	1.4 – 11.8	1.9	5 000	—		
PSS2030N1D0708	II		0.030	0.023	0.075	1.4 – 11.8	2.1	5 000	—		
PSS2030N1D0808	II		0.035	0.025	0.095	1.4 – 11.8	2.4	5 000	—		
PSS2030N1D0908	II		0.040	0.027	0.095	0.8 – 13.8	2.6	3 900	—		
PSS2030N1D1035	I		0.040	0.027	0.120	0.8 – 13.8	2.9	3 100	4 600		
PSS2030N1D1235	I		0.046	0.030	0.120	0.8 – 13.8	3.4	2 100	3 000		
PSS2030N1D1435	I		0.054	0.035	0.160	0.8 – 13.8	3.9	1 500	2 200		

4. Use of NSK support unit is recommended. Refer to page B375 for details.
5. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.

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-packed grease	NSK grease LR3

Recommended support unit

For drive side	For opposite to drive side	
(Fixed)	(Fixed)	(Simple)
WBK15-01B (low-profile, square)	WBK15-01B (low-profile, square)	WBK15S-01B (low-profile, square)
WBK15-11 (round)	WBK15-11 (round)	

Unit: mm

Ball screw No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions				Left shaft end (opposite driven side)	Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *2		Internal spatial volume of nut	Standard volume of grease replenishing
			Dynamic	Static	Nominal	Max.							Target value	Error	Variation				Fixed-Simple	Fixed-Fixed		
	d	l	C_a	C_{0a}		L_t-L	L	L_t	L_a	L_o	L_1		T	e_p	υ_u	C	(N·cm) *1	(kg)			(cm^3)	(cm^3)
PSS2040N1D0658	20	40	5 900	11 700	400	461	92	553	585	658	32	Ⅱ	0	0.030	0.023	0.075	2.2 – 12.8	2.1	5 000	—	5.3	2.7
PSS2040N1D0758					500	561		653	685	758		Ⅱ		0.035	0.025	0.075	2.2 – 12.8	2.4	5 000	—		
PSS2040N1D0858					600	661		753	785	858		Ⅱ		0.035	0.025	0.095	2.2 – 12.8	2.6	5 000	—		
PSS2040N1D0958					700	761		853	885	958		Ⅱ		0.040	0.027	0.095	1.8 – 14.8	2.8	3 500	—		
PSS2040N1D1085					800	861		953	985	1 085		Ⅰ		0.040	0.027	0.120	1.8 – 14.8	3.1	2 800	4 200		
PSS2040N1D1285					1 000	1 061		1 153	1 185	1 285		Ⅰ		0.046	0.030	0.160	1.8 – 14.8	3.6	1 900	2 800		
PSS2040N1D1485					1 200	1 261		1 353	1 385	1 485		Ⅰ		0.054	0.035	0.160	1.8 – 14.8	4.1	1 400	2 000		
PSS2040N1D1885					1 600	1 661		1 753	1 785	1 885		Ⅰ		0.065	0.040	0.200	1.8 – 14.8	5.1	800	1 200		
PSS2040N1D2285					2 000	2 061		2 153	2 185	2 285		Ⅰ		0.077	0.046	0.240	1.8 – 14.8	6.0	500	800		
PSS2060N1D0708		60	5 900	11 700	400	464	129	593	635	708	42	Ⅱ		0.030	0.023	0.075	2.7 – 13.8	2.4	5 000	—	7.0	3.5
PSS2060N1D0808					500	564		693	735	808		Ⅱ		0.035	0.025	0.095	2.7 – 13.8	2.6	5 000	—		
PSS2060N1D0908					600	664		793	835	908		Ⅱ		0.035	0.025	0.095	2.7 – 13.8	2.9	4 200	—		
PSS2060N1D1008					700	764		893	935	1 008		Ⅱ		0.040	0.027	0.120	1.8 – 14.8	3.1	3 300	—		
PSS2060N1D1135					800	864		993	1 035	1 135		Ⅰ		0.040	0.027	0.120	1.8 – 14.8	3.4	2 600	3 900		
PSS2060N1D1335					1 000	1 064		1 193	1 235	1 335		Ⅰ		0.046	0.030	0.160	1.8 – 14.8	3.9	1 800	2 700		
PSS2060N1D1535					1 200	1 264		1 393	1 435	1 535		Ⅰ		0.054	0.035	0.160	1.8 – 14.8	4.4	1 300	1 900		
PSS2060N1D1935					1 600	1 664		1 793	1 835	1 935		Ⅰ		0.065	0.040	0.200	1.8 – 14.8	5.4	800	1 100		
PSS2060N1D2335					2 000	2 064		2 193	2 235	2 335		Ⅰ		0.077	0.046	0.240	1.8 – 14.8	6.3	500	700		

Notes:
1. Indicates ball screw preload control value. Approximately 2.0 N·cm of torque is added due to thin plastic seals.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0 to 80˚C.
4. Use of NSK support unit is recommended. Refer to page B375 for details.
5. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.

Compact FA PSS Type (Fine lead)

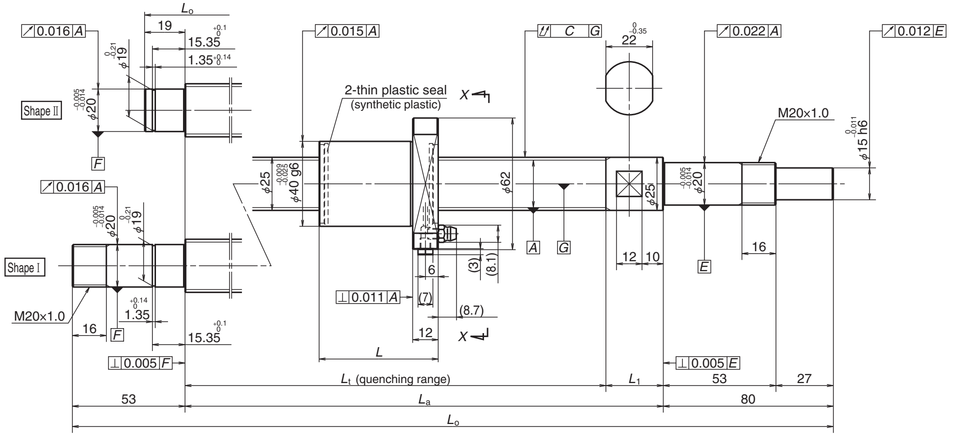
Nut model: BSS

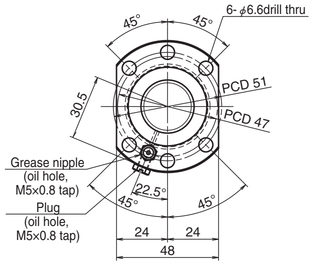
NSK

Screw shaft ø25

Lead 5, 10

Unit: mm





Cross-section X-X

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-packed grease	NSK grease LR3

Recommended support unit

For drive side	For opposite to drive side	
(Fixed)	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

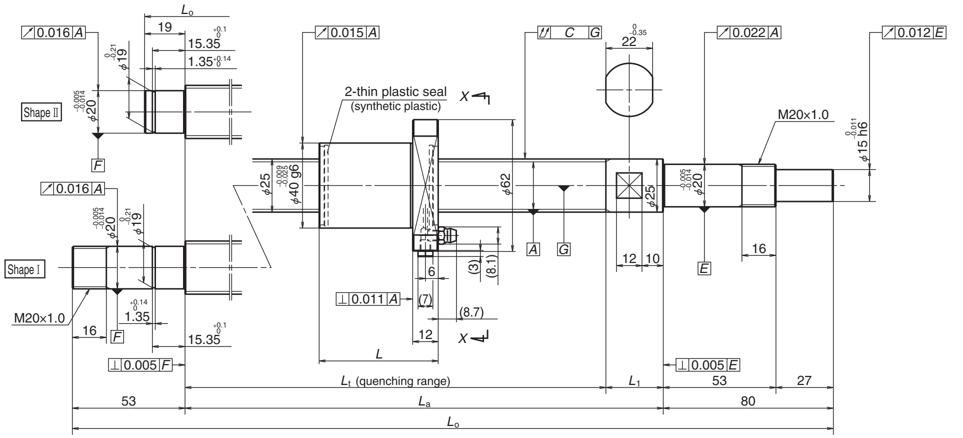
Unit: mm

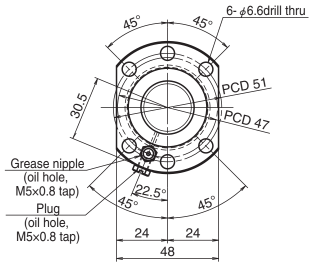
Ball screw No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions				Left shaft end (opposite driven side)	Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *2		Internal spatial volume of nut	Standard volume of grease replenishing
	d	l	Dynamic C_a	Static C_{0a}	Nominal	Max. L_t-L	L	L_t	L_a	L_o	L_1		Target value T	Error e_p	Variation υ_u	C	(N·cm) *1	(kg)	Fixed-Simple	Fixed-Fixed	(cm^3)	(cm^3)
PSS2505N1D0349	25	5	9 760	23 600	150	191	32	223	250	349	27	Ⅱ	0	0.023	0.018	0.035	1.2 – 9.3	1.5	5 000	—	4.4	2.2
PSS2505N1D0399					200	241		273	300	399		Ⅱ		0.023	0.018	0.035	1.2 – 9.3	1.6	5 000	—		
PSS2505N1D0499					300	341		373	400	499		Ⅱ		0.025	0.020	0.040	1.2 – 9.3	2.0	5 000	—		
PSS2505N1D0599					400	441		473	500	599		Ⅱ		0.027	0.020	0.045	1.2 – 9.3	2.3	5 000	—		
PSS2505N1D0699					500	541		573	600	699		Ⅱ		0.030	0.023	0.055	0.8 – 10.8	2.7	5 000	—		
PSS2505N1D0899					700	741		773	800	899		Ⅱ		0.035	0.025	0.065	0.8 – 10.8	3.4	5 000	—		
PSS2505N1D0999					800	841		873	900	999		Ⅱ		0.040	0.027	0.065	0.8 – 10.8	3.7	4 100	—		
PSS2505N1D1233					1 000	1 041		1 073	1 100	1 233		Ⅰ		0.046	0.030	0.080	0.8 – 13.8	4.5	2 700	4 000		
PSS2510N1D0549		10	12 800	32 300	300	367	56	423	450	549	27	Ⅱ		0.027	0.020	0.045	3.1 – 11.8	2.4	5 000	—	4.7	2.4
PSS2510N1D0649					400	467		523	550	649		Ⅱ		0.030	0.023	0.055	2.2 – 12.8	2.7	5 000	—		
PSS2510N1D0749					500	567		623	650	749		Ⅱ		0.030	0.023	0.055	2.2 – 12.8	3.1	5 000	—		
PSS2510N1D0849					600	667		723	750	849		Ⅱ		0.035	0.025	0.065	2.2 – 12.8	3.5	5 000	—		
PSS2510N1D0949					700	767		823	850	949		Ⅱ		0.040	0.027	0.065	2.2 – 12.8	3.8	5 000	—		
PSS2510N1D1049					800	867		923	950	1 049		Ⅱ		0.040	0.027	0.080	2.2 – 12.8	4.2	3 600	—		
PSS2510N1D1283					1 000	1 067		1 123	1 150	1 283		Ⅰ		0.046	0.030	0.100	1.8 – 14.8	5.0	2 500	3 700		
PSS2510N1D1883					1 600	1 667		1 723	1 750	1 883		Ⅰ		0.065	0.040	0.130	1.8 – 14.8	7.2	1 000	1 600		

Notes:
1. Indicates ball screw preload control value. Approximately 2.0 N·cm of torque is added due to thin plastic seals.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0 to 80˚C.
4. Use of NSK support unit is recommended. Refer to page B375 for details.
5. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.

Screw shaft ø25
Lead 20, 25

Unit: mm





Cross-section X-X

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-packed grease	NSK grease LR3

Recommended support unit

For drive side	For opposite to drive side	
(Fixed)	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

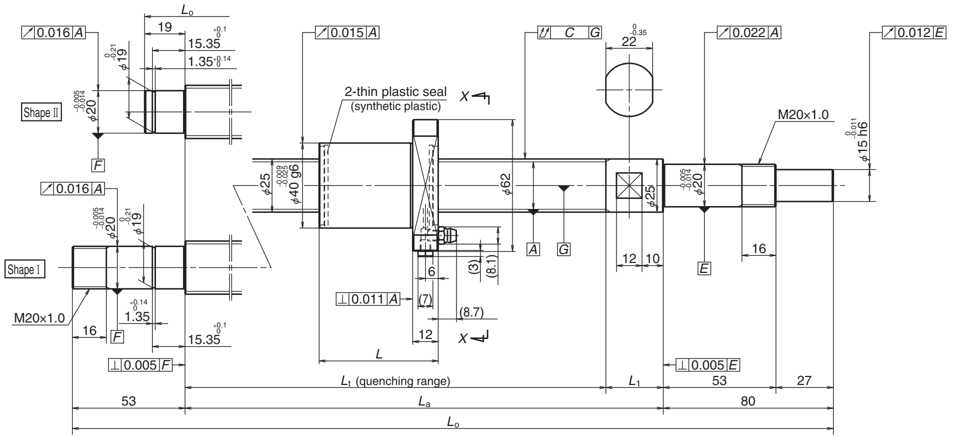
Unit: mm

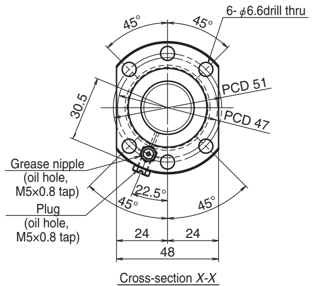
Ball screw No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions				Left shaft end (opposite driven side)	Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *2		Internal spatial volume of nut	Standard volume of grease replenishing
			Dynamic	Static	Nominal	Max.	length						Target value	Error	Variation				Fixed-Simple	Fixed-Fixed		
	d	l	C_a	C_{0a}		L_t-L	L	L_t	L_a	L_o	L_1		T	e_p	υ_u	C	(N·cm) *1	(kg)			(cm^3)	(cm^3)
PSS2520N1D0729	25	20	6 560	14 600	500	550	54	604	630	729	26	Ⅱ	0	0.030	0.023	0.055	2.2 – 12.8	3.1	5 000	—	3.9	2.0
PSS2520N1D0829					600	650		704	730	829		Ⅱ		0.035	0.025	0.065	2.2 – 12.8	3.4	5 000	—		
PSS2520N1D0929					700	750		804	830	929		Ⅱ		0.040	0.027	0.065	2.2 – 12.8	3.8	4 800	—		
PSS2520N1D1029					800	850		904	930	1 029		Ⅱ		0.040	0.027	0.080	2.2 – 12.8	4.2	3 800	—		
PSS2520N1D1263					1 000	1 050		1 104	1 130	1 263		Ⅰ		0.046	0.030	0.100	1.8 – 14.8	5.0	2 600	3 800		
PSS2520N1D1463					1 200	1 250		1 304	1 330	1 463		Ⅰ		0.054	0.035	0.100	1.8 – 14.8	5.8	1 800	2 700		
PSS2520N1D1863					1 600	1 650		1 704	1 730	1 863		Ⅰ		0.065	0.040	0.130	1.8 – 14.8	7.3	1 100	1 600		
PSS2520N1D2263					2 000	2 050		2 104	2 130	2 263		Ⅰ		0.077	0.046	0.170	1.8 – 14.8	8.8	700	1 000		
PSS2525N1D0779		25	6 560	14 600	500	587	63	650	680	779	30	Ⅱ		0.035	0.025	0.055	2.7 – 13.8	3.3	5 000	—	4.3	2.2
PSS2525N1D0879					600	687		750	780	879		Ⅱ		0.035	0.025	0.065	2.7 – 13.8	3.7	5 000	—		
PSS2525N1D0979					700	787		850	880	979		Ⅱ		0.040	0.027	0.065	2.7 – 13.8	4.1	4 300	—		
PSS2525N1D1079					800	887		950	980	1 079		Ⅱ		0.040	0.027	0.080	2.7 – 13.8	4.4	3 400	—		
PSS2525N1D1313					1 000	1 087		1 150	1 180	1 313		Ⅰ		0.046	0.030	0.100	1.8 – 14.8	5.3	2 300	3 500		
PSS2525N1D1513					1 200	1 287		1 350	1 380	1 513		Ⅰ		0.054	0.035	0.100	1.8 – 14.8	6.0	1 700	2 600		
PSS2525N1D1913					1 600	1 687		1 750	1 780	1 913		Ⅰ		0.065	0.040	0.130	1.8 – 14.8	7.5	1 000	1 500		
PSS2525N1D2313					2 000	2 087		2 150	2 180	2 313		Ⅰ		0.077	0.046	0.170	1.8 – 14.8	9.1	700	1 000		

Notes:
1. Indicates ball screw preload control value. Approximately 2.0 N·cm of torque is added due to thin plastic seals.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0 to 80˚C.
4. Use of NSK support unit is recommended. Refer to page B375 for details.
5. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.

Screw shaft ø25
Lead 30, 50

Unit: mm





Cross-section X-X

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-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Fixed)	For opposite to drive side (Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20-11 (round)	

Unit: mm

Ball screw No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions				Left shaft end (opposite driven side)	Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *2		Internal spatial volume of nut	Standard volume of grease replenishing
	d	l	Dynamic C_a	Static C_{0a}	Nominal	Max. L_t-L	L	L_t	L_a	L_o	L_1		Target value T	Error e_p	Variation υ_u	C	(N·cm) *1	(kg)	Fixed-Simple	Fixed-Fixed	(cm^3)	(cm^3)
PSS2530N1D0779	25	30	6 560	14 600	500	576	74	650	680	779	30	Ⅱ	0	0.035	0.025	0.055	2.7 – 13.8	3.4	5 000	—	5.5	2.8
PSS2530N1D0879					600	676		750	780	879		Ⅱ		0.035	0.025	0.065	2.7 – 13.8	3.7	5 000	—		
PSS2530N1D0979					700	776		850	880	979		Ⅱ		0.040	0.027	0.065	2.7 – 13.8	4.1	4 300	—		
PSS2530N1D1079					800	876		950	980	1 079		Ⅱ		0.040	0.027	0.080	2.7 – 13.8	4.5	3 400	—		
PSS2530N1D1313					1 000	1 076		1 150	1 180	1 313		Ⅰ		0.046	0.030	0.100	1.8 – 14.8	5.3	2 300	3 600		
PSS2530N1D1513					1 200	1 276		1 350	1 380	1 513		Ⅰ		0.054	0.035	0.100	1.8 – 14.8	6.1	1 700	2 600		
PSS2530N1D1913					1 600	1 676		1 750	1 780	1 913		Ⅰ		0.065	0.040	0.130	1.8 – 14.8	7.6	1 000	1 500		
PSS2530N1D2313					2 000	2 076		2 150	2 180	2 313		Ⅰ		0.077	0.046	0.170	1.8 – 14.8	9.1	700	1 000		
PSS2550N1D0829		50	6 560	14 600	500	576	114	690	730	829	40	Ⅱ		0.035	0.025	0.065	5.4 – 17.6	3.8	5 000	—	7.7	3.9
PSS2550N1D0929					600	676		790	830	929		Ⅱ		0.035	0.025	0.065	5.4 – 17.6	4.1	4 800	—		
PSS2550N1D1029					700	776		890	930	1 029		Ⅱ		0.040	0.027	0.080	5.4 – 17.6	4.5	3 800	—		
PSS2550N1D1129					800	876		990	1 030	1 129		Ⅱ		0.040	0.027	0.080	5.4 – 17.6	4.9	3 100	—		
PSS2550N1D1363					1 000	1 076		1 190	1 230	1 363		Ⅰ		0.046	0.030	0.100	4.1 – 19.6	5.8	2 200	3 400		
PSS2550N1D1563					1 200	1 276		1 390	1 430	1 563		Ⅰ		0.054	0.035	0.100	4.1 – 19.6	6.5	1 600	2 500		
PSS2550N1D1963					1 600	1 676		1 790	1 830	1 963		Ⅰ		0.065	0.040	0.130	4.1 – 19.6	8.0	900	1 500		
PSS2550N1D2363					2 000	2 076		2 190	2 230	2 363		Ⅰ		0.077	0.046	0.170	4.1 – 19.6	9.6	600	1 000		

Notes:
1. Indicates ball screw preload control value. Approximately 2.0 N·cm of torque is added due to thin plastic seals.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0 to 80˚C.
4. Use of NSK support unit is recommended. Refer to page B375 for details.
5. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.

Compact FA USS Type (Medium lead)

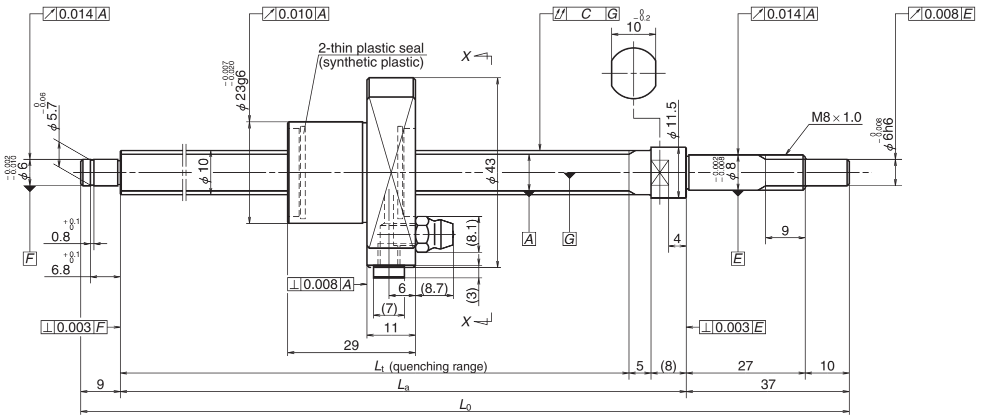
Nut model: BSS

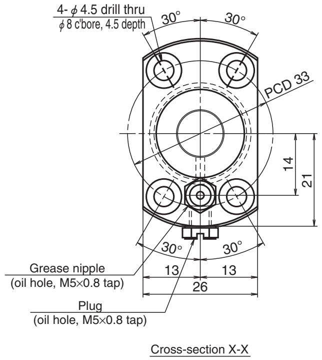
NSK

Screw shaft ø10

Lead 5

Unit: mm





Cross-section X-X

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	C3 / 0
Factory-packed grease	NSK grease LR2

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK08-01B (low-profile, square)	WBK08S-01B (low-profile, square)
WBK08-11 (round)	WBK08S-01C (square, clean)
WBK08-01C (square, clean)	
WBK08-11C (round, clean)	

Unit: mm

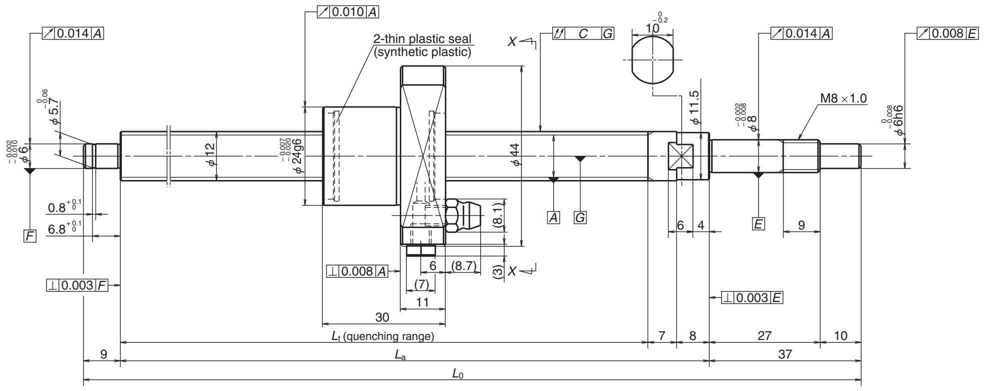
Ball screw No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Screw shaft dimensions			Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *2	Internal spatial volume of nut	Standard volume of grease replenishing
			Dynamic	Static	Nominal	Max.				Target value	Error	Variation						
	d	l	C_a	C_{0a}		L_t-L	L_t	L_a	L_o	T	e_p	V_u	C	(N·cm) *1	(kg)	Fixed-Simple	(cm^3)	(cm^3)
USS1005N1D0221	10	5	2 930	4 790	100	133	162	175	221	0	0.010	0.008	0.035	0.2–1.8	0.3	5 000	0.8	0.4
USS1005N1D0321					200	233	262	275	321		0.012	0.008	0.045	0.2–2.0	0.3			
USS1005N1D0521					400	433	462	475	521		0.015	0.010	0.070	0.2–3.0	0.5			

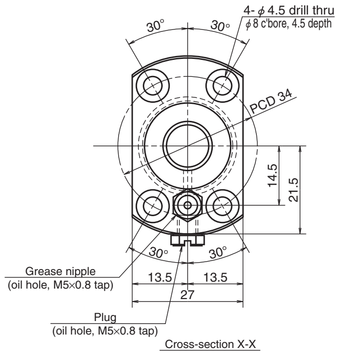
Notes: 1. Indicates ball screw preload control value. Approximately 0.5 N·cm of torque is added due to thin plastic seals.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0 to 80°C.
4. Use of NSK support unit is recommended. See page B375 for details.

Screw shaft ø12

Lead 5

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	C3 / 0
Factory-packed grease	NSK grease LR2

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK08-01B (low-profile, square)	WBK08S-01B (low-profile, square)
WBK08-11 (round)	WBK08S-01C (square, clean)
WBK08-01C (square, clean)	
WBK08-11C (round, clean)	

Unit: mm

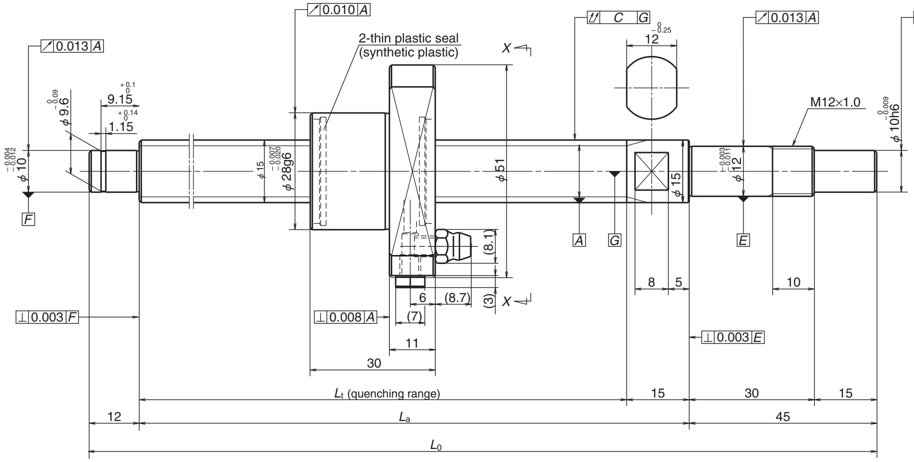
Ball screw No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Screw shaft dimensions			Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *2	Internal spatial volume of nut	Standard volume of grease replenishing
			Dynamic	Static	Nominal	Max.				Target value	Error	Variation						
	d	l	C_a	C_{0a}		L_t-L	L_t	L_a	L_o	T	e_p	V_u	C	(N·cm) *1	(kg)	Fixed-Simple	(cm^3)	(cm^3)
USS1205N1D0221	12	5	3 200	5 860	100	130	160	175	221	0	0.010	0.008	0.035	0.2–1.8	0.3	5 000	1.0	0.5
USS1205N1D0321					200	230	260	275	321		0.012	0.008	0.045	0.2–2.0	0.3			
USS1205N1D0621					500	530	560	575	621		0.016	0.012	0.070	0.2–3.0	0.7			

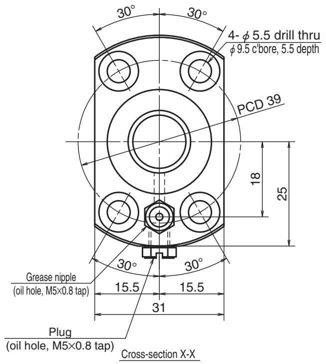
Notes: 1. Indicates ball screw preload control value. Approximately 0.5 N·cm of torque is added due to thin plastic seals.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0 to 80°C.
4. Use of NSK support unit is recommended. See page B375 for details.

Screw shaft ø15

Lead 5

Unit: mm





Cross-section X-X

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	C3 / 0
Factory-packed grease	NSK grease LR2

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK12-01B (low-profile, square)	WBK12S-01B (low-profile, square)
WBK12-11 (round)	WBK12S-01C (square, clean)
WBK12-01C (square, clean)	
WBK12-11C (round, clean)	

Unit: mm

Ball screw No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Screw shaft dimensions			Lead accuracy			Shaft run-out	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *2	Internal spatial volume of nut	Standard volume of grease replenishing
			Dynamic	Static	Nominal	Max.				Target value	Error	Variation						
	d	l	C_a	C_{0a}		L_t-L	L_t	L_a	L_o	T	e_p	V_u	C	(N·cm) *1	(kg)	Fixed-Simple	(cm^3)	(cm^3)
USS1505N1D0261	15	5	5 460	10 200	100	159	189	204	261	0	0.010	0.008	0.025	0.2–5.0	0.5	5 000	2.0	1.0
USS1505N1D0361					200	259	289	304	361		0.012	0.008	0.035	0.2–5.0	0.6	5 000		
USS1505N1D0561					400	459	489	504	561		0.015	0.010	0.045	0.2–6.0	0.9	5 000		
USS1505N1D0761					600	659	689	704	761		0.018	0.013	0.060	0.2–8.0	1.1	3 600		

Notes: 1. Indicates ball screw preload control value. Approximately 0.5 N·cm of torque is added due to thin plastic seals.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0 to 80°C.
4. Use of NSK support unit is recommended. See page B375 for details.

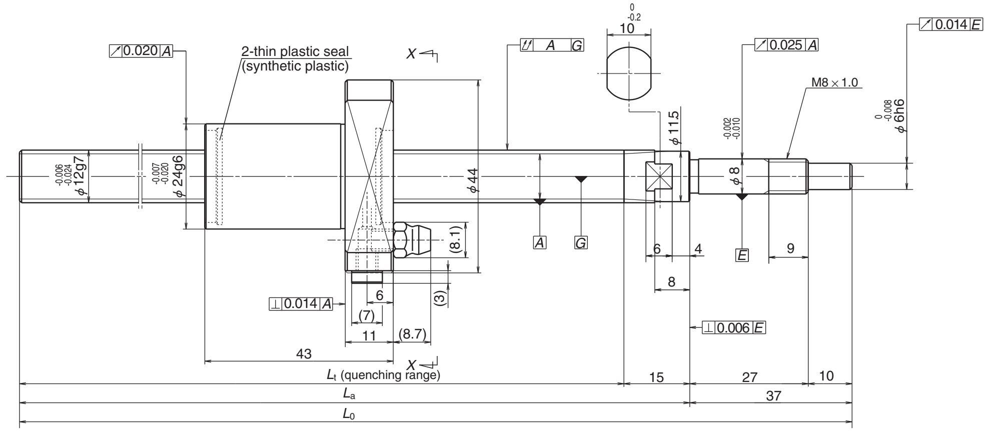
Compact FA FSS Type (Medium lead)

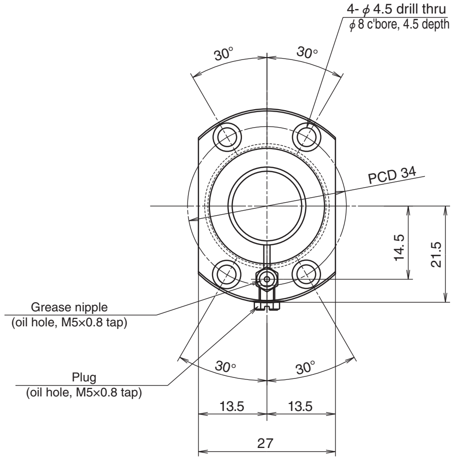
Nut model: BSS

Screw shaft ø12

Lead 10

Unit: mm





Ball screw specification	
Ball diameter/screw shaft root diameter	2.000 / 10.2
Accuracy grade/axial play	Ct7 / 0.010 or less
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK08-01B (low-profile, square)	WBK12SF-01B (low-profile, square)

Unit: mm

Ball screw No.	Screw shaft diameter	Lead	Basic load ratings (N)		Screw shaft dimensions			Lead accuracy			Shaft run-out	Mass	Internal spatial volume of nut	Standard volume of grease replenishing
			Dynamic	Static				Target value	Error	Variation				
	d	l	C_a	C_{0a}	L_t	L_a	L_o	T	e_p	V_{300}	A	(kg)	(cm^3)	(cm^3)
FSS1210N1D0400	12	10	3 200	5 860	348	363	400	0	0.120	0.052	0.080	0.5	1.0	0.5
FSS1210N1D0600					548	563	600		0.195		0.120	0.7		
FSS1210N1D0900					848	863	900		0.310		0.180	1.0		

Notes:1. Indicates ball screw preload control value. Approximately 2.0 N·cm of torque is added due to thin plastic seals.
2. Service temperature range is 0 to 80°C.
3. Use of NSK support unit is recommended. See page B375 for details.
4. Permissible rotational speed varies when using cut screw shaft. It is necessary to calculate two items below, and whichever smaller is the permissible rotational speed.
*Critical speed which is the resonance vibration of the shaft (page B47).
*Maximum rotational speed 5 000 min^{-1}

Compact FA FSS Type (Medium, High helix lead)

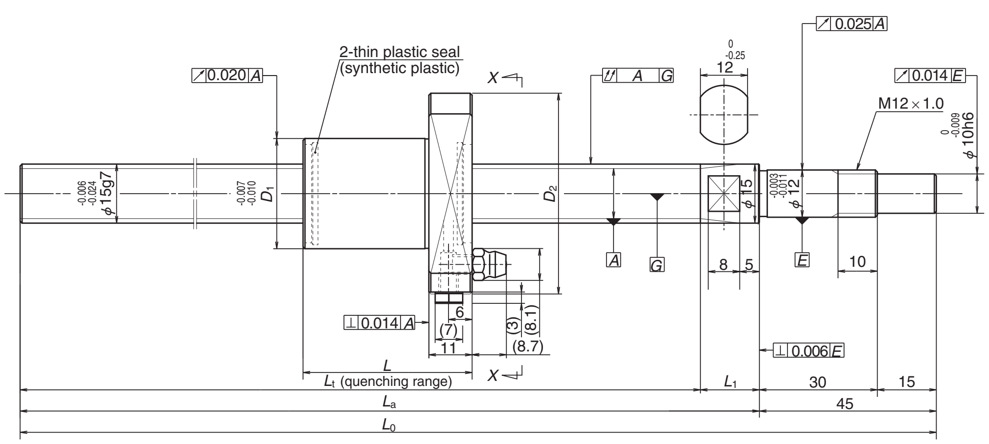
Nut model: BSS

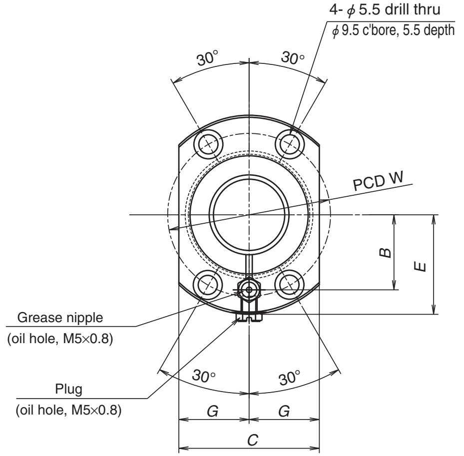
NSK

Screw shaft ø15

Lead 10, 20

Unit: mm





Ball screw specification		
Lead	10	20
Ball diameter/screw shaft root diameter	2.278 / 12.6	3.175 / 12.2
Accuracy grade/axial play	Ct7 / 0.010 or less	
Factory-packed grease	NSK grease LR3	

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK12-01B (low-profile, square)	WBK15SF-01B (low-profile, square)

Unit: mm

Ball screw No.	Screw shaft diameter	Lead	Basic load ratings (N)		Screw shaft dimensions				Nut dimensions								Lead accuracy			Shaft run-out	Mass	Internal spatial volume of nut	Standard volume of grease replenishing
			Dynamic	Static													Target value	Error	Variation				
	d	l	C_a	C_{0a}	L_t	L_a	L_o	L_1	L	D_1	D_2	W	B	C	E	G	T	e_p	V_{300}	A	(kg)	(cm³)	(cm³)
FSS1510N1D0500	15	10	5 460	10 200	440	455	500	15	43	28	51	39	18	31	25	15.5	0	0.155	0.052	0.070	0.9	2.0	1.0
FSS1510N1D1000					940	955	1 000											0.310		0.125	1.7		
FSS1510N1D1450					1 390	1 405	1 450											0.490		0.200	2.3		
FSS1520N1D0500		20	5 070	8 730	437	455	500	18	51	32	55	43	20	33	27	16.5		0.155		0.070	1.0	2.8	1.4
FSS1520N1D1000					937	955	1 000											0.310		0.125	1.7		
FSS1520N1D1450					1 387	1 405	1 450											0.490		0.200	2.3		

Notes:
1. Indicates ball screw preload control value. Approximately 2.0 N·cm of torque is added due to thin plastic seals.
2. Service temperature range is 0 to 80°C.
3. Use of NSK support unit is recommended. See page B375 for details.
4. Permissible rotational speed varies when using cut screw shaft. It is necessary to calculate two items below, and whichever smaller is the permissible rotational speed.

*Critical speed which is the resonance vibration of the shaft (page B47).

*Maximum rotational speed 5 000 min^{-1}

Compact FA FSS Type (Medium, High helix lead)

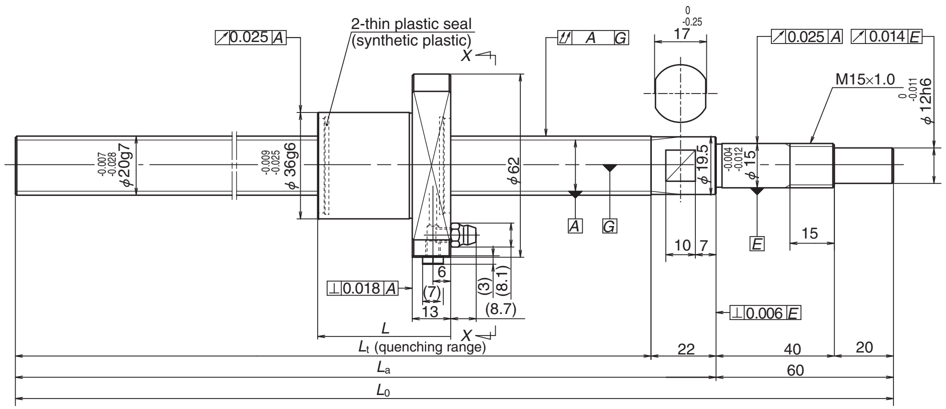
Nut model: BSS

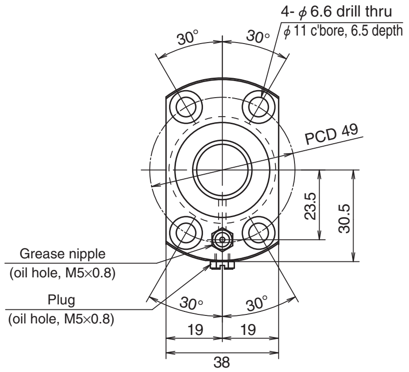
NSK

Screw shaft ø20

Lead 10, 20

Unit: mm





Ball screw specification	
Ball diameter/screw shaft root diameter	3.175 / 17.2
Accuracy grade/axial play	Ct7 / 0.010 or less
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK15-01B (low-profile, square)	WBK20SF-01B (low-profile, square)

Unit: mm

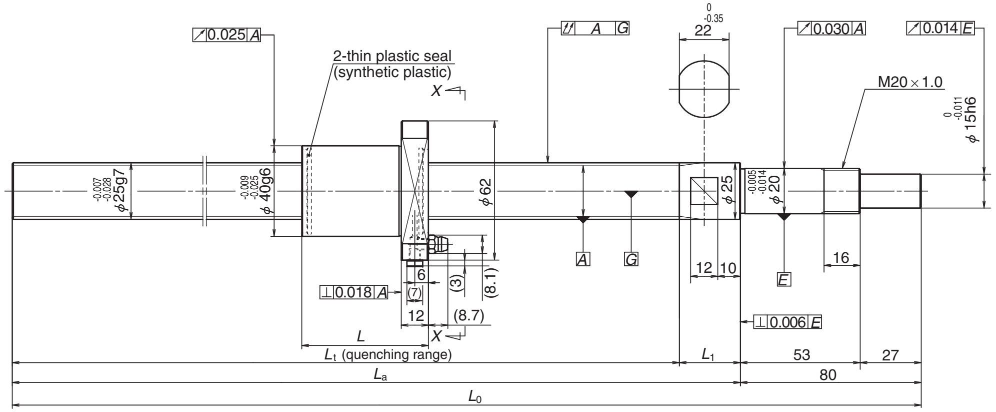
Ball screw No.	Screw shaft diameter	Lead	Basic load ratings (N)		Screw shaft dimensions			Nut length	Lead accuracy			Shaft run-out	Mass	Internal spatial volume of nut	Standard volume of grease replenishing
			Dynamic	Static					Target value	Error	Variation				
	d	l	C_a	C_{0a}	L_t	L_a	L_o	L	T	e_p	V_{300}	A	(kg)	(cm^3)	(cm^3)
FSS2010N1D0600	20	10	8 790	18 500	518	540	600	45	0	0.195	0.052	0.085	1.7	3.2	1.6
FSS2010N1D1000					918	940	1 000			0.310		0.125	2.6		
FSS2010N1D1450					1 368	1 390	1 450			0.490		0.200	3.6		
FSS2020N1D0600		20	5 900	1 1700	518	540	600	54		0.195		0.085	1.8		
FSS2020N1D1000					918	940	1 000			0.310		0.125	2.7		
FSS2020N1D1450					1 368	1 390	1 450			0.490		0.200	3.8		

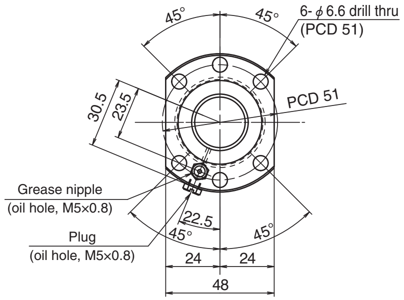
Notes: 1. Indicates ball screw preload control value. Approximately 2.0 N·cm of torque is added due to thin plastic seals.
2. Service temperature range is 0 to 80°C.
3. Use of NSK support unit is recommended. See page B375 for details.
4. Permissible rotational speed varies when using cut screw shaft. It is necessary to calculate two items below, and whichever smaller is the permissible rotational speed.
*Critical speed which is the resonance vibration of the shaft (page B47).
*Maximum rotational speed 5 000 min^{-1}

Screw shaft ø25

Lead 10, 20, 25

Unit: mm





Ball screw specification	
Ball diameter/screw shaft root diameter	3.175 / 22.2
Accuracy grade/axial play	Ct7 / 0.010 or less
Factory-packed grease	NSK grease LR3

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK20-01 (square)	WBK25SF-01 (square)

Unit: mm

Ball screw No.	Screw shaft diameter	Lead	Basic load ratings (N)		Screw shaft dimensions				Nut length	Lead accuracy			Shaft run-out	Mass	Internal spatial volume of nut	Standard volume of grease replenishing
			Dynamic	Static						Target value	Error	Variation				
	d	l	C_a	C_{0a}	L_t	L_a	L_0	L_1	L	T	e_p	V_{300}	A	(kg)	(cm^3)	(cm^3)
FSS2510N1D0600	25	10	12 800	32 300	493	520	600	27	56	0	0.155	0.052	0.065	2.6	4.7	2.4
FSS2510N1D1000					893	920	1 000				0.310		0.090	4.0		
FSS2510N1D1450					1 343	1 370	1 450				0.490		0.130	5.8		
FSS2520N1D0600		20	6 560	1 4600	494	520	600	26	54		0.155		0.065	2.6	3.9	2.0
FSS2520N1D1000					894	920	1 000				0.310		0.090	4.0		
FSS2520N1D1450					1 344	1 370	1 450				0.490		0.130	5.8		
FSS2525N1D0600		25	6 560	1 4600	490	520	600	30	63		0.155		0.065	2.6	4.3	2.2
FSS2525N1D1000					890	920	1 000				0.310		0.090	4.1		
FSS2525N1D1450					1 340	1 370	1 450				0.490		0.130	5.8		

Notes: 1. Indicates ball screw preload control value. Approximately 2.0 N·cm of torque is added due to thin plastic seals.
2. Service temperature range is 0 to 80°C.
3. Use of NSK support unit is recommended. See page B375 for details.
4. Permissible rotational speed varies when using cut screw shaft. It is necessary to calculate two items below, and whichever smaller is the permissible rotational speed.
*Critical speed which is the resonance vibration of the shaft (page B47).
*Maximum rotational speed 5 000 min^{-1}

B-3-1.2 Finished Shaft End MA type, FA type, SA type

1. Order of the dimension tables

The tables begin 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.

2. 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_1).

●Lead accuracy

Lead accuracy is either C3 or C5 grades

T : Travel compensation

e_p : Tolerance on specified travel

ν_u : Travel variation

See "Technical Description: Lead Accuracy" (page B37) 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, the d·n and critical speed, will determine the overall permissible rotational speed of the ball screw. For details, see "Technical Description: Permissible Rotational Speed" (page B47).

3. 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, see pages B70 and D2. For lubricants, see pages B67 and D13.

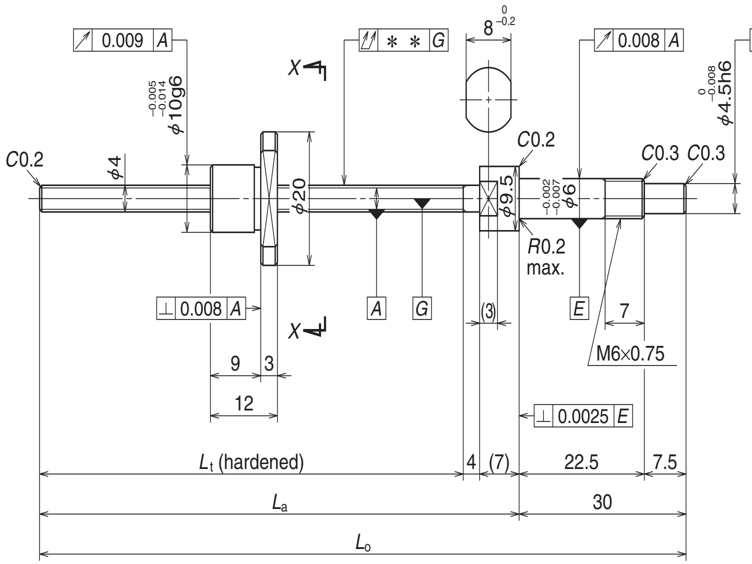
Note: For details of standard stock products, contact NSK.

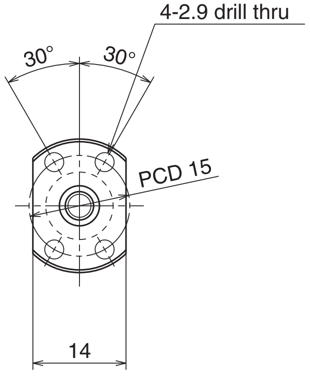
Table 1 Combinations of screw shaft diameter and lead

Lead (mm) / Screw shaft diameter (mm)	1	1.5	2	2.5	4	5	6	8	10	12	16	20	25	32	40	50
4	B145															
6	B147															
8	B149	B151	B153													
10			B155	B157	B167											
12			B159	B161		B169			B171							
14						B173		B175								
15									B177			B179				
16			B163	B165		B181					B183			B185		
20					B203	B205			B187			B189			B191	
25					B207	B209	B211		B213			B193	B195			B197
28						B215	B219									
						B217	B221									
32						B223	B227	B231	B233				B199	B201		
						B225	B229		B235							
36									B237							
									B239							
40						B241		B243	B245	B249						
									B247	B251						
45									B253							
50									B255							
									B257							

Screw shaft ø4

Lead 1





View *X-X*

Unit: mm

Ball screw specifications

Product classification	Preloaded	Precise clearance
Shaft dia. × 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	
Basic load rating (N) Static C_{0a}	370	
Axial play	0	0.005 or less
Preload (N)	19.6	—
Dynamic friction torque, (N·cm)	1.0 or less	0.3 or less
Spacer ball	None	
Factory-packed grease	NSK grease PS2	

Recommended support unit

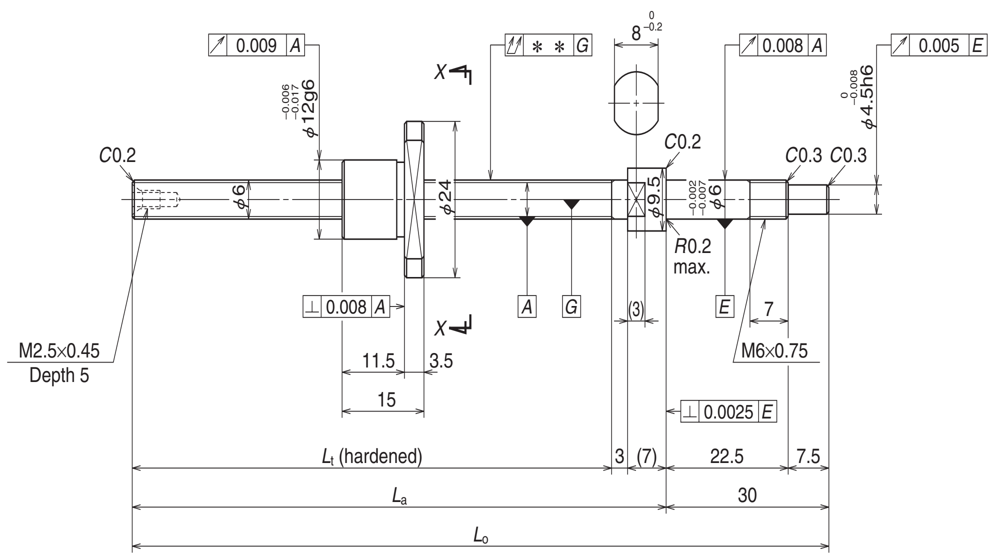
For drive side (Fixed)
WBK06-01A (square)
WBK06-11 (round)

Unit: mm

Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ↗↗	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Free
W0400MA-1PY-C3Z1	**W0400MA-2Y-C3T1**	20	32	44	55	85	0	0.008	0.008	0.015	0.024	3 000
W0400MA-3PY-C3Z1	**W0400MA-4Y-C3T1**	40	52	64	75	105	0	0.008	0.008	0.020	0.026	3 000
W0401MA-1PY-C3Z1	**W0401MA-2Y-C3T1**	70	82	94	105	135	0	0.008	0.008	0.025	0.028	3 000

Notes: 1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease PS2 is recommended. Apply to screw shaft surface when replenishing. See page D16 for details.
3. Ball nut does not have seal.
4. Contact NSK if the permissible rotational speed is to be exceeded.

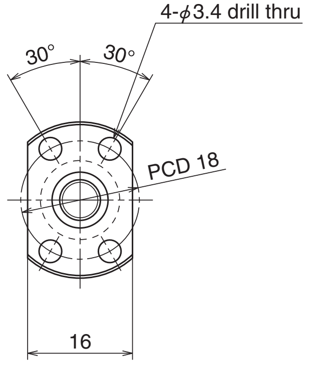
Finished shaft end MA Type (Fine lead)



Nut models: MPFD, MSFD

Screw shaft ø6

Lead 1



View X-X

Unit: mm

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		6 × 1 / Right	
Preload / Ball recirculation		P-preload / Deflector	
Ball dia. / Ball circle dia.		0.800 / 6.2	
Screw shaft root diameter		5.2	
Effective turns of balls		1 × 3	
Accuracy grade / Preload / Axial play		C3 / Z	C3 / T
Basic load rating (N)	Dynamic C_a	575	
	Static C_{0a}	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

For drive side (Fixed)
WBK06-01A (square)
WBK06-11 (round)

Unit: mm

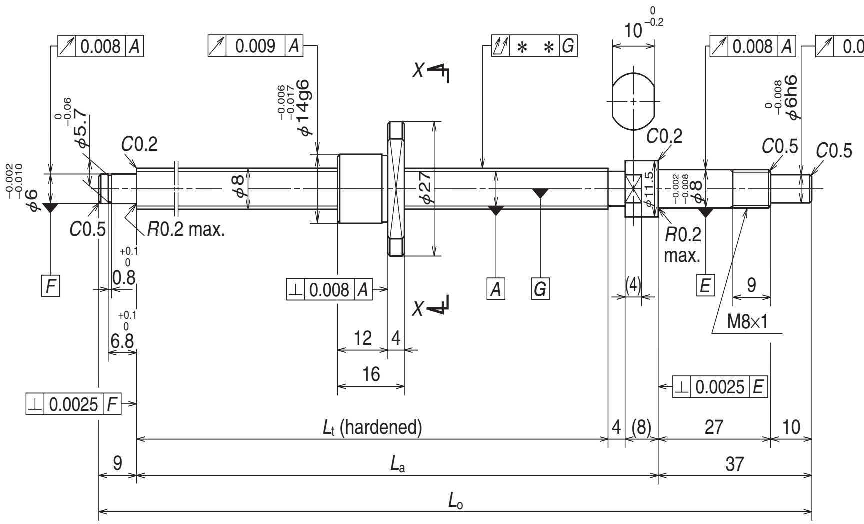
Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ↗	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Free
W0600MA-1PY-C3Z1	**W0600MA-2Y-C3T1**	40	50	65	75	105	0	0.008	0.008	0.015	0.039	3 000
W0601MA-1PY-C3Z1	**W0601MA-2Y-C3T1**	70	80	95	105	135	0	0.008	0.008	0.020	0.045	3 000
W0601MA-3PY-C3Z1	**W0601MA-4Y-C3T1**	100	110	125	135	165	0	0.010	0.008	0.025	0.051	3 000

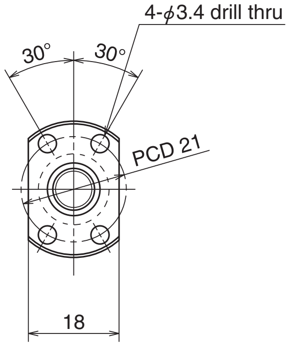
Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease PS2 is recommended. Apply to screw shaft surface when replenishing. See page D16 for details.
3. Ball nut does not have seal.
4. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø8

Lead 1

Unit: mm





View X-X

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}	1 290	
Axial play		0	0.005 or less
Preload (N)		29.4	—
Dynamic friction torque, (N·cm)		1.8 or less	0.5 or less
Spacer ball		None	
Factory-packed grease		NSK grease PS2	

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK08-01A (square)	WBK08S-01 (square)
WBK08-11 (round)	

Unit: mm

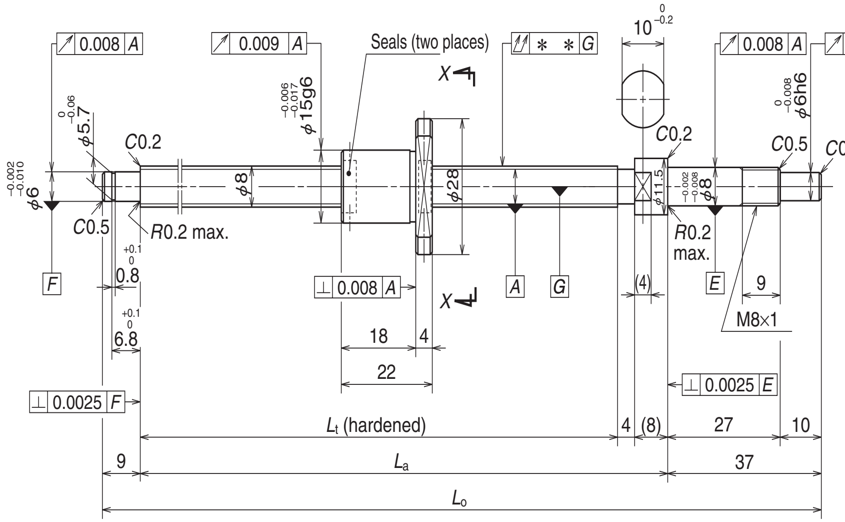
Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Supporting condition Fixed - Simple support
W0800MA-1PY-C3Z1	**W0800MA-2Y-C3T1**	40	64	80	92	138	0	0.008	0.008	0.025	0.073	3 000
W0801MA-1PY-C3Z1	**W0801MA-2Y-C3T1**	70	94	110	122	168	0	0.010	0.008	0.030	0.084	3 000
W0801MA-3PY-C3Z1	**W0801MA-4Y-C3T1**	100	124	140	152	198	0	0.010	0.008	0.030	0.095	3 000
W0802MA-1PY-C3Z1	**W0802MA-2Y-C3T1**	150	174	190	202	248	0	0.010	0.008	0.035	0.11	3 000

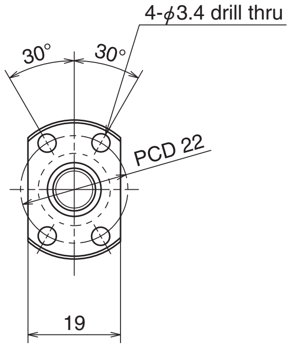
Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease PS2 is recommended. Apply to screw shaft surface when replenishing. See page D16 for details.
3. Ball nut does not have seal.
4. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø8

Lead 1.5

Unit: mm





View *X-X*

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	1 080	
Basic load rating (N) Static C_{0a}	1 980	
Axial play	0	0.005 or less
Preload (N)	49.0	—
Dynamic friction torque, (N·cm)	2.0 or less	0.5 or less
Spacer ball	None	
Factory-packed grease	NSK grease PS2	

Recommended support unit

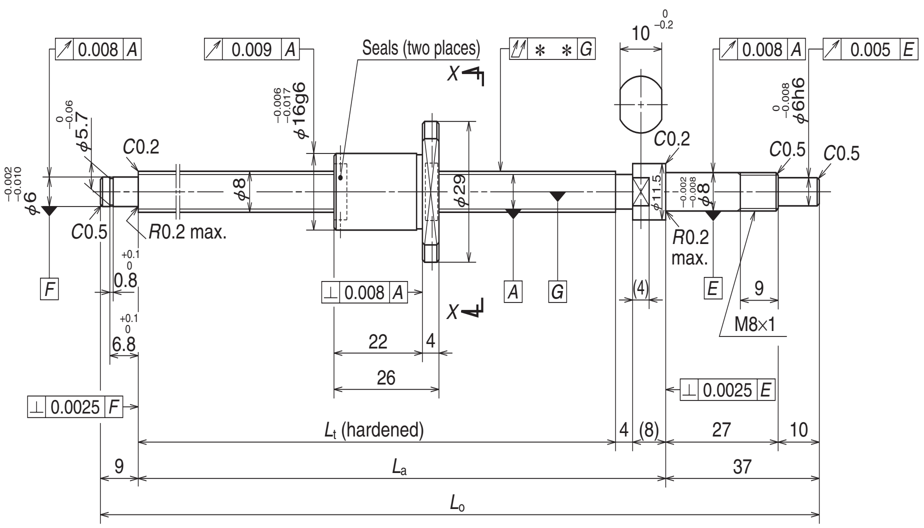
For drive side (Fixed)	For opposite to drive side (Simple)
WBK08-01A (square)	WBK08S-01 (square)
WBK08-11 (round)	

Unit: mm

Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ↗↗	Mass (kg)	Permissible rotational speed N (min^{-1})
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Supporting condition Fixed - Simple support
W0800MA-3PY-C3Z1.5	**W0800MA-4Y-C3T1.5**	40	58	80	92	138	0	0.008	0.008	0.025	0.082	3 000
W0801MA-5PY-C3Z1.5	**W0801MA-6Y-C3T1.5**	70	88	110	122	168	0	0.010	0.008	0.030	0.093	3 000
W0801MA-7PY-C3Z1.5	**W0801MA-8Y-C3T1.5**	100	118	140	152	198	0	0.010	0.008	0.030	0.10	3 000
W0802MA-3PY-C3Z1.5	**W0802MA-4Y-C3T1.5**	150	168	190	202	248	0	0.010	0.008	0.035	0.12	3 000

Notes: 1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease PS2 is recommended. Apply to screw shaft surface when replenishing. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Finished shaft end MA Type (Fine lead)

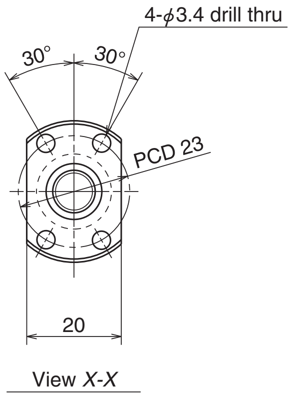


Nut models: MPFD, MSFD

NSK

Screw shaft ø8

Lead 2



View *X*-*X*

Unit: mm

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. × 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	1 320	
	Static C_{0a}	2 210	
Axial play		0	0.005 or less
Preload (N)		49.0	—
Dynamic friction torque, (N·cm)		2.0 or less	0.5 or less
Spacer ball		None	
Factory-packed grease		NSK grease PS2	

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK08-01A (square)	WBK08S-01 (square)
WBK08-11 (round)	

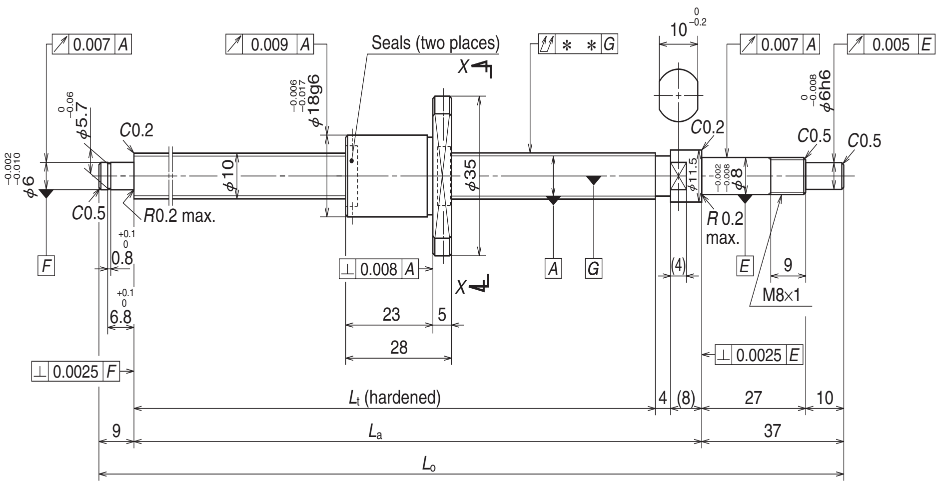
MA

Ball screw No.		Stroke	
		Nominal	Maximum (L_t—Nut length)
Preloaded (MPFD)	Precise clearance (MSFD)		
W0800MA-5PY-C3Z2	**W0800MA-6Y-C3T2**	40	54
W0801MA-9PY-C3Z2	**W0801MA-10Y-C3T2**	70	84
W0801MA-11PY-C3Z2	**W0801MA-12Y-C3T2**	100	114
W0802MA-5PY-C3Z2	**W0802MA-6Y-C3T2**	150	164

Unit: mm

Screw shaft length			Lead accuracy			Shaft run-out ** ↗	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition
L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support
80	92	138	0	0.008	0.008	0.025	0.09	3 000
110	122	168	0	0.010	0.008	0.030	0.10	3 000
140	152	198	0	0.010	0.008	0.030	0.11	3 000
190	202	248	0	0.010	0.008	0.035	0.13	3 000

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease PS2 is recommended. Apply to screw shaft surface when replenishing. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.



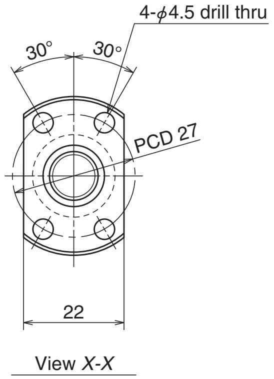
Ball screw No.		Stroke	
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum (L_t—Nut length)
W1001MA-1PY-C3Z2	**W1001MA-2Y-C3T2**	50	72
W1001MA-3PY-C3Z2	**W1001MA-4Y-C3T2**	100	122
W1002MA-1PY-C3Z2	**W1002MA-2Y-C3T2**	150	172
W1002MA-3PY-C3Z2	**W1002MA-4Y-C3T2**	200	222

Notes: 1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease PS2 is recommended. Apply to screw shaft surface when replenishing. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø10

Lead 2

Unit: mm



View X-X

Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		10 × 2 / Right	
Preload / Ball recirculation		P-preload / Deflector	
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	1 490	
	Static C_{0a}	2 850	
Axial play		0	0.005 or less
Preload (N)		58.8	—
Dynamic friction torque, (N·cm)		0.1 – 2.4	0.5 or less
Spacer ball		None	
Factory-packed grease		NSK grease PS2	

Recommended support unit

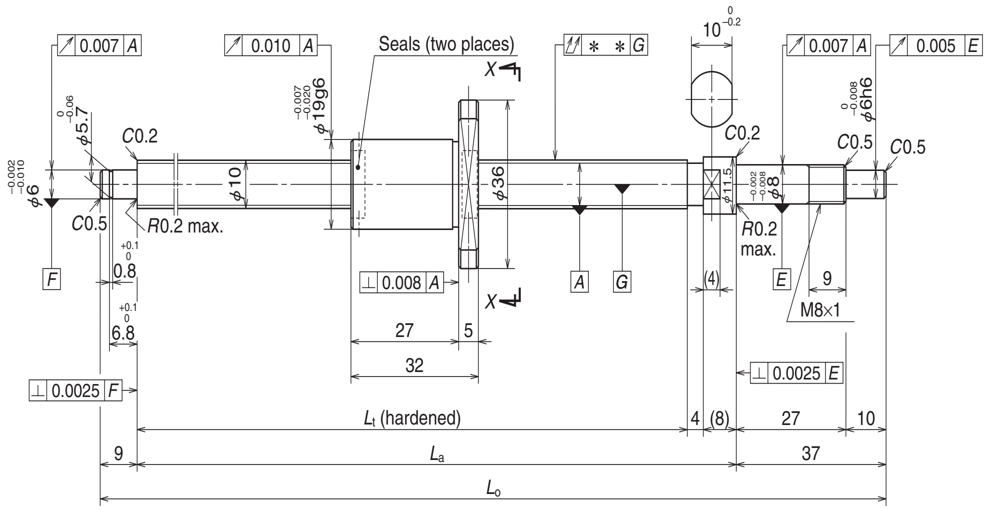
For drive side (Fixed)	For opposite to drive side (Simple)
WBK08-01A (square)	WBK08S-01 (square)
WBK08-11 (round)	

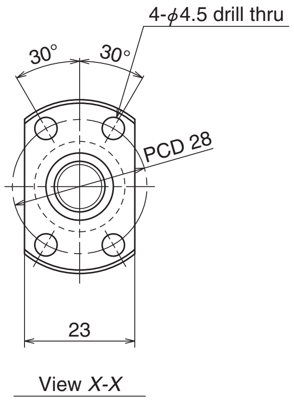
Unit: mm

Screw shaft length			Lead accuracy			Shaft run-out ** ↑↓	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition
L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support
100	112	158	0	0.008	0.008	0.020	0.13	3 000
150	162	208	0	0.010	0.008	0.030	0.16	3 000
200	212	258	0	0.010	0.008	0.030	0.19	3 000
250	262	308	0	0.012	0.008	0.030	0.22	3 000

Screw shaft ø10

Lead 2.5





View *X*-*X*

Unit: mm

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		10 × 2.5 / 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		1 × 3	
Accuracy grade / Preload / Axial play		C3 / Z	C3 / T
Basic load rating (N)	Dynamic C_a	2 130	
	Static C_{0a}	3 640	
Axial play		0	0.005 or less
Preload (N)		98.1	—
Dynamic friction torque, (N·cm)		0.2 – 2.9	0.5 or less
Spacer ball		None	
Factory-packed grease		NSK grease PS2	

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK08-01A (square)	WBK08S-01 (square)
WBK08-11 (round)	

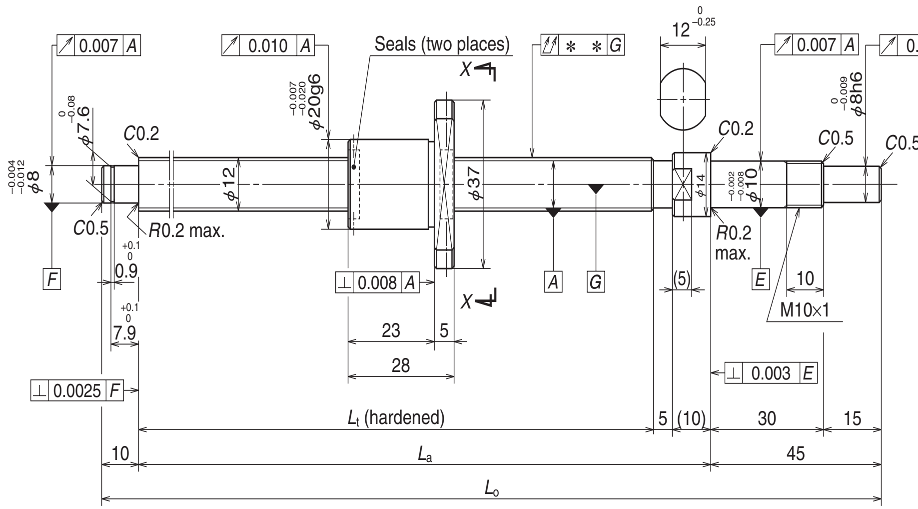
Unit: mm

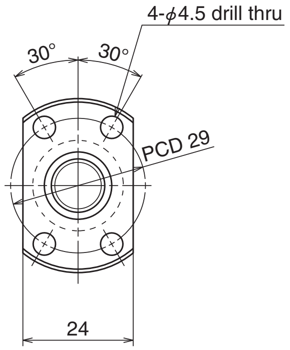
Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ↗↗	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support
W1001MA-5PY-C3Z2.5	**W1001MA-6Y-C3T2.5**	50	68	100	112	158	0	0.008	0.008	0.020	0.14	3 000
W1001MA-7PY-C3Z2.5	**W1001MA-8Y-C3T2.5**	100	118	150	162	208	0	0.010	0.008	0.030	0.17	3 000
W1002MA-5PY-C3Z2.5	**W1002MA-6Y-C3T2.5**	150	168	200	212	258	0	0.010	0.008	0.030	0.20	3 000
W1002MA-7PY-C3Z2.5	**W1002MA-8Y-C3T2.5**	200	218	250	262	308	0	0.012	0.008	0.030	0.23	3 000

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease PS2 is recommended. Apply to screw shaft surface when replenishing. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø12

Lead 2





View *X-X*

Unit: mm

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_a	1 660	
	Static C_{0a}	3 620	
Axial play		0	0.005 or less
Preload (N)		98.1	—
Dynamic friction torque, (N·cm)		0.4 – 3.4	1.0 or less
Spacer ball		None	
Factory-packed grease		NSK grease PS2	

Recommended support unit

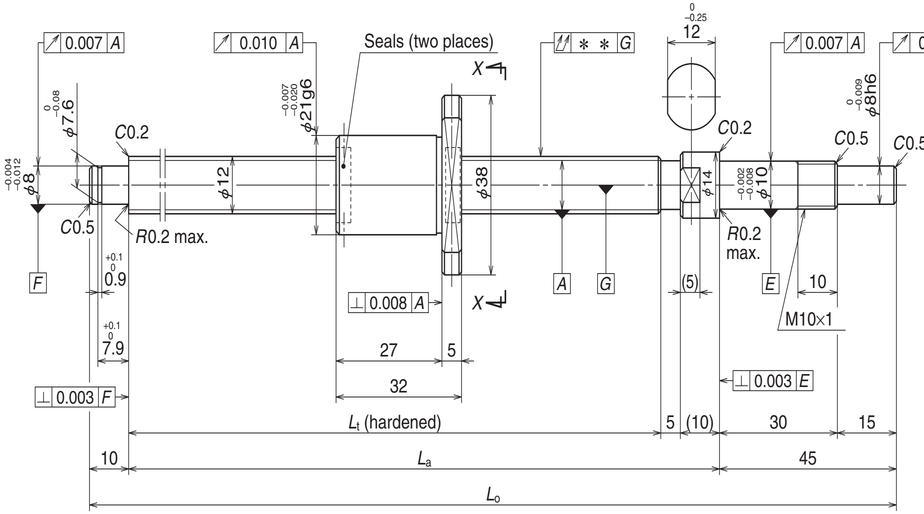
For drive side (Fixed)	For opposite to drive side (Simple)
WBK10-01A (square)	WBK10S-01 (square)
WBK10-11 (round)	

Unit: mm

Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ↗↗	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support
W1201MA-1PY-C3Z2	**W1201MA-2Y-C3T2**	50	82	110	125	180	0	0.010	0.008	0.020	0.20	3 000
W1201MA-3PY-C3Z2	**W1201MA-4Y-C3T2**	100	132	160	175	230	0	0.010	0.008	0.030	0.24	3 000
W1202MA-1PY-C3Z2	**W1202MA-2Y-C3T2**	150	182	210	225	280	0	0.012	0.008	0.030	0.28	3 000
W1202MA-3PY-C3Z2	**W1202MA-4Y-C3T2**	200	232	260	275	330	0	0.012	0.008	0.040	0.32	3 000
W1203MA-1PY-C3Z2	**W1203MA-2Y-C3T2**	250	282	310	325	380	0	0.012	0.008	0.040	0.36	3 000

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease PS2 is recommended. Apply to screw shaft surface when replenishing. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Finished shaft end MA Type (Fine lead)

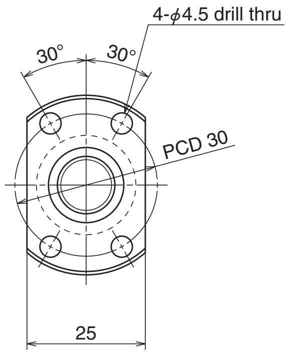


Nut models: MPFD, MSFD

Screw shaft ø12

Lead 2.5

Unit: mm



View *X-X*

Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		12 × 2.5 / Right	
Preload / Ball recirculation		P-preload / Deflector	
Ball dia. / Ball circle dia.		1.588 / 12.4	
Screw shaft root diameter		10.6	
Effective turns of balls		1 × 3	
Accuracy grade / Preload / Axial play		C3 / Z	C3 / T
Basic load rating (N)	Dynamic C_a	2 360	
	Static C_{0a}	4 540	
Axial play		0	0.005 or less
Preload (N)		98.1	—
Dynamic friction torque, (N·cm)		0.4 – 3.4	1.0 or less
Spacer ball		None	
Factory-packed grease		NSK grease PS2	

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK10-01A (square)	WBK10S-01 (square)
WBK10-11 (round)	

Unit: mm

Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)
		Nominal	Maximum (L_t—Nut length)									Supporting condition
Preloaded (MPFD)	Precise clearance (MSFD)			L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support
W1201MA-5PY-C3Z2.5	**W1201MA-6Y-C3T2.5**	50	78	110	125	180	0	0.010	0.008	0.020	0.21	3 000
W1201MA-7PY-C3Z2.5	**W1201MA-8Y-C3T2.5**	100	128	160	175	230	0	0.010	0.008	0.030	0.25	3 000
W1202MA-5PY-C3Z2.5	**W1202MA-6Y-C3T2.5**	150	178	210	225	280	0	0.012	0.008	0.030	0.29	3 000
W1202MA-7PY-C3Z2.5	**W1202MA-8Y-C3T2.5**	200	228	260	275	330	0	0.012	0.008	0.040	0.33	3 000
W1203MA-3PY-C3Z2.5	**W1203MA-4Y-C3T2.5**	250	278	310	325	380	0	0.012	0.008	0.040	0.37	3 000

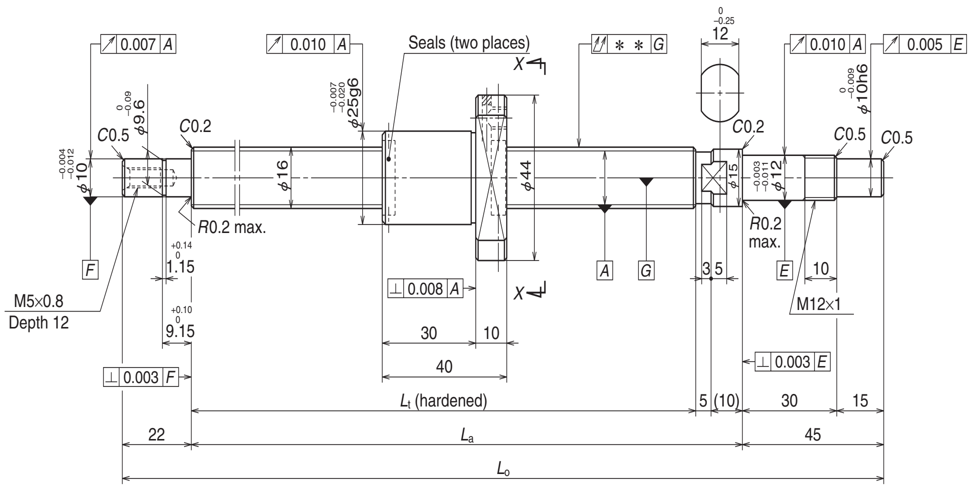
Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease PS2 is recommended. Apply to screw shaft surface when replenishing. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

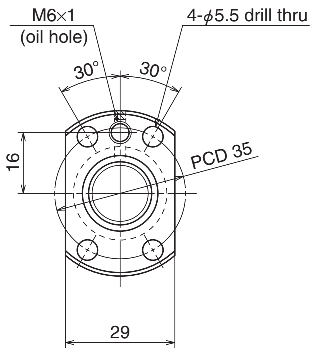
Finished shaft end MA Type (Fine lead)

Nut models: MPFD, MSFD

Screw shaft ø16

Lead 2





View X-X

Unit: mm

Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		16 × 2 / 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		1 × 4	
Accuracy grade / Preload / Axial play		C3 / Z	C3 / T
Basic load rating (N)	Dynamic C_a	3 510	
	Static C_{0a}	8 450	
Axial play		0	0.005 or less
Preload (N)		147	—
Dynamic friction torque, (N·cm)		0.5 – 4.9	1.5 or less
Spacer ball		None	
Factory-packed grease		NSK grease PS2	
Internal spatial volume of nut (cm^3)		1.6	
Standard volume of grease replenishing (cm^3)		0.8	

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

Unit: mm

Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ⌰	Mass (kg)	Permissible rotational speed N (min^{-1})	
												Supporting condition	
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W1601MA-1PY-C3Z2	**W1601MA-2Y-C3T2**	50	99	139	154	221	0	0.010	0.008	0.020	0.41	3 000	3 000
W1601MA-3PY-C3Z2	**W1601MA-4Y-C3T2**	100	149	189	204	271	0	0.010	0.008	0.020	0.48	3 000	3 000
W1602MA-1PY-C3Z2	**W1602MA-2Y-C3T2**	150	199	239	254	321	0	0.012	0.008	0.030	0.55	3 000	3 000
W1602MA-3PY-C3Z2	**W1602MA-4Y-C3T2**	200	249	289	304	371	0	0.012	0.008	0.030	0.62	3 000	3 000
W1603MA-1PY-C3Z2	**W1603MA-2Y-C3T2**	300	349	389	404	471	0	0.013	0.010	0.035	0.77	3 000	3 000

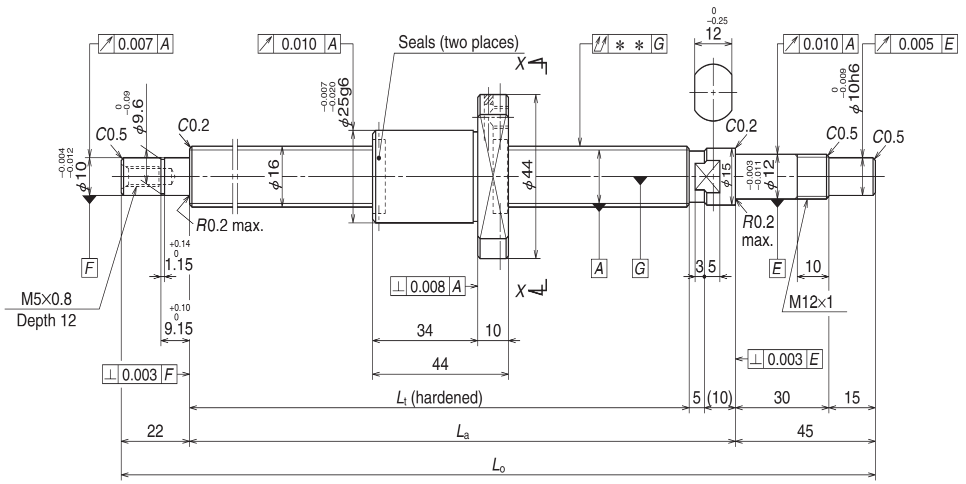
Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease PS2 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

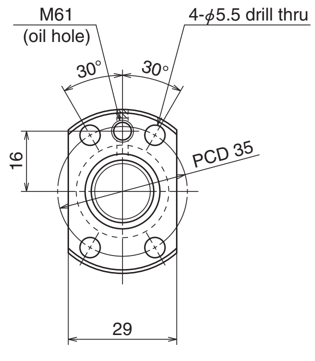
Finished shaft end MA Type (Fine lead)

Nut models: MPFD, MSFD

NSK

Screw shaft ø16
Lead 2.5





View *X-X*

Unit: mm

Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		16 × 2.5 / Right	
Preload / Ball recirculation		P-preload / Deflector	
Ball dia. / Ball circle dia.		1.588 / 16.4	
Screw shaft root diameter		14.6	
Effective turns of balls		1 × 4	
Accuracy grade / Preload / Axial play		C3 / Z	C3 / T
Basic load rating (N)	Dynamic C_a	3 510	
	Static C_{0a}	8 450	
Axial play		0	0.005 or less
Preload (N)		147	—
Dynamic friction torque, (N·cm)		0.5 – 4.9	1.5 or less
Spacer ball		None	
Factory-packed grease		NSK grease PS2	
Internal spatial volume of nut (cm^3)		1.6	
Standard volume of grease replenishing (cm^3)		0.8	

Recommended support unit

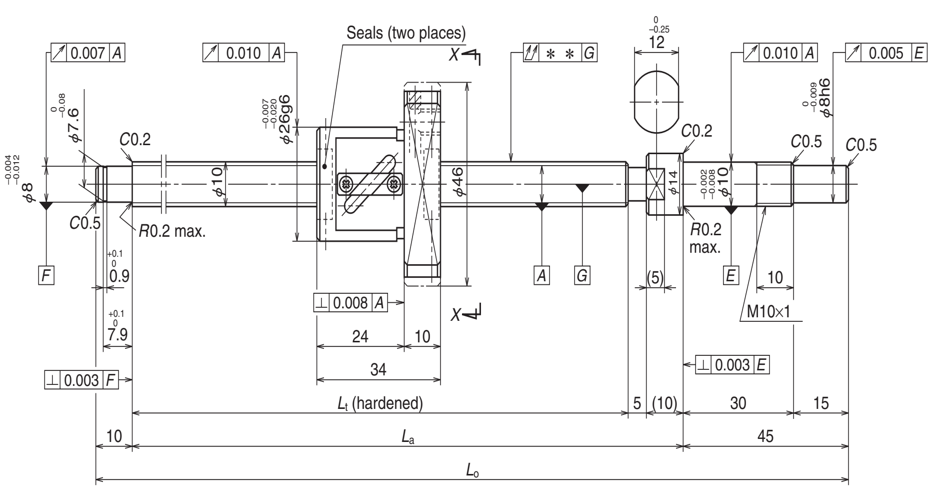
For drive side (Fixed)	For opposite to drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

Unit: mm

Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})	
		Nominal	Maximum (L_t—Nut length)									Supporting condition	
Preloaded (MPFD)	Precise clearance (MSFD)			L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W1601MA-5PY-C3Z2.5	**W1601MA-6Y-C3T2.5**	50	95	139	154	221	0	0.010	0.008	0.020	0.42	3 000	3 000
W1601MA-7PY-C3Z2.5	**W1601MA-8Y-C3T2.5**	100	145	189	204	271	0	0.010	0.008	0.020	0.49	3 000	3 000
W1602MA-5PY-C3Z2.5	**W1602MA-6Y-C3T2.5**	150	195	239	254	321	0	0.012	0.008	0.030	0.57	3 000	3 000
W1602MA-7PY-C3Z2.5	**W1602MA-8Y-C3T2.5**	200	245	289	304	371	0	0.012	0.008	0.030	0.64	3 000	3 000
W1603MA-3PY-C3Z2.5	**W1603MA-4Y-C3T2.5**	300	345	389	404	471	0	0.013	0.010	0.035	0.79	3 000	3 000

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease PS2 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

Finished shaft end FA Type (Fine lead)

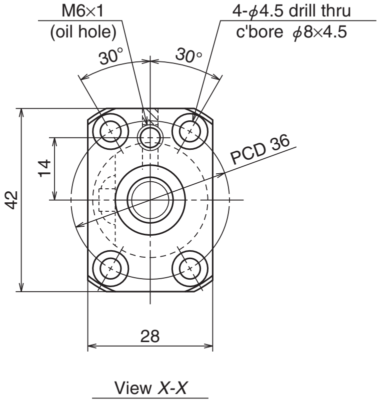


Nut models: PFT, SFT

Screw shaft ø10

Lead 4

Unit: mm



Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		10 × 4 / Right	
Preload / Ball recirculation		P-preload / Return tube	
Ball dia. / Ball circle dia.		2.000 / 10.3	
Screw shaft root diameter		8.2	
Effective turns of balls		2.5 × 1	
Accuracy grade / Preload / Axial play		C3 / Z	C3 / T
Basic load rating (N)	Dynamic C_a	1 730	2 740
	Static C_{0a}	2 230	4 450
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^3)		0.8	
Standard volume of grease replenishing (cm^3)		0.4	

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK10-01A (square)	WBK10S-01 (square)
WBK10-11 (round)	

Unit: mm

Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ∗∗ ↗	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition
Preloaded (PFT)	Precise clearance (SFT)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support
W1001FA-1P-C3Z4	**W1001FA-2-C3T4**	50	76	110	125	180	0	0.010	0.008	0.020	0.26	3 000
W1001FA-3P-C3Z4	**W1001FA-4-C3T4**	100	126	160	175	230	0	0.010	0.008	0.030	0.28	3 000
W1002FA-1P-C3Z4	**W1002FA-2-C3T4**	150	176	210	225	280	0	0.012	0.008	0.030	0.31	3 000
W1002FA-3P-C3Z4	**W1002FA-4-C3T4**	200	226	260	275	330	0	0.012	0.008	0.040	0.34	3 000
W1003FA-1P-C3Z4	**W1003FA-2-C3T4**	250	276	310	325	380	0	0.012	0.008	0.040	0.37	3 000
W1003FA-3P-C3Z4	**W1003FA-4-C3T4**	300	326	360	375	430	0	0.013	0.010	0.050	0.39	3 000

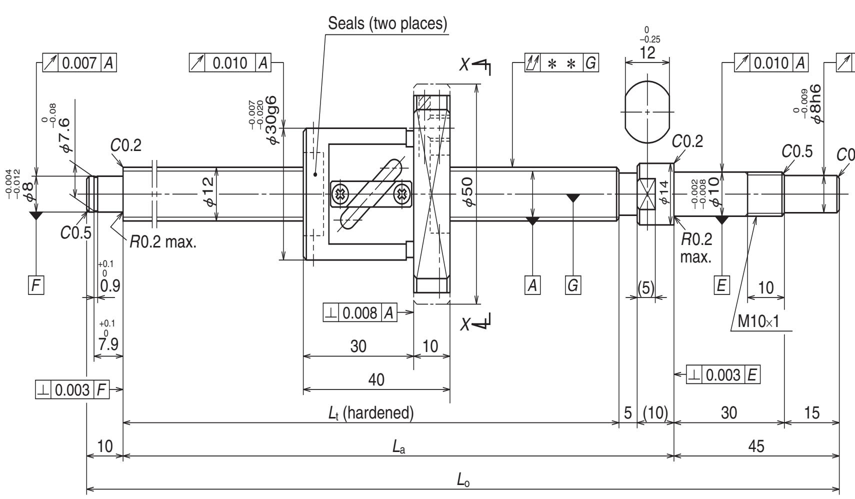
Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease PS2 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

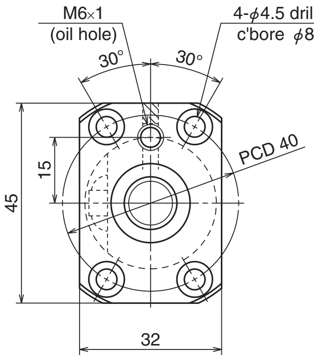
Finished shaft end FA Type (Fine lead)

Nut models: PFT, SFT

Screw shaft ø12

Lead 5





View X-X

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_a	2 370	3 760
	Static C_{0a}	3 160	6 310
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^3)		1.2	
Standard volume of grease replenishing (cm^3)		0.6	

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK10-01A (square)	WBK10S-01 (square)
WBK10-11 (round)	

Unit: mm

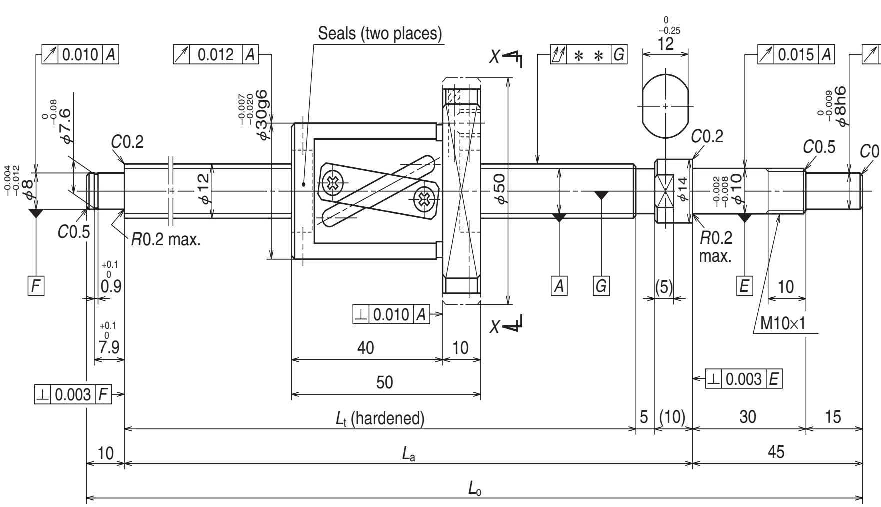
Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition
Preloaded (PFT)	Precise clearance (SFT)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support
W1201FA-1P-C3Z5	**W1201FA-2-C3T5**	50	70	110	125	180	0	0.010	0.008	0.020	0.35	3 000
W1201FA-3P-C3Z5	**W1201FA-4-C3T5**	100	120	160	175	230	0	0.010	0.008	0.030	0.38	3 000
W1202FA-1P-C3Z5	**W1202FA-2-C3T5**	150	170	210	225	280	0	0.012	0.008	0.030	0.42	3 000
W1202FA-3P-C3Z5	**W1202FA-4-C3T5**	200	220	260	275	330	0	0.012	0.008	0.040	0.46	3 000
W1203FA-1P-C3Z5	**W1203FA-2-C3T5**	250	270	310	325	380	0	0.012	0.008	0.040	0.50	3 000
W1204FA-1P-C3Z5	**W1204FA-2-C3T5**	350	370	410	425	480	0	0.015	0.010	0.050	0.58	3 000
W1205FA-1P-C3Z5	**W1205FA-2-C3T5**	450	470	510	525	580	0	0.016	0.012	0.065	0.66	3 000

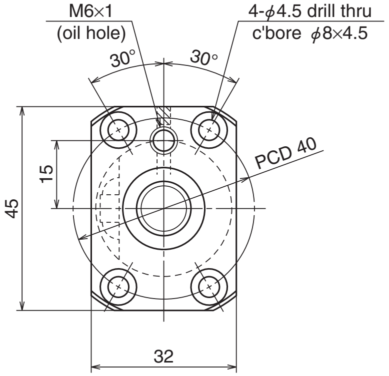
Notes: 1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease PS2 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft ø12

Lead 10

Unit: mm





View X-X

Ball screw specifications	Preloaded	Precise clearance
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_a	2 360	3 750
Basic load rating (N) Static C_{0a}	3 240	6 480
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^3)	1.4	
Standard volume of grease replenishing (cm^3)	0.7	

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK10-01A (square)	WBK10S-01 (square)
WBK10-11 (round)	

Unit: mm

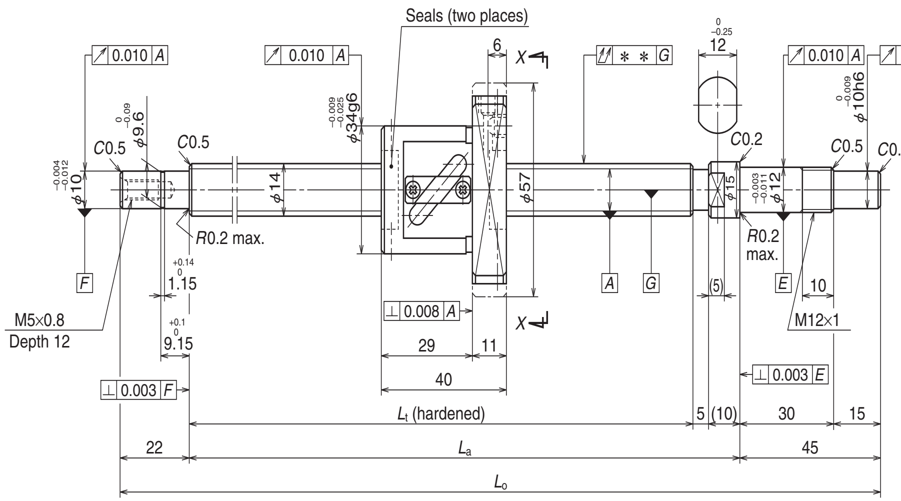
Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ⌰	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support
W1201FA-5P-C5Z10	**W1201FA-6-C5T10**	100	110	160	175	230	0	0.020	0.018	0.035	0.43	3 000
W1202FA-5P-C5Z10	**W1202FA-6-C5T10**	150	160	210	225	280	0	0.023	0.018	0.035	0.47	3 000
W1203FA-3P-C5Z10	**W1203FA-4-C5T10**	250	260	310	325	380	0	0.023	0.018	0.050	0.56	3 000
W1204FA-3P-C5Z10	**W1204FA-4-C5T10**	350	360	410	425	480	0	0.027	0.020	0.060	0.64	3 000
W1205FA-3P-C5Z10	**W1205FA-4-C5T10**	450	460	510	525	580	0	0.030	0.023	0.075	0.72	3 000

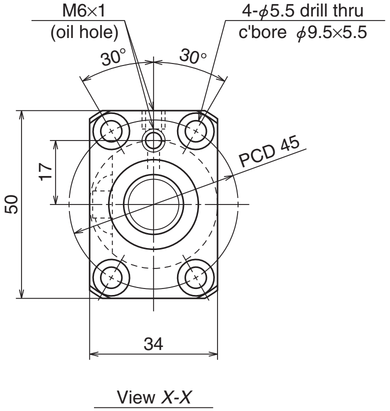
Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø14

Lead 5

Unit: mm





Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		14 × 5 / 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		2.5 × 1	
Accuracy grade / Preload / Axial play		C3 / Z	C3 / T
Basic load rating (N)	Dynamic C_a	4 280	6 790
	Static C_{0a}	5 840	11 700
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 (cm³)		2.2	
Standard volume of grease replenishing (cm³)		1.1	

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

Unit: mm

Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
Preloaded (PFT)	Precise clearance (SFT)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W1401FA-1P-C3Z5	**W1401FA-2-C3T5**	100	149	189	204	271	0	0.010	0.008	0.020	0.52	3 000	3 000
W1402FA-1P-C3Z5	**W1402FA-2-C3T5**	150	199	239	254	321	0	0.012	0.008	0.030	0.57	3 000	3 000
W1403FA-1P-C3Z5	**W1403FA-2-C3T5**	250	299	339	354	421	0	0.013	0.010	0.035	0.67	3 000	3 000
W1404FA-1P-C3Z5	**W1404FA-2-C3T5**	350	399	439	454	521	0	0.015	0.010	0.045	0.77	3 000	3 000
W1405FA-1P-C3Z5	**W1405FA-2-C3T5**	450	499	539	554	621	0	0.016	0.012	0.045	0.87	3 000	3 000
W1406FA-1P-C3Z5	**W1406FA-2-C3T5**	600	649	689	704	771	0	0.018	0.013	0.055	1.0	3 000	3 000

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

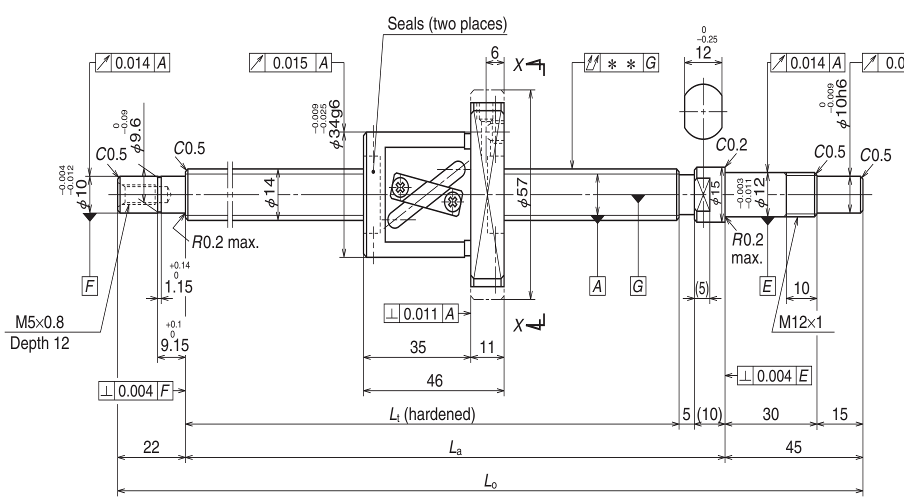
Finished shaft end FA Type (Medium lead)

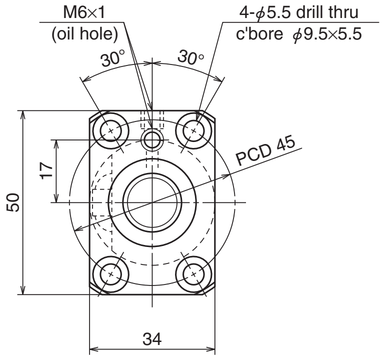
Nut models: LPFT, LSFT

NSK

Screw shaft ø14

Lead 8





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Unit: mm

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		14 × 8 / 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		2.5 × 1	
Accuracy grade / Preload / Axial play		C5 / Z	C5 / T
Basic load rating (N)	Dynamic C_a	4 280	6 790
	Static C_{0a}	5 840	11 700
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^3)		2.1	
Standard volume of grease replenishing (cm^3)		1.1	

Recommended support unit

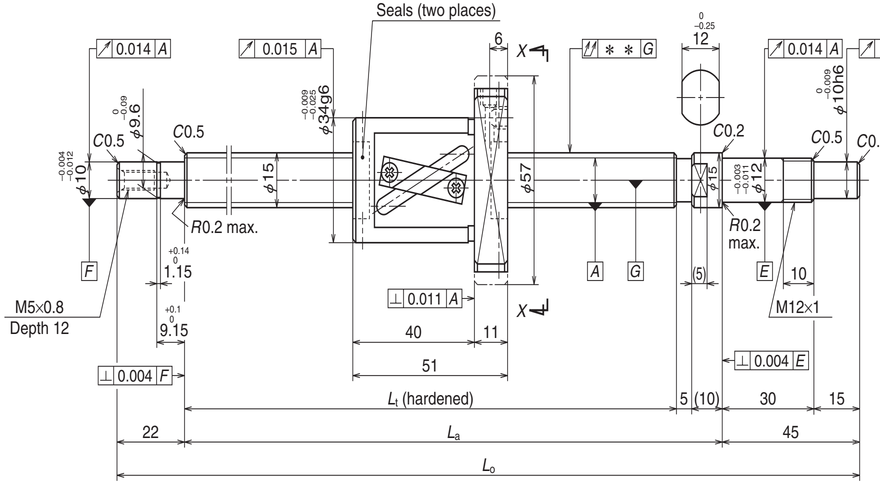
For drive side (Fixed)	For opposite to drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

Unit: mm

Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ↗	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W1401FA-3P-C5Z8	**W1401FA-4-C5T8**	100	143	189	204	271	0	0.020	0.018	0.025	0.56	3 000	3 000
W1402FA-3P-C5Z8	**W1402FA-4-C5T8**	150	193	239	254	321	0	0.023	0.018	0.035	0.61	3 000	3 000
W1402FA-5P-C5Z8	**W1402FA-6-C5T8**	200	243	289	304	371	0	0.023	0.018	0.035	0.67	3 000	3 000
W1403FA-3P-C5Z8	**W1403FA-4-C5T8**	250	293	339	354	421	0	0.025	0.020	0.040	0.72	3 000	3 000
W1403FA-5P-C5Z8	**W1403FA-6-C5T8**	300	343	389	404	471	0	0.025	0.020	0.040	0.78	3 000	3 000
W1404FA-3P-C5Z8	**W1404FA-4-C5T8**	350	393	439	454	521	0	0.027	0.020	0.050	0.83	3 000	3 000
W1404FA-5P-C5Z8	**W1404FA-6-C5T8**	400	443	489	504	571	0	0.027	0.020	0.050	0.88	3 000	3 000
W1405FA-3P-C5Z8	**W1405FA-4-C5T8**	450	493	539	554	621	0	0.030	0.023	0.050	0.94	3 000	3 000
W1405FA-5P-C5Z8	**W1405FA-6-C5T8**	500	543	589	604	671	0	0.030	0.023	0.065	0.99	3 000	3 000
W1406FA-3P-C5Z8	**W1406FA-4-C5T8**	550	593	639	654	721	0	0.035	0.025	0.065	1.0	3 000	3 000
W1406FA-5P-C5Z8	**W1406FA-6-C5T8**	600	643	689	704	771	0	0.035	0.025	0.065	1.1	3 000	3 000
W1407FA-1P-C5Z8	**W1407FA-2-C5T8**	700	743	789	804	871	0	0.035	0.025	0.085	1.2	2 800	3 000

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Finished shaft end FA Type (Medium lead)

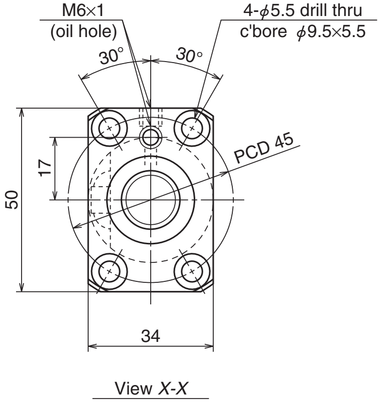


Nut models: LPFT, LSFT

Screw shaft ø15

Lead 10

Unit: mm



View *X-X*

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_a	4 450	7 070
	Static C_{0a}	6 380	12 800
Axial play		0	0.005 or less
Preload (N)		147	—
Dynamic friction torque, (N·cm)		1.5 – 7.8	2.4 or less
Spacer ball		Yes	None
Factory-packed grease		NSK grease LR3	
Internal spatial volume of nut (cm^3)		2.3	
Standard volume of grease replenishing (cm^3)		1.2	

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

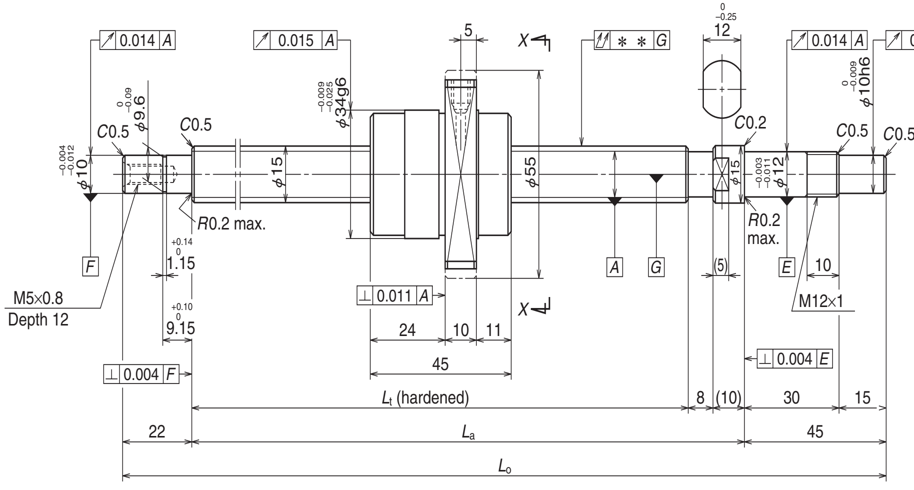
Unit: mm

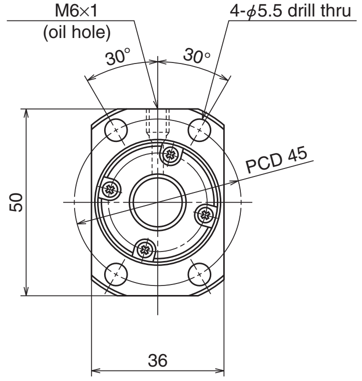
Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ↗↗	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W1501FA-1P-C5Z10	**W1501FA-2-C5T10**	100	138	189	204	271	0	0.020	0.018	0.025	0.61	3 000	3 000
W1502FA-1P-C5Z10	**W1502FA-2-C5T10**	150	188	239	254	321	0	0.023	0.018	0.035	0.67	3 000	3 000
W1502FA-3P-C5Z10	**W1502FA-4-C5T10**	200	238	289	304	371	0	0.023	0.018	0.035	0.74	3 000	3 000
W1503FA-1P-C5Z10	**W1503FA-2-C5T10**	250	288	339	354	421	0	0.025	0.020	0.040	0.80	3 000	3 000
W1503FA-3P-C5Z10	**W1503FA-4-C5T10**	300	338	389	404	471	0	0.025	0.020	0.040	0.86	3 000	3 000
W1504FA-1P-C5Z10	**W1504FA-2-C5T10**	350	388	439	454	521	0	0.027	0.020	0.050	0.93	3 000	3 000
W1504FA-3P-C5Z10	**W1504FA-4-C5T10**	400	438	489	504	571	0	0.027	0.020	0.050	1.0	3 000	3 000
W1505FA-1P-C5Z10	**W1505FA-2-C5T10**	450	488	539	554	621	0	0.030	0.023	0.050	1.1	3 000	3 000
W1505FA-3P-C5Z10	**W1505FA-4-C5T10**	500	538	589	604	671	0	0.030	0.023	0.065	1.1	3 000	3 000
W1506FA-1P-C5Z10	**W1506FA-2-C5T10**	550	588	639	654	721	0	0.035	0.025	0.065	1.2	3 000	3 000
W1506FA-3P-C5Z10	**W1506FA-4-C5T10**	600	638	689	704	771	0	0.035	0.025	0.065	1.2	3 000	3 000
W1507FA-1P-C5Z10	**W1507FA-2-C5T10**	700	738	789	804	871	0	0.035	0.025	0.085	1.4	3 000	3 000
W1508FA-1P-C5Z10	**W1508FA-2-C5T10**	800	838	889	904	971	0	0.040	0.027	0.085	1.5	2 400	3 000
W1510FA-1P-C5Z10	**W1510FA-2-C5T10**	1 000	1 038	1 089	1 104	1 171	0	0.046	0.030	0.110	1.8	1 590	2 250

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø15
Lead 20

Unit: mm





View X-X

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. × 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 / Axial play		C5 / Z	C5 / T
Basic load rating (N)	Dynamic C_a	3 870	5 070
	Static C_{0a}	5 820	8 730
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 (cm³)		1.9	
Standard volume of grease replenishing (cm³)		1.0	

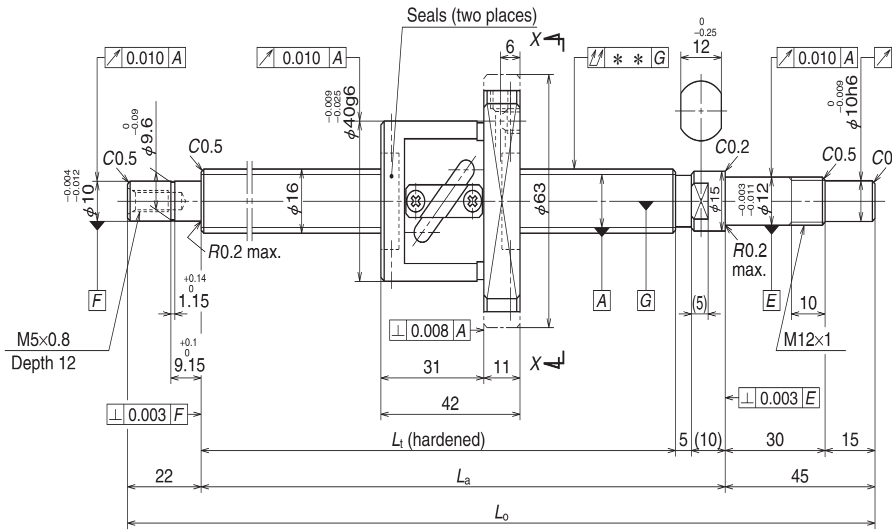
Unit: mm

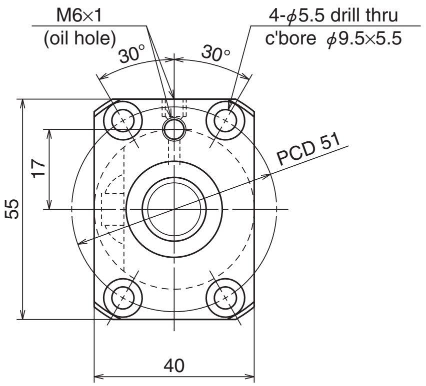
Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
Preloaded (UPFC)	Precise clearance (USFC)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W1501FA-3PG-C5Z20	**W1501FA-4G-C5T20**	100	141	186	204	271	0	0.020	0.018	0.025	0.61	3 000	3 000
W1502FA-5PG-C5Z20	**W1502FA-6G-C5T20**	150	191	236	254	321	0	0.023	0.018	0.035	0.68	3 000	3 000
W1502FA-7PG-C5Z20	**W1502FA-8G-C5T20**	200	241	286	304	371	0	0.023	0.018	0.035	0.75	3 000	3 000
W1503FA-5PG-C5Z20	**W1503FA-6G-C5T20**	250	291	336	354	421	0	0.025	0.020	0.040	0.81	3 000	3 000
W1503FA-7PG-C5Z20	**W1503FA-8G-C5T20**	300	341	386	404	471	0	0.025	0.020	0.040	0.88	3 000	3 000
W1504FA-5PG-C5Z20	**W1504FA-6G-C5T20**	350	391	436	454	521	0	0.027	0.020	0.050	0.95	3 000	3 000
W1504FA-7PG-C5Z20	**W1504FA-8G-C5T20**	400	441	486	504	571	0	0.027	0.020	0.050	1.0	3 000	3 000
W1505FA-5PG-C5Z20	**W1505FA-6G-C5T20**	450	491	536	554	621	0	0.030	0.023	0.050	1.1	3 000	3 000
W1505FA-7PG-C5Z20	**W1505FA-8G-C5T20**	500	541	586	604	671	0	0.030	0.023	0.065	1.1	3 000	3 000
W1506FA-5PG-C5Z20	**W1506FA-6G-C5T20**	550	591	636	654	721	0	0.035	0.025	0.065	1.2	3 000	3 000
W1506FA-7PG-C5Z20	**W1506FA-8G-C5T20**	600	641	686	704	771	0	0.035	0.025	0.065	1.3	3 000	3 000
W1507FA-3PG-C5Z20	**W1507FA-4G-C5T20**	700	741	786	804	871	0	0.035	0.025	0.085	1.4	3 000	3 000
W1508FA-3PG-C5Z20	**W1508FA-4G-C5T20**	800	841	886	904	971	0	0.040	0.027	0.085	1.5	2 400	3 000
W1510FA-3PG-C5Z20	**W1510FA-4G-C5T20**	1 000	1 041	1 086	1 104	1 171	0	0.046	0.030	0.110	1.8	1 590	2 240

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø16

Lead 10





View X-X

Unit: mm

Ball screw specifications

Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	16 × 5 / 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	2.5 × 1	
Accuracy grade / Preload / Axial play	C3 / Z	C3 / T
Basic load rating (N) Dynamic C_a	4 620	7 330
Basic load rating (N) Static C_{0a}	6 750	13 500
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 (cm³)	2.6	
Standard volume of grease replenishing (cm³)	1.3	

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

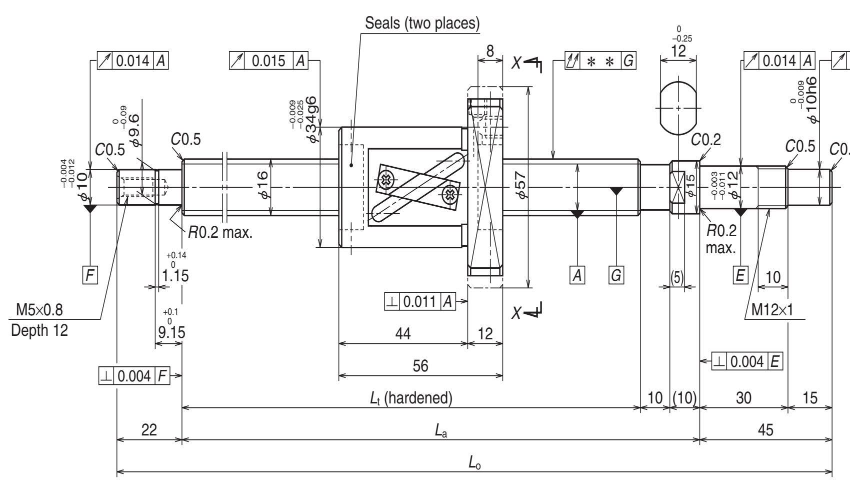
FA

Unit: mm

Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
Preloaded (PFT)	Precise clearance (SFT)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W1601FA-1P-C3Z5	**W1601FA-2-C3T5**	100	147	189	204	271	0	0.010	0.008	0.020	0.70	3 000	3 000
W1602FA-1P-C3Z5	**W1602FA-2-C3T5**	200	247	289	304	371	0	0.012	0.008	0.030	0.83	3 000	3 000
W1603FA-1P-C3Z5	**W1603FA-2-C3T5**	300	347	389	404	471	0	0.013	0.010	0.035	0.97	3 000	3 000
W1604FA-1P-C3Z5	**W1604FA-2-C3T5**	400	447	489	504	571	0	0.015	0.010	0.045	1.1	3 000	3 000
W1606FA-1P-C3Z5	**W1606FA-2-C3T5**	600	647	689	704	771	0	0.018	0.013	0.055	1.4	3 000	3 000
W1608FA-1P-C3Z5	**W1608FA-2-C3T5**	800	847	889	904	971	0	0.021	0.015	0.075	1.6	2 570	3 000

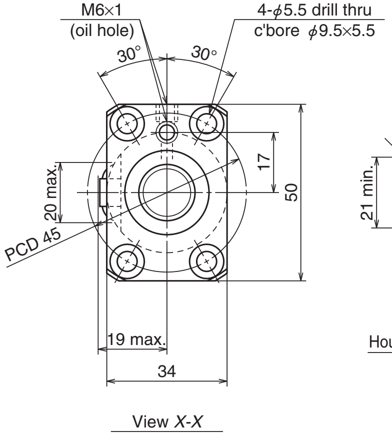
Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Nut models: LPFT, LSFT



Screw shaft ø16

Lead 16



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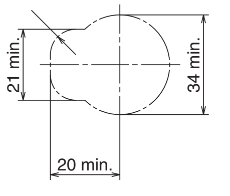


Housing hole and its clearance

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

Unit: mm

Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		16 × 16 / 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		1.5 × 1	
Accuracy grade / Preload / Axial play		C5 / Z	C5 / T
Basic load rating (N)	Dynamic C_a	3 600	4 710
	Static C_{0a}	5 410	8 110
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^3)		2.1	
Standard volume of grease replenishing (cm^3)		1.1	

Unit: mm

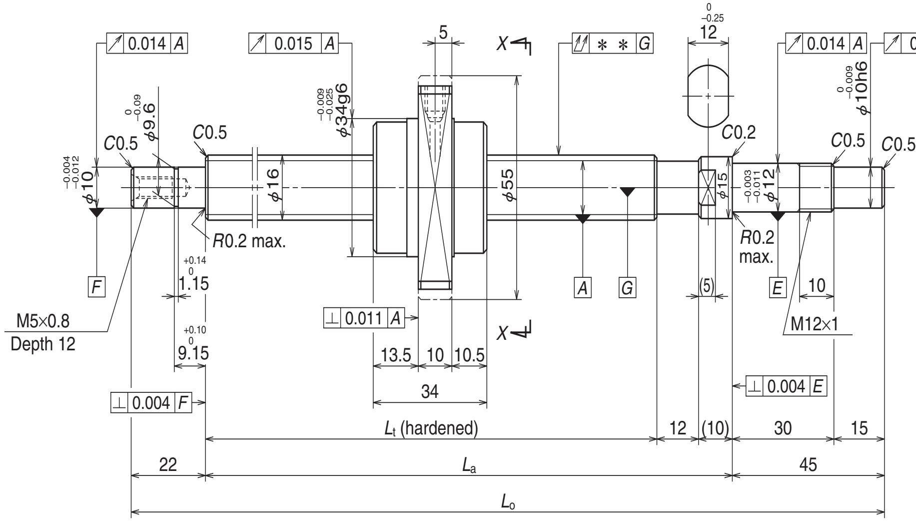
Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W1601FA-3P-C5Z16	**W1601FA-4-C5T16**	100	128	184	204	271	0	0.020	0.018	0.025	0.69	3 000	3 000
W1602FA-3P-C5Z16	**W1602FA-4-C5T16**	150	178	234	254	321	0	0.023	0.018	0.035	0.77	3 000	3 000
W1602FA-5P-C5Z16	**W1602FA-6-C5T16**	200	228	284	304	371	0	0.023	0.018	0.035	0.84	3 000	3 000
W1603FA-3P-C5Z16	**W1603FA-4-C5T16**	250	278	334	354	421	0	0.025	0.020	0.040	0.92	3 000	3 000
W1603FA-5P-C5Z16	**W1603FA-6-C5T16**	300	328	384	404	471	0	0.025	0.020	0.040	0.99	3 000	3 000
W1604FA-3P-C5Z16	**W1604FA-4-C5T16**	350	378	434	454	521	0	0.027	0.020	0.050	1.1	3 000	3 000
W1604FA-5P-C5Z16	**W1604FA-6-C5T16**	400	428	484	504	571	0	0.027	0.020	0.050	1.1	3 000	3 000
W1605FA-1P-C5Z16	**W1605FA-2-C5T16**	450	478	534	554	621	0	0.030	0.023	0.050	1.2	3 000	3 000
W1605FA-3P-C5Z16	**W1605FA-4-C5T16**	500	528	584	604	671	0	0.030	0.023	0.065	1.3	3 000	3 000
W1606FA-3P-C5Z16	**W1606FA-4-C5T16**	550	578	634	654	721	0	0.035	0.025	0.065	1.4	3 000	3 000
W1606FA-5P-C5Z16	**W1606FA-6-C5T16**	600	628	684	704	771	0	0.035	0.025	0.065	1.4	3 000	3 000
W1607FA-1P-C5Z16	**W1607FA-2-C5T16**	700	728	784	804	871	0	0.035	0.025	0.085	1.6	3 000	3 000
W1608FA-3P-C5Z16	**W1608FA-4-C5T16**	800	828	884	904	971	0	0.040	0.027	0.085	1.7	2 690	3 000
W1610FA-1P-C5Z16	**W1610FA-2-C5T16**	1 000	1 028	1 084	1 104	1 171	0	0.046	0.030	0.110	2.0	1 770	2 480

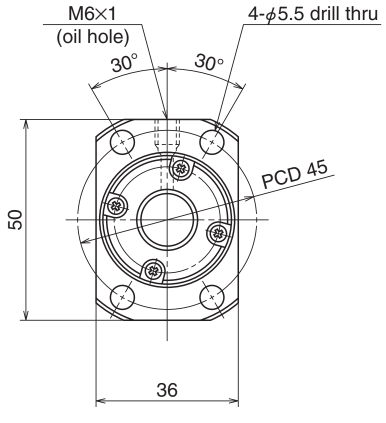
Notes: 1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

Screw shaft ø16

Lead 32

Unit: mm





View X-X

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_a	4 000	
Basic load rating (N) Static C_{0a}	6 690	
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^3)	2.0	
Standard volume of grease replenishing (cm^3)	1.0	

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK12-01A (square)	WBK12S-01 (square)
WBK12-11 (round)	

Unit: mm

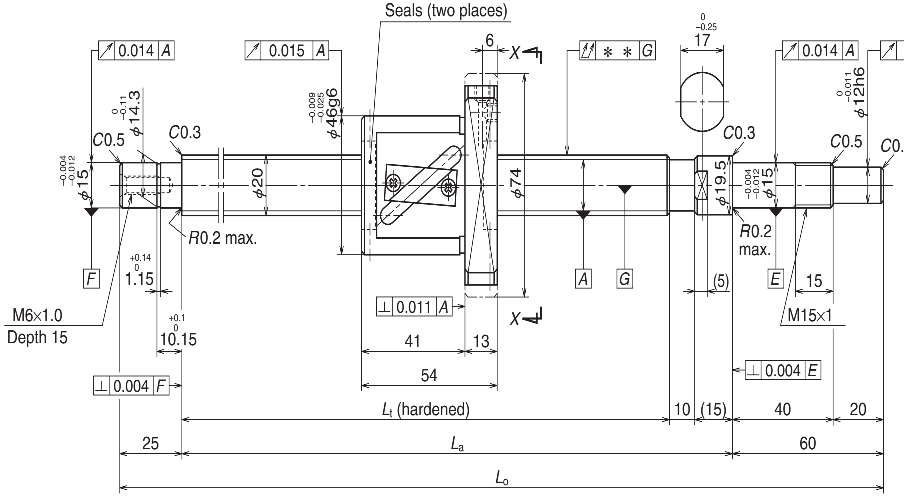
Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
Preloaded (UPFC)	Precise clearance (USFC)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W1603FA-7PGX-C5Z32	**W1603FA-8GX-C5T32**	300	348	382	404	471	0	0.025	0.020	0.040	0.90	3 000	3 000
W1605FA-5PGX-C5Z32	**W1605FA-6GX-C5T32**	500	548	582	604	671	0	0.030	0.023	0.065	1.2	3 000	3 000
W1608FA-5PGX-C5Z32	**W1608FA-6GX-C5T32**	800	848	882	904	971	0	0.040	0.027	0.085	1.7	2 630	3 000
W1612FA-1PGX-C5Z32	**W1612FA-2GX-C5T32**	1 200	1 248	1 282	1 304	1 371	0	0.054	0.035	0.150	2.3	1 240	1 740

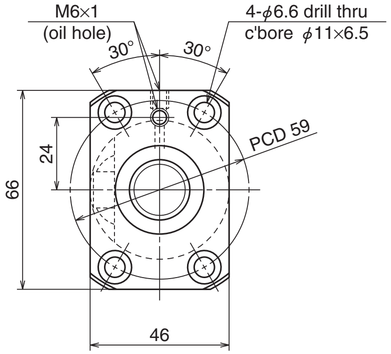
Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Ball nut does not have seal.
4. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø20

Lead 10

Unit: mm





View X-X

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK15-01A (square)	WBK15S-01 (square)
WBK15-11 (round)	

Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		20 × 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	6 880	10 900
	Static C_{0a}	10 800	21 700
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^3)		4.7	
Standard volume of grease replenishing (cm^3)		2.4	

Unit: mm

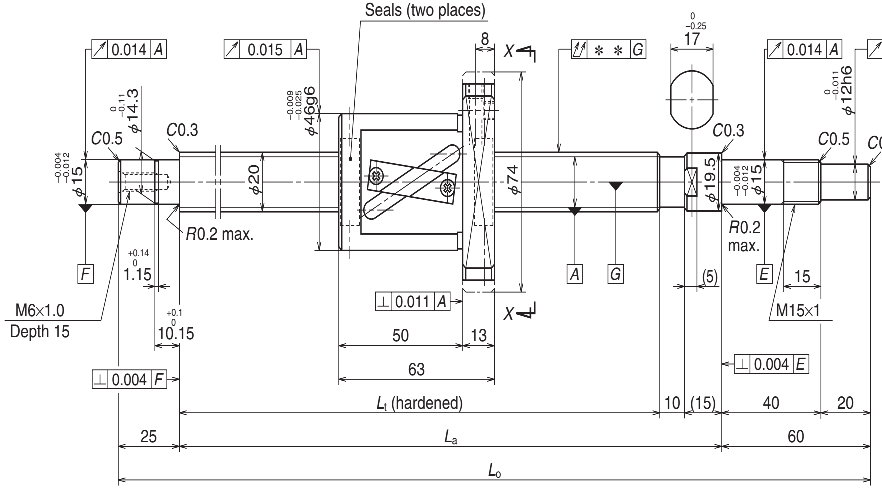
Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W2002FA-1P-C5Z10	**W2002FA-2-C5T10**	200	235	289	314	399	0	0.023	0.018	0.035	1.4	3 000	3 000
W2003FA-1P-C5Z10	**W2003FA-2-C5T10**	300	335	389	414	499	0	0.025	0.020	0.040	1.6	3 000	3 000
W2004FA-1P-C5Z10	**W2004FA-2-C5T10**	400	435	489	514	599	0	0.027	0.020	0.050	1.9	3 000	3 000
W2005FA-1P-C5Z10	**W2005FA-2-C5T10**	500	535	589	614	699	0	0.030	0.023	0.065	2.1	3 000	3 000
W2006FA-1P-C5Z10	**W2006FA-2-C5T10**	600	635	689	714	799	0	0.035	0.025	0.065	2.3	3 000	3 000
W2007FA-1P-C5Z10	**W2007FA-2-C5T10**	700	735	789	814	899	0	0.035	0.025	0.085	2.5	3 000	3 000
W2008FA-1P-C5Z10	**W2008FA-2-C5T10**	800	835	889	914	999	0	0.040	0.027	0.085	2.8	3 000	3 000
W2009FA-1P-C5Z10	**W2009FA-2-C5T10**	900	935	989	1 014	1 099	0	0.040	0.027	0.110	3.0	2 680	3 000
W2010FA-1P-C5Z10	**W2010FA-2-C5T10**	1 000	1 035	1 089	1 114	1 199	0	0.046	0.030	0.110	3.2	2 210	3 000
W2011FA-1P-C5Z10	**W2011FA-2-C5T10**	1 100	1 135	1 189	1 214	1 299	0	0.046	0.030	0.150	3.4	1 840	2 570
W2012FA-1P-C5Z10	**W2012FA-2-C5T10**	1 200	1 235	1 289	1 314	1 399	0	0.054	0.035	0.150	3.7	1 570	2 190

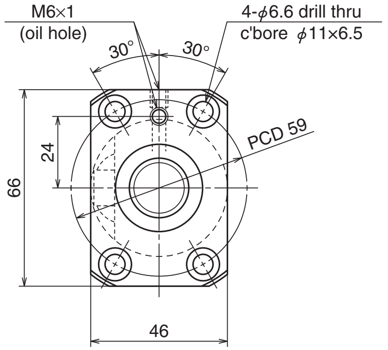
Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø20

Lead 20

Unit: mm





View *X-X*

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK15-01A (square)	WBK15S-01 (square)
WBK15-11 (round)	

Ball screw specifications

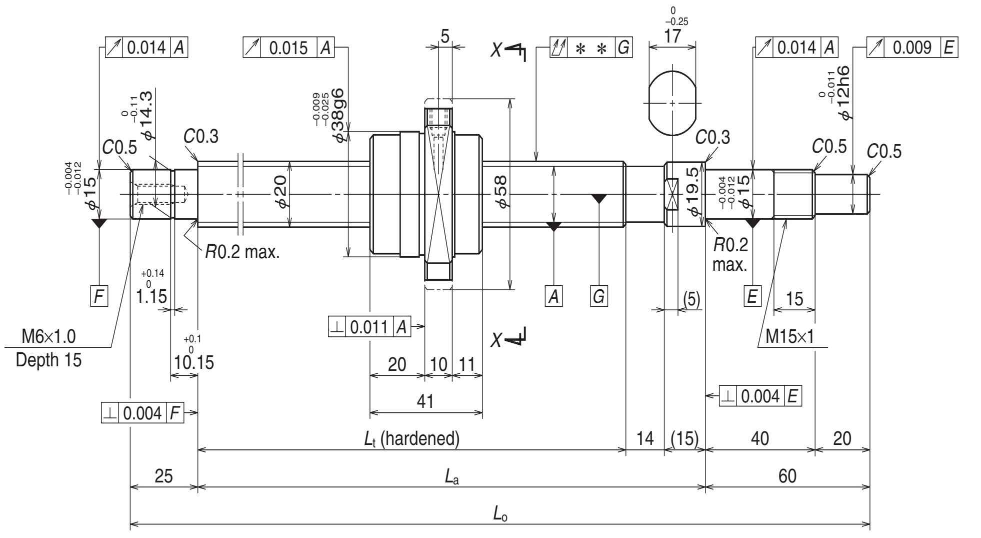
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		20 × 20 / Right	
Preload / Ball recirculation		P-preload / Return tube	
Ball dia. / Ball circle dia.		3.969 / 21	
Screw shaft root diameter		16.9	
Effective turns of balls		1.5 × 1	
Accuracy grade / Preload / Axial play		C5 / Z	C53 / T
Basic load rating (N)	Dynamic C_a	5 370	7 040
	Static C_{0a}	8 450	12 700
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^3)		4.2	
Standard volume of grease replenishing (cm^3)		2.1	

Unit: mm

Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})	
												Supporting condition	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W2003FA-3P-C5Z20	**W2003FA-4-C5T20**	200	247	310	335	420	0	0.023	0.018	0.040	1.6	3 000	3 000
W2004FA-3P-C5Z20	**W2004FA-4-C5T20**	300	347	410	435	520	0	0.027	0.020	0.050	1.8	3 000	3 000
W2005FA-3P-C5Z20	**W2005FA-4-C5T20**	400	447	510	535	620	0	0.030	0.023	0.050	2.0	3 000	3 000
W2006FA-3P-C5Z20	**W2006FA-4-C5T20**	500	547	610	635	720	0	0.030	0.023	0.065	2.3	3 000	3 000
W2007FA-3P-C5Z20	**W2007FA-4-C5T20**	600	647	710	735	820	0	0.035	0.025	0.085	2.5	3 000	3 000
W2008FA-3P-C5Z20	**W2008FA-4-C5T20**	700	747	810	835	920	0	0.040	0.027	0.085	2.7	3 000	3 000
W2009FA-3P-C5Z20	**W2009FA-4-C5T20**	800	847	910	935	1 020	0	0.040	0.027	0.110	3.0	3 000	3 000
W2010FA-3P-C5Z20	**W2010FA-4-C5T20**	900	947	1 010	1 035	1 120	0	0.046	0.030	0.110	3.2	2 590	3 000
W2011FA-3P-C5Z20	**W2011FA-4-C5T20**	1 000	1 047	1 110	1 135	1 220	0	0.046	0.030	0.110	3.4	2 140	2 970
W2012FA-3P-C5Z20	**W2012FA-4-C5T20**	1 100	1 147	1 210	1 235	1 320	0	0.046	0.030	0.150	3.7	1 790	2 500
W2015FA-1P-C5Z20	**W2015FA-2-C5T20**	1 400	1 447	1 510	1 535	1 620	0	0.054	0.035	0.180	4.4	1 140	1 610

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Finished shaft end FA Type (Ultra high helix lead)

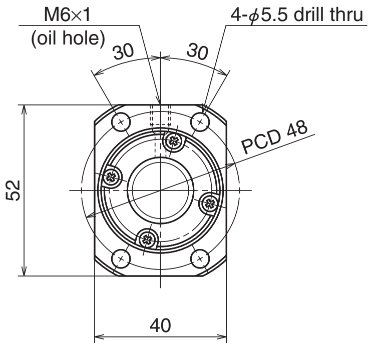


Nut models: UPFC, USFC

NSK

Screw shaft ø20

Lead 40



View *X-X*

Unit: mm

Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	20 × 40 / 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	0.7 × 2	
Accuracy grade / Preload / Axial play	C5 / Z	C5 / T
Basic load rating (N) Dynamic C_a	4 490	
Basic load rating (N) Static C_{0a}	8 640	
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^3)	2.8	
Standard volume of grease replenishing (cm^3)	1.4	

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK15-01A (square)	WBK15S-01 (square)
WBK15-11 (round)	

Unit: mm

Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})	
		Nominal	Maximum (L_t—Nut length)									Supporting condition	
Preloaded (UPFC)	Precise clearance (USFC)			L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W2005FA-5PGX-C5Z40	**W2005FA-6GX-C5T40**	400	465	506	535	620	0	0.030	0.023	0.050	1.7	3 000	3 000
W2007FA-5PGX-C5Z40	**W2007FA-6GX-C5T40**	600	665	706	735	820	0	0.035	0.025	0.085	2.2	3 000	3 000
W2009FA-5PGX-C5Z40	**W2009FA-6GX-C5T40**	800	865	906	935	1 020	0	0.040	0.027	0.110	2.7	3 000	3 000
W2011FA-5PGX-C5Z40	**W2011FA-6GX-C5T40**	1 000	1 065	1 106	1 135	1 220	0	0.046	0.030	0.110	3.1	2 170	3 000
W2013FA-1PGX-C5Z40	**W2013FA-2GX-C5T40**	1 200	1 265	1 306	1 335	1 420	0	0.054	0.035	0.150	3.6	1 550	2 160
W2017FA-1PGX-C5Z40	**W2017FA-2GX-C5T40**	1 600	1 665	1 706	1 735	1 820	0	0.065	0.040	0.230	4.6	910	1 270

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Ball nut does not have seal.
4. Contact NSK if the permissible rotational speed is to be exceeded.

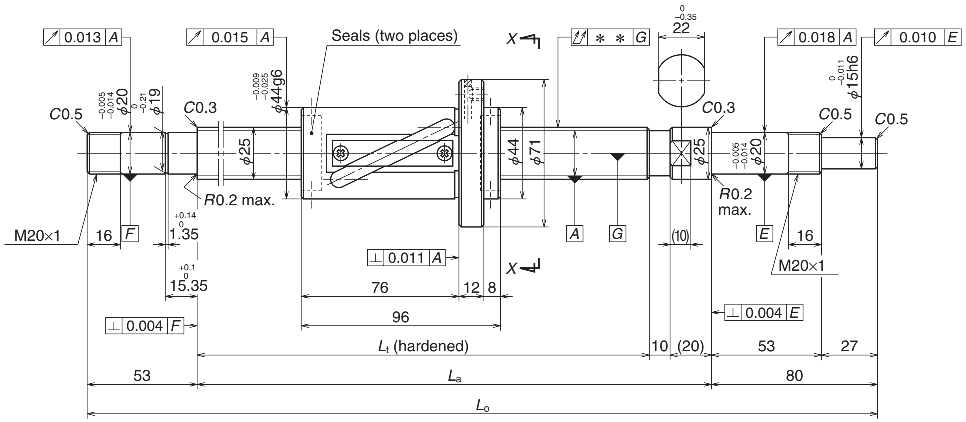
Finished shaft end FA Type (Medium lead)

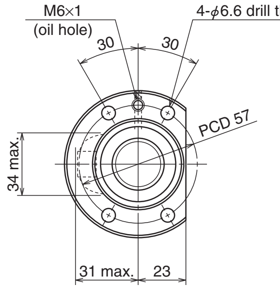
Nut models: LPFT, LSFT

NSK

Screw shaft ø25
Lead 20

Unit: mm





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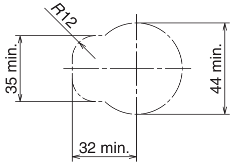


Housing hole and its clearance

Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	25 × 20 / 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	2.5 × 1	
Accuracy grade / Preload / Axial play	C5 / Z	C5 / T
Basic load rating (N) Dynamic C_a	9 900	15 700
Basic load rating (N) Static C_{0a}	16 400	32 800
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^3)	12	
Standard volume of grease replenishing (cm^3)	6	

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Fixed)	For opposite to drive side (Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20S-11 (round)	

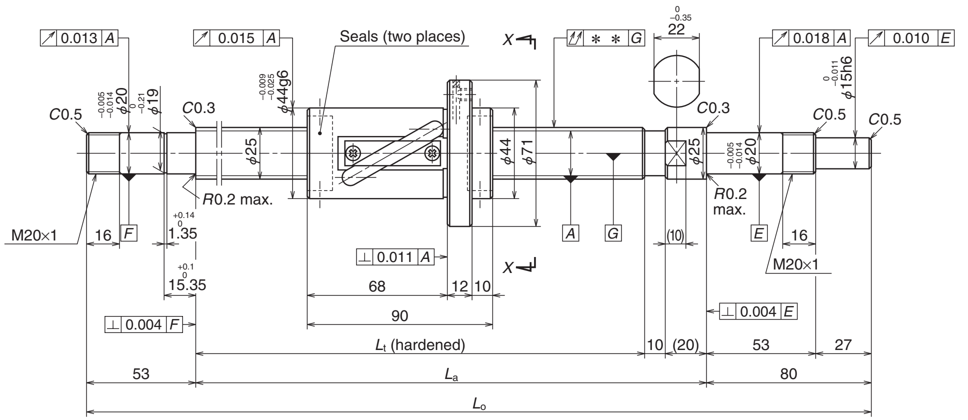
Unit: mm

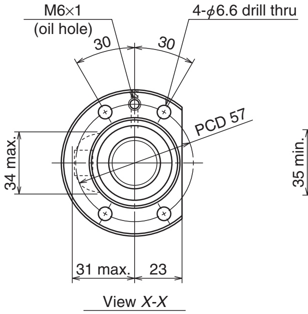
Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W2507FA-1P-C5Z20	**W2507FA-2-C5T20**	600	654	750	780	913	0	0.035	0.025	0.055	4.0	2 800	2 800
W2509FA-1P-C5Z20	**W2509FA-2-C5T20**	800	854	950	980	1 113	0	0.040	0.027	0.070	4.7	2 800	2 800
W2511FA-1P-C5Z20	**W2511FA-2-C5T20**	1 000	1 054	1 150	1 180	1 313	0	0.046	0.030	0.090	5.4	2 560	2 800
W2513FA-1P-C5Z20	**W2513FA-2-C5T20**	1 200	1 254	1 350	1 380	1 513	0	0.054	0.035	0.090	6.2	1 840	2 550
W2515FA-1P-C5Z20	**W2515FA-2-C5T20**	1 400	1 454	1 550	1 580	1 713	0	0.054	0.035	0.120	6.9	1 390	1 940
W2517FA-1P-C5Z20	**W2517FA-2-C5T20**	1 600	1 654	1 750	1 780	1 913	0	0.065	0.040	0.120	7.6	1 080	1 520
W2521FA-1P-C5Z20	**W2521FA-2-C5T20**	2 000	2 054	2 150	2 180	2 313	0	0.077	0.046	0.160	9.1	710	1 000

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø25

Lead 25





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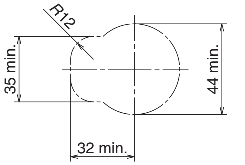


Housing hole and its clearance

Unit: mm

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. × 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	7 730	10 100
	Static C_{0a}	12 700	19 100
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 (cm³)		7.5	
Standard volume of grease replenishing (cm³)		3.8	

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Fixed)	For opposite to drive side (Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20S-11 (round)	

Unit: mm

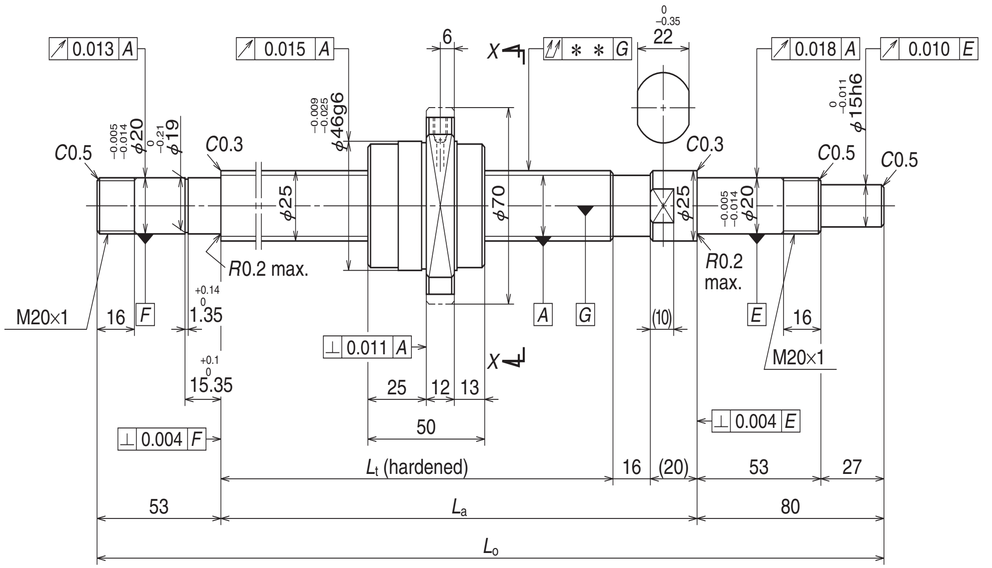
Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W2507FA-3P-C5Z25	**W2507FA-4-C5T25**	600	660	750	780	913	0	0.035	0.025	0.055	4.0	2 800	2 800
W2509FA-3P-C5Z25	**W2509FA-4-C5T25**	800	860	950	980	1 113	0	0.040	0.027	0.070	4.7	2 800	2 800
W2511FA-3P-C5Z25	**W2511FA-4-C5T25**	1 000	1 060	1 150	1 180	1 313	0	0.046	0.030	0.090	5.4	2 540	2 800
W2513FA-3P-C5Z25	**W2513FA-4-C5T25**	1 200	1 260	1 350	1 380	1 513	0	0.054	0.035	0.090	6.2	1 830	2 540
W2515FA-3P-C5Z25	**W2515FA-4-C5T25**	1 400	1 460	1 550	1 580	1 713	0	0.054	0.035	0.120	7.0	1 380	1 930
W2517FA-3P-C5Z25	**W2517FA-4-C5T25**	1 600	1 660	1 750	1 780	1 913	0	0.065	0.040	0.120	7.7	1 080	1 510
W2521FA-3P-C5Z25	**W2521FA-4-C5T25**	2 000	2 060	2 150	2 180	2 313	0	0.077	0.046	0.160	9.1	710	1 000

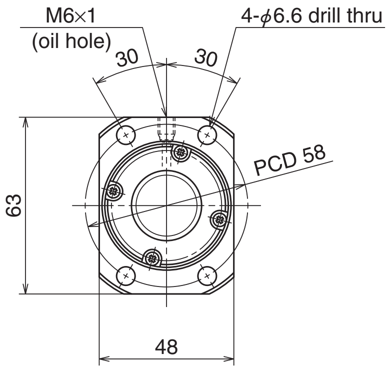
Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø25

Lead 50

Unit: mm





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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	6 690	
	Static C_{0a}	13 500	
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^3)		4.2	
Standard volume of grease replenishing (cm^3)		2.1	

Recommended support unit

For drive side	For opposite to drive side	
(Fixed)	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20S-11 (round)	

Unit: mm

Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ↗↗	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
Preloaded (UPFC)	Precise clearance (USFC)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W2508FA-1PGX-C5Z50	**W2508FA-2GX-C5T50**	700	794	844	880	1 013	0	0.040	0.027	0.070	4.1	2 800	2 800
W2511FA-5PGX-C5Z50	**W2511FA-6GX-C5T50**	1 000	1 094	1 144	1 180	1 313	0	0.046	0.030	0.090	5.3	2 550	2 800
W2516FA-1PGX-C5Z50	**W2516FA-2GX-C5T50**	1 500	1 594	1 644	1 680	1 813	0	0.065	0.040	0.120	7.2	1 230	1 710
W2521FA-5PGX-C5Z50	**W2521FA-6GX-C5T50**	2 000	2 094	2 144	2 180	2 313	0	0.077	0.046	0.160	9.1	720	1 010

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Ball nut does not have seal.
4. Contact NSK if the permissible rotational speed is to be exceeded.

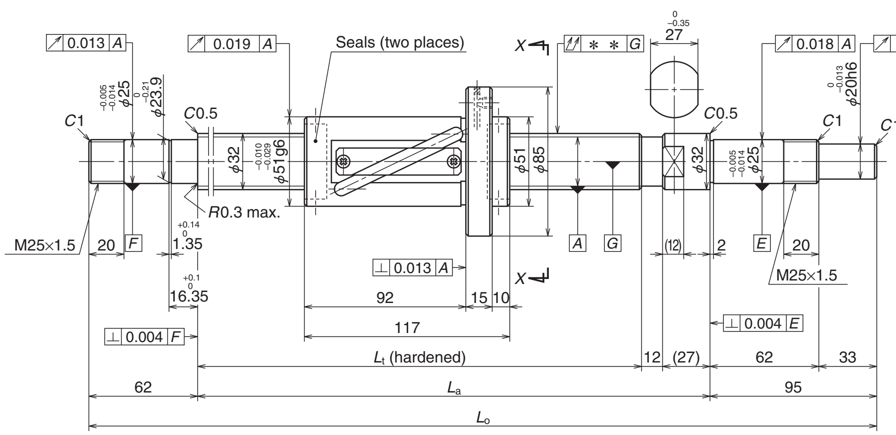
Finished shaft end FA Type (Medium lead)

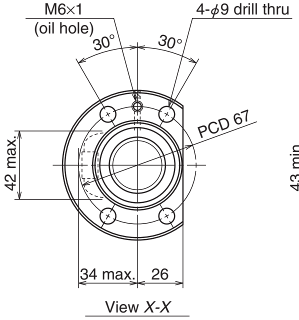
Nut models: LPFT, LSFT

Screw shaft ø32

Lead 25

Unit: mm





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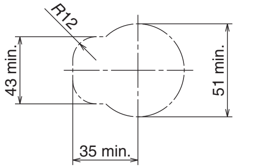


Housing hole and its clearance

Ball screw specifications

Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		32 × 25 / Right	
Preload / Ball recirculation		P-preload / 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	11 300	17 900
	Static C_{0a}	20 900	41 800
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 (cm³)		17.5	
Standard volume of grease replenishing (cm³)		8.8	

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Fixed)	For opposite to drive side (Simple)
WBK25-01W (square)	WBK25-01W (square)	WBK25S-01W (square)
WBK25-11 (round)	WBK25-11 (round)	

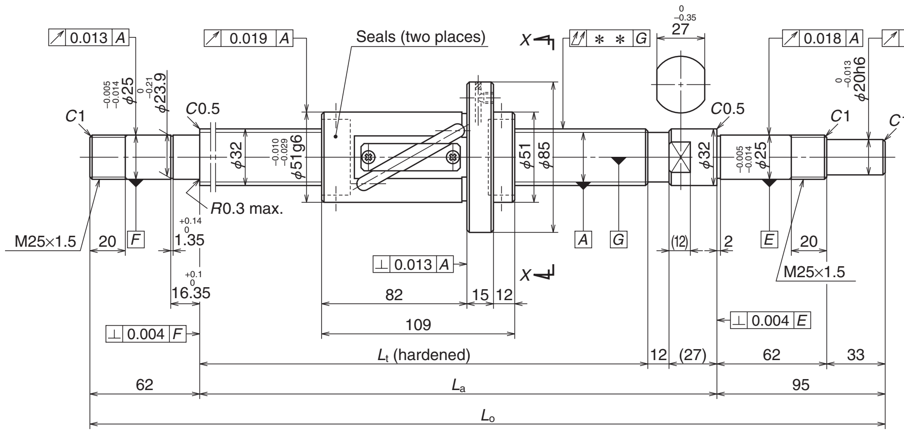
Unit: mm

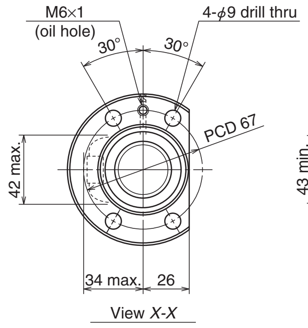
Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out ✻✻	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W3211FA-1P-C5Z25	**W3211FA-2-C5T25**	1 000	1 063	1 180	1 219	1 376	0	0.046	0.030	0.090	9.3	2 180	2 180
W3216FA-1P-C5Z25	**W3216FA-2-C5T25**	1 500	1 563	1 680	1 719	1 876	0	0.065	0.040	0.120	12.3	1 580	2 180
W3221FA-1P-C5Z25	**W3221FA-2-C5T25**	2 000	2 063	2 180	2 219	2 376	0	0.077	0.046	0.160	15.4	930	1 300
W3227FA-1P-C5Z25	**W3227FA-2-C5T25**	2 600	2 663	2 780	2 819	2 976	0	0.093	0.054	0.200	19.1	560	800

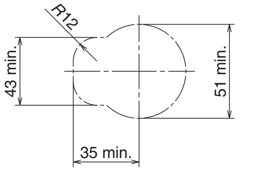
Notes:
1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø32

Lead 32







Housing hole and its clearance

Unit: mm

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	8 800	11 500
	Static C_{0a}	16 600	24 800
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 (cm³)		14	
Standard volume of grease replenishing (cm³)		7	

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Fixed)	For opposite to drive side (Simple)
WBK25-01W (square)	WBK25-01W (square)	WBK25S-01W (square)
WBK25-11 (round)	WBK25-11 (round)	

Unit: mm

Ball screw No.		Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W3211FA-3P-C5Z32	**W3211FA-4-C5T32**	1 000	1 071	1 180	1 219	1 376	0	0.046	0.030	0.090	9.3	2 180	2 180
W3216FA-3P-C5Z32	**W3216FA-4-C5T32**	1 500	1 571	1 680	1 719	1 876	0	0.065	0.040	0.120	12.3	1 570	2 180
W3221FA-3P-C5Z32	**W3221FA-4-C5T32**	2 000	2 071	2 180	2 219	2 376	0	0.077	0.046	0.160	15.4	920	1 290
W3227FA-3P-C5Z32	**W3227FA-4-C5T32**	2 600	2 671	2 780	2 819	2 976	0	0.093	0.054	0.200	19.1	560	790

Notes: 1. We recommend NSK support unit. See page B375 for details.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

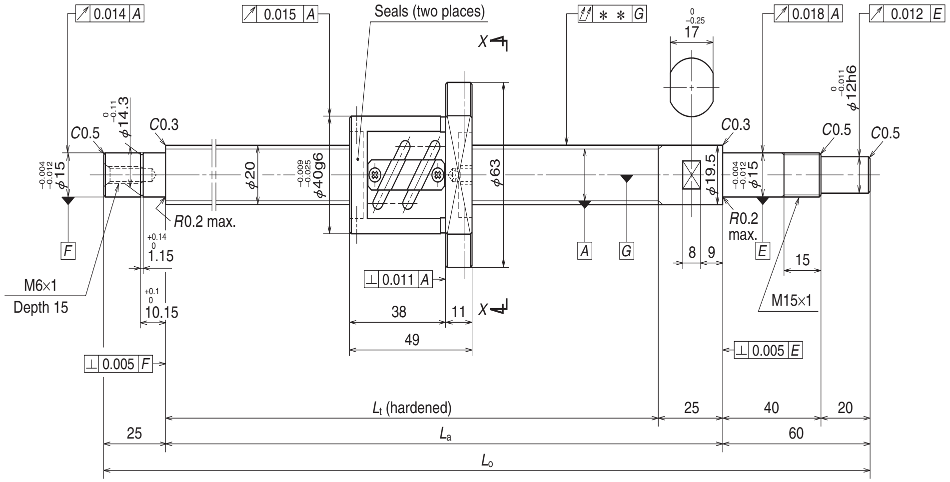
Finished shaft end SA Type (Fine lead)

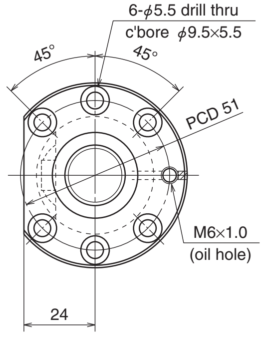
Nut model: PFT

Screw shaft ø20

Lead 4

Unit: mm





View *X-X*

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		20 × 4 / Right
Preload / Ball recirculation		P-preload / Return tube
Ball dia. / Ball circle dia.		2.381 / 20.3
Effective turns of balls		2.5 × 2
Screw shaft root diameter		17.8
Accuracy grade / Preload		C5 / Z
Basic load rating (N)	Dynamic C_a	5 420
	Static C_{0a}	10 700
Preload (N)		294
Dynamic friction torque, median, (N·cm)		3.9
Spacer ball		Yes
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm³)		2.7
Standard volume of grease replenishing (cm³)		1.4

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK15-01A (square)	WBK15S-01 (square)
WBK15-11 (round)	

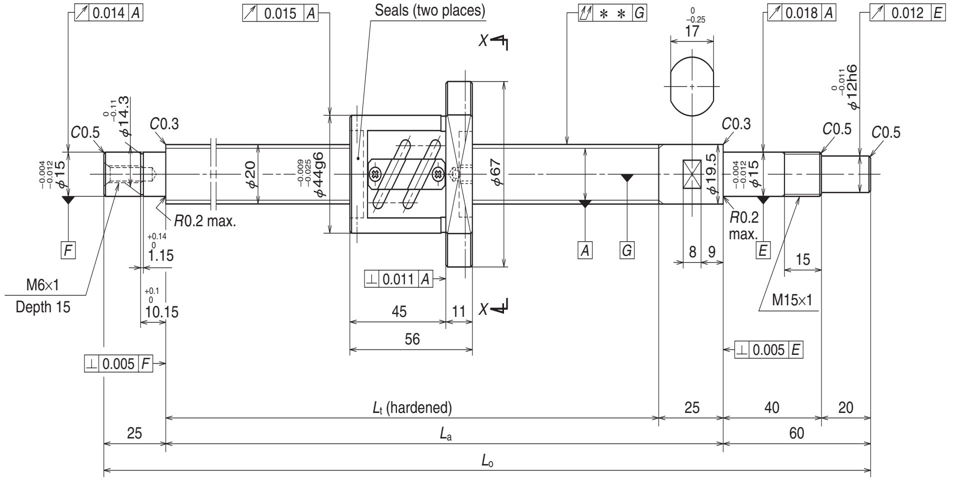
Unit: mm

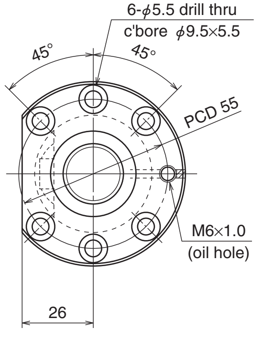
Ball screw No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W2002SA-1P-C5Z4	150	176	225	250	335	–0.005	0.023	0.018	0.045	1.1	3 000	3 000
W2002SA-2P-C5Z4	200	226	275	300	385	–0.007	0.023	0.018	0.045	1.2	3 000	3 000
W2003SA-1P-C5Z4	300	326	375	400	485	–0.009	0.025	0.020	0.055	1.5	3 000	3 000
W2004SA-1P-C5Z4	400	426	475	500	585	–0.011	0.027	0.020	0.070	1.7	3 000	3 000
W2005SA-1P-C5Z4	500	526	575	600	685	–0.014	0.030	0.023	0.085	1.9	3 000	3 000
W2006SA-1P-C5Z4	600	626	675	700	785	–0.016	0.035	0.025	0.085	2.1	3 000	3 000

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø20

Lead 5





View X-X

Unit: mm

Ball screw specifications	
Shaft dia. x Lead / Direction of turn	20 × 5 / 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	2.5 × 2
Accuracy grade / Preload	C5 / Z
Basic load rating (N) Dynamic C_a	9 410
Basic load rating (N) Static C_{0a}	17 100
Preload (N)	490
Dynamic friction torque, median, (N·cm)	7.8
Spacer ball	Yes
Factory-packed grease	**Refer to Notes 2.**
Internal spatial volume of nut (cm³)	4.3
Standard volume of grease replenishing (cm³)	2.2

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK15-01A (square)	WBK15S-01 (square)
WBK15-11 (round)	

Unit: mm

Ball screw No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)	
											Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W2002SA-3P-C5Z5	150	169	225	250	335	-0.005	0.023	0.018	0.045	1.3	3 000	3 000
W2002SA-4P-C5Z5	200	219	275	300	385	-0.007	0.023	0.018	0.045	1.4	3 000	3 000
W2003SA-2P-C5Z5	300	319	375	400	485	-0.009	0.025	0.020	0.055	1.6	3 000	3 000
W2004SA-2P-C5Z5	400	419	475	500	585	-0.011	0.027	0.020	0.070	1.8	3 000	3 000
W2005SA-2P-C5Z5	500	519	575	600	685	-0.014	0.030	0.023	0.085	2.0	3 000	3 000
W2007SA-1P-C5Z5	700	719	775	800	885	-0.019	0.035	0.025	0.110	2.5	3 000	3 000

Notes: 1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

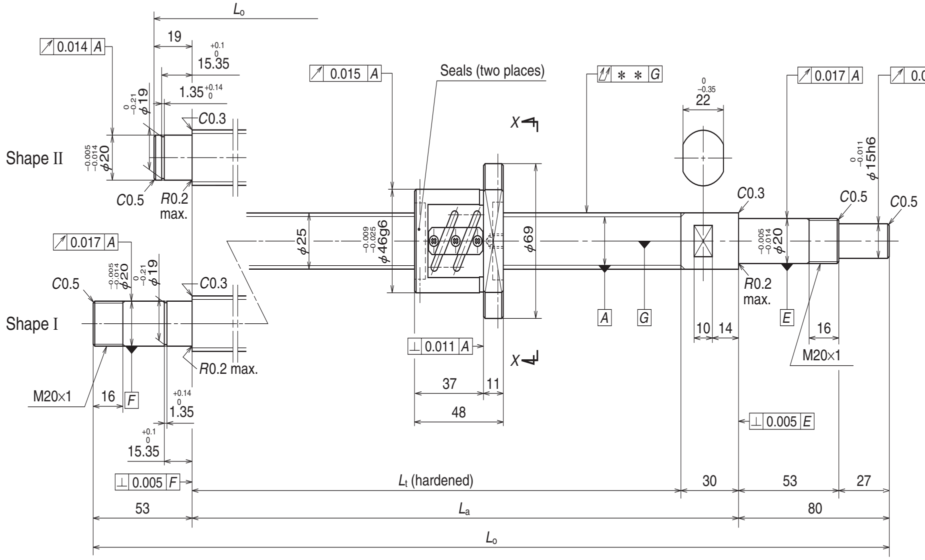
Finished shaft end SA Type (Fine lead)

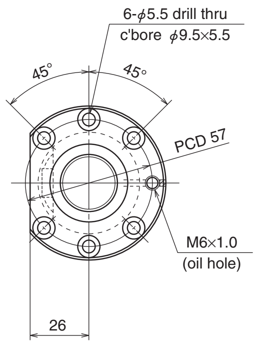
Nut model: PFT

NSK

Screw shaft ø25

Lead 4





View X-X

Unit: mm

Ball screw specifications

Shaft dia. x Lead / Direction of turn		25 × 4 / Right
Preload / Ball recirculation		P-preload / 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	6 020
	Static C_{0a}	13 600
Preload (N)		290
Dynamic friction torque, median, (N·cm)		4.9
Spacer ball		Yes
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm³)		3.2
Standard volume of grease replenishing (cm³)		1.6

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Fixed)	For opposite to drive side (Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20S-11 (round)	

Unit: mm

Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W2502SA-1P-C5Z4	150	172	220	250	349	Ⅱ	–0.005	0.023	0.018	0.035	1.6	2 800	—
W2502SA-2P-C5Z4	200	222	270	300	399	Ⅱ	–0.006	0.023	0.018	0.035	1.8	2 800	—
W2503SA-1P-C5Z4	300	322	370	400	499	Ⅱ	–0.009	0.025	0.020	0.040	2.2	2 800	—
W2504SA-1P-C5Z4	400	422	470	500	599	Ⅱ	–0.011	0.027	0.020	0.050	2.5	2 800	—
W2505SA-1P-C5Z4	500	522	570	600	733	Ⅰ	–0.014	0.030	0.023	0.060	3.0	2 800	2 800
W2507SA-1P-C5Z4	700	722	770	800	933	Ⅰ	–0.018	0.035	0.025	0.075	3.7	2 800	2 800

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

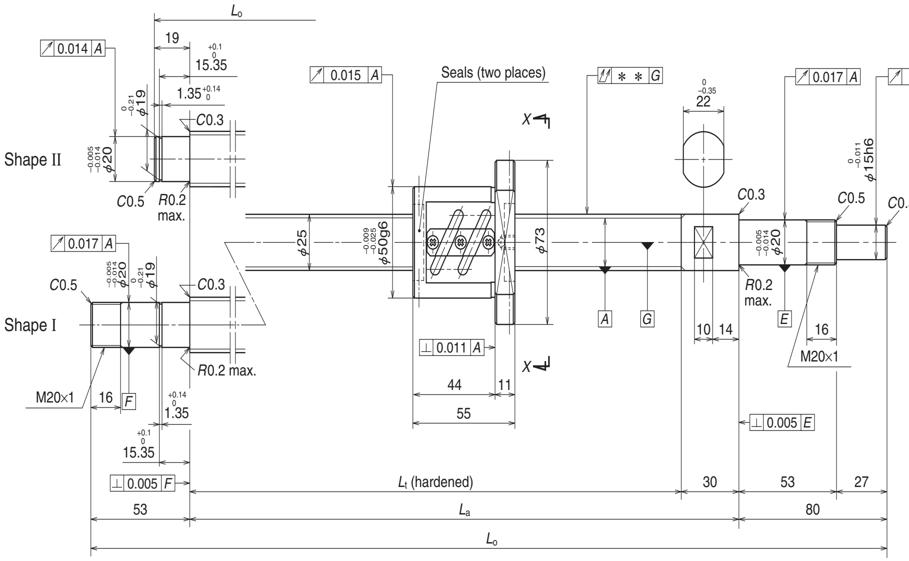
Finished shaft end SA Type (Fine lead)

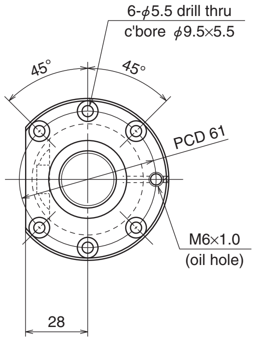
Nut model: PFT

NSK

Screw shaft ø25

Lead 7





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		25 × 5 / 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		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load rating (N)	Dynamic C_a	10 400
	Static C_{0a}	21 900
Preload (N)		540
Dynamic friction torque, median, (N·cm)		8.8
Spacer ball		Yes
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm³)		5.0
Standard volume of grease replenishing (cm³)		2.5

Recommended support unit

For drive side	**For opposite to drive side**	
(Fixed)	**(Fixed)**	**(Simple)**
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20S-11 (round)	

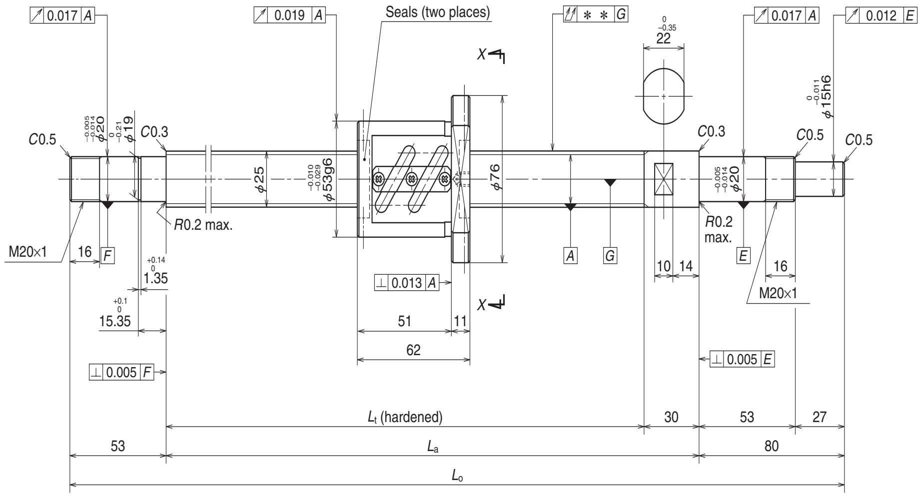
Unit: mm

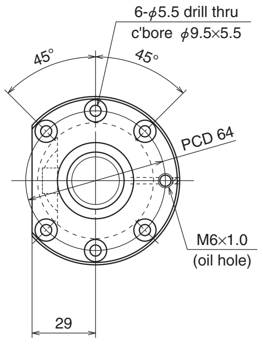
Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)	
												Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W2502SA-3P-C5Z5	150	165	220	250	349	II	–0.005	0.023	0.018	0.035	1.8	2 800	—
W2502SA-4P-C5Z5	200	215	270	300	399	II	–0.006	0.023	0.018	0.035	2.0	2 800	—
W2503SA-2P-C5Z5	300	315	370	400	499	II	–0.009	0.025	0.020	0.040	2.3	2 800	—
W2504SA-2P-C5Z5	400	415	470	500	599	II	–0.011	0.027	0.020	0.050	2.7	2 800	—
W2505SA-2P-C5Z5	500	515	570	600	733	I	–0.014	0.030	0.023	0.060	3.1	2 800	2 800
W2506SA-1P-C5Z5	600	615	670	700	833	I	–0.016	0.035	0.025	0.075	3.4	2 800	2 800
W2507SA-2P-C5Z5	700	715	770	800	933	I	–0.018	0.035	0.025	0.075	3.8	2 800	2 800
W2509SA-1P-C5Z5	900	915	970	1 000	1 133	I	–0.023	0.040	0.027	0.090	4.5	2 800	2 800
W2511SA-1P-C5Z5	1 000	1 115	1 170	1 200	1 333	I	–0.028	0.046	0.030	0.120	5.2	2 480	2 800

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the the permissible rotational speed is to be exceeded.

Screw shaft ø25

Lead 6





View X-X

Unit: mm

Ball screw specifications	
Shaft dia. x Lead / Direction of turn	25 × 6 / 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	2.5 × 2
Accuracy grade / Preload	C5 / Z
Basic load rating (N) Dynamic C_a	14 100
Basic load rating (N) Static C_{0a}	26 800
Preload (N)	685
Dynamic friction torque, median, (N·cm)	13.8
Spacer ball	Yes
Factory-packed grease	**Refer to Notes 2.**
Internal spatial volume of nut (cm³)	7.0
Standard volume of grease replenishing (cm³)	3.5

Recommended support unit

For drive side	**For opposite to drive side**	
(Fixed)	**(Fixed)**	**(Simple)**
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20S-11 (round)	

Unit: mm

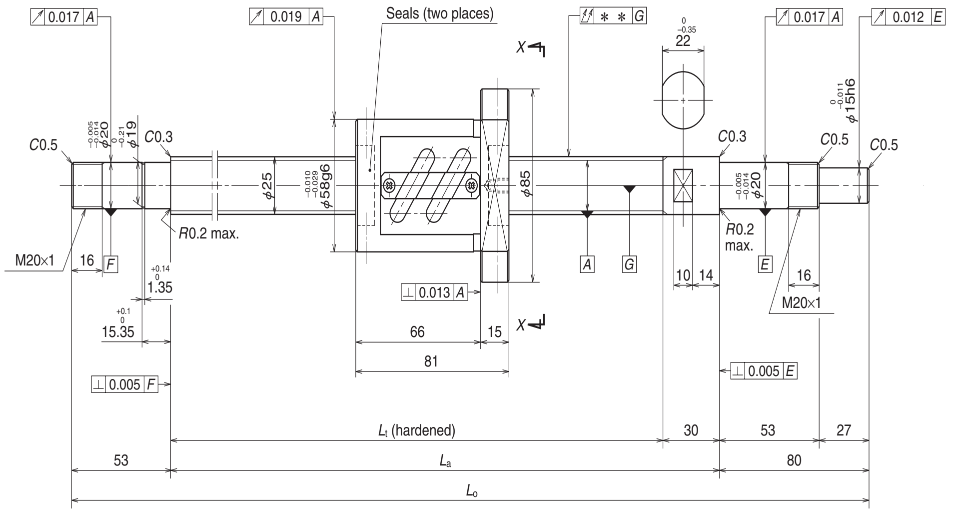
Ball screw No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W2503SA-3P-C5Z6	250	308	370	400	533	–0.009	0.025	0.020	0.050	2.5	2 800	2 800
W2505SA-3P-C5Z6	450	508	570	600	733	–0.014	0.030	0.023	0.060	3.2	2 800	2 800
W2507SA-3P-C5Z6	650	708	770	800	933	–0.018	0.035	0.025	0.075	3.9	2 800	2 800
W2511SA-2P-C5Z6	1 050	1 108	1 170	1 200	1 333	–0.028	0.046	0.030	0.120	5.2	2 410	2 800

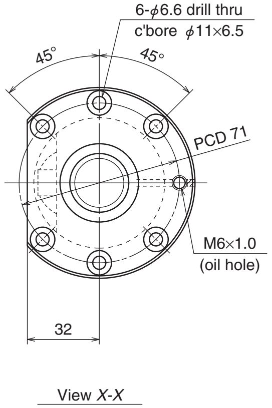
Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø25

Lead 10

Unit: mm





View X-X

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_a	11 600
	Static C_{0a}	19 000
Preload (N)		585
Dynamic friction torque, median, (N·cm)		13.8
Spacer ball		Yes
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm³)		9.5
Standard volume of grease replenishing (cm³)		4.8

Recommended support unit

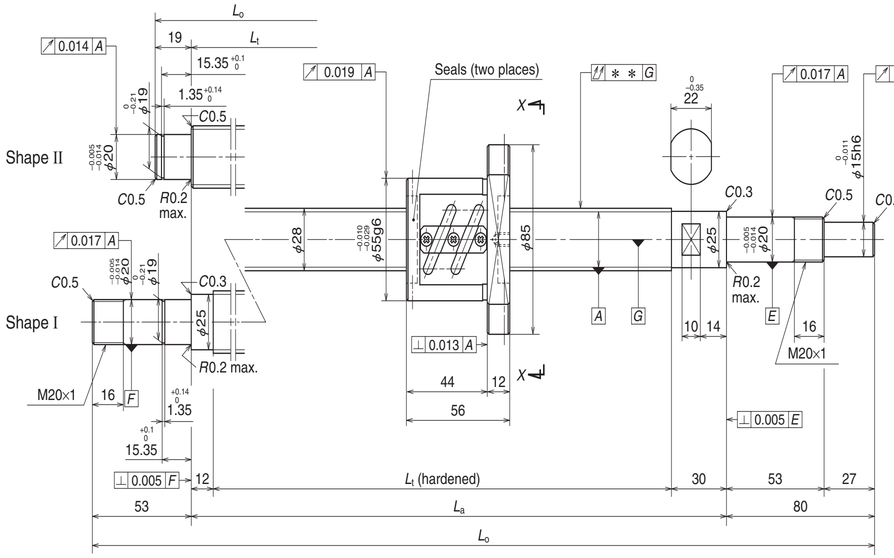
For drive side	For opposite to drive side	
(Fixed)	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20S-11 (round)	

Unit: mm

Ball screw No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ⌰	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W2503SA-4P-C5Z10	250	289	370	400	533	–0.009	0.025	0.020	0.050	3.2	2 800	2 800
W2505SA-4P-C5Z10	450	489	570	600	733	–0.014	0.030	0.023	0.060	3.8	2 800	2 800
W2507SA-4P-C5Z10	650	689	770	800	933	–0.018	0.035	0.025	0.075	4.5	2 800	2 800
W2509SA-2P-C5Z10	850	889	970	1 000	1 133	–0.023	0.040	0.027	0.090	5.2	2 800	2 800
W2511SA-3P-C5Z10	1 050	1 089	1 170	1 200	1 333	–0.028	0.046	0.030	0.120	5.9	2 340	2 800
W2514SA-1P-C5Z10	1 350	1 389	1 470	1 500	1 633	–0.035	0.054	0.035	0.150	6.9	1 470	2 050

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Finished shaft end SA Type (Fine lead)

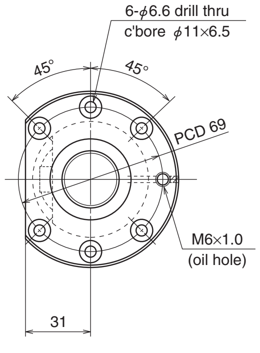


Nut model: PFT

Screw shaft ø28

Lead 5

Unit: mm



View X-X

Ball screw specifications		
Shaft dia. × Lead / Direction of turn		28 × 5 / Right
Preload / Ball recirculation		P-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	11 000
	Static C_{0a}	24 400
Preload (N)		540
Dynamic friction torque, median, (N·cm)		9.8
Spacer ball		Yes
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm³)		6.0
Standard volume of grease replenishing (cm³)		3.0

Recommended support unit

For drive side (Fixed)	**For opposite to drive side (Fixed)**	**For opposite to drive side (Simple)**
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20S-11 (round)	

Unit: mm

Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W2802SA-1P-C5Z5	200	214	270	300	399	II	–0.006	0.023	0.018	0.035	2.5	2 500	—
W2803SA-1P-C5Z5	300	314	370	400	499	II	–0.009	0.025	0.020	0.040	2.9	2 500	—
W2804SA-1P-C5Z5	400	414	470	500	599	II	–0.011	0.027	0.020	0.050	3.3	2 500	—
W2805SA-1P-C5Z5	450	502	558	600	733	I	–0.014	0.030	0.023	0.060	3.8	2 500	2 500
W2807SA-1P-C5Z5	650	702	758	800	933	I	–0.018	0.035	0.025	0.075	4.7	2 500	2 500
W2809SA-1P-C5Z5	850	902	958	1 000	1 133	I	–0.024	0.040	0.027	0.090	5.6	2 500	2 500
W2811SA-1P-C5Z5	1 050	1 102	1 158	1 200	1 333	I	–0.028	0.046	0.030	0.120	6.5	2 500	2 500

Notes: 1. We recommend NSK support unit. See page B375 for details.

2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.

3. Contact NSK if the permissible rotational speed is to be exceeded.

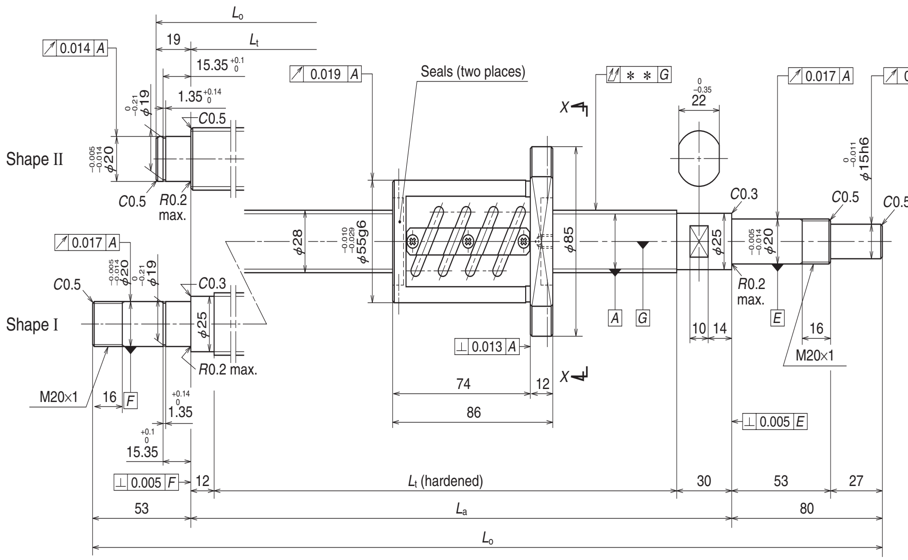
Finished shaft end SA Type (Fine lead)

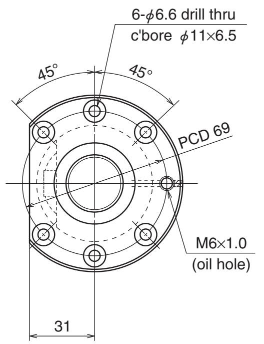
Nut model: ZFT

Screw shaft ø28

Lead 5

Unit: mm





View X-X

Ball screw specifications		
Shaft dia. × Lead / Direction of turn		28 × 5 / Right
Preload / Ball recirculation		Z-preload / 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	17 400
	Static C_{0a}	48 800
Preload (N)		1 220
Dynamic friction torque, median, (N·cm)		21.5
Spacer ball		None
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm^3)		9.0
Standard volume of grease replenishing (cm^3)		4.5

Recommended support unit

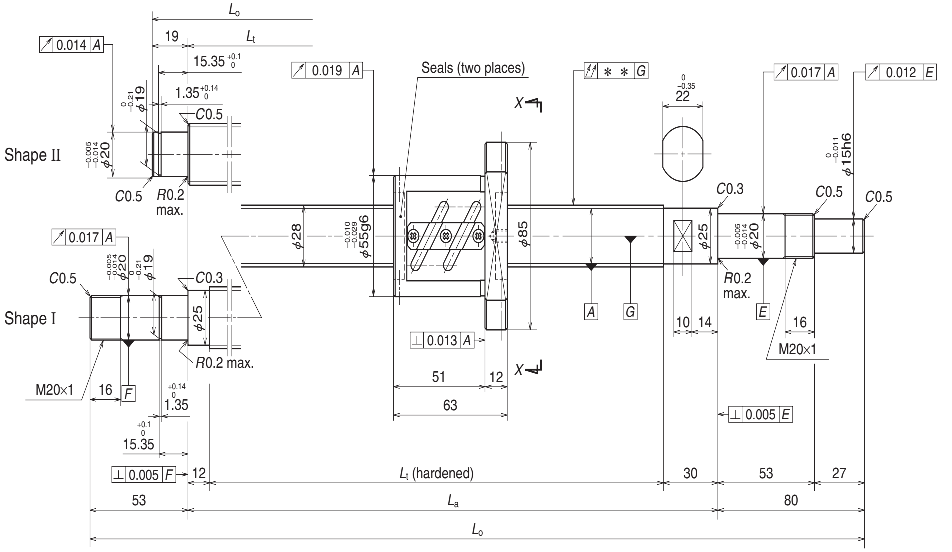
For drive side (Fixed)	**For opposite to drive side (Fixed)**	**(Simple)**
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20S-11 (round)	

Unit: mm

Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out ** ↗↗	Mass (kg)	Permissible rotational speed N (min^{-1})	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o		T	e_p	υ_u			Supporting condition	
												Fixed - Simple support	Fixed - Fixed
W2802SA-2Z-C5Z5	150	184	270	300	399	Ⅱ	–0.006	0.023	0.018	0.035	2.8	2 500	—
W2803SA-2Z-C5Z5	250	284	370	400	499	Ⅱ	–0.009	0.025	0.020	0.040	3.2	2 500	—
W2804SA-2Z-C5Z5	350	384	470	500	599	Ⅱ	–0.011	0.027	0.020	0.050	3.7	2 500	—
W2805SA-2Z-C5Z5	450	472	558	600	733	Ⅰ	–0.013	0.030	0.023	0.060	4.2	2 500	2 500
W2807SA-2Z-C5Z5	650	672	758	800	933	Ⅰ	–0.018	0.035	0.025	0.075	5.1	2 500	2 500
W2809SA-2Z-C5Z5	850	872	958	1 000	1 133	Ⅰ	–0.023	0.040	0.027	0.090	5.9	2 500	2 500
W2811SA-2Z-C5Z5	1 050	1 072	1 158	1 200	1 333	Ⅰ	–0.028	0.046	0.030	0.120	6.8	2 500	2 500

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Finished shaft end SA Type (Fine lead)

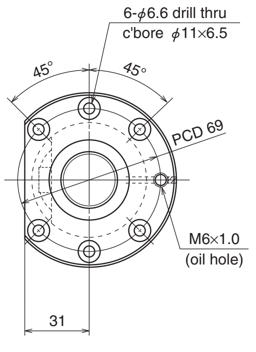


Nut model: PFT

NSK

Screw shaft ø28

Lead 6



View X-X

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		28 × 6 / Right
Preload / Ball recirculation		P-preload / 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	11 000
	Static C_{0a}	24 400
Preload (N)		540
Dynamic friction torque, median, (N·cm)		11.8
Spacer ball		Yes
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm^3)		6.0
Standard volume of grease replenishing (cm^3)		3.0

Recommended support unit

For drive side	For opposite to drive side	
(Fixed)	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20S-11 (round)	

Unit: mm

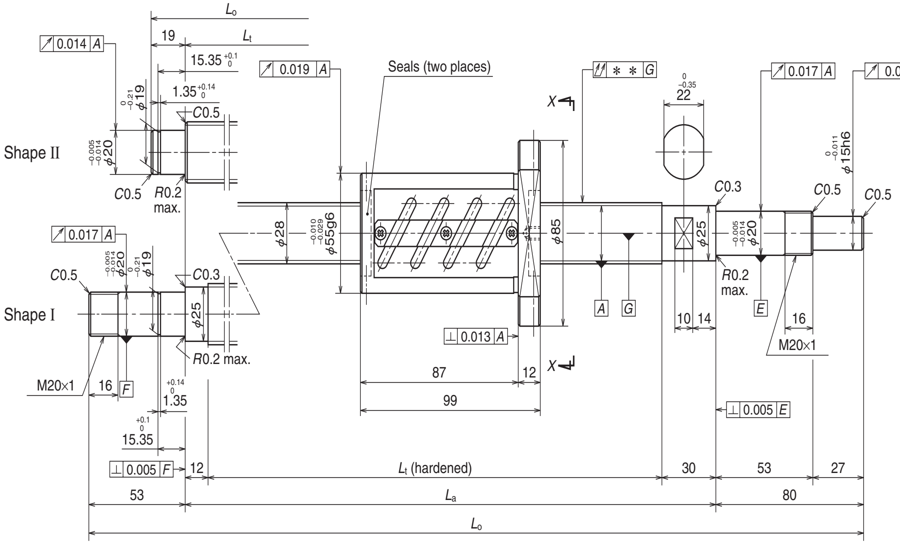
Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out ** ↗↗	Mass (kg)	Permissible rotational speed N (min^{-1})	
	Nominal	Maximum (L_t—Nut length)										Supporting condition	
			L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W2803SA-3P-C5Z6	250	307	370	400	499	Ⅱ	–0.009	0.025	0.020	0.040	3.0	2 500	—
W2805SA-3P-C5Z6	450	507	570	600	699	Ⅱ	–0.014	0.030	0.023	0.060	3.9	2 500	—
W2807SA-3P-C5Z6	650	695	758	800	933	Ⅰ	–0.018	0.035	0.025	0.075	4.9	2 500	2 500
W2809SA-3P-C5Z6	850	895	958	1 000	1 133	Ⅰ	–0.023	0.040	0.027	0.090	5.8	2 500	2 500
W2811SA-3P-C5Z6	1 050	1 095	1 158	1 200	1 333	Ⅰ	–0.028	0.046	0.030	0.120	6.6	2 500	2 500

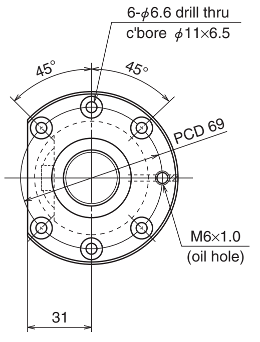
Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Nut model: ZFT

Screw shaft ø28

Lead 6





View X-X

Unit: mm

Ball screw specifications	
Shaft dia. × 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	17 400
Basic load rating (N) Static C_{0a}	48 800
Preload (N)	1 220
Dynamic friction torque, median, (N·cm)	23.5
Spacer ball	None
Factory-packed grease	**Refer to Notes 2.**
Internal spatial volume of nut (cm³)	9.5
Standard volume of grease replenishing (cm³)	4.8

Recommended support unit

For drive side	For opposite to drive side	
(Fixed)	(Fixed)	(Simple)
WBK20-01 (square)	WBK20-01 (square)	WBK20S-01 (square)
WBK20-11 (round)	WBK20S-11 (round)	

Unit: mm

Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)	
												Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o		T	e_p	υ_u	↗		Fixed - Simple support	Fixed - Fixed
W2803SA-4Z-C5Z6	250	271	370	400	499	II	–0.009	0.025	0.020	0.040	3.4	2 500	—
W2805SA-4Z-C5Z6	450	471	570	600	699	II	–0.014	0.030	0.023	0.060	4.3	2 500	—
W2807SA-4Z-C5Z6	650	659	758	800	933	I	–0.018	0.035	0.025	0.075	5.3	2 500	2 500
W2809SA-4Z-C5Z6	850	859	958	1 000	1 133	I	–0.023	0.040	0.027	0.090	6.2	2 500	2 500
W2811SA-4Z-C5Z6	1 050	1 059	1 158	1 200	1 333	I	–0.028	0.046	0.030	0.120	7.1	2 500	2 500

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

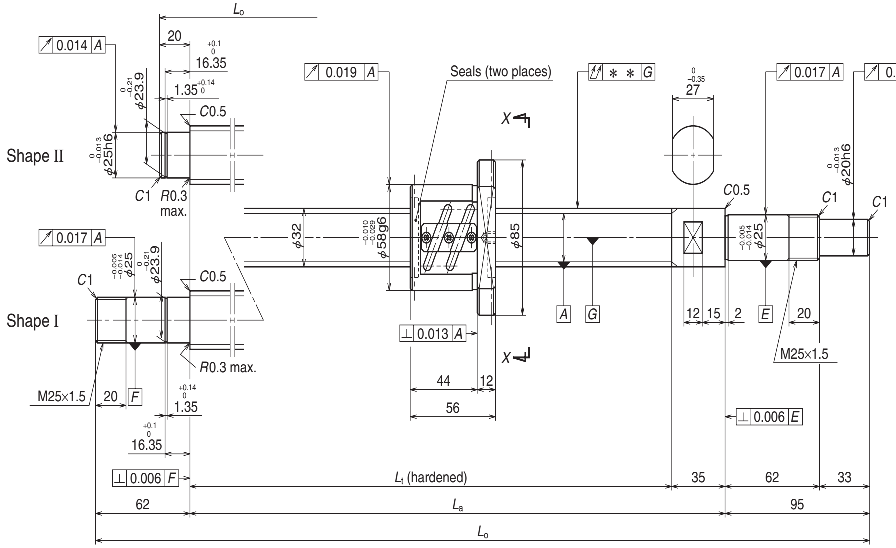
Finished shaft end SA Type (Fine lead)

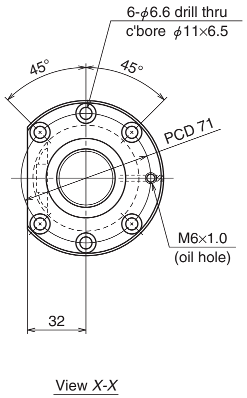
Nut model: PFT

NSK

Screw shaft ø32

Lead 5





Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		32 × 5 / 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		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load rating (N)	Dynamic C_a	11 600
	Static C_{0a}	28 000
Preload (N)		590
Dynamic friction torque, median, (N·cm)		11.8
Spacer ball		Yes
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm³)		7.0
Standard volume of grease replenishing (cm³)		3.5

Recommended support unit

For drive side	For opposite to drive side	
(Fixed)	**(Fixed)**	**(Simple)**
WBK25-01W (square)	WBK25-01W (square)	WBK25S-01W (square)
WBK25-11 (round)	WBK25-11 (round)	

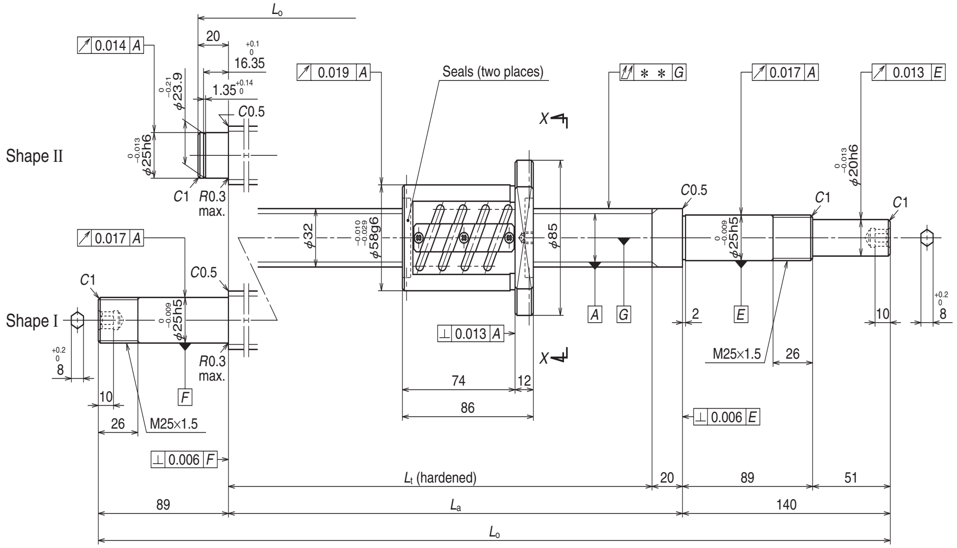
Unit: mm

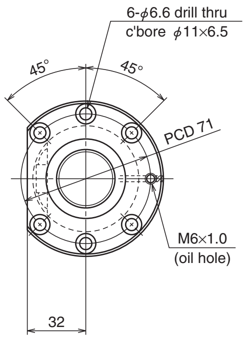
Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)	
												Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o		T	e_p	υ_u	⌰		Fixed - Simple support	Fixed - Fixed
W3202SA-1P-C5Z5	150	209	265	300	415	Ⅱ	–0.006	0.023	0.018	0.040	3.1	2 180	—
W3203SA-1P-C5Z5	250	309	365	400	515	Ⅱ	–0.009	0.025	0.020	0.050	3.7	2 180	—
W3204SA-1P-C5Z5	350	409	465	500	615	Ⅱ	–0.011	0.027	0.020	0.050	4.2	2 180	—
W3205SA-1P-C5Z5	450	509	565	600	715	Ⅱ	–0.014	0.030	0.023	0.060	4.8	2 180	—
W3206SA-1P-C5Z5	550	609	665	700	857	Ⅰ	–0.016	0.035	0.025	0.075	5.6	2 180	2 180
W3207SA-1P-C5Z5	650	709	765	800	957	Ⅰ	–0.018	0.035	0.025	0.075	6.1	2 180	2 180
W3209SA-1P-C5Z5	850	909	965	1 000	1 157	Ⅰ	–0.023	0.040	0.027	0.090	7.3	2 180	2 180
W3211SA-1P-C5Z5	1 050	1 109	1 165	1 200	1 357	Ⅰ	–0.028	0.046	0.030	0.120	8.5	2 180	2 180
W3214SA-1P-C5Z5	1 350	1 409	1 465	1 500	1 657	Ⅰ	–0.035	0.054	0.035	0.150	10.2	2 070	2 180

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø32

Lead 5





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		32 × 5 / Right
Preload / Ball recirculation		Z-preload / Return tube
Ball dia. / Ball circle dia.		3.175 / 32.5
Screw shaft root diameter		29.2
Effective turns of balls		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load rating (N)	Dynamic C_a	18 500
	Static C_{0a}	56 100
Preload (N)		1 270
Dynamic friction torque, median, (N·cm)		23.5
Spacer ball		None
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm³)		10
Standard volume of grease replenishing (cm³)		5

Recommended support unit

For drive side (Fixed)
WBK25DF-31 (round)

Unit: mm

Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W3202SA-2Z-C5Z5	150	194	280	300	460	Ⅱ	−0.007	0.023	0.018	0.040	3.5	2 180	—
W3203SA-2Z-C5Z5	250	294	380	400	560	Ⅱ	−0.009	0.025	0.020	0.050	4.1	2 180	—
W3204SA-2Z-C5Z5	350	394	480	500	660	Ⅱ	−0.012	0.027	0.020	0.060	4.7	2 180	—
W3205SA-2Z-C5Z5	450	494	580	600	760	Ⅱ	−0.014	0.030	0.023	0.060	5.3	2 180	—
W3206SA-2Z-C5Z5	550	594	680	700	929	Ⅰ	−0.016	0.035	0.025	0.075	6.1	2 180	2 180
W3207SA-2Z-C5Z5	650	694	780	800	1 029	Ⅰ	−0.019	0.035	0.025	0.090	6.7	2 180	2 180
W3209SA-2Z-C5Z5	850	894	980	1 000	1 229	Ⅰ	−0.024	0.040	0.027	0.090	7.9	2 180	2 180
W3211SA-2Z-C5Z5	1 050	1 094	1 180	1 200	1 429	Ⅰ	−0.028	0.046	0.030	0.120	9.0	2 180	2 180
W3214SA-2Z-C5Z5	1 350	1 394	1 480	1 500	1 729	Ⅰ	−0.036	0.054	0.035	0.150	10.8	2 040	2 180

Notes: 1. We recommend NSK support unit. See page B375 for details.

2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.

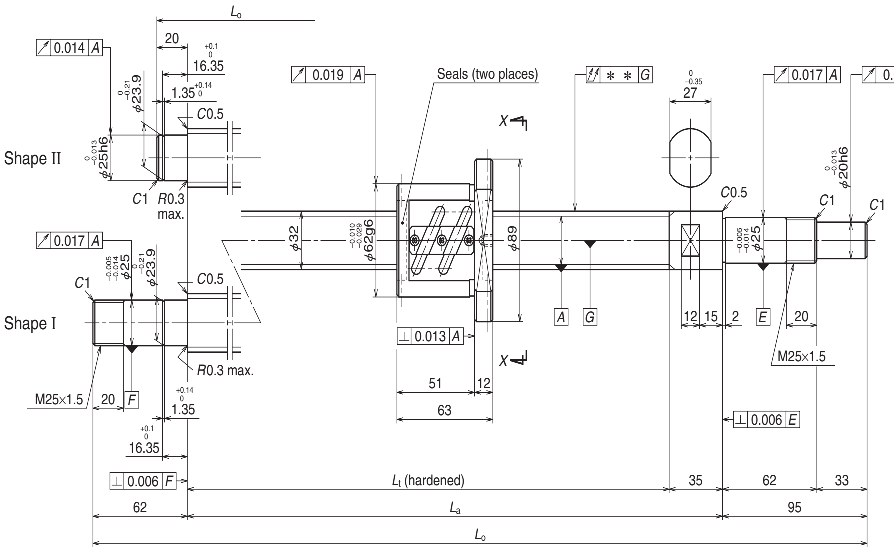
3. Contact NSK if the permissible rotational speed is to be exceeded.

Finished shaft end SA Type (Fine lead)

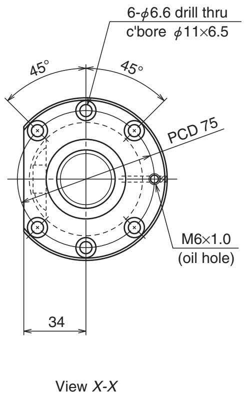
Nut model: PFT

Screw shaft ø32

Lead 6



Unit: mm



View X-X

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	15 500
	Static C_{0a}	34 700
Preload (N)		780
Dynamic friction torque, median, (N·cm)		15.7
Spacer ball		Yes
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm³)		9.5
Standard volume of grease replenishing (cm³)		4.8

Recommended support unit

For drive side	**For opposite to drive side**	
(Fixed)	**(Fixed)**	**(Simple)**
WBK25-01W (square)	WBK25-01W (square)	WBK25S-01W (square)
WBK25-11 (round)	WBK25-11 (round)	

Unit: mm

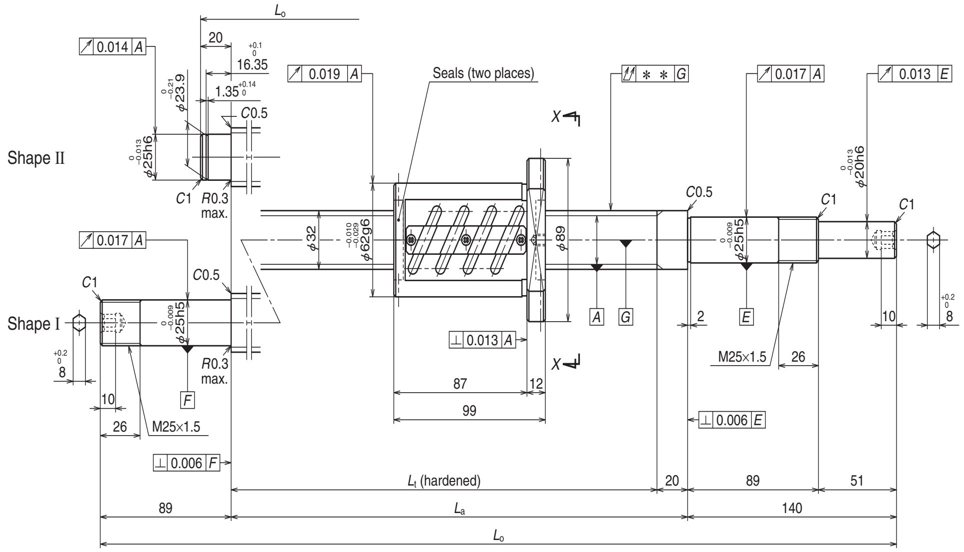
Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o		T	e_p	υ_u	↗		Fixed - Simple support	Fixed - Fixed
W3203SA-3P-C5Z6	250	302	365	400	515	II	−0.009	0.025	0.020	0.050	3.8	2 180	—
W3205SA-3P-C5Z6	450	502	565	600	715	II	−0.014	0.030	0.023	0.060	5.0	2 180	—
W3207SA-3P-C5Z6	650	702	765	800	957	I	−0.018	0.035	0.025	0.075	6.3	2 180	2 180
W3209SA-3P-C5Z6	850	902	965	1 000	1 157	I	−0.023	0.040	0.027	0.090	7.4	2 180	2 180
W3211SA-3P-C5Z6	1 050	1 102	1 165	1 200	1 357	I	−0.028	0.046	0.030	0.120	8.5	2 180	2 180
W3214SA-3P-C5Z6	1 350	1 402	1 465	1 500	1 657	I	−0.035	0.054	0.035	0.150	10.2	2 020	2 180

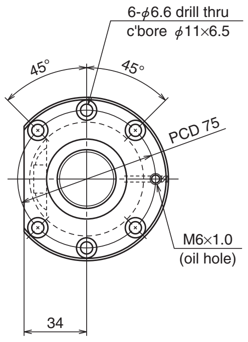
Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Nut model: ZFT

Screw shaft ø32

Lead 6





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		32 × 6 / Right
Preload / Ball recirculation		Z-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	24 700
	Static C_{0a}	69 400
Preload (N)		1 710
Dynamic friction torque, median, (N·cm)		35.0
Spacer ball		None
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm³)		14
Standard volume of grease replenishing (cm³)		7

Recommended support unit

For drive side (Fixed)
WBK25DF-31 (round)

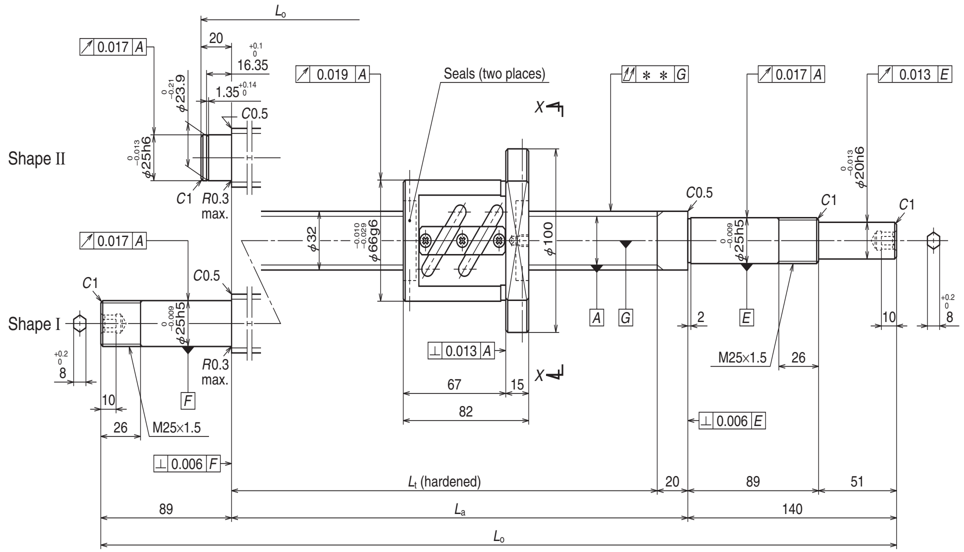
Unit: mm

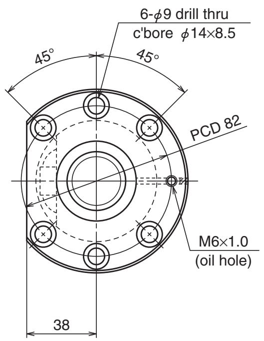
Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o		T	e_p	υ_u			Supporting condition: Fixed - Simple support	Fixed - Fixed
W3203SA-4Z-C5Z6	250	281	380	400	560	II	–0.009	0.025	0.020	0.050	4.5	2 180	—
W3205SA-4Z-C5Z6	450	481	580	600	760	II	–0.014	0.030	0.023	0.060	5.6	2 180	—
W3207SA-4Z-C5Z6	650	681	780	800	1 029	I	–0.019	0.035	0.025	0.090	7.0	2 180	2 180
W3209SA-4Z-C5Z6	850	881	980	1 000	1 229	I	–0.024	0.040	0.027	0.090	8.1	2 180	2 180
W3211SA-4Z-C5Z6	1 050	1 081	1 180	1 200	1 429	I	–0.028	0.046	0.030	0.120	9.3	2 180	2 180
W3214SA-4Z-C5Z6	1 350	1 381	1 480	1 500	1 729	I	–0.036	0.054	0.035	0.150	11.0	2 000	2 180

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø32

Lead 8





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		32 × 8 / Right
Preload / Ball recirculation		Z-preload / Return tube
Ball dia. / Ball circle dia.		4.762 / 32.5
Screw shaft root diameter		27.5
Effective turns of balls		2.5 × 1
Accuracy grade / Preload		C5 / Z
Basic load rating (N)	Dynamic C_a	17 500
	Static C_{0a}	41 000
Preload (N)		1 320
Dynamic friction torque, median, (N·cm)		31.0
Spacer ball		None
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm^3)		13
Standard volume of grease replenishing (cm^3)		6.5

Recommended support unit

For drive side (Fixed)
WBK25DF-31 (round)

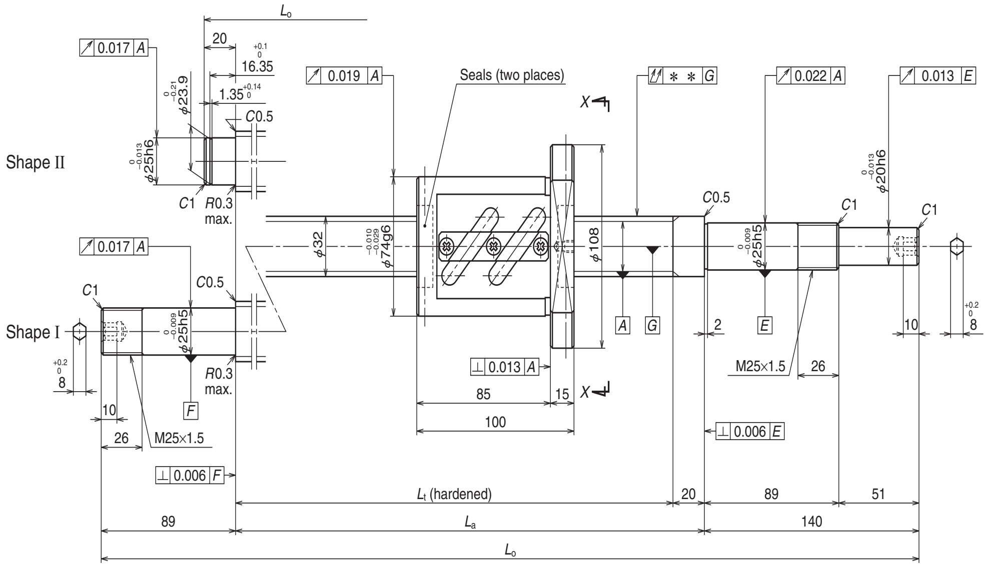
Unit: mm

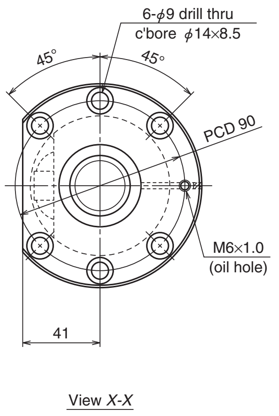
Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})	
												Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o		T	e_p	υ_u	↗↗		Fixed - Simple support	Fixed - Fixed
W3203SA-5Z-C5Z8	250	298	380	400	560	II	–0.009	0.025	0.020	0.050	4.7	2 180	—
W3205SA-5Z-C5Z8	450	498	580	600	760	II	–0.014	0.030	0.023	0.060	5.8	2 180	—
W3207SA-5Z-C5Z8	650	698	780	800	1 029	I	–0.019	0.035	0.025	0.090	7.2	2 180	2 180
W3209SA-5Z-C5Z8	850	898	980	1 000	1 229	I	–0.024	0.040	0.027	0.090	8.3	2 180	2 180
W3214SA-5Z-C5Z8	1 350	1 398	1 480	1 500	1 729	I	–0.036	0.054	0.035	0.150	11.1	1 920	2 180

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø32

Lead 10





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		32 × 10 / Right
Preload / Ball recirculation		Z-preload / Return tube
Ball dia. / Ball circle dia.		6.35 / 33
Screw shaft root diameter		26.4
Effective turns of balls		2.5 × 1
Accuracy grade / Preload		C5 / Z
Basic load rating (N)	Dynamic C_a	25 500
	Static C_{0a}	54 000
Preload (N)		1 960
Dynamic friction torque, median, (N·cm)		54.0
Spacer ball		None
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm³)		22
Standard volume of grease replenishing (cm³)		11

Recommended support unit

For drive side (Fixed)
WBK25DF-31 (round)

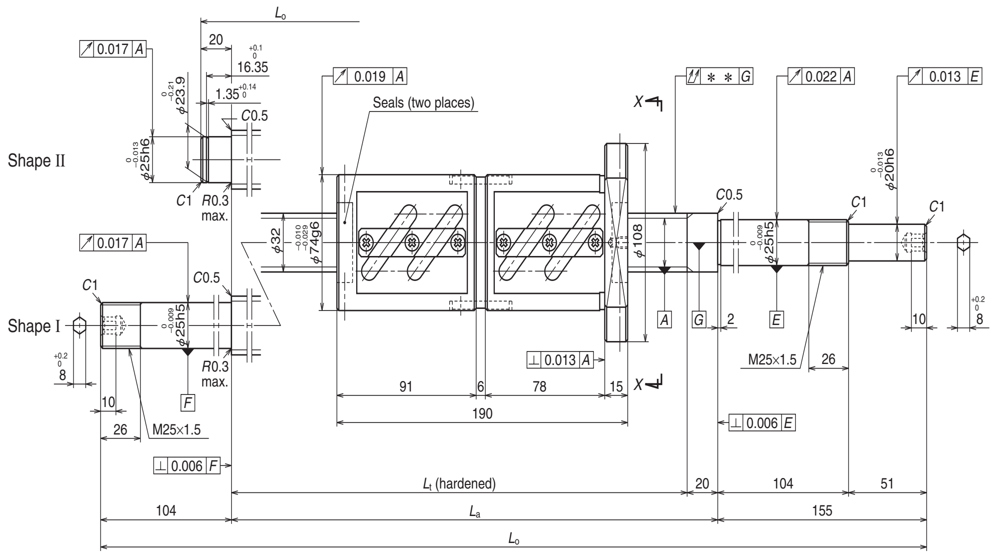
Unit: mm

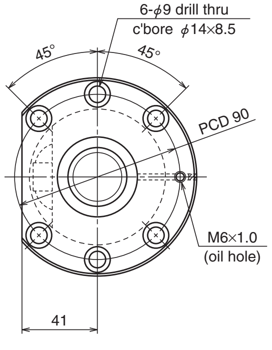
Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)	
												Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W3203SA-6Z-C5Z10	250	280	380	400	560	II	–0.009	0.025	0.020	0.050	5.5	2 180	—
W3204SA-3Z-C5Z10	350	380	480	500	660	II	–0.012	0.027	0.020	0.060	6.0	2 180	—
W3205SA-6Z-C5Z10	450	480	580	600	760	II	–0.014	0.030	0.023	0.060	6.6	2 180	—
W3206SA-3Z-C5Z10	550	580	680	700	929	I	–0.016	0.035	0.025	0.075	7.4	2 180	2 180
W3207SA-6Z-C5Z10	650	680	780	800	1 029	I	–0.019	0.035	0.025	0.090	7.9	2 180	2 180
W3209SA-6Z-C5Z10	850	880	980	1 000	1 229	I	–0.024	0.040	0.027	0.090	9.0	2 180	2 180
W3211SA-5Z-C5Z10	1 050	1 080	1 180	1 200	1 429	I	–0.028	0.046	0.030	0.120	10.1	2 180	2 180
W3214SA-6Z-C5Z10	1 350	1 380	1 480	1 500	1 729	I	–0.036	0.054	0.035	0.150	11.7	1 860	2 180
W3217SA-1Z-C5Z10	1 650	1 680	1 780	1 800	2 029	I	–0.043	0.065	0.040	0.200	13.3	1 280	1 820

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø32

Lead 10





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		32 × 10 / Right
Preload / Ball recirculation		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_a	46 300
	Static C_{0a}	108 000
Preload (N)		3 230
Dynamic friction torque, median, (N·cm)		83.0
Spacer ball		None
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm³)		44
Standard volume of grease replenishing (cm³)		22

Recommended support unit

For drive side (Fixed)
WBK25DFD-31 (round)

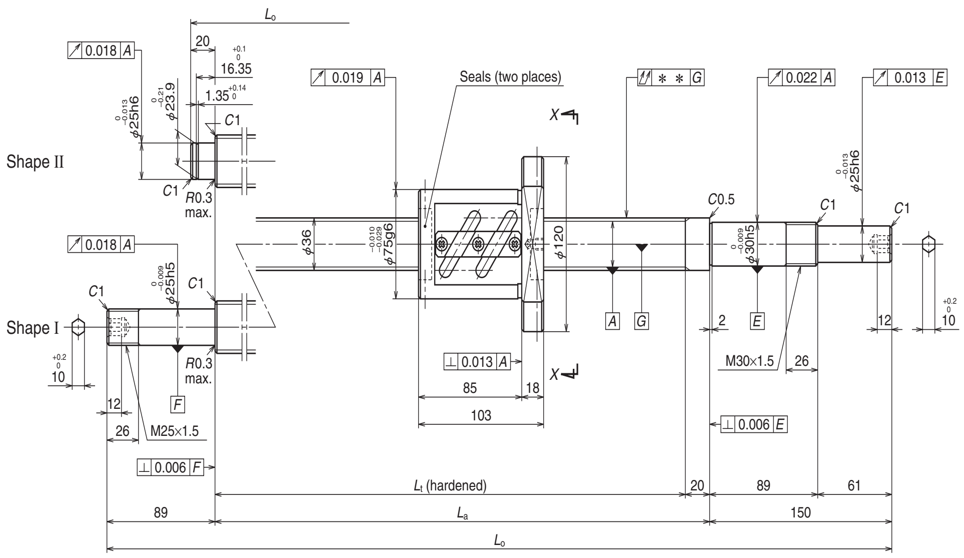
Unit: mm

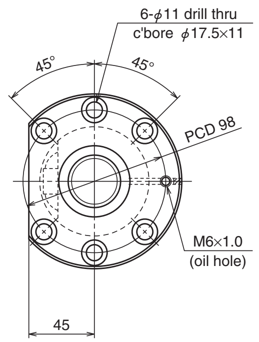
Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out ** ⌰	Mass (kg)	Permissible rotational speed N (min⁻¹)	
	Nominal	Maximum (L_t—Nut length)										Supporting condition	
			L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W3203SA-7D-C5Z10	150	190	380	400	575	II	−0.009	0.025	0.020	0.050	7.5	2 180	—
W3204SA-4D-C5Z10	250	290	480	500	675	II	−0.012	0.027	0.020	0.060	8.1	2 180	—
W3205SA-7D-C5Z10	350	390	580	600	775	II	−0.014	0.030	0.023	0.060	8.6	2 180	—
W3206SA-4D-C5Z10	450	490	680	700	959	I	−0.016	0.035	0.025	0.075	9.5	2 180	2 180
W3207SA-7D-C5Z10	550	590	780	800	1 059	I	−0.019	0.035	0.025	0.090	10.0	2 180	2 180
W3209SA-7D-C5Z10	750	790	980	1 000	1 259	I	−0.024	0.040	0.027	0.120	11.1	2 180	2 180
W3211SA-6D-C5Z10	950	990	1 180	1 200	1 459	I	−0.028	0.046	0.030	0.120	12.2	2 180	2 180
W3214SA-7D-C5Z10	1 250	1 290	1 480	1 500	1 759	I	−0.036	0.054	0.035	0.150	13.8	1 980	2 180
W3217SA-2D-C5Z10	1 550	1 590	1 780	1 800	2 059	I	−0.043	0.065	0.040	0.200	15.4	1 350	1 910

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø36

Lead 10





View X-X

Unit: mm

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_a	27 200
Basic load rating (N) Static C_{0a}	61 300
Preload (N)	2 060
Dynamic friction torque, median, (N·cm)	59.0
Spacer ball	None
Factory-packed grease	**Refer to Notes 2.**
Internal spatial volume of nut (cm^3)	32
Standard volume of grease replenishing (cm^3)	16

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK30DF-31 (round)	WBK25DF-31 (round)

Unit: mm

Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W3604SA-1Z-C5Z10	350	377	480	500	670	II	–0.012	0.027	0.020	0.040	7.4	1 940	—
W3606SA-1Z-C5Z10	550	577	680	700	870	II	–0.016	0.035	0.025	0.050	8.8	1 940	—
W3609SA-1Z-C5Z10	850	877	980	1 000	1 239	I	–0.024	0.040	0.027	0.065	11.1	1 940	1 940
W3613SA-1Z-C5Z10	1 250	1 277	1 380	1 400	1 639	I	–0.033	0.054	0.035	0.100	13.9	1 940	1 940
W3617SA-1Z-C5Z10	1 650	1 677	1 780	1 800	2 039	I	–0.043	0.065	0.040	0.130	16.6	1 480	1 940

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

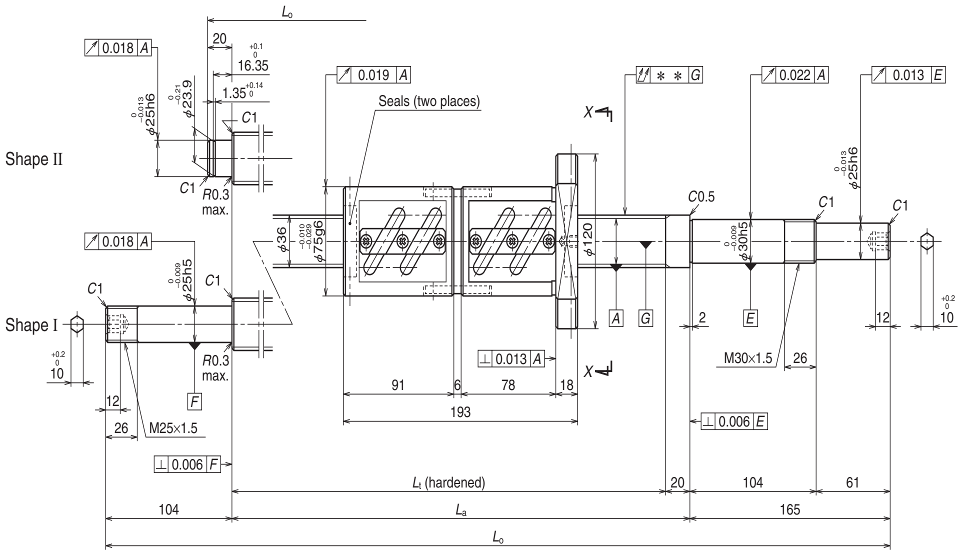
Finished shaft end SA Type (Fine lead)

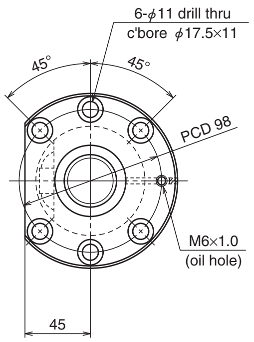
Nut model: DFT

NSK

Screw shaft ø36

Lead 10





View *X*-*X*

Unit: mm

Ball screw specifications		
Shaft dia. × Lead / Direction of turn		36 × 10 / Right
Preload / Ball recirculation		D-preload / Return tube
Ball dia. / Ball circle dia.		6.35 / 37
Screw shaft root diameter		30.4
Effective turns of balls		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load rating (N)	Dynamic C_a	49 300
	Static C_{0a}	123 000
Preload (N)		3 430
Dynamic friction torque, median, (N·cm)		93.0
Spacer ball		None
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm³)		64
Standard volume of grease replenishing (cm³)		27

Recommended support unit

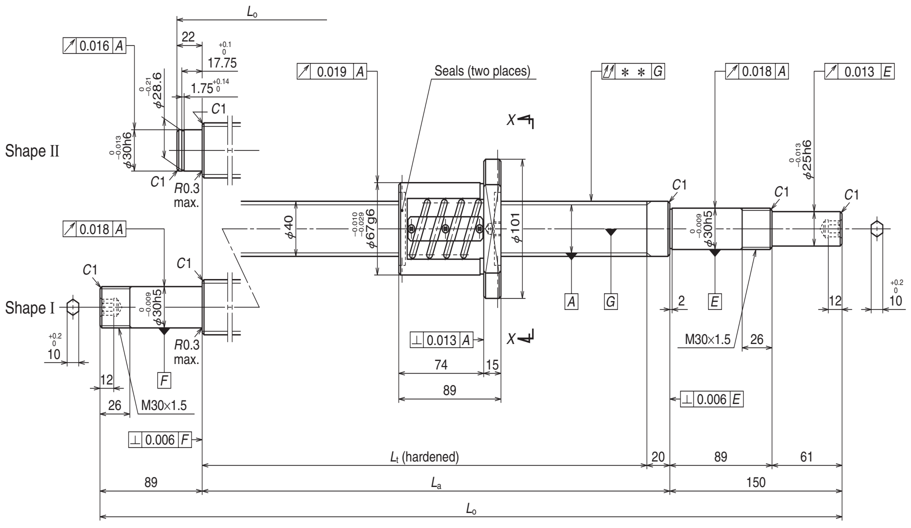
For drive side (Fixed)	**For opposite to drive side (Simple)**
WBK30DFD-31 (round)	WBK25DFD-31 (round)

Unit: mm

Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W3604SA-2D-C5Z10	250	287	480	500	685	II	–0.012	0.027	0.020	0.040	9.3	1 940	—
W3606SA-2D-C5Z10	450	487	680	700	885	II	–0.016	0.035	0.025	0.050	10.7	1 940	—
W3609SA-2D-C5Z10	750	787	980	1 000	1 269	I	–0.024	0.040	0.027	0.080	13.1	1 940	1 940
W3613SA-2D-C5Z10	1 150	1 187	1 380	1 400	1 669	I	–0.033	0.054	0.035	0.100	15.9	1 940	1 940
W3617SA-2D-C5Z10	1 550	1 587	1 780	1 800	2 069	I	–0.043	0.065	0.040	0.130	18.6	1 540	1 940

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Finished shaft end SA Type (Fine lead)

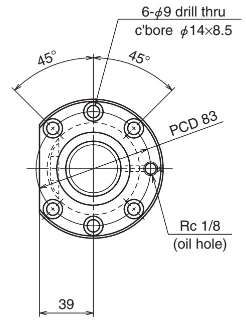


Nut model: ZFT

Screw shaft ø40

Lead 5

Unit: mm



View X-X

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		40 × 5 / 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		2.5 × 2
Accuracy grade / Preload		C5 / Z
Basic load rating (N)	Dynamic C_a	20 200
	Static C_{0a}	70 600
Preload (N)		1 420
Dynamic friction torque, median, (N·cm)		29.5
Spacer ball		None
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm³)		14
Standard volume of grease replenishing (cm³)		7

Recommended support unit

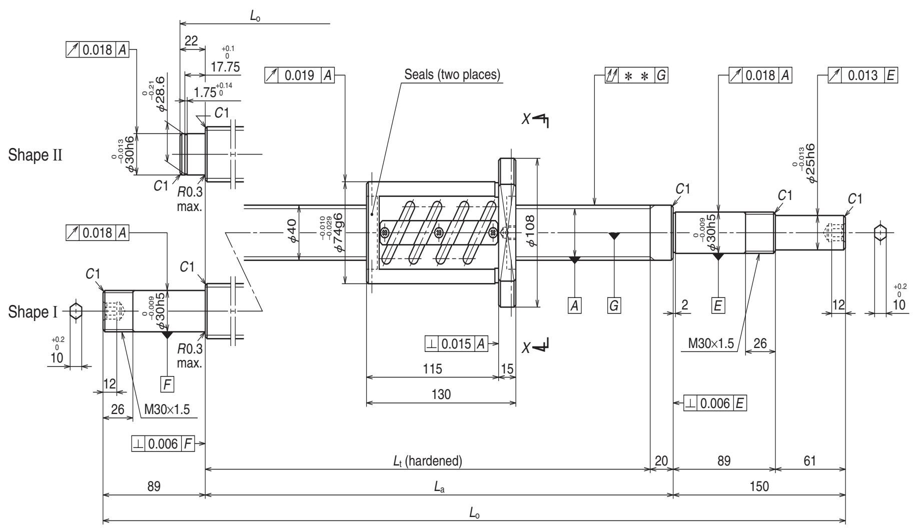
For drive side (Fixed)
WBK30DF-31 (round)

Unit: mm

Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)	
												Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W4003SA-1Z-C5Z5	250	291	380	400	572	II	–0.009	0.025	0.020	0.035	6.3	1 750	—
W4005SA-1Z-C5Z5	450	491	580	600	772	II	–0.014	0.030	0.023	0.040	8.1	1 750	—
W4007SA-1Z-C5Z5	650	691	780	800	1 039	I	–0.019	0.035	0.025	0.065	10.3	1 750	1 750
W4009SA-1Z-C5Z5	850	891	980	1 000	1 239	I	–0.024	0.040	0.027	0.065	12.2	1 750	1 750
W4011SA-1Z-C5Z5	1 050	1 091	1 180	1 200	1 439	I	–0.028	0.046	0.030	0.080	14.0	1 750	1 750
W4015SA-1Z-C5Z5	1 450	1 491	1 580	1 600	1 839	I	–0.038	0.054	0.035	0.100	17.7	1 750	1 750

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Finished shaft end SA Type (Fine lead)

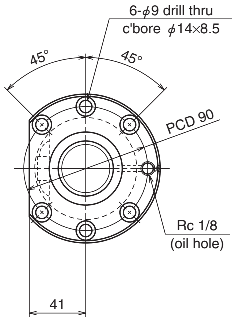


Nut model: ZFT

NSK

Screw shaft ø40

Lead 8



View *X-X*

Unit: mm

Ball screw specifications	
Shaft dia. x Lead / Direction of turn	40 × 8 / Right
Preload / Ball recirculation	Z-preload / Return tube
Ball dia. / Ball circle dia.	4.762 / 40.5
Screw shaft root diameter	35.5
Effective turns of balls	2.5 × 2
Accuracy grade / Preload	C5 / Z
Basic load rating (N) Dynamic C_a	34 900
Basic load rating (N) Static C_{0a}	103 000
Preload (N)	2 450
Dynamic friction torque, median, (N·cm)	64.0
Spacer ball	None
Factory-packed grease	**Refer to Notes 2.**
Internal spatial volume of nut (cm^3)	27
Standard volume of grease replenishing (cm^3)	14

Recommended support unit

For drive side (Fixed)
WBK30DF-31 (round)

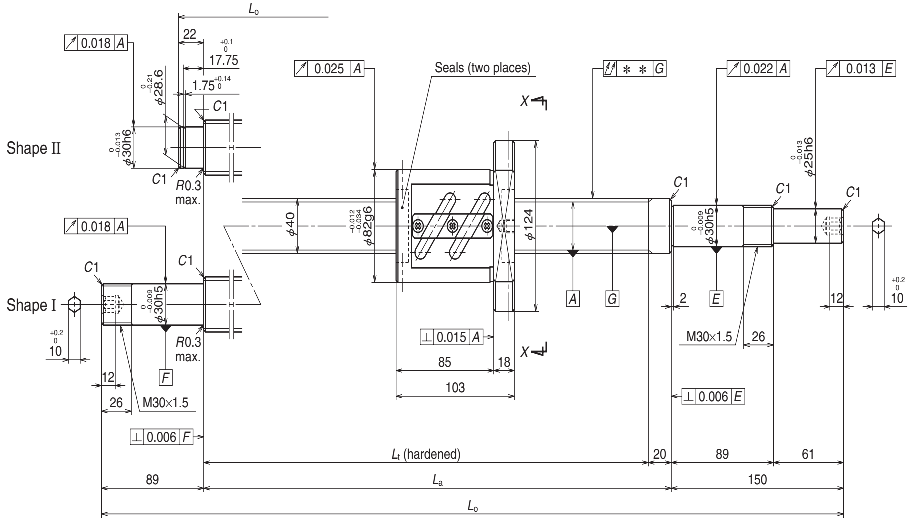
Unit: mm

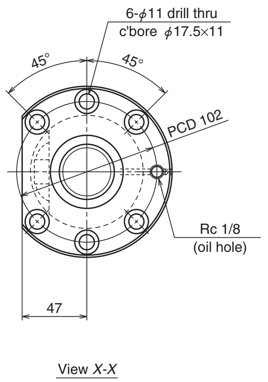
Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W4003SA-2Z-C5Z8	200	250	380	400	572	II	−0.009	0.025	0.020	0.035	7.4	1 750	—
W4005SA-2Z-C5Z8	400	450	580	600	772	II	−0.014	0.030	0.023	0.040	9.2	1 750	—
W4007SA-2Z-C5Z8	600	650	780	800	1 039	I	−0.019	0.035	0.025	0.065	11.3	1 750	1 750
W4009SA-2Z-C5Z8	800	850	980	1 000	1 239	I	−0.024	0.040	0.027	0.065	13.1	1 750	1 750
W4011SA-2Z-C5Z8	1 000	1 050	1 180	1 200	1 439	I	−0.028	0.046	0.030	0.080	14.9	1 750	1 750
W4015SA-2Z-C5Z8	1 400	1 450	1 580	1 600	1 839	I	−0.038	0.054	0.035	0.100	18.5	1 750	1 750

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø40

Lead 10





Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		40 × 10 / 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		2.5 × 1
Accuracy grade / Preload		C5 / Z
Basic load rating (N)	Dynamic C_a	28 600
	Static C_{0a}	68 600
Preload (N)		2 160
Dynamic friction torque, median, (N·cm)		64.0
Spacer ball		None
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm³)		30
Standard volume of grease replenishing (cm³)		15

Recommended support unit

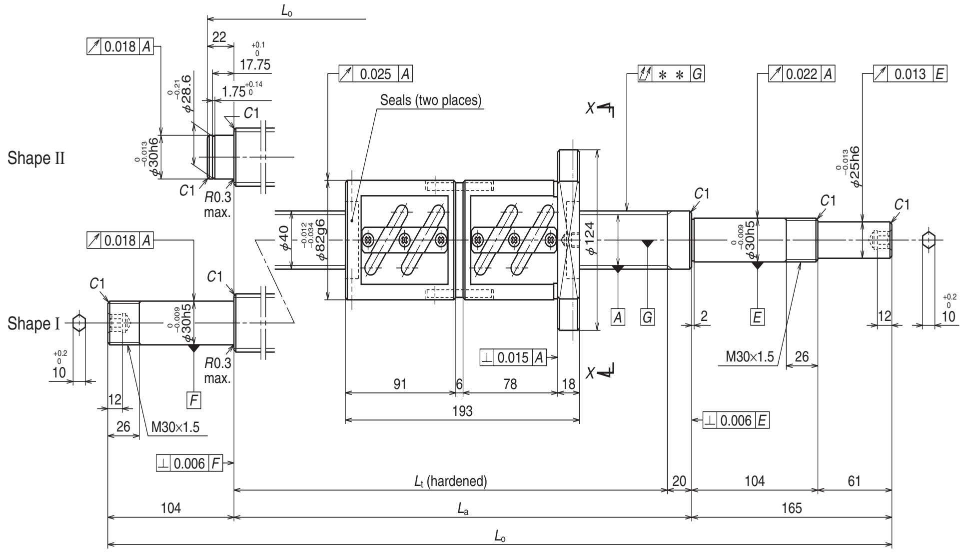
For drive side (Fixed)
WBK30DF-31 (round)

Unit: mm

Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)	
												Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o		T	e_p	υ_u	⌰		Fixed - Simple support	Fixed - Fixed
W4004SA-1Z-C5Z10	350	377	480	500	672	II	−0.012	0.027	0.020	0.040	8.7	1 750	—
W4005SA-3Z-C5Z10	450	477	580	600	772	II	−0.014	0.030	0.023	0.040	9.6	1 750	—
W4006SA-1Z-C5Z10	550	577	680	700	872	II	−0.016	0.035	0.025	0.050	10.4	1 750	—
W4007SA-3Z-C5Z10	650	677	780	800	1 039	I	−0.019	0.035	0.025	0.065	11.7	1 750	1 750
W4009SA-3Z-C5Z10	850	877	980	1 000	1 239	I	−0.024	0.040	0.027	0.065	13.4	1 750	1 750
W4011SA-3Z-C5Z10	1 050	1 077	1 180	1 200	1 439	I	−0.028	0.046	0.030	0.080	15.1	1 750	1 750
W4013SA-1Z-C5Z10	1 250	1 277	1 380	1 400	1 639	I	−0.033	0.054	0.035	0.100	16.9	1 750	1 750
W4015SA-3Z-C5Z10	1 450	1 477	1 580	1 600	1 839	I	−0.038	0.054	0.035	0.100	18.6	1 750	1 750
W4017SA-1Z-C5Z10	1 650	1 677	1 780	1 800	2 039	I	−0.043	0.065	0.040	0.130	20.3	1 670	1 750
W4023SA-1Z-C5Z10	2 250	2 277	2 380	2 400	2 639	I	−0.057	0.077	0.046	0.170	25.5	930	1 320

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Finished shaft end SA Type (Fine lead)

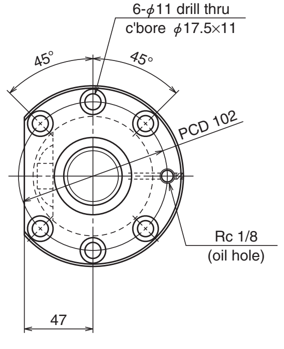


Nut model: DFT

Screw shaft ø40

Lead 10

Unit: mm



View X-X

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		40 × 10 / Right
Preload / Ball recirculation		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_a	52 000
	Static C_{0a}	137 000
Preload (N)		3 630
Dynamic friction torque, median, (N·cm)		108
Spacer ball		None
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm³)		59
Standard volume of grease replenishing (cm³)		30

Recommended support unit

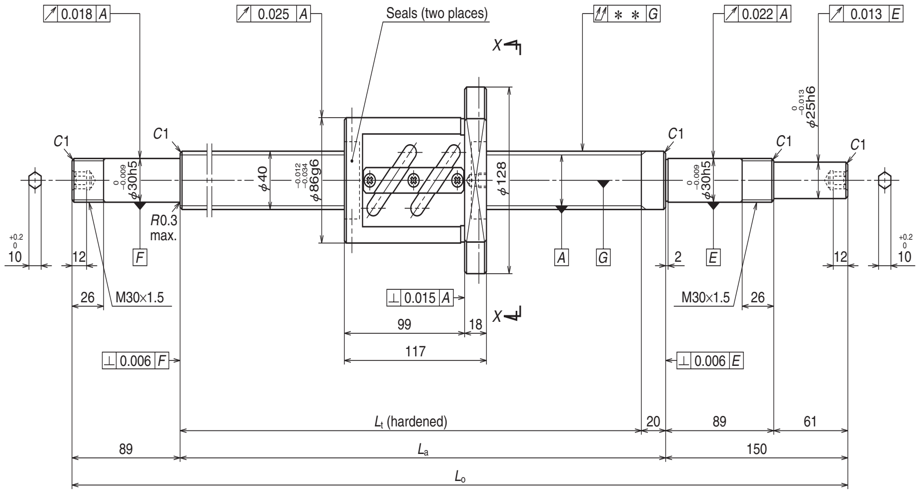
For drive side (Fixed)
WBK30DFD-31 (round)

Unit: mm

Ball screw No.	Stroke		Screw shaft length			Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o		T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W4004SA-2D-C5Z10	250	287	480	500	687	II	–0.012	0.027	0.020	0.040	11.0	1 750	—
W4005SA-4D-C5Z10	350	387	580	600	787	II	–0.014	0.030	0.023	0.040	11.9	1 750	—
W4006SA-2D-C5Z10	450	487	680	700	887	II	–0.016	0.035	0.025	0.050	12.7	1 750	—
W4007SA-4D-C5Z10	550	587	780	800	1 069	I	–0.019	0.035	0.025	0.065	14.1	1 750	1 750
W4009SA-4D-C5Z10	750	787	980	1 000	1 269	I	–0.024	0.040	0.027	0.080	15.8	1 750	1 750
W4011SA-4D-C5Z10	950	987	1 180	1 200	1 469	I	–0.028	0.046	0.030	0.080	17.5	1 750	1 750
W4013SA-2D-C5Z10	1 150	1 187	1 380	1 400	1 669	I	–0.033	0.054	0.035	0.100	19.3	1 750	1 750
W4015SA-4D-C5Z10	1 350	1 387	1 580	1 600	1 869	I	–0.038	0.054	0.035	0.100	21.0	1 750	1 750
W4017SA-2D-C5Z10	1 550	1 587	1 780	1 800	2 069	I	–0.043	0.065	0.040	0.130	22.7	1 750	1 750
W4023SA-2D-C5Z10	2 150	2 187	2 380	2 400	2 669	I	–0.057	0.077	0.046	0.170	27.9	960	1 370

Notes: 1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

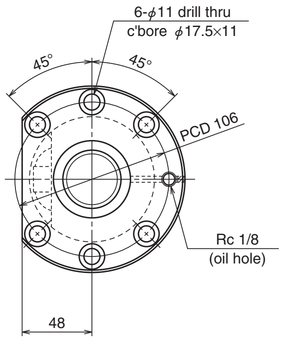
Finished shaft end SA Type (Fine lead)



Nut model: ZFT

Screw shaft ø40

Lead 12



View *X-X*

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		40 × 12 / Right
Preload / Ball recirculation		Z-preload / 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	33 600
	Static C_{0a}	77 500
Preload (N)		2 550
Dynamic friction torque, median, (N·cm)		83.0
Spacer ball		None
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm³)		33
Standard volume of grease replenishing (cm³)		17

Recommended support unit

For drive side (Fixed)
WBK30DF-31 (round)

Unit: mm

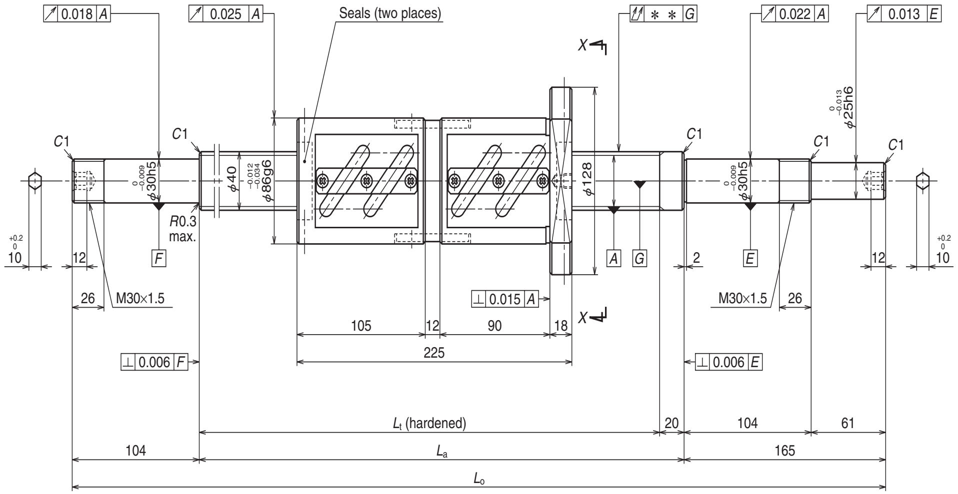
Ball screw No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out ** ↗	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W4006SA-3Z-C5Z12	500	563	680	700	939	−0.016	0.035	0.025	0.050	11.6	1 750	1 750
W4009SA-5Z-C5Z12	800	863	980	1 000	1 239	−0.024	0.040	0.027	0.065	14.2	1 750	1 750
W4013SA-3Z-C5Z12	1 200	1 263	1 380	1 400	1 639	−0.033	0.054	0.035	0.100	17.7	1 750	1 750
W4017SA-3Z-C5Z12	1 600	1 663	1 780	1 800	2 039	−0.043	0.065	0.040	0.130	21.2	1 670	1 750
W4024SA-1Z-C5Z12	2 300	2 363	2 480	2 500	2 739	−0.060	0.077	0.046	0.170	27.2	850	1 220

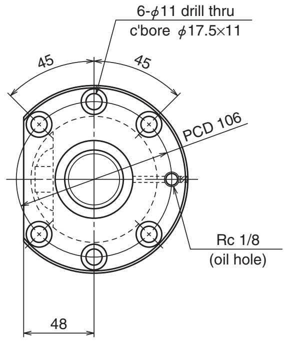
Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø40

Lead 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	61 000
Basic load rating (N) Static C_{0a}	155 000
Preload (N)	4 310
Dynamic friction torque, median, (N·cm)	137
Spacer ball	None
Factory-packed grease	**Refer to Notes 2.**
Internal spatial volume of nut (cm^3)	76
Standard volume of grease replenishing (cm^3)	38

Recommended support unit

For drive side (Fixed)
WBK30DFD-31 (round)

Unit: mm

Ball screw No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Supporting condition: Fixed - Simple support	Fixed - Fixed
W4006SA-4D-C5Z12	400	455	680	700	969	–0.016	0.035	0.025	0.050	14.8	1 750	1 750
W4009SA-6D-C5Z12	700	755	980	1 000	1 269	–0.024	0.040	0.027	0.080	17.4	1 750	1 750
W4013SA-4D-C5Z12	1 100	1 155	1 380	1 400	1 669	–0.033	0.054	0.035	0.100	20.9	1 750	1 750
W4017SA-4D-C5Z12	1 500	1 555	1 780	1 800	2 069	–0.043	0.065	0.040	0.130	24.3	1 750	1 750
W4024SA-2D-C5Z12	2 200	2 255	2 480	2 500	2 769	–0.060	0.077	0.046	0.170	30.4	880	1 260

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

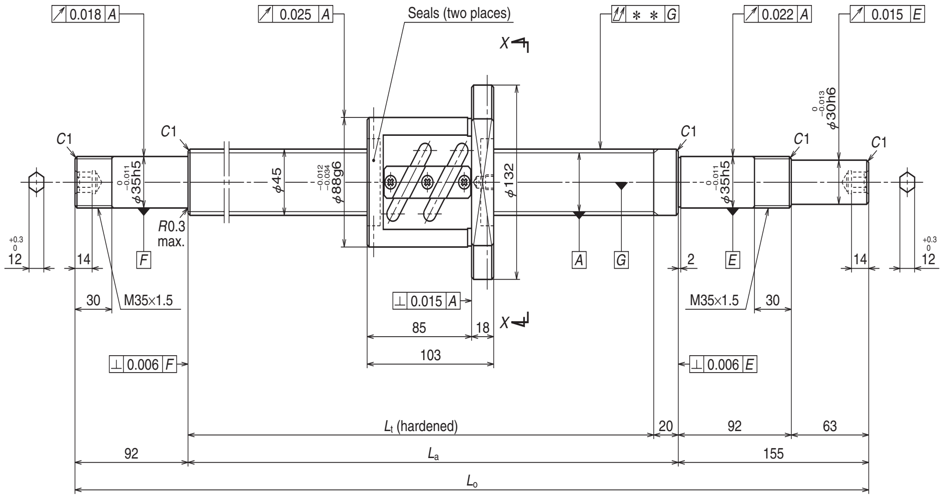
Finished shaft end SA Type (Fine lead)

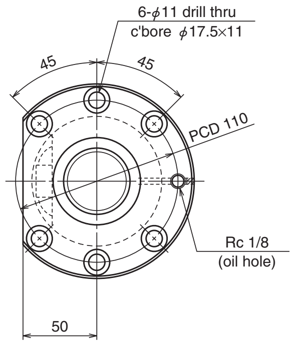
Nut model: ZFT

NSK

Screw shaft ø45

Lead 10





View *X*-*X*

Unit: mm

Ball screw specifications	
Shaft dia. x Lead / Direction of turn	45 × 10 / Right
Preload / Ball recirculation	Z-preload / 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_a	29 900
Basic load rating (N) Static C_{0a}	77 300
Preload (N)	2 260
Dynamic friction torque, median, (N·cm)	69.0
Spacer ball	None
Factory-packed grease	**Refer to Notes 2.**
Internal spatial volume of nut (cm^3)	33
Standard volume of grease replenishing (cm^3)	17

Recommended support unit

For drive side (Fixed)
WBK35DF-31 (round)

Unit: mm

Ball screw No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out ∗∗	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W4506SA-1Z-C5Z10	550	577	680	700	947	–0.016	0.035	0.025	0.050	13.4	1 550	1 550
W4509SA-1Z-C5Z10	850	877	980	1 000	1 247	–0.024	0.040	0.027	0.065	16.7	1 550	1 550
W4513SA-1Z-C5Z10	1 250	1 277	1 380	1 400	1 647	–0.033	0.054	0.035	0.100	21.2	1 550	1 550
W4517SA-1Z-C5Z10	1 650	1 677	1 780	1 800	2 047	–0.043	0.065	0.040	0.130	25.6	1 550	1 550
W4524SA-1Z-C5Z10	2 350	2 377	2 480	2 500	2 747	–0.060	0.077	0.046	0.170	33.4	980	1 400

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

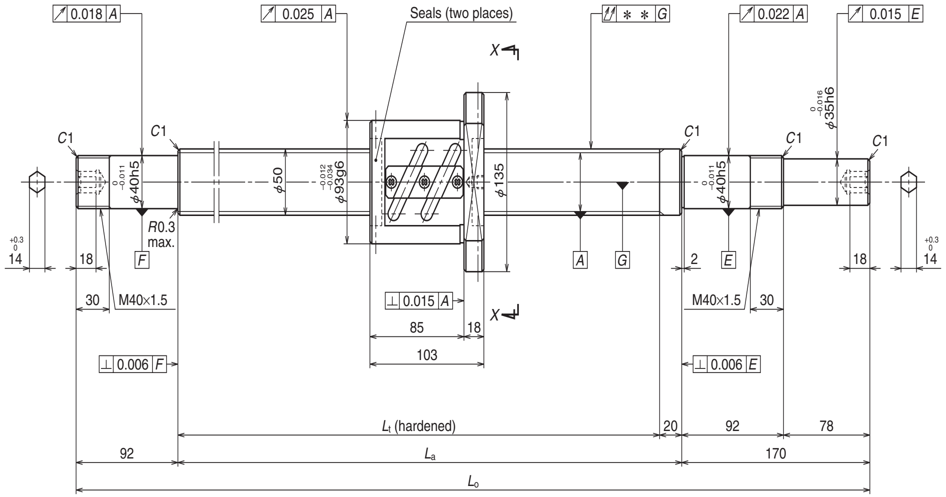
Finished shaft end SA Type (Fine lead)

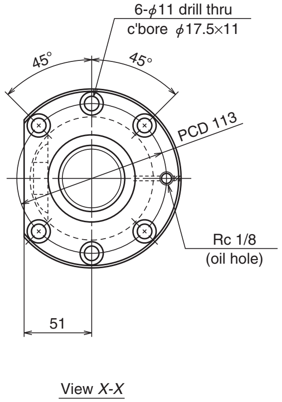
Nut model: ZFT

NSK

Screw shaft ø50

Lead 10





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. × Lead / Direction of turn		50 × 10 / Right
Preload / Ball recirculation		Z-preload / 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	31 800
	Static C_{0a}	87 400
Preload (N)		2 450
Dynamic friction torque, median, (N·cm)		79.0
Spacer ball		None
Factory-packed grease		**Refer to Notes 2.**
Internal spatial volume of nut (cm^3)		37
Standard volume of grease replenishing (cm^3)		19

Recommended support unit

For drive side (Fixed)
WBK40DF-31 (round)

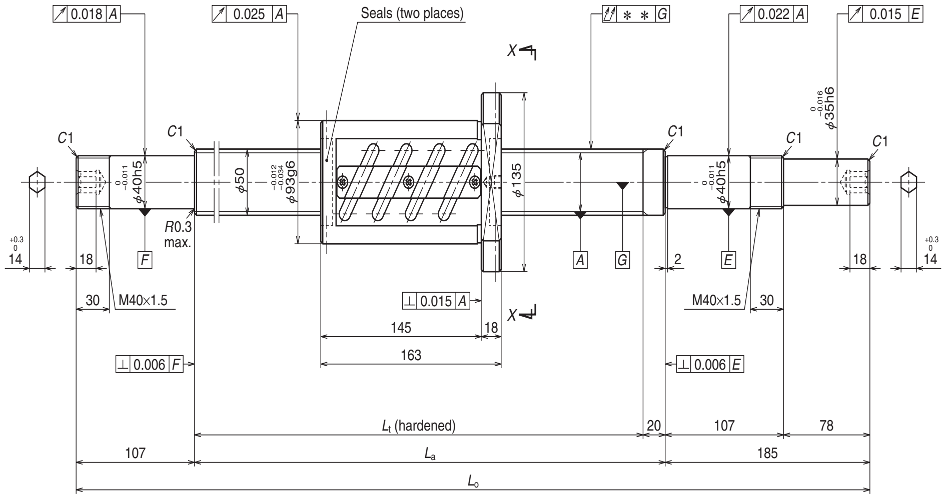
Unit: mm

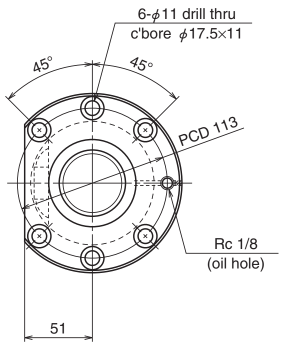
Ball screw No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
W5005SA-1Z-C5Z10	450	477	580	600	862	–0.014	0.030	0.023	0.050	14.8	1 400	1 400
W5007SA-1Z-C5Z10	650	677	780	800	1 062	–0.019	0.035	0.025	0.065	17.6	1 400	1 400
W5009SA-1Z-C5Z10	850	877	980	1 000	1 262	–0.024	0.040	0.027	0.080	20.3	1 400	1 400
W5011SA-1Z-C5Z10	1 050	1 077	1 180	1 200	1 462	–0.028	0.046	0.030	0.080	23.1	1 400	1 400
W5014SA-1Z-C5Z10	1 350	1 377	1 480	1 500	1 762	–0.036	0.054	0.035	0.100	27.3	1 400	1 400
W5019SA-1Z-C5Z10	1 850	1 877	1 980	2 000	2 262	–0.048	0.065	0.040	0.130	34.2	1 400	1 400
W5025SA-1Z-C5Z10	2 450	2 477	2 580	2 600	2 862	–0.062	0.093	0.054	0.170	42.5	1 020	1 400

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø50

Lead 10





View *X-X*

Unit: mm

Ball screw specifications	
Shaft dia. x Lead / Direction of turn	50 × 10 / Right
Preload / Ball recirculation	Z-preload / Return tube
Ball dia. / Ball circle dia.	6.35 / 51
Screw shaft root diameter	44.4
Effective turns of balls	2.5 × 2
Accuracy grade / Preload	C5 / Z
Basic load rating (N) Dynamic C_a	57 700
Basic load rating (N) Static C_{0a}	175 000
Preload (N)	4 020
Dynamic friction torque, median, (N·cm)	137
Spacer ball	None
Factory-packed grease	**Refer to Notes 2.**
Internal spatial volume of nut (cm³)	59
Standard volume of grease replenishing (cm³)	30

Recommended support unit

For drive side (Fixed)
WBK40DFD-31 (round)

Unit: mm

Ball screw No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o	T	e_p	υ_u	↗		Fixed - Simple support	Fixed - Fixed
W5005SA-2Z-C5Z10	350	417	580	600	892	–0.014	0.030	0.023	0.050	16.8	1 400	1 400
W5007SA-2Z-C5Z10	550	617	780	800	1 092	–0.019	0.035	0.025	0.065	19.6	1 400	1 400
W5009SA-2Z-C5Z10	750	817	980	1 000	1 292	–0.024	0.040	0.027	0.080	22.3	1 400	1 400
W5011SA-2Z-C5Z10	950	1 017	1 180	1 200	1 492	–0.028	0.046	0.030	0.080	25.1	1 400	1 400
W5014SA-2Z-C5Z10	1 250	1 317	1 480	1 500	1 792	–0.036	0.054	0.035	0.100	29.3	1 400	1 400
W5019SA-2Z-C5Z10	1 750	1 817	1 980	2 000	2 292	–0.048	0.065	0.040	0.130	36.2	1 400	1 400
W5025SA-2Z-C5Z10	2 350	2 417	2 580	2 600	2 892	–0.062	0.093	0.054	0.170	44.6	1 040	1 400

Notes:
1. We recommend NSK support unit. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Contact NSK if the permissible rotational speed is to be exceeded.

B-3-1.3 Finished Shaft End Ball Screws Made of Stainless Steel KA Type

1. Order of the dimension tables

The tables begin 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**.

2. 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.

●Lead accuracy

Lead accuracy is C3 and C5 grades.

T : Travel compensation
e_p : Tolerance on specified travel
υ_u: Travel variation

See "Technical Description: Lead Accuracy" (page B37) for details 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, the d·n and critical speed, will determine the overall permissible rotational speed of the ball screw. For details, see "Technical Description: Permissible Rotational Speed" (page B47).

3. Material

A martensitic stainless steel is used. A special heat treatment technology provides the ball groove section with sufficient hardness which produces high load carrying capacity and durability.

4. Other

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, see pages B70 and D2. See pages B67 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	4	5	10	20
6	B261					
8	B263	B265				
10		B267	B269			
12		B271		B273	B275	
15					B277	B279
16		B281				
20						B283

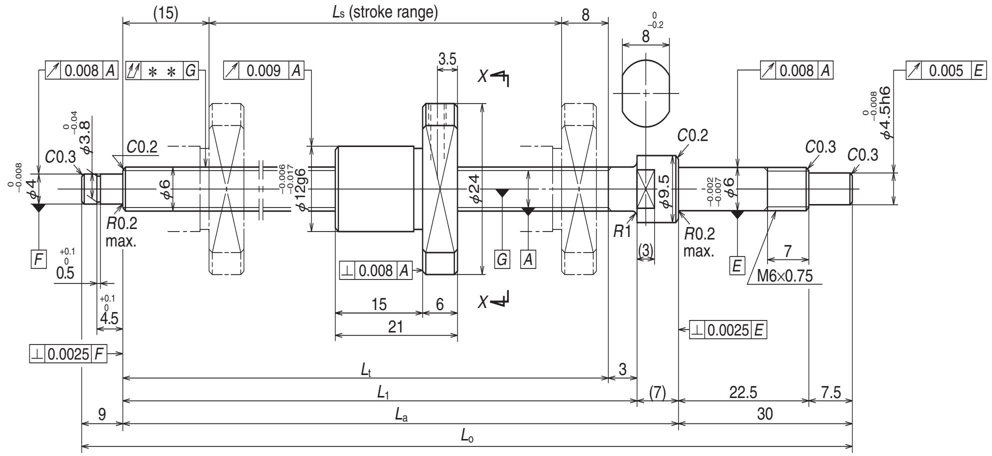
Finished shaft end stainless steel product KA Type (Fine lead)

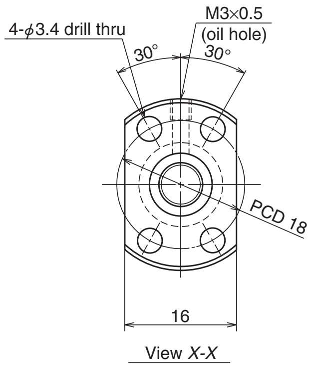
Nut model: MPFD

Screw shaft ø6

Lead 1

Unit: mm





View X-X

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		6 × 1 / Right
Preload / Ball recirculation		P-preload / Deflector
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_a	470
	Static C_{0a}	680
Axial play		0
Preload (N)		147
Dynamic friction torque, (N·cm)		1.3 or less
Spacer ball		None
Factory-packed grease		**Refer to Notes 1.**

Unit: mm

Ball screw No.	Stroke L_s		Thread length				Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)
												Supporting condition
	Nominal	Maximum	L_t	L_1	L_a	L_o	T	e_p	υ_u			Fixed - Simple support
W0601KA-3PY-C3Z1	100	102	125	128	135	174	0	0.010	0.008	0.025	0.06	3 000

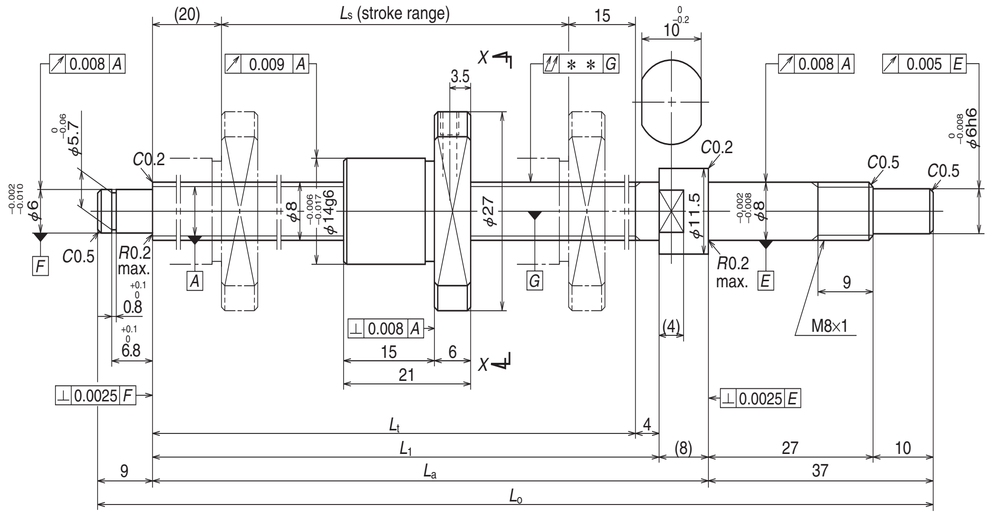
Notes:
1. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
   See page D13 for details.
   Use of NSK Clean Grease LG2 is recommended.
2. Ball nut does not have seal.
3. Contact NSK if the permissible rotational speed is to be exceeded.

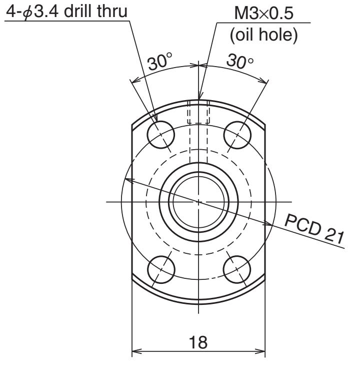
Nut model: MPFD

Screw shaft ø8

Lead 1

Unit: mm





View X-X

Ball screw specifications		
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		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 Notes 1.**

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Free)
WBK08-01C (square, clean)	WBK08S-01C (square, clean)
WBK08-11C (round, clean)	

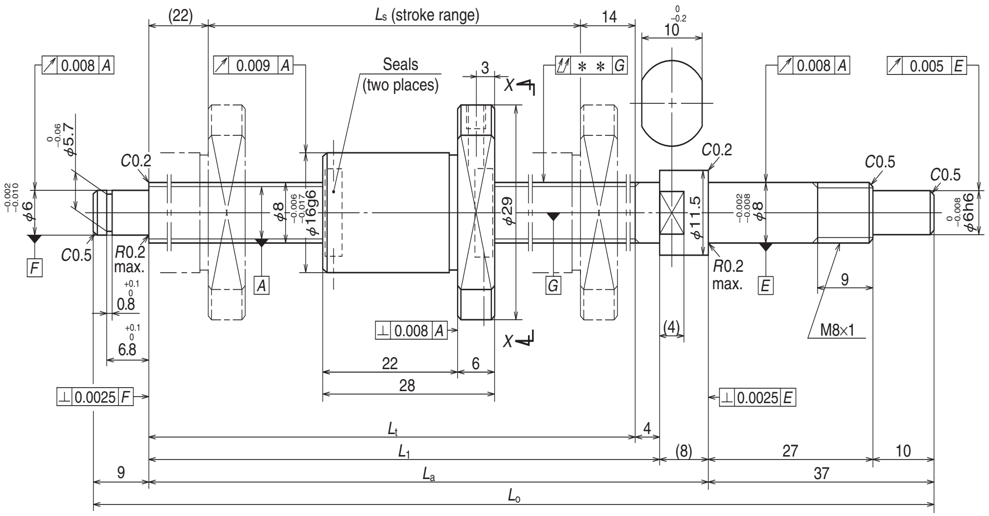
Unit: mm

Ball screw No.	Stroke L_s		Thread length				Lead accuracy			Shaft run-out ∗∗	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition
	Nominal	Maximum	L_t	L_1	L_a	L_o	T	e_p	υ_u	↗↗		Fixed - Simple support
W0802KA-1PY-C3Z1	150	155	190	194	202	248	0	0.010	0.008	0.035	0.12	3 000

Notes:
1. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
   See page D13 for details.
   Use of NSK Clean Grease LG2 is recommended.
2. Ball nut does not have seal.
3. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø8

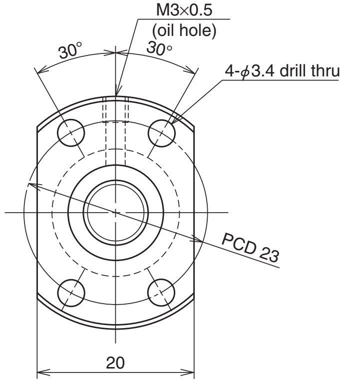
Lead 2



Unit: mm

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	1 080
Basic load rating (N) Static C_{0a}	1 630
Axial play	0
Preload (N)	49.0
Dynamic friction torque, (N·cm)	2.0 or less
Spacer ball	None
Factory-packed grease	**Refer to Notes 1.**
Internal spatial volume of nut (cm³)	0.34
Standard volume of grease replenishing (cm³)	0.17



View *X-X*

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Free)
WBK08-01C (square, clean)	WBK08S-01C (square, clean)
WBK08-11C (round, clean)	

Unit: mm

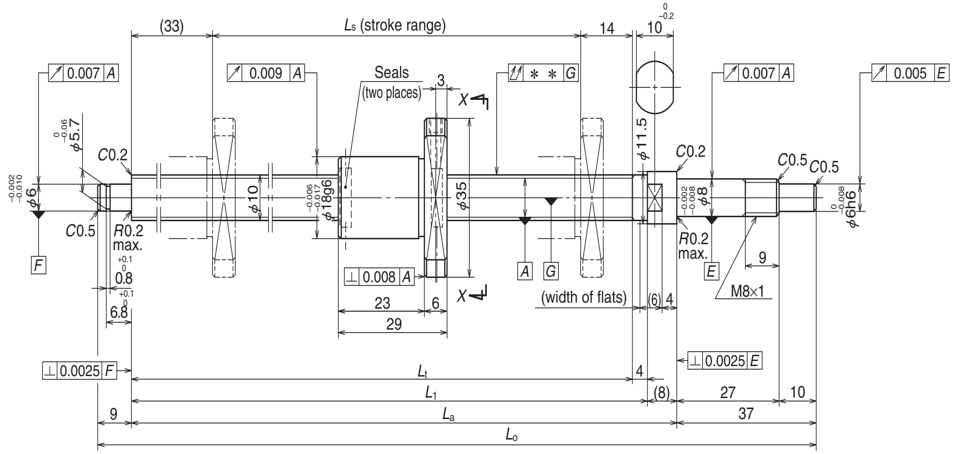
Ball screw No.	Stroke L_s		Thread length				Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})
	Nominal	Maximum										Supporting condition
			L_t	L_1	L_a	L_o	T	e_p	υ_u			Fixed - Simple support
W0802KA-5PY-C3Z2	150	154	190	194	202	248	0	0.010	0.008	0.035	0.13	3 000

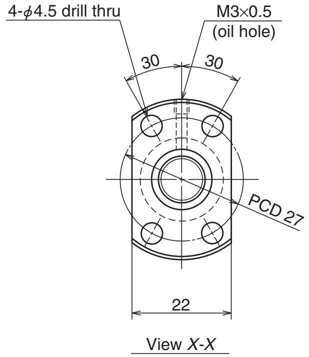
Notes:
1. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
   See page D13 for details.
   Use of NSK Clean Grease LG2 is recommended.
2. Contact NSK if the permissible rotational speed is to be exceeded.

Nut model: MPFD

Screw shaft ø10

Lead 2





View X-X

Unit: mm

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	1 210
	Static C_{0a}	2 110
Axial play		0
Preload (N)		58.8
Dynamic friction torque, (N·cm)		0.10 – 2.5
Spacer ball		None
Factory-packed grease		**Refer to Notes 1.**
Internal spatial volume of nut (cm³)		0.44
Standard volume of grease replenishing (cm³)		0.22

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Free)
WBK08-01C (square, clean)	WBK08S-01C (square, clean)
WBK08-11C (round, clean)	

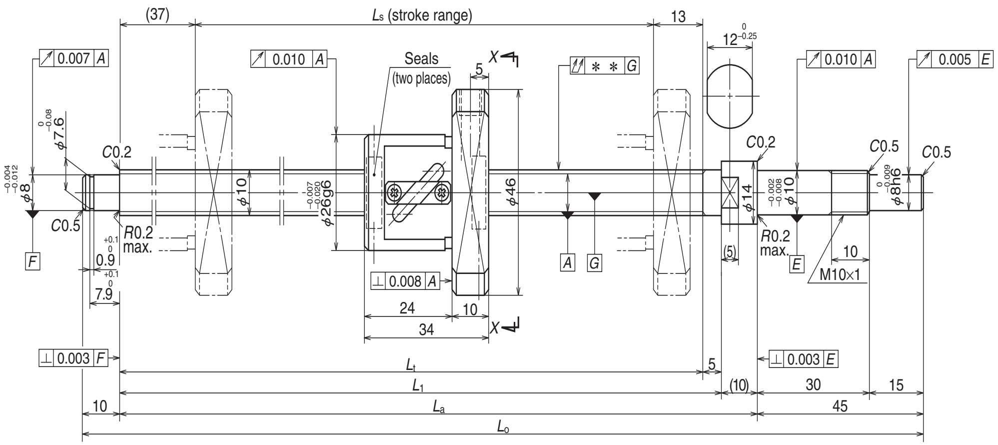
Unit: mm

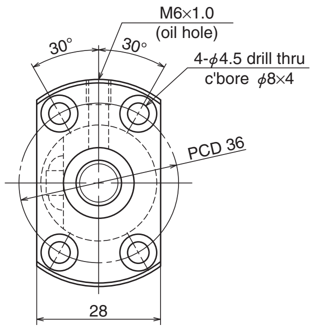
Ball screw No.	Stroke L_s		Thread length				Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition
	Nominal	Maximum	L_t	L_1	L_a	L_o	T	e_p	υ_u			Fixed - Simple support
W1002KA-3PY-C3Z2	200	203	250	254	262	308	0	0.012	0.008	0.030	0.22	3 000

Notes: 1. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
See page D13 for details.
Use of NSK Clean Grease LG2 is recommended.
2. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø10

Lead 4





View X-X

Unit: mm

Ball screw specifications	
Shaft dia. x Lead / Direction of turn	10 × 4 / 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	2.5 × 1
Accuracy grade / Preload	C3 / Z
Basic load rating (N) Dynamic C_a	2 250
Basic load rating (N) Static C_{0a}	3 290
Axial play	0
Preload (N)	98.1
Dynamic friction torque, (N·cm)	0.5 – 3.9
Spacer ball	None
Factory-packed grease	**Refer to Notes 1.**
Internal spatial volume of nut (cm³)	0.8
Standard volume of grease replenishing (cm³)	0.4

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Free)
WBK10-01C (square, clean)	WBK10S-01C (square, clean)
WBK10-11C (round, clean)	

Unit: mm

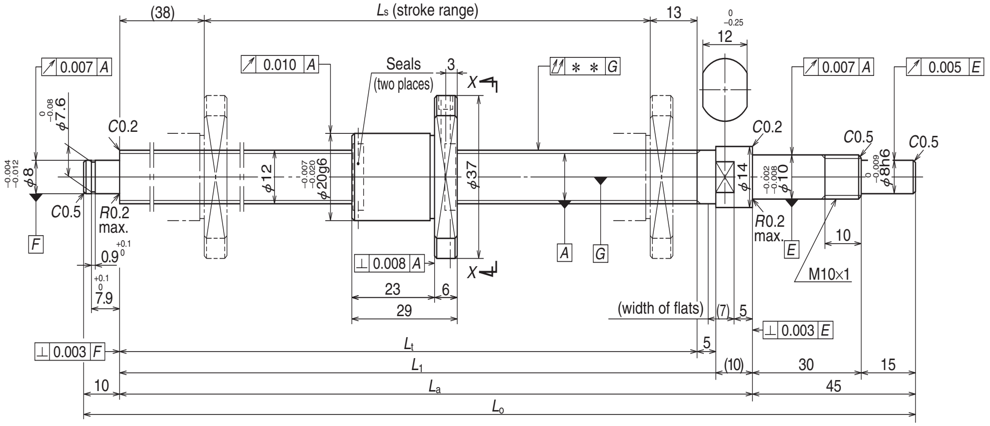
Ball screw No.	Stroke L_s		Thread length				Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition
	Nominal	Maximum	L_t	L_1	L_a	L_o	T	e_p	υ_u			Fixed - Simple support
W1001KA-3P-C3Z4	100	110	160	165	175	230	0	0.010	0.008	0.030	0.29	3 000
W1003KA-3P-C3Z4	300	310	360	365	375	430	0	0.013	0.008	0.050	0.39	3 000

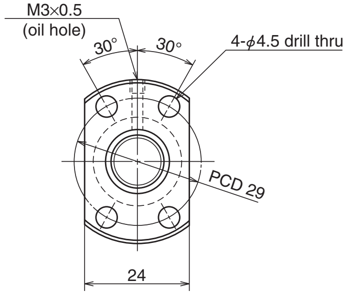
Notes:
1. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
   See page D13 for details.
   Use of NSK Clean Grease LG2 is recommended.
2. Contact NSK if the permissible rotational speed is to be exceeded.

Screw shaft ø12

Lead 2

Unit: mm





View X-X

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		12 × 2 / Right
Preload / Ball recirculation		P-preload / Deflector
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	1 360
	Static C_{0a}	2 680
Axial play		0
Preload (N)		98.1
Dynamic friction torque, (N·cm)		0.4 – 3.4
Spacer ball		None
Factory-packed grease		**Refer to Notes 1.**
Internal spatial volume of nut (cm^3)		0.53
Standard volume of grease replenishing (cm^3)		0.27

Recommended support unit

For drive side (Fixed)	**For opposite to drive side (Free)**
WBK10-01C (square, clean)	WBK10S-01C (square, clean)
WBK10-11C (round, clean)	

Unit: mm

Ball screw No.	Stroke L_s		Thread length				Lead accuracy			Shaft run-out ** ⌰	Mass (kg)	Permissible rotational speed N (min^{-1})
	Nominal	Maximum	L_t	L_1	L_a	L_o	T	e_p	υ_u			Supporting condition Fixed - Simple support
W1201KA-3PY-C3Z2	100	109	160	165	175	230	0	0.010	0.008	0.030	0.24	3 000
W1203KA-1PY-C3Z2	250	259	310	315	325	380	0	0.012	0.008	0.040	0.36	3 000

Notes:
1. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
   See page D13 for details.
   Use of NSK Clean Grease LG2 is recommended.
2. Contact NSK if the permissible rotational speed is to be exceeded.

Finished shaft end stainless steel product KA Type (Fine lead)

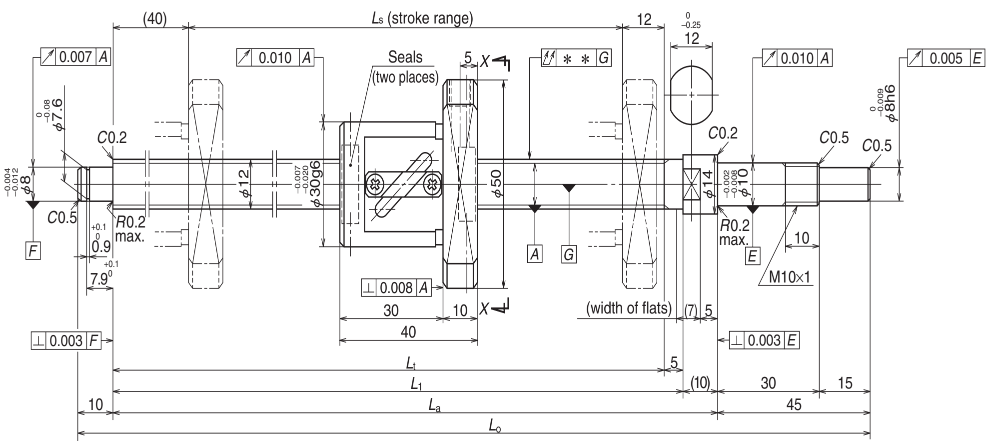
Nut model: PFT

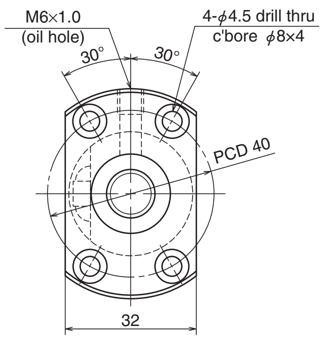
NSK

Screw shaft ø12

Lead 5

Unit: mm





View X-X

Ball screw specifications		
Shaft dia. × 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		C3 / Z
Basic load rating (N)	Dynamic C_a	3 070
	Static C_{0a}	4 670
Axial play		0
Preload (N)		98.1
Dynamic friction torque, (N·cm)		1.0 – 4.4
Spacer ball		None
Factory-packed grease		**Refer to Notes 1.**
Internal spatial volume of nut (cm³)		1.2
Standard volume of grease replenishing (cm³)		0.6

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Free)
WBK10-01C (square, clean)	WBK10S-01C (square, clean)
WBK10-11C (round, clean)	

KA

Unit: mm

Ball screw No.	Stroke L_s		Thread length				Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)
	Nominal	Maximum	L_t	L_1	L_a	L_o	T	e_p	υ_u			Supporting condition Fixed - Simple support
W1202KA-3P-C3Z5	200	208	260	265	275	330	0	0.012	0.008	0.040	0.47	3 000
W1205KA-1P-C3Z5	450	458	510	515	525	580	0	0.016	0.012	0.065	0.66	3 000

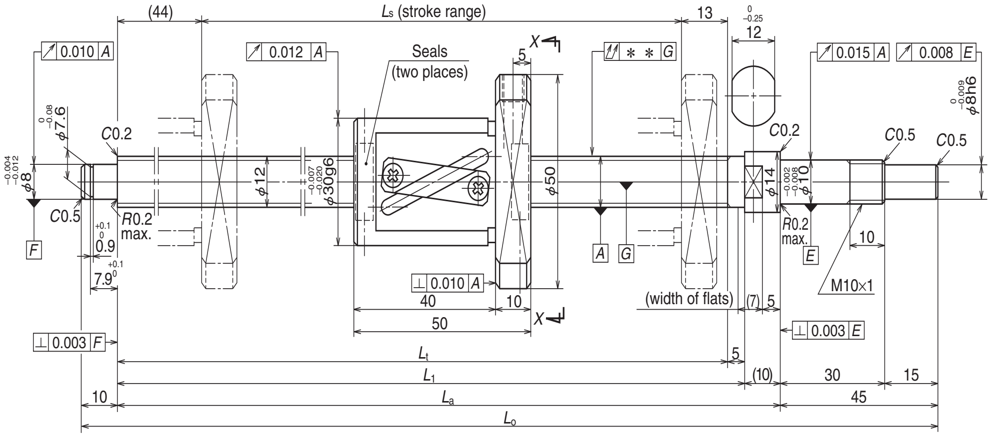
Notes: 1. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
See page D13 for details.
Use of NSK Clean Grease LG2 is recommended.
2. Contact NSK if the permissible rotational speed is to be exceeded.

Finished shaft end stainless steel product KA Type (Medium lead)

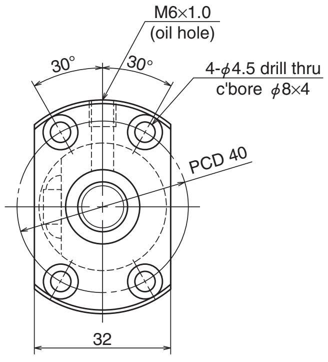
Nut model: LPFT

Screw shaft ø12

Lead 10



Unit: mm



View X-X

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		12 × 10 / Right
Preload / Ball recirculation		P-preload / 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_a	3 070
	Static C_{0a}	4 790
Axial play		0
Preload (N)		98.1
Dynamic friction torque, (N·cm)		1.0 – 4.9
Spacer ball		None
Factory-packed grease		**Refer to Notes 1.**
Internal spatial volume of nut (cm^3)		1.4
Standard volume of grease replenishing (cm^3)		0.7

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Free)
WBK10-01C (square, clean)	WBK10S-01C (square, clean)
WBK10-11C (round, clean)	

Unit: mm

Ball screw No.	Stroke L_s		Thread length				Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition
	Nominal	Maximum	L_t	L_1	L_a	L_o	T	e_p	υ_u	↗↗		Fixed - Simple support
W1203KA-3P-C5Z10	250	253	310	315	325	380	0	0.023	0.018	0.050	0.56	3 000
W1205KA-3P-C5Z10	450	453	510	515	525	580	0	0.030	0.023	0.075	0.72	3 000

Notes:
1. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
   See page D13 for details.
   Use of NSK Clean Grease LG2 is recommended.
2. Contact NSK if the permissible rotational speed is to be exceeded.

Finished shaft end stainless steel product KA Type (Medium lead)

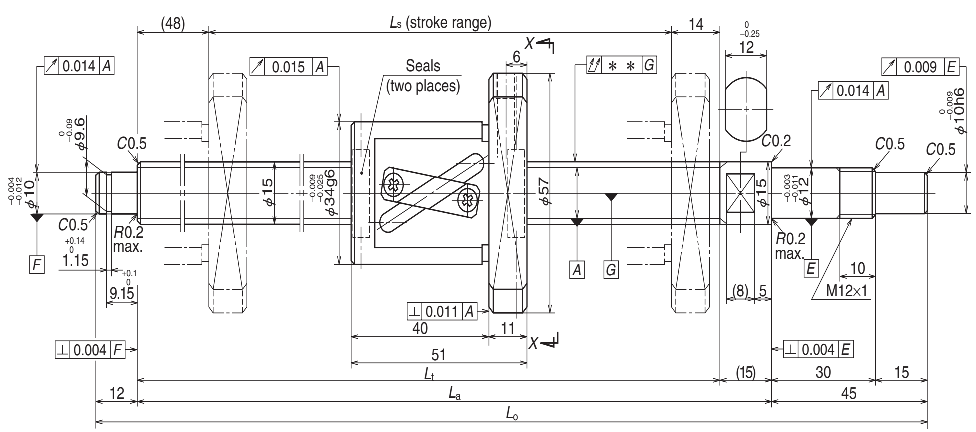
Nut model: LPFT

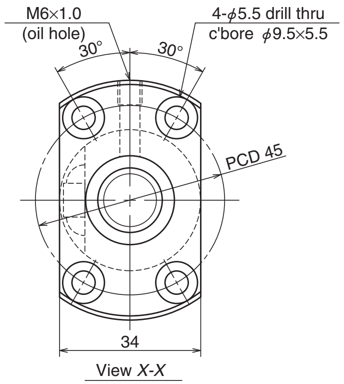
NSK

Screw shaft ø15

Lead 10

Unit: mm





View X-X

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	5 780
Basic load rating (N) Static C_{0a}	9 430
Axial play	0
Preload (N)	147
Dynamic friction torque, (N·cm)	1.5 – 7.9
Spacer ball	None
Factory-packed grease	**Refer to Notes 1.**
Internal spatial volume of nut (cm³)	2.3
Standard volume of grease replenishing (cm³)	1.4

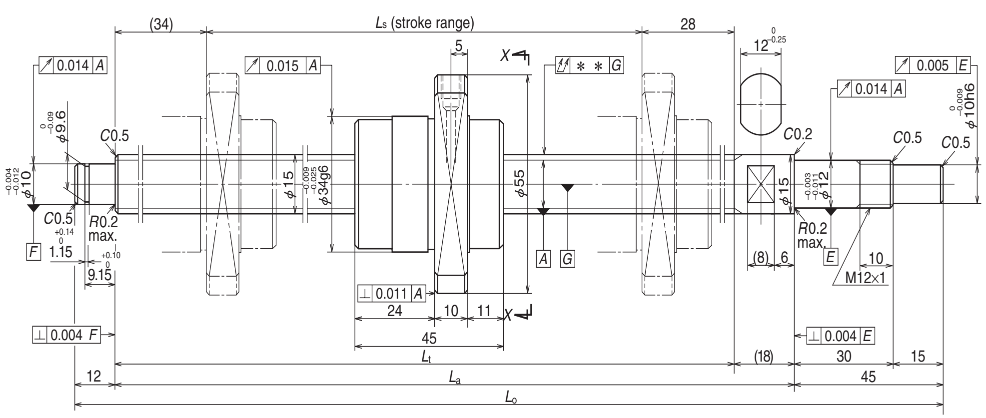
Recommended support unit

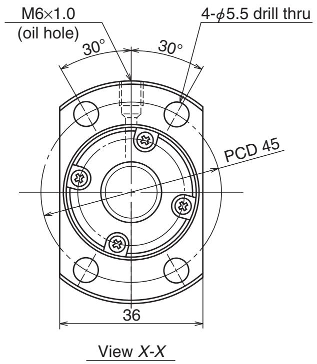
For drive side (Fixed)	For opposite to drive side (Free)
WBK12-01C (square, clean)	WBK12S-01C (square, clean)
WBK12-11C (round, clean)	

Unit: mm

Ball screw No.	Stroke L_s		Thread length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition
	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support
W1504KA-3P-C5Z10	400	427	489	504	561	0	0.027	0.020	0.050	0.99	3 000
W1506KA-3P-C5Z10	600	627	689	704	761	0	0.035	0.025	0.065	1.2	3 000
W1510KA-1P-C5Z10	1 000	1 027	1 089	1 104	1 161	0	0.046	0.030	0.110	1.7	1 610

Notes:
1. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
   See page D13 for details.
   Use of NSK Clean Grease LG2 is recommended.
2. Contact NSK if the permissible rotational speed is to be exceeded.





Screw shaft ø15
Lead 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	4 150
	Static C_{0a}	6 450
Axial play		0
Preload (N)		147
Dynamic friction torque, (N·cm)		1.5 – 7.9
Spacer ball		None
Factory-packed grease		**Refer to Notes 1.**
Internal spatial volume of nut (cm^3)		1.9
Standard volume of grease replenishing (cm^3)		1.0

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Free)
WBK12-01C (square, clean)	WBK12S-01C (square, clean)
WBK12-11C (round, clean)	

Unit: mm

Ball screw No.	Stroke L_s		Thread length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})
	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u	⌰		Supporting condition Fixed - Simple support
W1504KA-7PG-C5Z20	400	424	486	504	561	0	0.027	0.020	0.050	1.0	3 000
W1506KA-7PG-C5Z20	600	624	686	704	761	0	0.035	0.025	0.065	1.3	3 000
W1510KA-3PG-C5Z20	1 000	1 024	1 086	1 104	1 161	0	0.046	0.030	0.110	1.8	1 610

Notes:
1. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
   See page D13 for details.
   Use of NSK Clean Grease LG2 is recommended.
2. Contact NSK if the permissible rotational speed is to be exceeded.

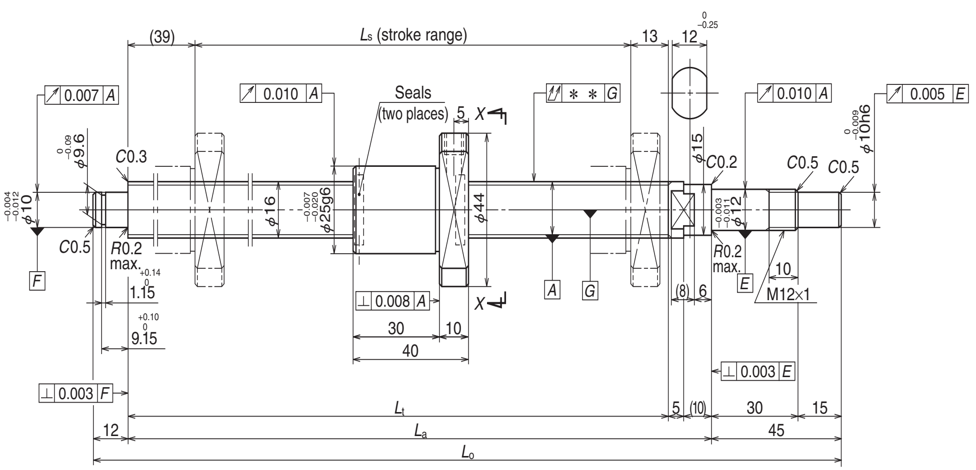
Finished shaft end stainless steel product KA Type (Fine lead)

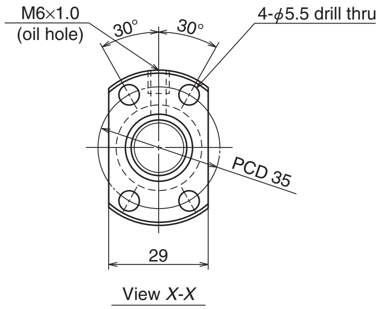
Nut model: MPFD

NSK

Screw shaft ø16

Lead 2





View X-X

Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		16 × 2 / 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		1 × 4
Accuracy grade / Preload		C3 / Z
Basic load rating (N)	Dynamic C_a	2 870
	Static C_{0a}	6 250
Axial play		0
Preload (N)		147
Dynamic friction torque, (N·cm)		0.5 – 4.9
Spacer ball		None
Factory-packed grease		**Refer to Notes 1.**
Internal spatial volume of nut (cm³)		1.6
Standard volume of grease replenishing (cm³)		0.8

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Free)
WBK12-01C (square, clean)	WBK12S-01C (square, clean)
WBK12-11C (round, clean)	

Unit: mm

Ball screw No.	Stroke L_s		Thread length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)
											Supporting condition
	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support
W1601KA-3PY-C3Z2	100	137	189	204	261	0	0.010	0.008	0.020	0.46	3 000
W1603KA-1PY-C3Z2	300	337	389	404	461	0	0.013	0.010	0.035	0.75	3 000

Notes:
1. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
   See page D13 for details.
   Use of NSK Clean Grease LG2 is recommended.
2. Contact NSK if the permissible rotational speed is to be exceeded.

Finished shaft end stainless steel product KA Type (High helix lead)

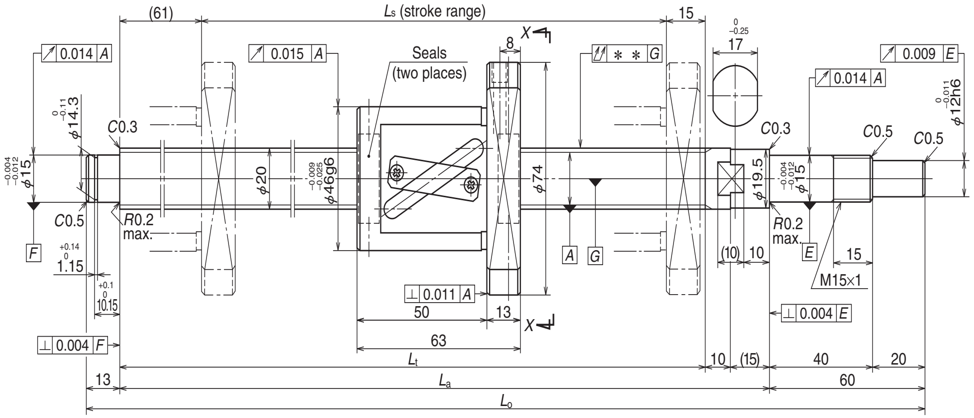
Nut model: LPFT

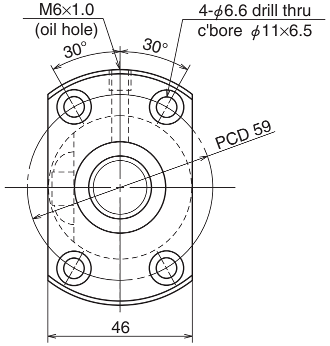
NSK

Screw shaft ø20

Lead 20

Unit: mm





View X-X

Ball screw specifications

Shaft dia. x Lead / Direction of turn		20 × 20 / Right
Preload / Ball recirculation		P-preload / 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	5 760
	Static C_{0a}	9 370
Axial play		0
Preload (N)		196
Dynamic friction torque, (N·cm)		2.0 – 11.8
Spacer ball		None
Factory-packed grease		**Refer to Notes 1.**
Internal spatial volume of nut (cm³)		4.2
Standard volume of grease replenishing (cm³)		2.1

Recommended support unit

For drive side (Fixed)	**For opposite to drive side (Free)**
WBK15-01C (square, clean)	WBK15S-01C (square, clean)
WBK15-11C (round, clean)	

KA

Unit: mm

Ball screw No.	Stroke L_s		Thread length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹)
	Nominal	Maximum	L_t	L_a	L_o	T	e_p	υ_u			Supporting condition Fixed - Simple support
W2005KA-3P-C5Z20	400	434	510	535	608	0	0.030	0.023	0.050	2.0	3 000
W2007KA-3P-C5Z20	600	634	710	735	808	0	0.035	0.025	0.085	2.5	3 000
W2011KA-3P-C5Z20	1 000	1 034	1 110	1 135	1 208	0	0.046	0.030	0.110	3.4	2 160

Notes:
1. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
   See page D13 for details.
   Use of NSK Clean Grease LG2 is recommended.
2. Contact NSK if the permissible rotational speed is to be exceeded.

B-3-1.4 Blank Shaft End MS Type, FS Type, SS Type

1. Order of the dimension tables

The dimension table begins with the smallest shaft diameter of each MS, FS and SS type ball screws, and proceed 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 the **Table 1**.

2. 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:

● Lead accuracy

Lead accuracy is either C3 or C5 grades.

T : Travel compensation

e_p : Tolerance of specified travel

υ_u : Travel variation

See "Technical Description: Lead Accuracy" (page B37) for 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.

Criterion of maximum rotational speed : 3 000 min^{-1}

The lower of the two criteria, d·n and critical speed, will determine the overall permissible rotational speed of the ball screw. For details, see "Technical Description: Permissible Rotational Speed" (page B47).

3. Shaft end processing

MS, FS, and SS types require shaft end processing to your specification. The exclusive support units (page B375) are available to design the bearing seats. See "Configuration of shaft end" (page B27 and following pages) when using a support unit. See "Technical Description: Shaft End Processing" (page B79) for procedures of shaft end processing and precautions.

4. Other

The seals of the ball screw, ball recirculating deflectors and end caps are made of synthetic resin. Consult NSK when using the ball screws under extreme environments or special environments, or using special lubricant or oil. For special environments, see pages B70 and D2. See pages B67 and D13 for lubricants.

Note: For details of standard stock products, contact NSK.

Table 1 Cambinations of screw shaft diameter and lead

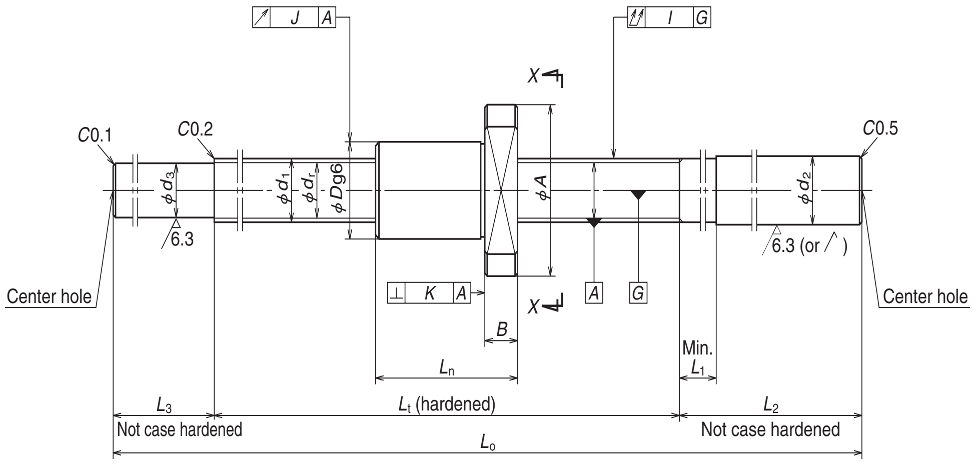
Lead(mm) Screw shaft diameter(mm)	1	1.5	2	2.5	4	5	6	8	10	12	16	20	25	32	40	50
4	B287															
6	B287															
8	B287	B289	B289													
10			B289	B291	B295											
12			B291	B291		B295			B295							
14						B297		B315								
15									B297			B299				
16			B293	B293		B301					B301			B299		
20					B307	B307			B301			B301			B299	
25					B309	B309 B311	B309		B311 B313			B303	B303			B303
28						B313 B315	B313 B315									
32						B317 B319 B321	B317 B319	B319	B321 B323 B325				B305	B305		
36									B323 B325							
40						B323		B327	B327 B329 B331	B327 B329						
45									B333							
50									B331 B333							

Blank shaft end MS type (Fine lead: Deflector type)

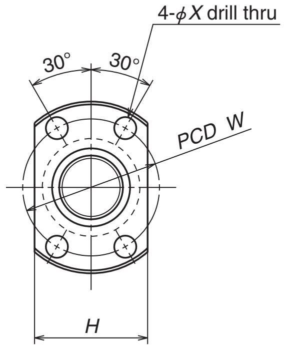
Nut model: MSFD

NSK

Screw shaft ø4, ø6, ø8, Lead 1



Nut type code: MSFD



View X-X

Unit: mm

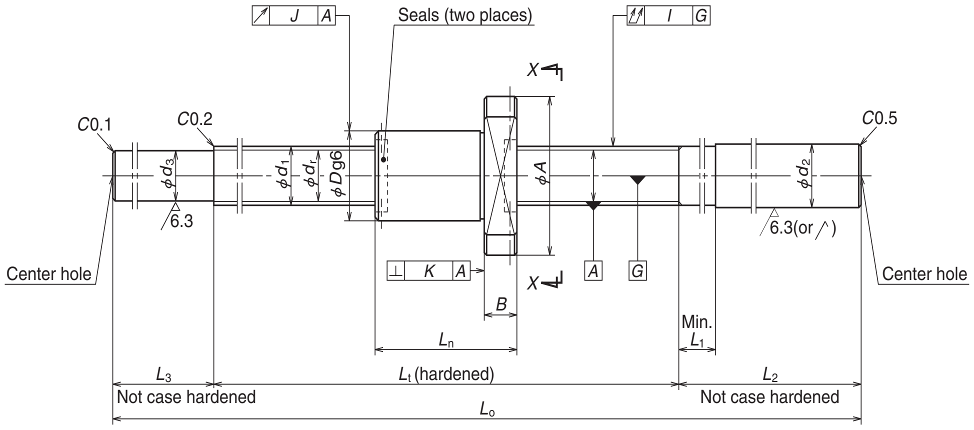
Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Axial play Max.	Nut				dimensions			Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed
								Dynamic	Static		Outside dia.	Flange			Overall length	Bolt hole		Threaded length	Shaft end, right			Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity		
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	H	B	L_n	W	X	L_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K		N (min^{-1})
W0400MS-1Y-C3T1	68	4	1	0.8	4.2	3.2	2	315	370	0.005	10	20	14	3	12	15	2.9	80	6.0	4	40	3.3	10	130	0	0.008	0.008	0.030	0.009	0.008	0.026	3 000
W0601MS-1Y-C3T1	110	6	1	0.8	6.2	5.2	3	575	925	0.005	12	24	16	3.5	15	18	3.4	125	8.0	4	50	5.3	15	190	0	0.010	0.008	0.030	0.009	0.008	0.063	3 000
W0801MS-1Y-C3T1	94	8	1	0.8	8.2	7.2	3	670	1 290	0.005	14	27	18	4	16	21	3.4	110	10.2	4	60	7.3	25	195	0	0.010	0.008	0.030	0.009	0.008	0.11	3 000
W0802MS-1Y-C3T1	174																	190						275				0.050			0.14	

Notes:
1. Use of NSK support unit is recommended. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Ball nut does not have seal.
4. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

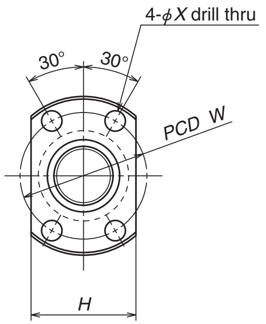
Blank shaft end MS type (Fine lead: Deflector type)

Nut model: MSFD

Screw shaft ø8
Lead 1.5, 2
Screw shaft ø10
Lead 2



Nut type code: MSFD



View X-X

Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Axial play Max.	Nut			
								Dynamic	Static		Outside dia.	Flange		
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	H	B
W0801MS-2Y-C3T1.5	88	8	1.5	1.0	8.3	7.0	3	1 080	1 980	0.005	15	28	19	4
W0802MS-2Y-C3T1.5	168													
W0801MS-3Y-C3T2	84	8	2	1.2	8.3	6.9	3	1 320	2 210	0.005	16	29	20	4
W0802MS-3Y-C3T2	164													
W1001MS-1Y-C3T2	122	10	2	1.2	10.3	8.9	3	1 490	2 850	0.005	18	35	22	5
W1002MS-1Y-C3T2	222													

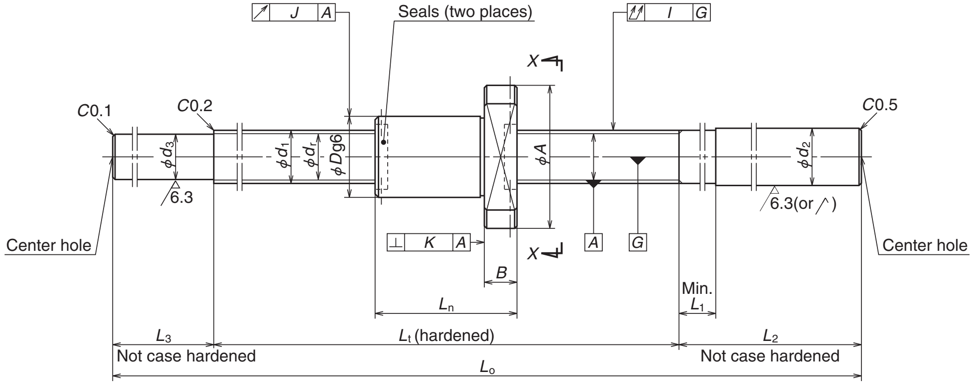
Ball screw No.	dimensions			Screw shaft dimensions						Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min^{-1})
	Overall length	Bolt hole		Threaded length	Shaft end, right			Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity		
	L_n	W	X	L_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K		
W0801MS-2Y-C3T1.5	22	22	3.4	110	10.2	4	60	7.2	25	195	0	0.010	0.008	0.030	0.009	0.008	0.12	3 000
W0802MS-2Y-C3T1.5				190						275				0.050			0.15	
W0801MS-3Y-C3T2	26	23	3.4	110	10.2	4	60	7.0	25	195	0	0.010	0.008	0.030	0.009	0.008	0.12	3 000
W0802MS-3Y-C3T2				190						275				0.050			0.15	
W1001MS-1Y-C3T2	28	27	4.5	150	12.2	4	70	9.0	30	250	0	0.010	0.008	0.035	0.009	0.008	0.22	3 000
W1002MS-1Y-C3T2				250						350		0.012		0.050			0.17	

Notes: 1. Use of NSK support unit is recommended. See page B375 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.
See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

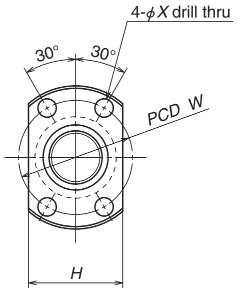
Blank shaft end MS type (Fine lead: Deflector type)

Nut model: MSFD

Screw shaft ø10
Lead 2.5
Screw shaft ø12
Lead 2, 2.5



Nut type code: MSFD



View X-X

Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Axial play Max.	Nut			
								Dynamic	Static		Outside dia.	Flange		
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	H	B
W1001MS-2Y-C3T2.5	118	10	2.5	1.588	10.4	8.6	3	2 130	3 640	0.005	19	36	23	5
W1002MS-2Y-C3T2.5	218													
W1202MS-1Y-C3T2	182	12	2	1.200	12.3	10.9	3	1 660	3 620	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	2 360	4 540	0.005	21	38	25	5
W1203MS-2Y-C3T2.5	278													

Ball screw No.	dimensions			Screw shaft dimensions							Lead accuracy		Run-out			Mass (kg)	Permissible rotational speed
	Overall length	Bolt hole		Threaded length	Shaft end, right		Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity		
	L_n	W	X	L_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K		N (min^{-1})
W1001MS-2Y-C3T2.5	32	28	4.5	150	12.2	4	70	8.7	30	250	0	0.010	0.008	0.035	0.010	0.008	0.23	3 000
W1002MS-2Y-C3T2.5				250						350		0.012		0.050			0.28	
W1202MS-1Y-C3T2	28	29	4.5	210	14.2	5	80	11.0	35	325	0	0.012	0.008	0.050	0.010	0.008	0.36	3 000
W1203MS-1Y-C3T2				310						425				0.060			0.44	
W1202MS-2Y-C3T2.5	32	30	4.5	210	14.2	5	80	10.7	35	325	0	0.012	0.008	0.050	0.010	0.008	0.37	3 000
W1203MS-2Y-C3T2.5				310						425				0.060			0.45	

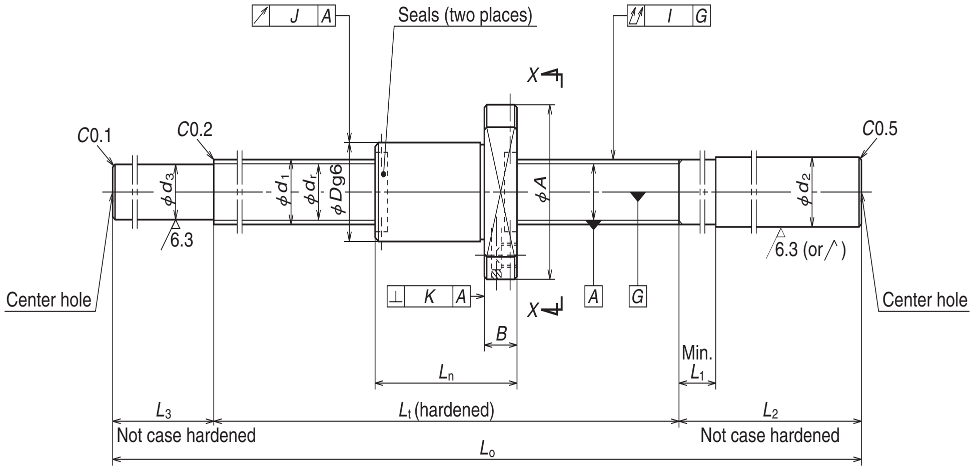
Notes: 1. Use of NSK support unit is recommended. See page B375 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.
See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

Blank shaft end MS type (Fine lead: Deflector type)

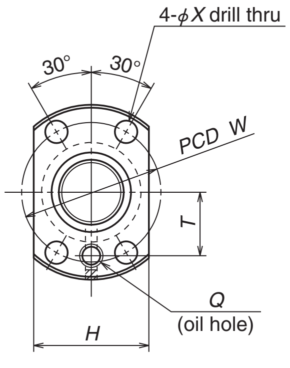
Nut model: MSFD

NSK

Screw shaft ø16
Lead 2, 2.5



Nut type code: MSFD



View X-X

Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Axial play Max.	Nut							dimensions		Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed	Internal spatial volume of nut	Standard volume of grease replenishing
								Dynamic	Static		Outside dia.	Flange			Overall length	Bolt hole		Oil hole		Threaded length	Shaft end, right			Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity				
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	H	B	L_n	W	X	Q	T	L_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K		N (min^{-1})	(cm^3)	(cm^3)
W1602MS-1Y-C3T2	210	16	2	1.588	16.4	14.6	4	3 510	8 450	0.005	25	44	29	10	40	35	5.5	M6×1	16	250	16.2	30	100	14.7	40	390	0	0.012	0.008	0.035	0.010	0.008	0.71	3 000	1.5	0.8
W1604MS-1Y-C3T2	360																			400						540		0.013	0.010	0.050			0.93			
W1602MS-2Y-C3T2.5	206	16	2.5	1.588	16.4	14.6	4	3 510	8 450	0.005	25	44	29	10	44	35	5.5	M6×1	16	250	16.2	30	100	14.7	40	390	0	0.012	0.008	0.035	0.010	0.008	0.73	3 000	1.5	0.8
W1604MS-2Y-C3T2.5	356																			400						540		0.013	0.010	0.050			0.95			

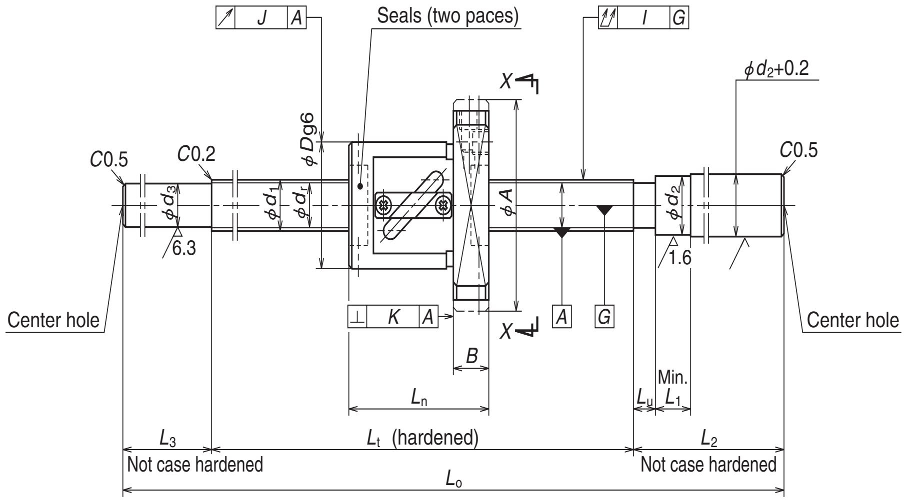
Notes: 1. Use of NSK support unit is recommended. See page B375 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.
See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

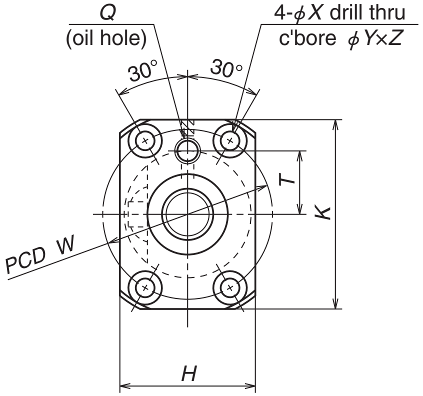
Blank shaft end FS type (Fine, Medium lead: Tube type)

Nut models: SFT, LSFT

NSK

Screw shaft ø10
Lead 4
Screw shaft ø12
Lead 5, 10





View X-X

Nut type code: SFT, LSFT

Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Axial play Max.	Nut dimensions												Screw shaft dimensions								Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min^{-1})	Internal spatial volume of nut (cm^3)	Standard volume of grease replenishing (cm^3)
							Turns × Circuits	Dynamic	Static		Outside dia.	Flange				Overall length	Bolt hole				Oil hole		Threaded length	Shaft end, right				Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity				
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	H	K	B	L_n	W	X	Y	Z	Q	T	L_t	d_2	L_u	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
W1001FS-1-C3T4	126	10	4	2.000	10.3	8.2	2.5×1	2 740	4 450	0.005	26	46	28	42	10	34	36	4.5	8	4.5	M6×1	14	160	14	5	40	70	8.2	35	265	0	0.010	0.008	0.030	0.010	0.008	0.34	3 000	0.86	0.43
W1002FS-1-C3T4	226																						260							365		0.012	0.008	0.040			0.39			
W1003FS-1-C3T4	326																						360							465		0.013	0.010	0.050			0.45			
W1201FS-1-C3T5	110	12	5	2.381	12.3	9.8	2.5×1	3 760	6 310	0.005	30	50	32	45	10	40	40	4.5	8	4.5	M6×1	15	150	14	5	40	70	9.8	35	255	0	0.010	0.008	0.030	0.010	0.008	0.44	3 000	1.2	0.6
W1202FS-1-C3T5	210																						250							355		0.012	0.008	0.040			0.52			
W1204FS-1-C3T5	410																						450							555		0.015	0.010	0.065			0.67			
W1202FS-2-C5T10	200	12	10	2.381	12.5	10.0	2.5×1	3 750	6 480	0.005	30	50	32	45	10	50	40	4.5	8	4.5	M6×1	15	250	14	8	40	70	10.0	35	355	0	0.023	0.018	0.050	0.012	0.010	0.57	3 000	1.4	0.7
W1204FS-2-C5T10	400																						450							555		0.027	0.020	0.075			0.74			

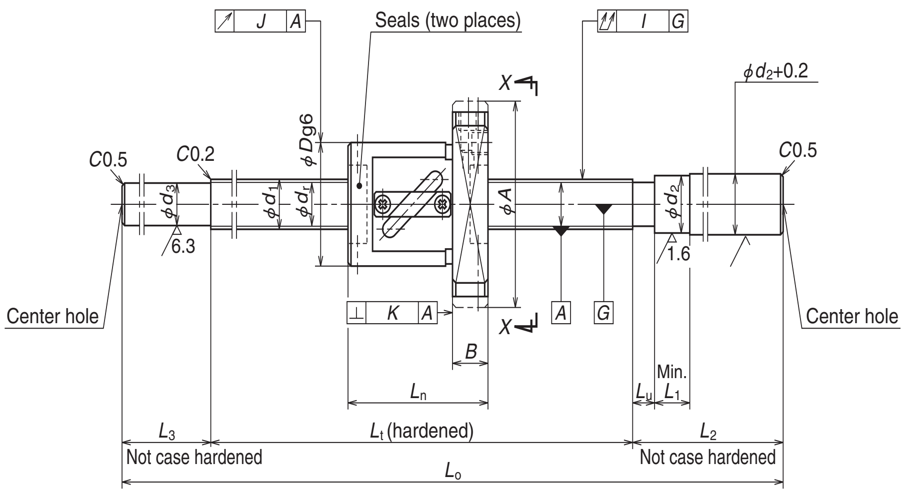
Notes:
1. Use of NSK support unit is recommended. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

Blank shaft end FS type (Fine, Medium lead: Tube type)

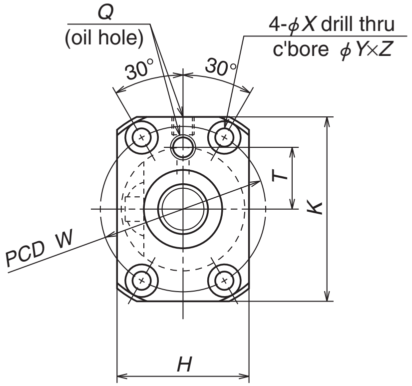
Nut models: SFT, LSFT

NSK

Screw shaft ø14
Lead 5, 8
Screw shaft ø15
Lead 10



Nut type code: SFT, LSFT



View X-X

Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Axial play Max.	Nut dimensions												Screw shaft dimensions								Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed	Internal spatial volume of nut	Standard volume of grease replenishing
							Turns x Circuits	Dynamic	Static		Outside dia.	Flange				Overall length	Bolt hole				Oil hole		Threaded length	Shaft end, right				Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity				
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	H	K	B	L_n	W	X	Y	Z	Q	T	L_t	d_2	L_u	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K		N (min^{-1})	(cm^3)	(cm^3)
W1403FS-1-C3T5	310	14	5	3.175	14.5	11.2	2.5×1	6 790	11 700	0.005	34	57	34	50	11	40	45	5.5	9.5	5.5	M6×1	17	350	15	5	40	100	11.2	40	490	0	0.013	0.010	0.035	0.012	0.008	0.78	3 000	2.0	1.0
W1406FS-1-C3T5	560																						600							740		0.016	0.012	0.055			1.0			
W1405FS-1-C5T8	454	14	8	3.175	14.5	11.2	2.5×1	6 790	11 700	0.005	34	57	34	50	11	46	45	5.5	9.5	5.5	M6×1	17	500	15	8	40	100	11.2	40	640	0	0.027	0.020	0.065	0.015	0.011	1.0	3 000	2.0	1.0
W1408FS-1-C5T8	754																						800							940		0.035	0.025	0.085			1.3			
W1504FS-1-C5T10	349	15	10	3.175	15.5	12.2	2.5×1	7 070	12 800	0.005	34	57	34	50	11	51	45	5.5	9.5	5.5	M6×1	17	400	15	8	40	120	12.2	50	570	0	0.025	0.020	0.050	0.015	0.011	1.0	3 000	2.3	1.2
W1506FS-1-C5T10	549																						600							770		0.030	0.023	0.065			1.3			
W1509FS-1-C5T10	849																						900							1 070		0.040	0.027	0.110			1.7			
W1511FS-1-C5T10	1 049																						1 100							1 270		0.046	0.030	0.150			1.9			

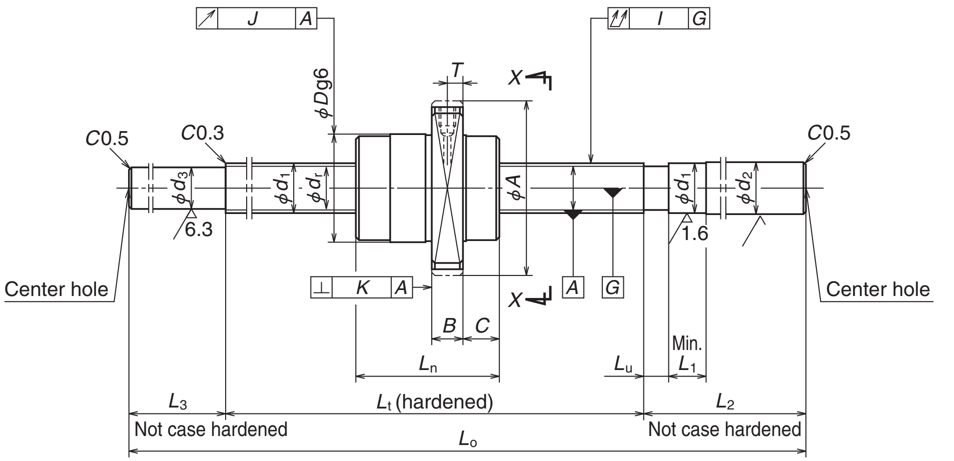
Notes:
1. Use of NSK support unit is recommended. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

Blank shaft end FS type (High helix, Ultra high helix: End cap type)

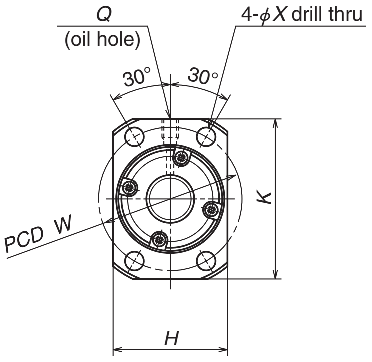
Nut model: USFC

NSK

Screw shaft ø15
Lead 20
Screw shaft ø16
Lead 32
Screw shaft ø20
Lead 40



Nut type code: USFC



View X-X

Unit: mm

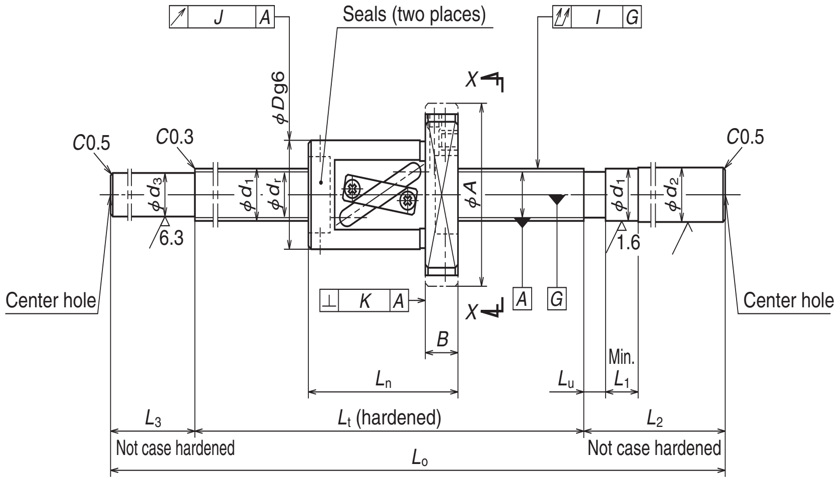
Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Axial play Max.	Nut dimensions											Screw shaft dimensions								Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min^{-1})	Internal spatial volume of nut (cm³)	Standard volume of grease replenishing (cm³)
							Turns x Circuits	Dynamic	Static		Outside dia.	Flange					Overall length	Bolt hole		Oil hole		Threaded length	Shaft end, right				Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity				
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	H	K	B	C	L_n	W	X	Q	T	L_t	d_2	L_u	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
W1504FS-2G-C5T20	355	15	20	3.175	15.5	12.2	1.7×1	5 070	8 730	0.005	34	55	36	50	10	11	45	45	5.5	M6×1	5	400	15.2	13	40	120	12.2	50	570	0	0.025	0.020	0.050	0.015	0.011	1.0	3 000	1.9	1.0
W1506FS-2G-C5T20	555																					600							770		0.030	0.023	0.065			1.3			
W1509FS-2G-C5T20	855																					900							1 070		0.040	0.027	0.110			1.7			
W1511FS-2G-C5T20	1 055																					1 100							1 270		0.046	0.030	0.150			2.0			
W1609FS-2GX-C5T32	866	16	32	3.175	16.75	13.4	0.7×2	4 000	6 690	0.005	34	55	36	50	10	10.5	34	45	5.5	M6×1	5	900	16.2	19	40	150	13.4	60	1 110	0	0.040	0.027	0.110	0.015	0.011	1.9	3 000	2.0	1.0
W1613FS-1GX-C5T32	1 266																					1 300							1 510		0.054	0.035	0.150			2.5			
W2011FS-1GX-C5T40	1 059	20	40	3.175	20.75	17.4	0.7×2	4 490	8 640	0.005	38	58	40	52	10	11	41	48	5.5	M6×1	5	1 100	20.2	22	60	150	17.4	80	1 330	0	0.046	0.030	0.150	0.015	0.011	3.5	3 000	2.7	1.4
W2017FS-1GX-C5T40	1 659																					1 700							1 930		0.065	0.040	0.200			4.9			

Notes: 1. Use of NSK support unit is recommended. See page B375 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.
See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

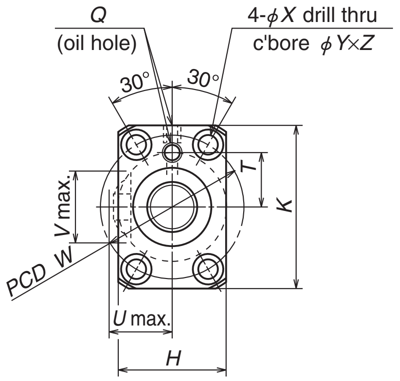
Blank shaft end FS type (Fine, Medium, High helix lead: Tube type)

Nut models: SFT, LSFT

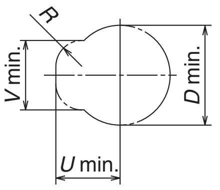
Screw shaft ø16
Lead 5, 16
Screw shaft ø20
Lead 10, 20



Nut type code: SFT, LSFT



View X-X



Housing hole and its clearance
(only applicable to shaft dia. ϕ16, lead 16)

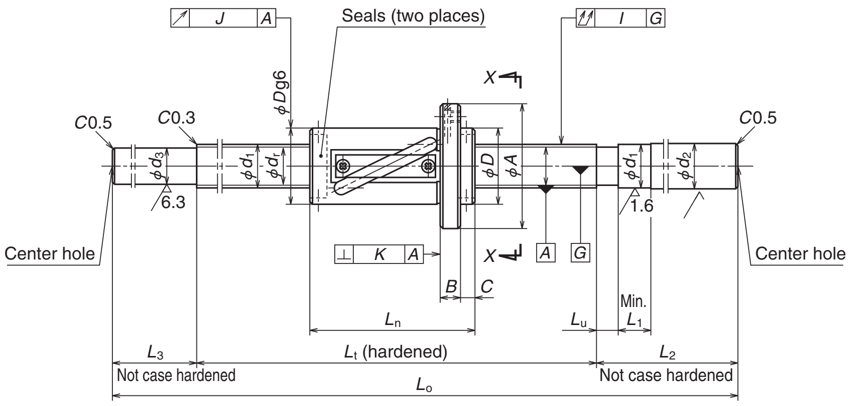
Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Axial play Max.	Nut									
							Turns × Circuits	Dynamic	Static		Outside dia.	Flange				Overall length	Bolt		hole	
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	H	K	B	L_n	W	X	Y	Z
W1605FS-1-C3T5	458	16	5	3.175	16.5	13.2	2.5×1	7 330	13 500	0.005	40	63	40	55	11	42	51	5.5	9.5	5.5
W1609FS-1-C3T5	858																			
W1606FS-1-C5T16	544	16	16	3.175	16.75	13.4	1.5×1	4 710	8 110	0.005	34	57	34	50	12	56	45	5.5	9.5	5.5
W1611FS-1-C5T16	1 044																			
W2009FS-1-C5T10	846	20	10	3.969	21	16.9	2.5×1	10 900	21 700	0.005	46	74	46	66	13	54	59	6.6	11	6.5
W2013FS-1-C5T10	1 246																			
W2010FS-1-C5T20	937	20	20	3.969	21	16.9	1.5×1	7 040	12 700	0.005	46	74	46	66	13	63	59	6.6	11	6.5
W2015FS-1-C5T20	1 437																			

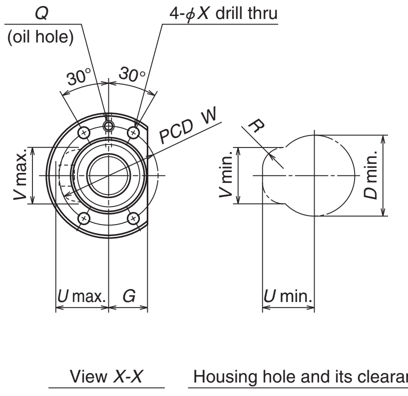
Ball screw No.	dimensions					Screw shaft dimensions								Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min⁻¹)	Internal spatial volume of nut (cm³)	Standard volume of grease replenishing (cm³)
	Projecting tube			Oil hole		Threaded length	Shaft end, right				Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity				
	U	V	R	Q	T	L_t	d_2	L_u	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
W1605FS-1-C3T5	—	—	—	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	3 000	2.6	1.3
W1609FS-1-C3T5						900							1 110		0.021	0.015	0.095			1.9			
W1606FS-1-C5T16	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	3 000	2.1	1.1
W1611FS-1-C5T16						1 100							1 310		0.046	0.030	0.150			2.3			
W2009FS-1-C5T10	—	—	—	M6×1	24	900	20.2	10	60	150	16.9	80	1 130	0	0.040	0.027	0.110	0.015	0.011	3.2	3 000	4.7	2.4
W2013FS-1-C5T10						1 300							1 530		0.054	0.035	0.150			4.1			
W2010FS-1-C5T20	—	—	—	M6×1	24	1 000	20.2	13	60	150	16.9	80	1 230	0	0.040	0.027	0.110	0.015	0.011	3.6	3 000	4.2	2.1
W2015FS-1-C5T20						1 500							1 730		0.054	0.035	0.200			4.8			

Notes: 1. Use of NSK support unit is recommended. See page B375 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.
See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

Screw shaft ø25
Lead 20, 25, 50

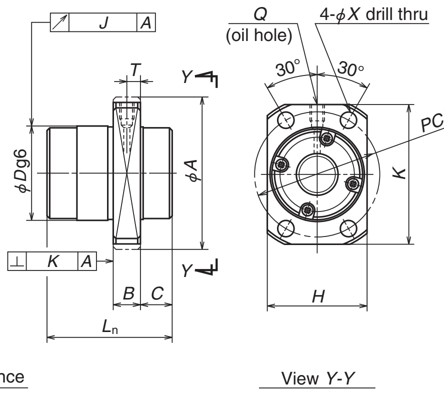


Nut type code: LSFT



View X-X

Housing hole and its clearance



View Y-Y

Nut type code: USFC

Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Axial play Max.	Nut										
							Turns x Circuits	Dynamic	Static		Nut type code	Outside dia.	Flange						Overall length	Bolt hole	
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	H	K	B	C	L_n	W	X
W2513FS-1-C5T20	1 254	25	20	4.762	26.25	21.3	2.5x1	15 700	32 800	0.005	LSFT	44	71	23	—	—	12	8	96	57	6.8
W2521FS-1-C5T20	2 054																				
W2513FS-2-C5T25	1 260	25	25	4.762	26.25	21.3	1.5x1	10 100	19 100	0.005	LSFT	44	71	23	—	—	12	10	90	57	6.6
W2521FS-2-C5T25	2 060																				
W2515FS-1GX-C5T50	1 450	25	50	3.969	26	21.9	0.7x2	6 700	13 500	0.005	USFC	46	70	—	48	63	12	13	50	58	6.6
W2521FS-3GX-C5T50	2 100																				

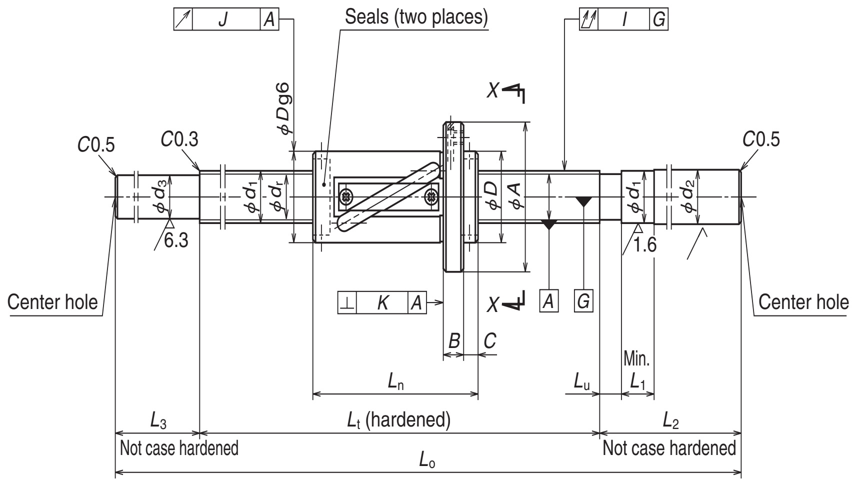
Ball screw No.	dimensions					Screw shaft dimensions									Lead accuracy		Run-out			Mass (kg)	Permissible rotational speed N (min^{-1})	Internal spatial volume of nut (cm^3)	Standard volume of grease replenishing (cm^3)
	Projecting tube			Oil hole		Threaded length	Shaft end, right				Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity				
	U	V	R	Q	T	L_t	d_2	L_u	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
W2513FS-1-C5T20	31	35	12	M6x1	—	1 350	25.2	13	70	200	21.3	100	1 650	0	0.054	0.035	0.120	0.015	0.011	6.8	2 800	12	6.0
W2521FS-1-C5T20						2 150							2 450		0.077	0.046	0.160			9.8			
W2513FS-2-C5T25	32	34	12	M6x1	—	1 350	25.2	15	70	200	21.3	100	1 650	0	0.054	0.035	0.120	0.015	0.011	6.8	2 800	10	5.0
W2521FS-2-C5T25						2 150							2 450		0.077	0.046	0.160			9.8			
W2515FS-1GX-C5T50	—	—	—	M6x1	6	1 500	25.2	26	70	200	21.9	100	1 800	0	0.054	0.035	0.120	0.015	0.011	7.3	2 800	5.3	2.7
W2521FS-3GX-C5T50						2 150							2 450		0.077	0.046	0.160			9.8			

Notes: 1. Use of NSK support unit is recommended. See page B375 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.
See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

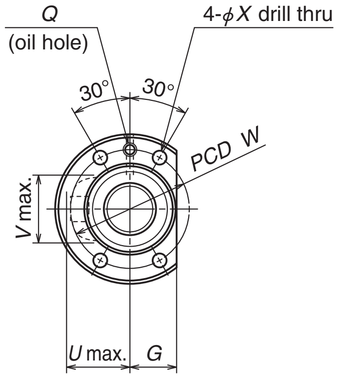
Blank shaft end FS type (Medium, High helix lead: Tube type)

Nut model: LSFT

Screw shaft ø32
Lead 25, 32



Nut type code: LSFT



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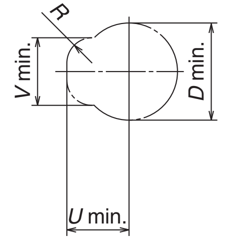


Housing hole and its clearance

Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Axial play Max.	Nut							
							Turns x Circuits	Dynamic	Static		Outside dia.	Flange				Overall length	Bolt hole	
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}		D	A	G	B	C	L_n	W	X
W3217FS-1-C5T25	1 583	32	25	4.762	33.25	28.3	2.5x1	17 900	41 800	0.005	51	85	26	15	10	117	67	9
W3227FS-1-C5T25	2 583																	
W3217FS-2-C5T32	1 591	32	32	4.762	33.25	28.3	1.5x1	11 500	24 800	0.005	51	85	26	15	12	109	67	9
W3227FS-2-C5T32	2 591																	

Ball screw No.	dimensions				Screw shaft dimensions								Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed	Internal spatial volume of nut	Standard volume of grease replenishing
	Projecting tube			Oil hole	Threaded length	Shaft end, right				Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity				
	U	V	R	Q	L_t	d_2	L_u	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K		N (min^{-1})	(cm^3)	(cm^3)
W3217FS-1-C5T25	34	42	12	M6x1	1 700	32.3	15	70	250	28.3	120	2 070	0	0.065	0.040	0.160	0.019	0.013	13.8	2 180	17	8.5
W3227FS-1-C5T25					2 700							3 070		0.093	0.054	0.210			20.0			
W3217FS-2-C5T32	34	42	12	M6x1	1 700	32.3	19	70	250	28.3	120	2 070	0	0.065	0.040	0.160	0.019	0.013	13.9	2 180	15	7.5
W3227FS-2-C5T32					2 700							3 070		0.093	0.054	0.210			20.0			

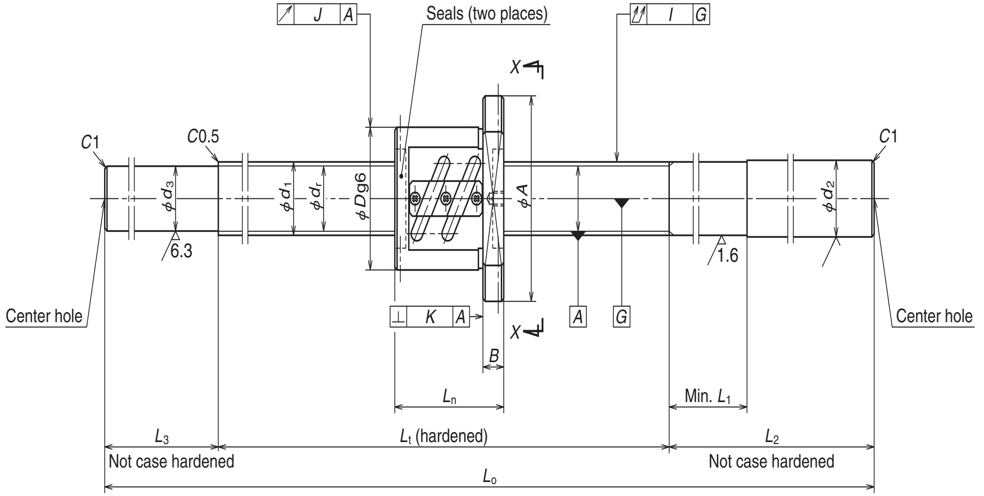
Notes: 1. Use of NSK support unit is recommended. See page B375 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.
See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

Blank shaft end SS type (Fine lead: Tube type)

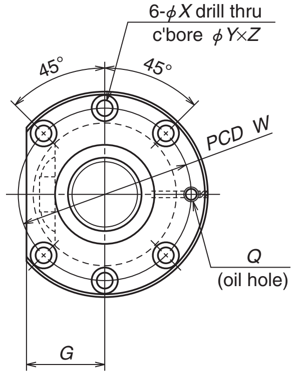
Nut model: PFT

Screw shaft ø20

Lead 4, 5



Nut type code: PFT



View X-X

Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Preload	Dynamic friction torque, median	Nut dimensions										Screw shaft dimensions							Lead accuracy			Run-out			Mass	Permissible rotational speed	Internal spatial volume of nut	Standard volume of grease replenishing
							Turns × Circuits	Dynamic	Static	(N)	(N·cm)	Outside dia.	Flange			Overall length	Bolt hole		Bolt hole		Oil hole	Threaded length	Shaft end, right		Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity	(kg)	N (min-1)	(cm³)	(cm³)
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n	W	X	Y	Z	Q	L_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
W2003SS-1P-C5Z4	251	20	4	2.381	20.3	17.8	2.5×2	5 420	10 700	290	3.9	40	63	24	11	49	51	5.5	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	3 000	2.7	1.4
W2005SS-1P-C5Z4	451																					500			150		50	700	-0.012	0.027	0.020	0.085			2.0			
W2008SS-1P-C5Z4	751																					800			200		100	1 100	-0.019	0.035	0.025	0.140			2.9			
W2003SS-2P-C5Z5	244	20	5	3.175	20.5	17.2	2.5×2	9 410	17 100	490	7.8	44	67	26	11	56	55	5.5	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	3 000	4.3	2.2
W2005SS-2P-C5Z5	444																					500			150		50	700	-0.012	0.027	0.020	0.085			2.2			
W2007SS-1P-C5Z5	644																					700			200		100	1 000	-0.017	0.035	0.025	0.110			2.8			
W2010SS-1P-C5Z5	944																					1 000			200		100	1 300	-0.024	0.040	0.027	0.180			3.5			

Notes: 1. Use of NSK support unit is recommended. See page B375 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

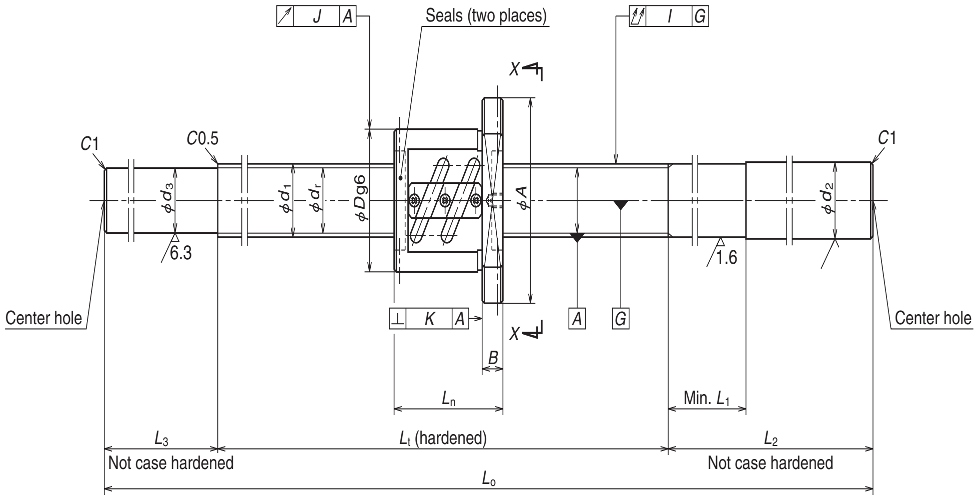
Blank shaft end SS type (Fine lead: Tube type)

Nut model: PFT

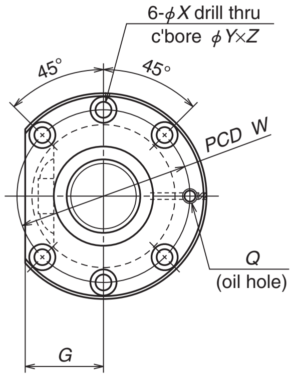
NSK

Screw shaft ø25

Lead 4, 5, 6



Nut type code: PFT



View X-X

Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Preload	Dynamic friction torque, median	Nut dimensions										Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed	Internal spatial volume of nut	Standard volume of grease replenishing
							Turns × Circuits	Dynamic	Static	(N)	(N·cm)	Outside dia.	Flange			Overall length	Bolt hole				Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity		N (min^{-1})	(cm^3)	(cm^3)
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n	W	X	Y	Z	Q	L_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
W2503SS-1P-C5Z4	252	25	4	2.381	25.3	22.8	2.5x2	6020	13 600	290	4.9	46	69	26	11	48	57	5.5	9.5	5.5	M6×1	300	25.2	40	150	22.8	—	450	-0.007	0.023	0.018	0.040	0.015	0.011	2.2	2 800	3.2	1.6
W2506SS-1P-C5Z4	552																					600			200		100	900	-0.014	0.030	0.023	0.075			3.8			
W2510SS-1P-C5Z4	952																					1 000			200		100	1 300	-0.024	0.040	0.027	0.120			5.2			
W2503SS-2P-C5Z5	245	25	5	3.175	25.5	22.2	2.5x2	10 400	21 900	540	8.8	50	73	28	11	55	61	5.5	9.5	5.5	M6×1	300	25.2	40	200	22.2	—	500	-0.007	0.023	0.018	0.040	0.015	0.011	2.5	2 800	5.2	2.6
W2505SS-1P-C5Z5	445																					500			200		50	750	-0.012	0.027	0.020	0.060			3.4			
W2508SS-1P-C5Z5	745																					800			250		100	1 150	-0.019	0.035	0.025	0.090			4.8			
W2512SS-1P-C5Z5	1 145																					1 200			300		100	1 600	-0.029	0.046	0.030	0.120			6.3			
W2504SS-1P-C5Z6	338	25	6	3.969	25.5	21.4	2.5x2	14 100	26 800	690	13.8	53	76	29	11	62	64	5.5	9.5	5.5	M6×1	400	25.2	40	200	21.4	—	600	-0.010	0.025	0.020	0.050	0.019	0.013	3.0	2 800	7.0	3.5
W2508SS-2P-C5Z6	738																					800			250		100	1 150	-0.019	0.035	0.025	0.090			4.8			
W2512SS-2P-C5Z6	1 138																					1 200			300		100	1 600	-0.029	0.046	0.030	0.120			6.3			

Notes:
1. Use of NSK support unit is recommended. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

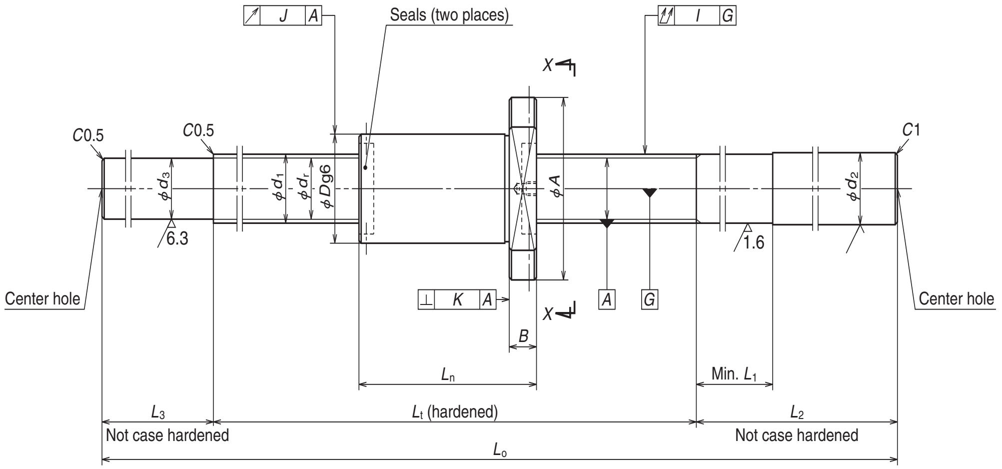
Blank shaft end SS type (Fine lead: Deflector type)

Nut model: ZFD

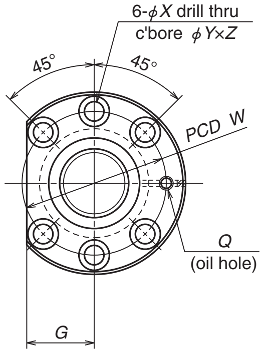
NSK

Screw shaft ø25

Lead 5, 10



Nut type code: ZFD



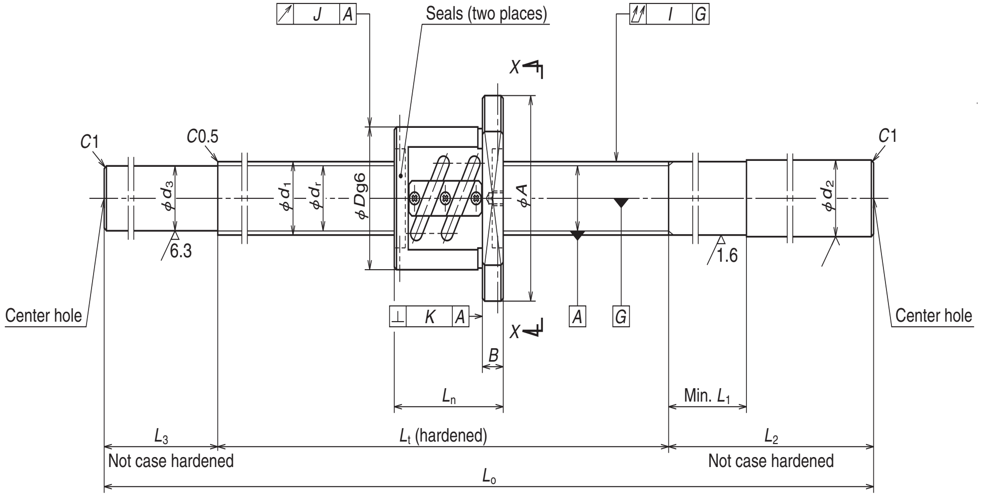
View X-X

Unit: mm

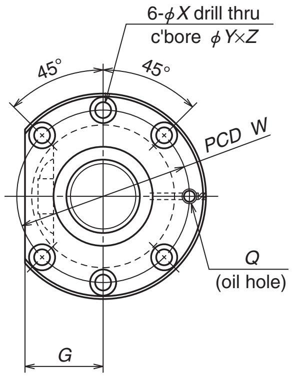
Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns Turns × Circuits	Basic load rating (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut							dimensions			Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min^{-1})	Internal spatial volume of nut (cm^3)	Standard volume of grease replenishing (cm^3)
								Dynamic	Static			Outside dia.	Flange			Overall length	Bolt hole		Bolt hole		Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity				
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n	W	X	Y	Z	Q	L_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
W2502SS-1ZY-C5Z5	184	25	5	3.175	25.75	22.4	1×3	9 790	22 900	740	13.8	40	63	24	11	66	51	5.5	9.5	5.5	M6×1	250	25.2	40	200	22.4	—	450	-0.005	0.023	0.018	0.040	0.015	0.011	2.1	2 800	5.4	2.7
W2504SS-3ZY-C5Z5	334																					400			200		50	650	-0.009	0.025	0.020	0.060			2.8			
W2506SS-2ZY-C5Z5	534																					600			250		100	950	-0.013	0.030	0.023	0.075			3.9			
W2509SS-1ZY-C5Z5	834																					900			250		100	1 250	-0.021	0.040	0.027	0.090			4.9			
W2512SS-3ZY-C5Z5	1 134																					1 200			300		100	1 600	-0.028	0.046	0.030	0.120			6.2			
W2504SS-4ZY-C5Z10	312	25	10	4.762	26.25	21.3	1×2	11 400	21 400	880	21.5	42	69	26	15	88	55	6.6	11	6.5	M6×1	400	25.2	60	200	21.3	50	650	-0.008	0.025	0.020	0.060	0.015	0.011	3.0	2 800	9.0	4.5
W2506SS-3ZY-C5Z10	512																					600			250		100	950	-0.012	0.030	0.023	0.075			4.1			
W2508SS-3ZY-C5Z10	712																					800			250		100	1 150	-0.017	0.035	0.025	0.090			4.8			
W2511SS-1ZY-C5Z10	1 012																					1 100			300		100	1 500	-0.024	0.046	0.030	0.120			6.0			
W2515SS-2ZY-C5Z10	1 412																					1 500			300		100	1 900	-0.034	0.054	0.035	0.150			7.4			

Notes:
1. Use of NSK support unit is recommended. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

Screw shaft ø25
Lead 10
Screw shaft ø28
Lead 5, 6



Nut type code: PFT



View X-X

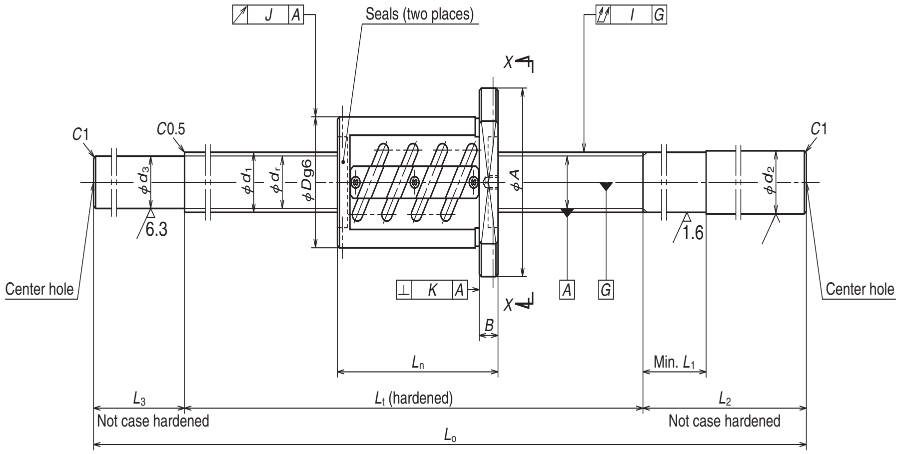
Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns Turns × Circuits	Basic load rating (N)		Preload	Dynamic friction torque, median	Nut dimensions										Screw shaft dimensions							Lead accuracy			Run-out			Mass	Permissible rotational speed	Internal spatial volume of nut	Standard volume of grease replenishing
								Dynamic	Static	(N)	(N·cm)	Outside dia.	Flange			Overall length	Bolt hole		Bolt hole		Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity	(kg)	N (min^{-1})	(cm^3)	(cm^3)
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n	W	X	Y	Z	Q	L_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
W2504SS-2P-C5Z10	319	25	10	4.762	25.5	20.5	1.5×2	11 600	19 000	590	13.8	58	85	32	15	81	71	6.6	11	6.5	M6×1	400	25.2	60	200	20.5	50	650	–0.010	0.025	0.020	0.060	0.019	0.013	3.8	2 800	9.7	4.9
W2507SS-1P-C5Z10	619																					700			250		100	1 050	–0.017	0.035	0.025	0.090			5.1			
W2510SS-2P-C5Z10	919																					1 000			250		100	1 350	–0.024	0.040	0.027	0.120			6.1			
W2515SS-1P-C5Z10	1 419																					1 500			300		100	1 900	–0.036	0.054	0.035	0.150			8.0			
W2804SS-1P-C5Z5	344	28	5	3.175	28.5	25.2	2.5×2	11 000	24 400	540	9.8	55	85	31	12	56	69	6.6	11	6.5	M6×1	400	28.2	40	200	25.2	—	600	–0.010	0.025	0.020	0.050	0.019	0.013	3.7	2 500	6.1	3.1
W2806SS-1P-C5Z5	544																					600			250		100	950	–0.014	0.030	0.023	0.075			5.2			
W2808SS-1P-C5Z5	744																					800			250		100	1 150	–0.019	0.035	0.025	0.090			6.1			
W2812SS-1P-C5Z5	1 144																					1 200			300		100	1 600	–0.029	0.046	0.030	0.120			8.1			
W2804SS-3P-C5Z6	337	28	6	3.175	28.5	25.2	2.5×2	11 000	24 400	540	10.8	55	85	31	12	63	69	6.6	11	6.5	M6×1	400	28.2	40	200	25.2	—	600	–0.010	0.025	0.020	0.050	0.019	0.013	3.8	2 500	6.1	3.1
W2806SS-3P-C5Z6	537																					600			250		100	950	–0.014	0.030	0.023	0.075			5.3			
W2808SS-3P-C5Z6	737																					800			250		100	1 150	–0.019	0.035	0.025	0.090			6.2			
W2812SS-3P-C5Z6	1 137																					1 200			300		100	1 600	–0.029	0.046	0.030	0.120			8.2			

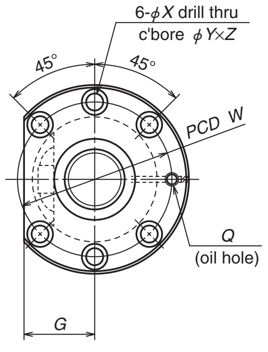
Notes: 1. Use of NSK support unit is recommended. See page B375 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.
See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

Screw shaft ø28

Lead 5, 6



Nut type code: ZFT



View X-X

Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns Turns × Circuits	Basic load rating (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut						
								Dynamic	Static			Outside dia.	Flange			Overall length	Bolt hole	
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n	W	X
W2804SS-2Z-C5Z5	314	28	5	3.175	28.5	25.2	2.5×2	17 400	48 800	1 225	21.5	55	85	31	12	86	69	6.6
W2806SS-2Z-C5Z5	514																	
W2808SS-2Z-C5Z5	714																	
W2812SS-2Z-C5Z5	1 114																	
W2804SS-4Z-C5Z6	301	28	6	3.175	28.5	25.2	2.5×2	17 400	48 800	1 225	22.5	55	85	31	12	99	69	6.6
W2806SS-4Z-C5Z6	501																	
W2808SS-4Z-C5Z6	701																	
W2812SS-4Z-C5Z6	1 101																	

Ball screw No.	dimensions			Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed	Internal spatial volume of nut	Standard volume of grease replenishing
	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_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K		N(min^{-1})	(cm^3)	(cm^3)
W2804SS-2Z-C5Z5	11	6.5	M6×1	400	28.2	40	200	25.2	—	600	–0.010	0.025	0.020	0.050	0.019	0.013	4.7	2 500	9.2	4.6
W2806SS-2Z-C5Z5				600			250		100	950	–0.014	0.030	0.023	0.075			5.5			
W2808SS-2Z-C5Z5				800			250		100	1 150	–0.019	0.035	0.025	0.090			6.4			
W2812SS-2Z-C5Z5				1 200			300		100	1 600	–0.029	0.046	0.030	0.120			8.4			
W2804SS-4Z-C5Z6	11	6.5	M6×1	400	28.2	40	200	25.2	—	600	–0.010	0.025	0.020	0.050	0.019	0.013	4.2	2 500	9.5	4.8
W2806SS-4Z-C5Z6				600			250		100	950	–0.014	0.030	0.023	0.075			5.7			
W2808SS-4Z-C5Z6				800			250		100	1 150	–0.019	0.035	0.025	0.090			6.6			
W2812SS-4Z-C5Z6				1 200			300		100	1 600	–0.029	0.046	0.030	0.120			8.6			

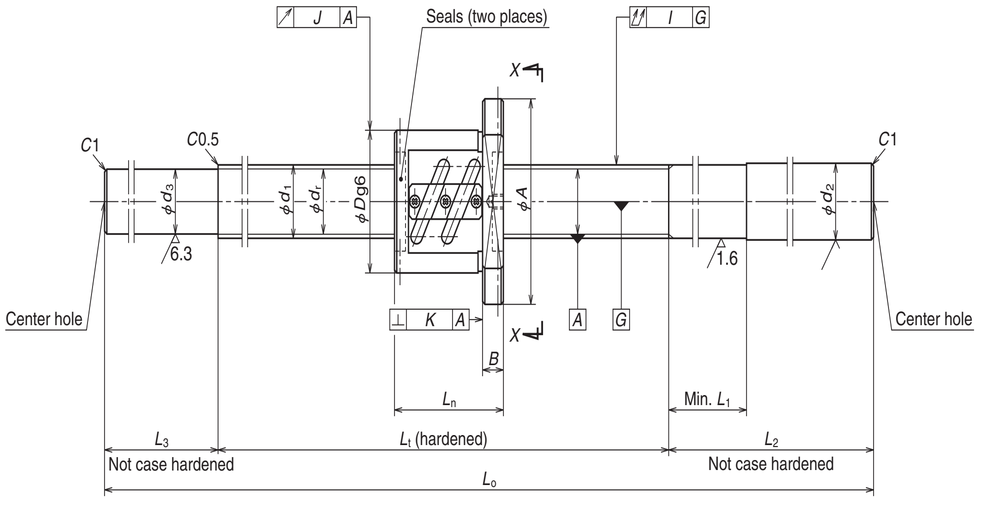
Notes:
1. Use of NSK support unit is recommended. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

Blank shaft end SS type (Fine lead: Tube type)

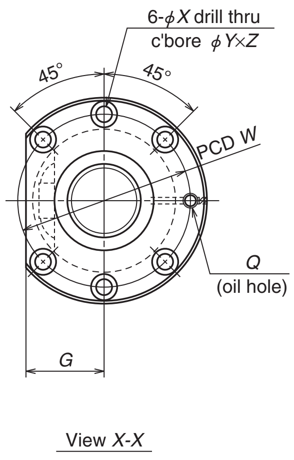
Nut model: PFT

Screw shaft ø32

Lead 5



Nut type code: PFT



View X-X

Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut				
							Turns × Circuits	Dynamic	Static			Outside dia.	Flange			Overall length
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n
W3204SS-1P-C5Z5	344	32	5	3.175	32.5	29.2	2.5×2	11 600	28 000	590	10.8	58	85	32	12	56
W3206SS-1P-C5Z5	544															
W3208SS-1P-C5Z5	744															
W3212SS-1P-C5Z5	1 144															
W3215SS-1P-C5Z5	1 444															
W3206SS-3P-C5Z6	537	32	6	3.969	32.5	28.4	2.5×2	15 500	34 700	780	15.6	62	89	34	12	63
W3210SS-1P-C5Z6	937															
W3215SS-3P-C5Z6	1 437															

Ball screw No.	dimensions					Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min-1)	Internal spatial volume of nut (cm3)	Standard volume of grease replenishing (cm3)
	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_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
W3204SS-1P-C5Z5	71	6.6	11	6.5	M6×1	400	32.3	40	200	29.2	50	650	-0.010	0.025	0.020	0.060	0.019	0.013	4.8	2 180	6.9	3.5
W3206SS-1P-C5Z5						600			250		100	950	-0.014	0.030	0.023	0.075			6.5			
W3208SS-1P-C5Z5						800			250		100	1 150	-0.019	0.035	0.025	0.090			7.7			
W3212SS-1P-C5Z5						1 200			300		100	1 600	-0.029	0.046	0.030	0.120			10.3			
W3215SS-1P-C5Z5						1 500			300		100	1 900	-0.036	0.054	0.035	0.150			12.1			
W3206SS-3P-C5Z6	75	6.6	11	6.5	M6×1	600	32.3	40	250	28.4	100	950	-0.014	0.030	0.023	0.075	0.019	0.013	6.7	2 180	9.4	4.7
W3210SS-1P-C5Z6						1 000			300			1 400	-0.024	0.040	0.027	0.120			9.2			
W3215SS-3P-C5Z6						1 500			300			1 900	-0.036	0.054	0.035	0.150			12.1			

Notes: 1. Use of NSK support unit is recommended. See page B375 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.
See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

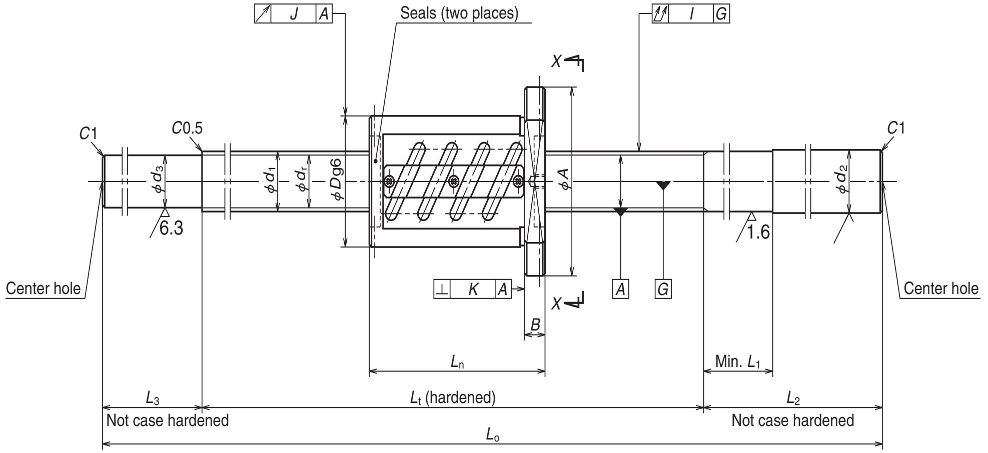
Blank shaft end SS type (Fine lead: Tube type)

Nut model: ZFT

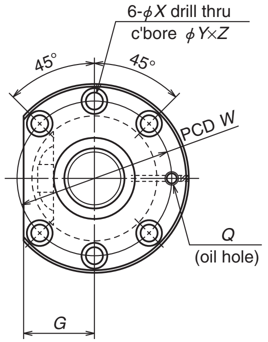
NSK

Screw shaft ø32

Lead 5, 6, 8



Nut type code: ZFT



View X-X

Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut					dimensions					Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min-1)	Internal spatial volume of nut (cm3)	Standard volume of grease replenishing (cm3)
							Turns × Circuits	Dynamic	Static			Outside dia.	Flange			Overall length	Bolt hole				Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity				
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n	W	X	Y	Z	Q	L_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
W3204SS-2Z-C5Z5	314	32	5	3.175	32.5	29.2	2.5×2	18 500	56 100	1 270	22.5	58	85	32	12	86	71	6.6	11	6.5	M6×1	400	32.3	40	200	29.2	50	650	-0.010	0.025	0.020	0.060	0.019	0.013	5.1	2 180	10	5.0
W3206SS-2Z-C5Z5	514																					600			250		100	950	-0.014	0.030	0.023	0.075			6.9			
W3208SS-2Z-C5Z5	714																					800			250		100	1 150	-0.019	0.035	0.025	0.090			8.0			
W3212SS-2Z-C5Z5	1 114																					1 200			300		100	1 600	-0.029	0.046	0.030	0.120			10.1			
W3215SS-2Z-C5Z5	1 414																					1 500			300		100	1 900	-0.036	0.054	0.035	0.150			12.4			
W3206SS-4Z-C5Z6	501	32	6	3.969	32.5	28.4	2.5×2	24 700	69 400	1 720	34.5	62	89	34	12	99	75	6.6	11	6.5	M6×1	600	32.3	40	250	28.4	—	950	-0.014	0.030	0.023	0.075	0.019	0.013	7.1	2 180	15	7.5
W3210SS-2Z-C5Z6	901																					1 000			300		100	1 400	-0.024	0.040	0.027	0.120			9.7			
W3215SS-4Z-C5Z6	1 401																					1 500			300		—	1 900	-0.036	0.054	0.035	0.150			12.6			
W3206SS-5Z-C5Z8	518	32	8	4.762	32.5	27.5	2.5×1	17 500	41 000	1 320	30.5	66	100	38	15	82	82	9	14	8.5	M6×1	600	32.3	50	250	27.5	—	950	-0.014	0.030	0.023	0.075	0.019	0.013	7.3	2 180	7.9	4.0
W3210SS-3Z-C5Z8	918																					1 000			300		100	1 400	-0.024	0.040	0.027	0.120			9.8			
W3215SS-5Z-C5Z8	1 418																					1 500			300		—	1 900	-0.036	0.054	0.035	0.150			12.6			

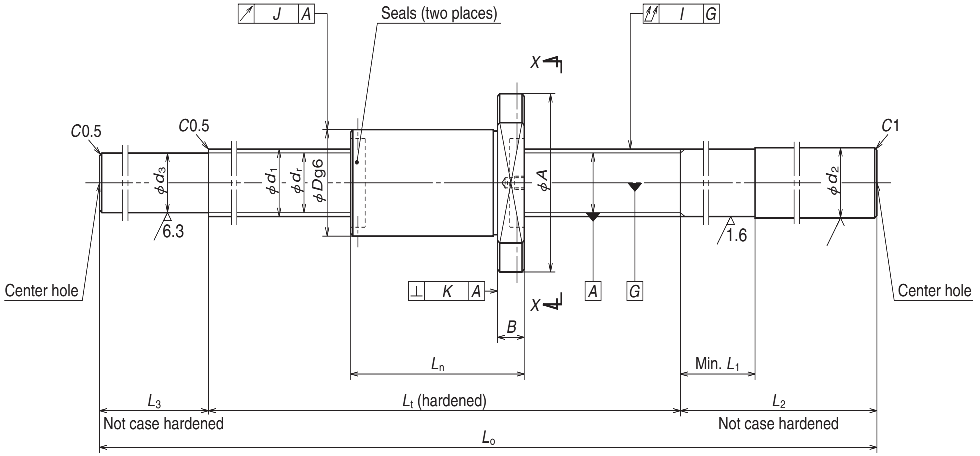
Notes:
1. Use of NSK support unit is recommended. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

Blank shaft end SS type (Fine lead: Deflector type)

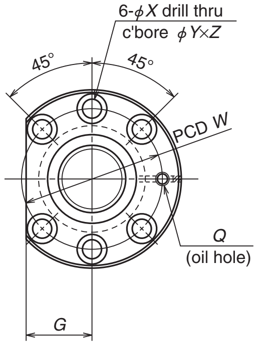
Nut model: ZFD

Screw shaft ø32

Lead 5, 10



Nut type code: ZFD



View X-X

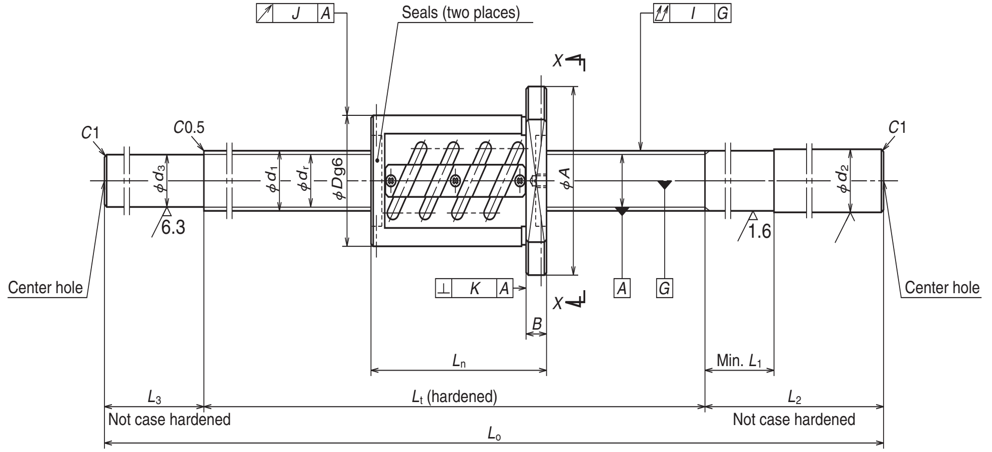
Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut				
							Turns × Circuits	Dynamic	Static			Outside dia.	Flange			Overall length
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n
W3204SS-3ZY-C5Z5	323	32	5	3.175	32.75	29.4	4	14 200	40 700	1 080	19.6	48	75	29	12	77
W3206SS-6ZY-C5Z5	523															
W3209SS-1ZY-C5Z5	823															
W3212SS-3ZY-C5Z5	1 123															
W3216SS-1ZY-C5Z5	1 523															
W3205SS-3ZY-C5Z10	380	32	10	6.35	33.75	27.1	3	25 900	52 800	1 860	49.0	54	88	34	15	120
W3207SS-3ZY-C5Z10	580															
W3210SS-6ZY-C5Z10	880															
W3214SS-3ZY-C5Z10	1 280															
W3218SS-3ZY-C5Z10	1 680															

Ball screw No.	dimensions					Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min⁻¹)	Internal spatial volume of nut (cm³)	Standard volume of grease replenishing (cm³)
	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_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
W3204SS-3ZY-C5Z5	61	6.6	11	6.5	M6×1	400	32.3	40	200	29.4	50	650	-0.009	0.025	0.020	0.060	0.015	0.011	4.6	2 180	22	11
W3206SS-6ZY-C5Z5						600			250		100	950	-0.013	0.030	0.023	0.075			6.4			
W3209SS-1ZY-C5Z5						900			250		100	1 250	-0.021	0.040	0.027	0.090			8.1			
W3212SS-3ZY-C5Z5						1 200			300		100	1 600	-0.028	0.046	0.030	0.120			10.2			
W3216SS-1ZY-C5Z5						1 600			300		100	2 000	-0.037	0.054	0.035	0.150			12.6			
W3205SS-3ZY-C5Z10	70	9	14	8.5	M6×1	500	32.3	60	250	27.1	100	850	-0.010	0.027	0.020	0.075	0.019	0.013	6.2	2 180	23	12
W3207SS-3ZY-C5Z10						700			250		100	1 050	-0.015	0.035	0.025	0.090			7.3			
W3210SS-6ZY-C5Z10						1 000			300		100	1 400	-0.022	0.040	0.027	0.120			9.3			
W3214SS-3ZY-C5Z10						1 400			350		120	1 870	-0.032	0.054	0.035	0.150			11.9			
W3218SS-3ZY-C5Z10						1 800			350		120	2 270	-0.041	0.065	0.040	0.200			14.1			

Notes:
1. Use of NSK support unit is recommended. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

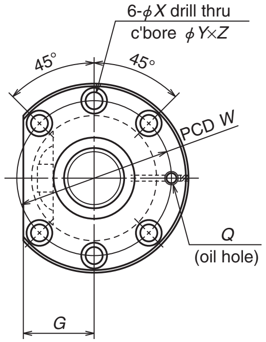
Blank shaft end SS type (Fine lead: Tube type)



Nut type code: ZFT

Nut model: ZFT

Screw shaft ø32, ø36
Lead 10
Screw shaft ø40
Lead 5



View X-X

Unit: mm

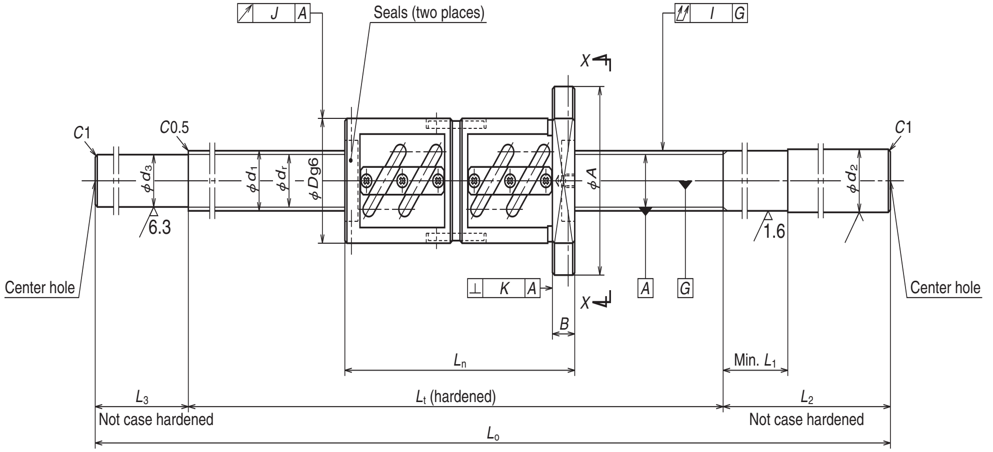
Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut				
							Turns × Circuits	Dynamic	Static			Outside dia.	Flange			Overall length
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n
W3205SS-1Z-C5Z10	400	32	10	6.350	33	26.4	2.5×1	25 500	54 000	1 960	50	74	108	41	15	100
W3207SS-1Z-C5Z10	600															
W3210SS-4Z-C5Z10	900															
W3214SS-1Z-C5Z10	1 300															
W3218SS-1Z-C5Z10	1 700															
W3607SS-1Z-C5Z10	597	36	10	6.350	37	30.4	2.5×1	27 200	61 300	2 060	56	75	120	45	18	103
W3612SS-1Z-C5Z10	1 097															
W3620SS-1Z-C5Z10	1 897															
W4006SS-1Z-C5Z5	511	40	5	3.175	40.5	37.2	2.5×2	20 200	70 600	1 420	28.5	67	101	39	15	89
W4010SS-1Z-C5Z5	911															
W4016SS-1Z-C5Z5	1 511															

Ball screw No.	dimensions					Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min^{-1})	Internal spatial volume of nut (cm^3)	Standard volume of grease replenishing (cm^3)
	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_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
W3205SS-1Z-C5Z10	90	9	14	8.5	M6×1	500	32.3	60	250	26.4	100	850	-0.012	0.027	0.020	0.075	0.019	0.013	7.5	2 180	22	11
W3207SS-1Z-C5Z10						700			250		100	1 050	-0.017	0.035	0.025	0.090			8.5			
W3210SS-4Z-C5Z10						1 000			300		100	1 400	-0.024	0.040	0.027	0.120			10.5			
W3214SS-1Z-C5Z10						1 400			350		120	1 870	-0.034	0.054	0.035	0.150			13.1			
W3218SS-1Z-C5Z10						1 800			350		120	2 270	-0.043	0.065	0.040	0.200			15.2			
W3607SS-1Z-C5Z10	98	11	17.5	11	M6×1	700	36.3	60	300	30.4	100	1 100	-0.017	0.035	0.025	0.065	0.019	0.013	10.9	1 940	27	14
W3612SS-1Z-C5Z10						1 200			350		120	1 670	-0.029	0.046	0.030	0.100			14.9			
W3620SS-1Z-C5Z10						2 000			350		120	2 470	-0.048	0.065	0.040	0.130			20.4			
W4006SS-1Z-C5Z5	83	9	14	8.5	Rc1/8	600	40.3	50	300	37.2	100	1 000	-0.014	0.030	0.023	0.050	0.019	0.013	11.1	1 750	14	7.0
W4010SS-1Z-C5Z5						1 000			300			1 400	-0.024	0.040	0.027	0.080			14.8			
W4016SS-1Z-C5Z5						1 600			350			2 050	-0.038	0.054	0.035	0.130			20.8			

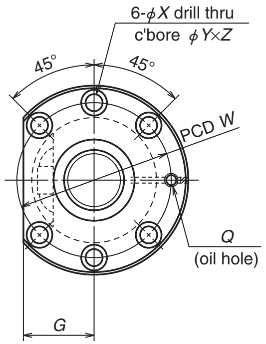
Notes: 1. Use of NSK support unit is recommended. See page B375 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.
See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

Screw shaft ø32, ø36

Lead 10



Nut type code: DFT



View X-X

Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut					dimensions					Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min^{-1})	Internal spatial volume of nut (cm^3)	Standard volume of grease replenishing (cm^3)
							Turns × Circuits	Dynamic	Static			Outside dia.	Flange			Overall length	Bolt hole				Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity				
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n	W	X	Y	Z	Q	L_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
W3205SS-2D-C5Z10	310	32	10	6.350	33	26.4	2.5×2	46 300	108 000	3 240	83	74	108	41	15	190	90	9	14	8.5	M6×1	500	32.3	60	250	26.4	100	850	-0.012	0.027	0.020	0.075	0.019	0.013	9.5	2 180	57	29
W3207SS-2D-C5Z10	510																					700			250		100	1 050	-0.017	0.035	0.025	0.090			10.6			
W3210SS-5D-C5Z10	810																					1 000			300		100	1 400	-0.024	0.040	0.027	0.120			12.5			
W3214SS-2D-C5Z10	1 210																					1 400			350		120	1 870	-0.034	0.054	0.035	0.150			15.1			
W3218SS-2D-C5Z10	1 610																					1 800			350		120	2 270	-0.043	0.065	0.040	0.200			17.2			
W3607SS-2D-C5Z10	507	36	10	6.350	37	30.4	2.5×2	49 300	123 000	3 430	93	75	120	45	18	193	98	11	17.5	11	M6×1	700	36.3	60	300	30.4	100	1 100	-0.017	0.035	0.025	0.065	0.019	0.013	12.8	1 940	67	34
W3612SS-2D-C5Z10	1 007																					1 200			350		120	1 670	-0.029	0.046	0.030	0.100			16.8			
W3620SS-2D-C5Z10	1 807																					2 000			350		120	2 470	-0.048	0.065	0.040	0.130			22.3			

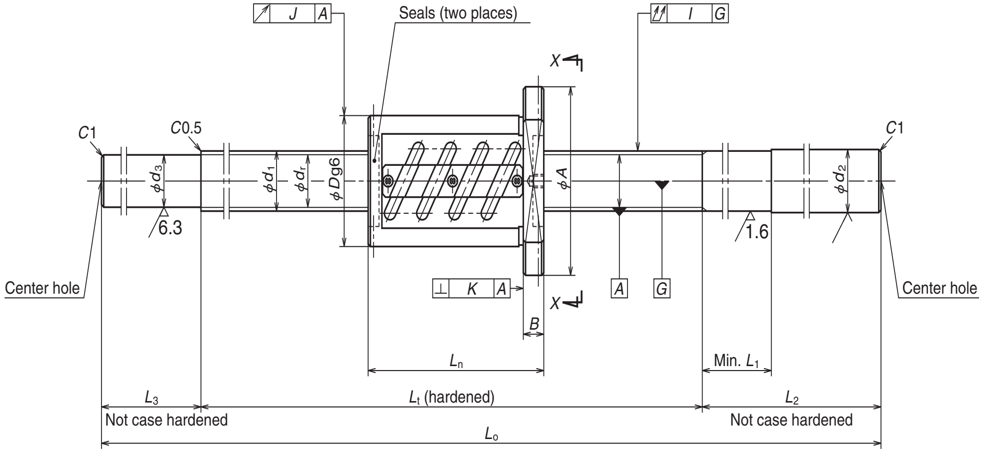
Notes:
1. Use of NSK support unit is recommended. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

Blank shaft end SS type (Fine lead: Tube type)

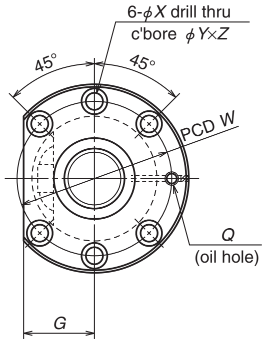
Nut model: ZFT

NSK

Screw shaft ø40
Lead 8, 10, 12



Nut type code: ZFT



View X-X

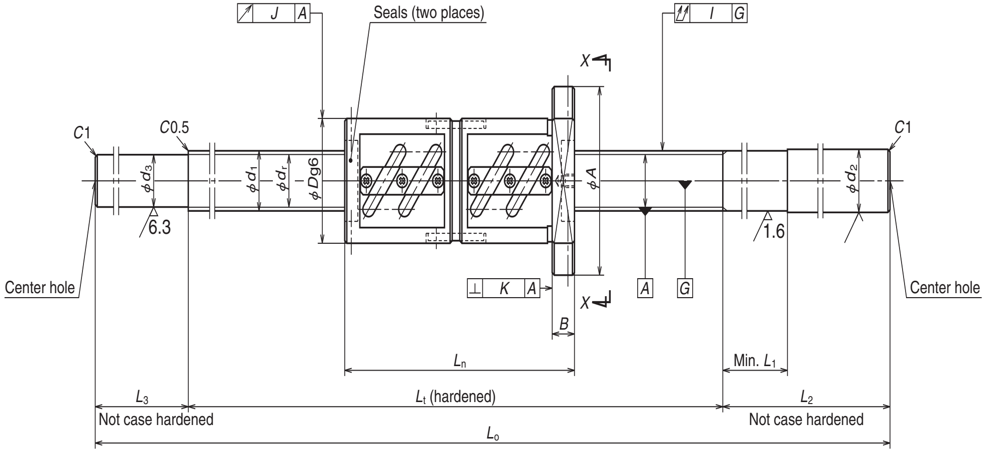
Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut					dimensions					Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min^{-1})	Internal spatial volume of nut (cm^3)	Standard volume of grease replenishing (cm^3)
							Turns × Circuits	Dynamic	Static			Outside dia.	Flange			Overall length	Bolt hole				Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity				
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n	W	X	Y	Z	Q	L_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
W4007SS-1Z-C5Z8	570	40	8	4.762	40.5	35.5	2.5×2	34 900	103 000	2 450	64	74	108	41	15	130	90	9	14	8.5	Rc1/8	700	40.3	50	300	35.5	100	1 100	–0.017	0.035	0.025	0.065	0.019	0.013	13.0	1 750	27	14
W4012SS-1Z-C5Z8	1 070																					1 200			350		100	1 650	–0.029	0.046	0.030	0.100			18.0			
W4018SS-1Z-C5Z8	1 670																					1 800			350		120	2 270	–0.043	0.065	0.040	0.130			23.5			
W4007SS-2Z-C5Z10	597	40	10	6.350	41	34.4	2.5×1	28 600	68 600	2 160	64	82	124	47	18	103	102	11	17.5	11	Rc1/8	700	40.3	60	300	34.4	100	1 100	–0.017	0.035	0.025	0.065	0.025	0.015	13.3	1 750	30	15
W4010SS-2Z-C5Z10	897																					1 000			300		100	1 400	–0.024	0.040	0.027	0.080			15.9			
W4014SS-1Z-C5Z10	1 297																					1 400			350		120	1 870	–0.034	0.054	0.035	0.100			20.0			
W4018SS-2Z-C5Z10	1 697																					1 800			350		120	2 270	–0.043	0.065	0.040	0.130			23.4			
W4024SS-1Z-C5Z10	2 297																					2 400			400		150	2 950	–0.058	0.077	0.046	0.170			29.4			
W4010SS-4Z-C5Z12	883	40	12	7.144	41.5	34.1	2.5×1	33 600	77 500	2 550	83	86	128	48	18	117	106	11	17.5	11	Rc1/8	1 000	40.3	70	300	34.1	100	1 400	–0.024	0.040	0.027	0.080	0.025	0.015	16.7	1 750	35	18
W4016SS-2Z-C5Z12	1 483																					1 600			350		150	2 100	–0.038	0.054	0.035	0.130			22.9			
W4025SS-1Z-C5Z12	2 383																					2 500			400		150	3 050	–0.060	0.077	0.046	0.170			31.1			

Notes:
1. Use of NSK support unit is recommended. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

Screw shaft ø40

Lead 10, 12



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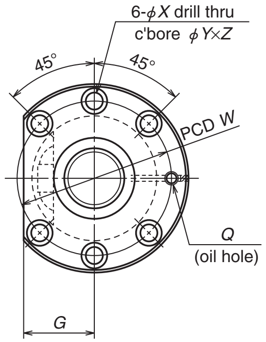


View X-X

Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut				
							Turns × Circuits	Dynamic	Static			Outside dia.	Flange			Overall length
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n
W4007SS-3D-C5Z10	507	40	10	6.350	41	34.4	2.5×2	52 000	137 000	3 630	108	82	124	47	18	193
W4010SS-3D-C5Z10	807															
W4014SS-2D-C5Z10	1 207															
W4018SS-3D-C5Z10	1 607															
W4024SS-2D-C5Z10	2 207															
W4010SS-5D-C5Z12	775	40	12	7.144	41.5	34.1	2.5×2	61 000	155 000	4 310	138	86	128	48	18	225
W4016SS-3D-C5Z12	1 375															
W4025SS-2D-C5Z12	2 275															

Ball screw No.	dimensions					Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min⁻¹)	Internal spatial volume of nut (cm³)	Standard volume of grease replenishing (cm³)
	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_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
W4007SS-3D-C5Z10	102	11	17.5	11	Rc1/8	700	40.3	60	300	34.4	100	1 100	–0.017	0.035	0.025	0.065	0.025	0.015	15.5	1 750	74	37
W4010SS-3D-C5Z10						1 000			300		100	1 400	–0.024	0.040	0.027	0.080			18.1			
W4014SS-2D-C5Z10						1 400			350		120	1 870	–0.034	0.054	0.035	0.100			22.2			
W4018SS-3D-C5Z10						1 800			350		120	2 270	–0.043	0.065	0.040	0.130			25.6			
W4024SS-2D-C5Z10						2 400			400		150	2 950	–0.058	0.077	0.046	0.170			31.6			
W4010SS-5D-C5Z12	106	11	17.5	11	Rc1/8	1 000	40.3	70	300	34.1	100	1 400	–0.024	0.040	0.027	0.080	0.025	0.015	19.7	1 750	93	47
W4016SS-3D-C5Z12						1 600			350		150	2 100	–0.038	0.054	0.035	0.130			25.8			
W4025SS-2D-C5Z12						2 500			400		150	3 050	–0.060	0.077	0.046	0.170			34.0			

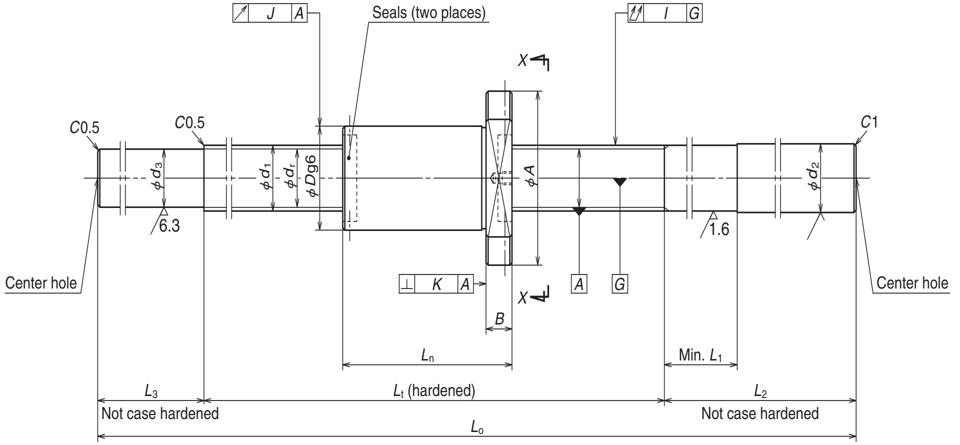
Notes: 1. Use of NSK support unit is recommended. See page B375 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.
See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

Blank shaft end SS type (Fine lead: Deflector type)

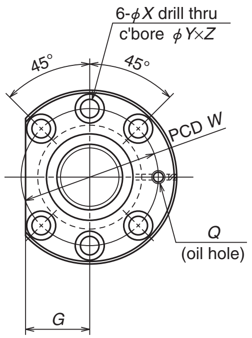
Nut model: ZFD

Screw shaft ø40, ø50

Lead 10



Nut type code: ZFD



View X-X

Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut				
								Dynamic	Static			Outside dia.	Flange			Overall length
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n
W4007SS-4ZY-C5Z10	557	40	10	6.350	41.75	35.1	4	38 400	93 300	2 840	83	62	104	40	18	143
W4010SS-6ZY-C5Z10	857															
W4014SS-3ZY-C5Z10	1 257															
W4018SS-4ZY-C5Z10	1 657															
W4024SS-3ZY-C5Z10	2 257															
W5007SS-1ZY-C5Z10	557	50	10	6.350	51.75	45.1	4	43 600	122 000	3 240	108	72	114	44	18	143
W5010SS-3ZY-C5Z10	857															
W5015SS-3ZY-C5Z10	1 357															
W5020SS-3ZY-C5Z10	1 857															
W5026SS-3ZY-C5Z10	2 457															

Ball screw No.	dimensions					Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed N (min^{-1})	Internal spatial volume of nut (cm^3)	Standard volume of grease replenishing (cm^3)
	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_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
W4007SS-4ZY-C5Z10	82	11	17.5	11	Rc1/8	700	40.3	60	300	35.1	100	1 100	–0.015	0.035	0.025	0.065	0.019	0.013	12.1	1 750	32	16
W4010SS-6ZY-C5Z10						1 000			300		100	1 400	–0.022	0.040	0.027	0.080			14.7			
W4014SS-3ZY-C5Z10						1 400			350		120	1 870	–0.032	0.054	0.035	0.100			18.9			
W4018SS-4ZY-C5Z10						1 800			350		120	2 270	–0.041	0.065	0.040	0.130			22.5			
W4024SS-3ZY-C5Z10						2 400			400		150	2 950	–0.056	0.077	0.046	0.170			28.5			
W5007SS-1ZY-C5Z10	92	11	17.5	11	Rc1/8	700	50.3	60	300	45.1	100	1 100	–0.015	0.035	0.025	0.065	0.019	0.013	18.3	1 400	39	20
W5010SS-3ZY-C5Z10						1 000			300		100	1 400	–0.022	0.040	0.027	0.080			22.5			
W5015SS-3ZY-C5Z10						1 500			400		150	2 050	–0.034	0.054	0.035	0.130			31.8			
W5020SS-3ZY-C5Z10						2 000			400		150	2 550	–0.046	0.065	0.040	0.170			38.9			
W5026SS-3ZY-C5Z10						2 600			500		200	3 300	–0.060	0.093	0.054	0.220			49.5			

Notes:
1. Use of NSK support unit is recommended. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

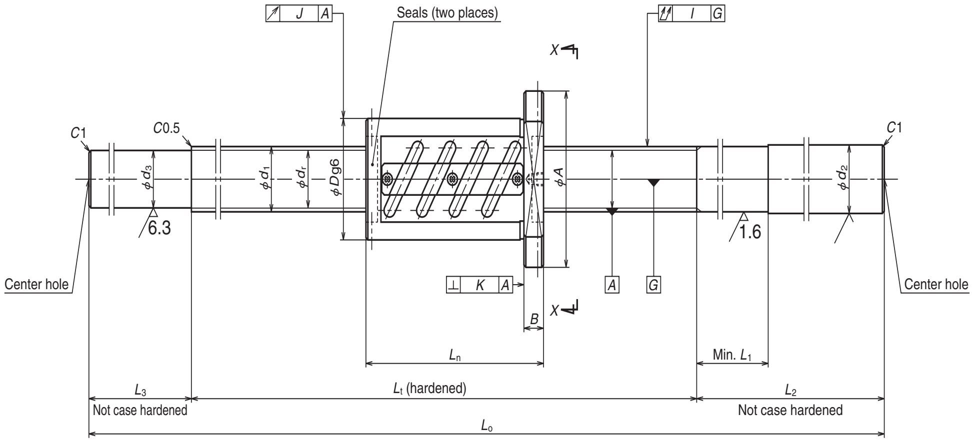
Blank shaft end SS type (Fine lead: Tube type)

Nut model: ZFT

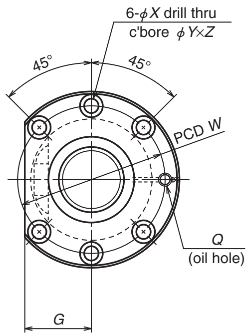
NSK

Screw shaft ø45, ø50

Lead 10



Nut type code: ZFT



View X-X

Unit: mm

Ball screw No.	Stroke Max.	Screw shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective ball turns	Basic load rating (N)		Preload (N)	Dynamic friction torque, median (N·cm)	Nut					dimensions					Screw shaft dimensions							Lead accuracy			Run-out			Mass (kg)	Permissible rotational speed	Internal spatial volume of nut	Standard volume of grease replenishing
							Turns × Circuits	Dynamic	Static			Outside dia.	Flange			Overall length	Bolt hole				Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity				
	L_t-L_n	d_1	l	D_w	d_m	d_r		C_a	C_{0a}			D	A	G	B	L_n	W	X	Y	Z	Q	L_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K		N (min^{-1})	(cm^3)	(cm^3)
W4510SS-1Z-C5Z10	897	45	10	6.350	46	39.4	2.5×1	29 900	77 300	2 260	69	88	132	50	18	103	110	11	17.5	11	Rc1/8	1 000	45.3	60	300	39.4	100	1 400	-0.024	0.040	0.027	0.080	0.025	0.015	19.7	1 550	34	17
W4516SS-1Z-C5Z10	1 497																					1 600			400		150	2 150	-0.038	0.054	0.035	0.130			28.1			
W4525SS-1Z-C5Z10	2 397																					2 500			450		150	3 100	-0.060	0.077	0.046	0.170			38.8			
W5010SS-1Z-C5Z10	897	50	10	6.350	51	44.4	2.5×1	31 800	87 400	2 450	78	93	135	51	18	103	113	11	17.5	11	Rc1/8	1 000	50.3	60	300	44.4	100	1 400	-0.024	0.040	0.027	0.080	0.025	0.015	23.8	1 400	37	19
W5015SS-1Z-C5Z10	1 397																					1 500			400		150	2 050	-0.036	0.054	0.035	0.130			32.9			
W5020SS-1Z-C5Z10	1 897																					2 000			400		150	2 550	-0.048	0.065	0.040	0.170			39.8			
W5026SS-1Z-C5Z10	2 497																					2 600			450		150	3 200	-0.062	0.093	0.054	0.220			48.9			
W5010SS-2Z-C5Z10	837	50	10	6.350	51	44.4	2.5×2	57 700	175 000	4 020	138	93	135	51	18	163	113	11	17.5	11	Rc1/8	1 000	50.3	60	300	44.4	100	1 400	-0.024	0.040	0.027	0.080	0.025	0.015	25.5	1 400	59	30
W5015SS-2Z-C5Z10	1 337																					1 500			400		150	2 050	-0.036	0.054	0.035	0.130			34.6			
W5020SS-2Z-C5Z10	1 837																					2 000			400		150	2 550	-0.048	0.065	0.040	0.170			41.5			
W5026SS-2Z-C5Z10	2 437																					2 600			450		150	3 200	-0.062	0.093	0.054	0.220			50.7			

Notes: 1. Use of NSK support unit is recommended. See page B375 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B285.

B-3-1.10 Ball Screws for Transfer Equipment

1. Features

● Transporting mechanism

A series with accuracy grades of Ct7 and Ct10 only demonstrates 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, RNFBL, RNCT, RNFCL, and RNSTL types have blank shaft ends.

Table 1 Classifications of ball screws for transfer equipment

Finished shaft end	VFA type, RMA type
Blank shaft end	RMS type
	R Series RNFTL type, RNFBL type RNCT type, RNFCL 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) Ball recirculation system

Figs. 1, **2**, and **3** show the structures of ball return tube, deflector, and end cap ball 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.

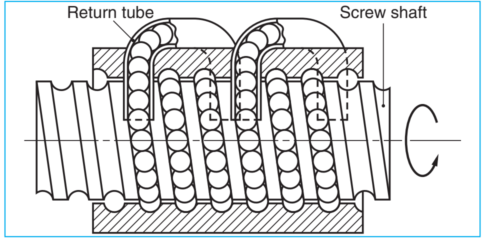


Fig. 1 Structure of return tube recirculation system

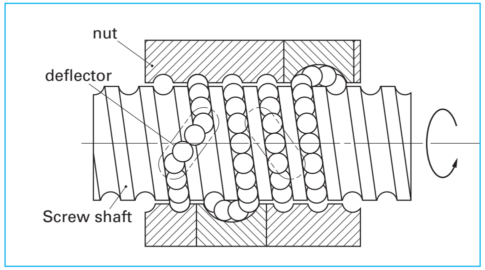


Fig. 2 Structure of deflector recirculation system

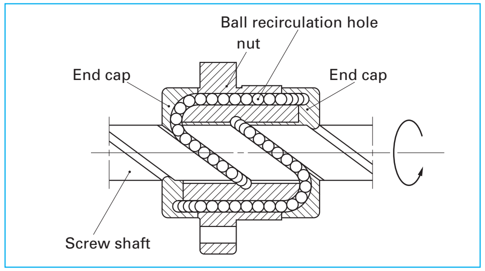


Fig. 3 Structure of end cap recirculation system

(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 3 Allowable d·n value and the criterion of maximum rotational speed

Allowable d·n value	50 000 or less
Criterion of maximum rotational speed	3 000 min^{-1}

d•n value: shaft dia. d [mm] × rotational speed n [min^{-1}]

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

3. Design precautions

For general precautions regarding ball screws, refer to "Design Precautions" (page B80) and "Handling Precautions" (page B99).

(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 B73) for installation of ball nut assembly.

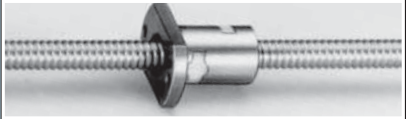
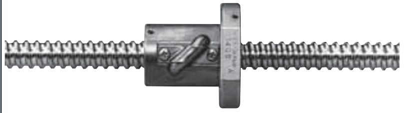
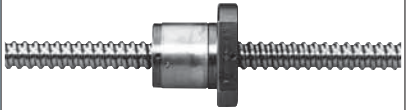
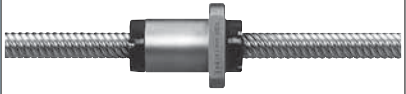
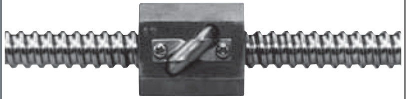
(2) Shaft end machining

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 B79) 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 model	Shape	Flange shape	Recirculation system	Preload system	Page
VFA		Flanged rectangular	Return tube type	Non-preload Slight axial play	B339 – B344
RMA RMS		Flanged Circular Ⅲ	Deflector type	Non-preload Slight axial play	B345 – B358
RNFTL		Flanged Circular I Projecting tube type	Return tube type	Non-preload Slight axial play	B359 – B362
RNFBL		Flanged Circular Ⅱ	Return tube type	Non-preload Slight axial play	B365
RNCT		V-thread (no flange) Projecting tube type	Return tube type	Non-preload Slight axial play	B367
RNFCL		Flanged Circular Ⅲ	End cap type	Non-preload Slight axial play	B369 – B372
RNSTL		Square type	Return tube type	Non-preload Slight axial play	B373

5. Structure of reference number

The followings describe the structure of "Reference number for ball screw".

◇Reference number for VFA, RMA, and RMS types

VFA 15 10 - C7 S - 500

Ball screw for transfer equipment:
VFA, RMA, RMS

Screw shaft diameter (mm)

Lead (mm)

Accuracy grade code

Axial play

Screw shaft length (mm)

◇Reference number for R series

Nut assembly (example)

RNFTL 25 10 A5 S

Nut model : RNFTL, RNFBL, RNCT,
RNFCL, RNSTL

Screw shaft diameter (mm)

Lead (mm)

Internal design code

Effective turns of balls
(turns of balls × number of circuit)

Seal code S: With seal
No code: Without seal

Screw shaft (example)

RS 25 10 A 20

Product code

Screw shaft diameter (mm)

Lead (mm)

Internal design code

Screw shaft length (in the unit of 100 mm)

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	B345, 357				
8	B347, 357	B349, 357	B351, 357		
10			B353, 357		
12			B355, 357	B339	
15				B341	B343

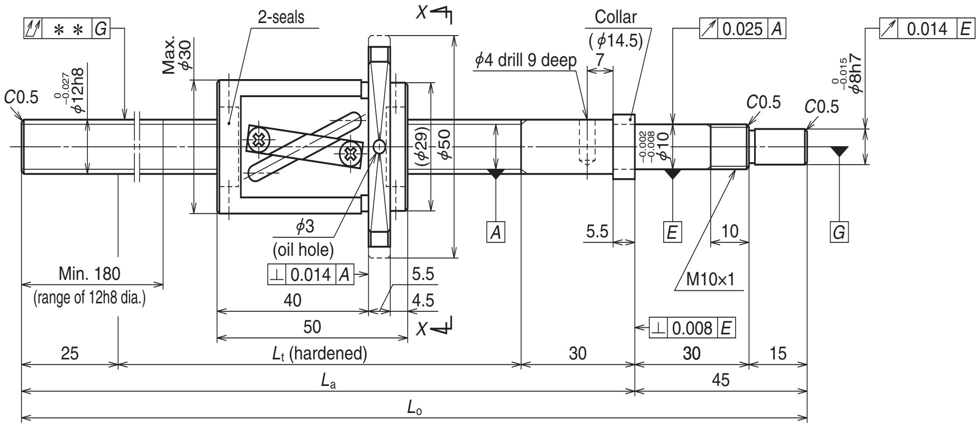
Table 6 Combinations of shaft diameter and lead for R series

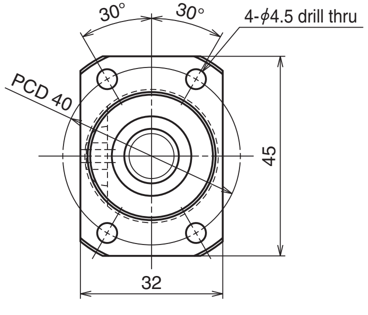
Screw shaft diameter (mm)	Lead (mm)													
	3	4	5	6	8	10	12	16	20	25	32	40	50	64	80
10	○B359 △B367			○B359●B365											
12					○B359●B365		○B363◎B369								
14		○B359●B365 △B367□B373	○B359●B365 △B367□B373												
15									◎B369						
16						○B359		○B363 ◎B369			◎B371				
18					○B359●B365 △B367□B373										
20			○B359●B365 △B367□B373			○B359●B365 □B373			○B363 ◎B369			◎B371			
25			○B359●B365 △B367□B373			○B359●B365 △B367□B373				○B363 ◎B369			◎B371		
28				○B361●B365 △B367□B373											
32						○B361●B365 △B367□B373					○B363 ◎B369			◎B371	
36						○B361●B365 △B367□B373									
40						○B361△B367 ●B365						○B363 ◎B369			◎B371
45							○B361 △B367□B373								
50						○B361 △B367		○B361 △B367					◎B369		

○: RNFTL ●: RNFBL △: RNCT ◎: RNFCL □: RNSTL

Screw shaft ø12

Lead 10





View *X*-*X*

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	3 750
	Static C_{0a}	6 480
Axial play		0.010 or less
Dynamic friction torque (N·cm)		1.5 or less
Spacer ball		None
Factory-packed grease		NSK grease LR3
Internal spatial volume of nut (cm^3)		1.4
Reference of grease replenishing amount		0.7

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK10-01A (square)	WBK12SF-01 (square)
WBK10-11 (round)	

Unit: mm

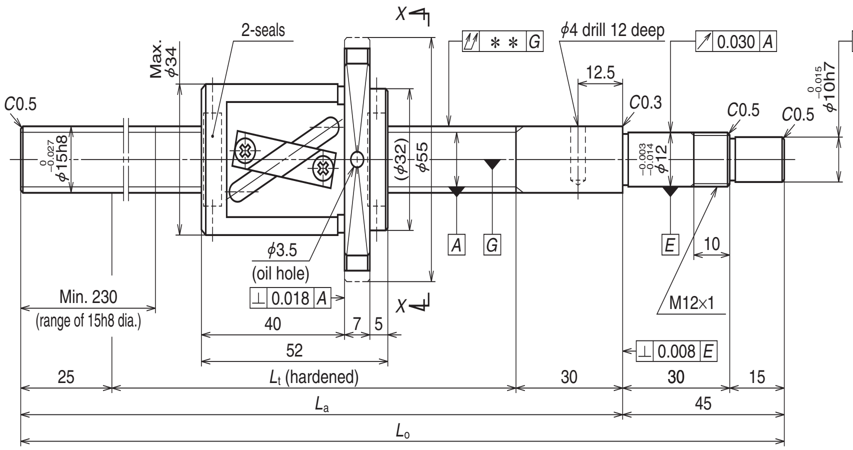
Ball screw No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out** ⇗	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	Nominal	Maximum (L_t-nut length)	L_t	L_a	L_o	T	e_p	υ_{300}			Fixed - Simple support	Fixed - Free
VFA1210C7S-410	250	260	310	365	410	0	0.085	0.052	0.100	0.56	3 000	3 000
VFA1210C7S-610	450	460	510	565	610	0	0.155	0.052	0.160	0.73	3 000	1 300

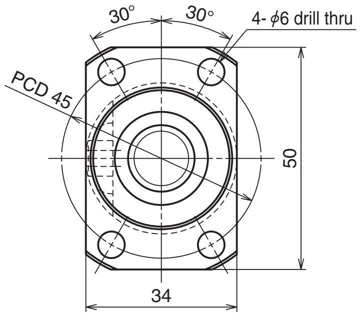
Notes:
1. We recommend NSK support units (page B375). WBK12SF-01 (on simple support side) supports ball screw directly on shaft outside diameter.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Permissible rotational speed is determined by d · n value and critical speed. See pages B47 and B335.

Screw shaft ø15

Lead 10

Unit: mm





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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	7 070
	Static C_{0a}	12 800
Axial play		0.010 or less
Dynamic friction torque (N·cm)		2.5 or less
Spacer ball		None
Factory-packed grease		NSK grease LR3
Internal spatial volume of nut (cm^3)		2.3
Reference of grease replenishing amount		1.2

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK12-01A (square)	WBK15SF-01 (square)
WBK12-11 (round)	

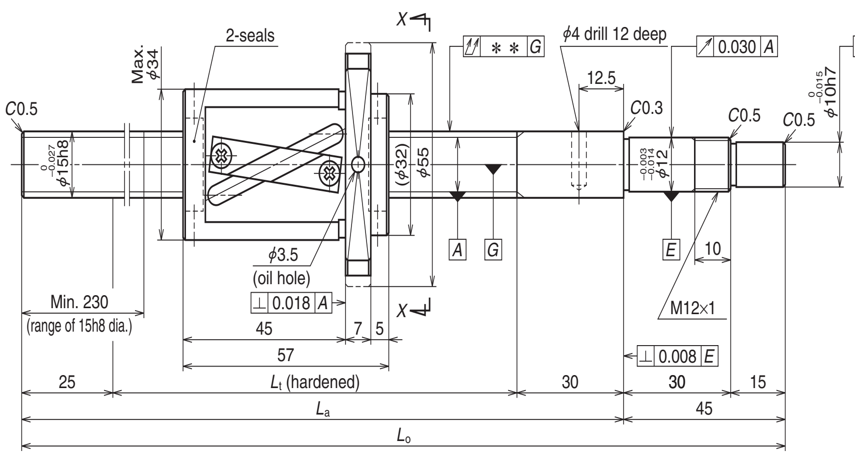
Unit: mm

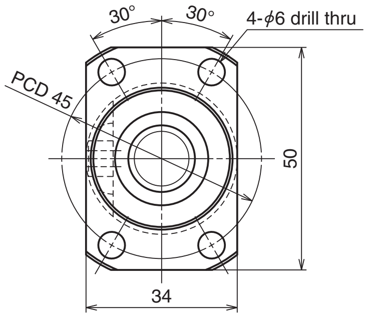
Ball screw No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out** ⌰	Mass (kg)	Permissible rotational speed N (min^{-1})	
	Nominal	Maximum (L_t-nut length)									Supporting condition	
			L_t	L_a	L_o	T	e_p	υ_{300}			Fixed - Simple support	Fixed - Free
VFA1510C7S-500	300	348	400	455	500	0	0.120	0.052	0.075	0.89	3 000	2 600
VFA1510C7S-700	500	548	600	655	700	0	0.195	0.052	0.110	1.1	3 000	1 150
VFA1510C7S-1000	800	848	900	955	1 000	0	0.310	0.052	0.180	1.5	2 340	510

Notes:
1. We recommend NSK support units (page B375). WBK12SF-01 (on simple support side) supports ball screw directly on shaft outside diameter.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Permissible rotational speed is determined by d · n value and critical speed. See pages B47 and B335.

Screw shaft ø15

Lead 20





View X-X

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_a	4 560
	Static C_{0a}	7 730
Axial play		0.010 or less
Dynamic friction torque (N·cm)		2.5 or less
Spacer ball		None
Factory-packed grease		NSK grease LR3
Internal spatial volume of nut (cm^3)		2.3
Reference of grease replenishing amount		1.4

Recommended support unit

For drive side (Fixed)	For opposite to drive side (Simple)
WBK12-01A (square)	WBK15SF-01 (square)
WBK12-11 (round)	

Unit: mm

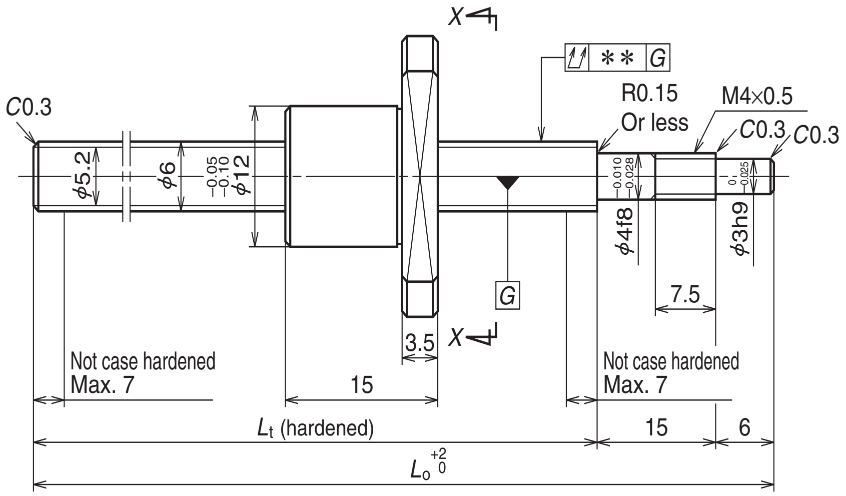
Ball screw No.	Stroke		Screw shaft length			Lead accuracy			Shaft run-out** ↗↗	Mass (kg)	Permissible rotational speed N (min^{-1})	
											Supporting condition	
	Nominal	Maximum (L_t-nut length)	L_t	L_a	L_o	T	e_p	υ_{300}			Fixed - Simple support	Fixed - Free
VFA1520C7S-500	300	343	400	455	500	0	0.120	0.052	0.075	0.94	3000	2 630
VFA1520C7S-700	500	543	600	655	700	0	0.195	0.052	0.110	1.2	3 000	1 160
VFA1520C7S-1000	800	843	900	955	1 000	0	0.310	0.052	0.180	1.6	2 350	510

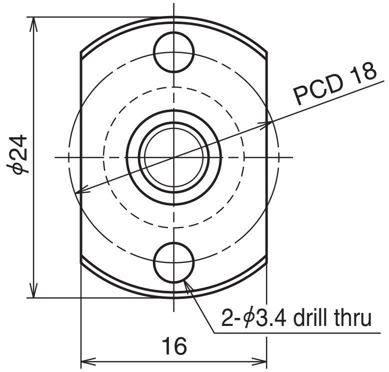
Notes:
1. We recommend NSK support units (page B375). WBK12SF-01 (on simple support side) supports ball screw directly on shaft outside diameter.
2. Use of NSK grease LR3 is recommended. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.
3. Permissible rotational speed is determined by d · n value and critical speed. See pages B47 and B335.

Screw shaft ø6

Lead 1

Unit: mm





View *X-X*

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-packed grease		**See Notes 2.**

Recommended support unit

For drive side (Fixed)
WBK04R-11 (round)

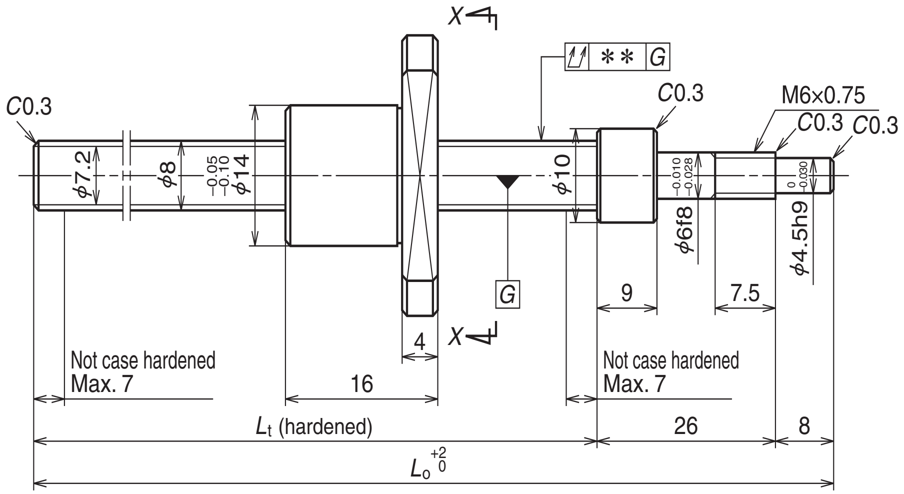
Unit: mm

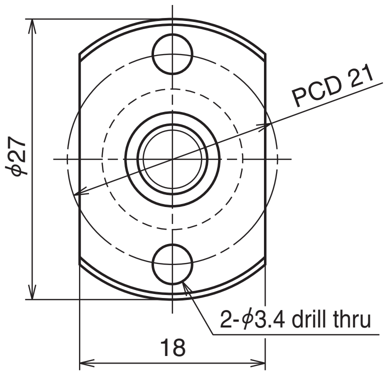
Ball screw No.	Stroke		Screw shaft length		Lead accuracy			Shaft run-out∗∗	Mass (kg)	Permissible rotational speed N (min^{-1})
	Nominal	Maximum (L_t-Nut length)	L_t	L_o	Target compensation T	Deviation e_p	Variation υ_{300}			
RMA0601C7S-160	100	124	139	160	0	0.052	0.052	0.060	0.045	3 000
RMA0601C7S-260	200	224	239	260	0	0.085	0.052	0.090	0.065	3 000

Notes: 1. We recommend NSK support bearing kit (page B375).
2. Only rust preventive oil is applied at time of delivery. Please apply lubricant (oil or grease) before use.
See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B335.

Screw shaft ø8

Lead 1





View *X-X*

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}	1 290
Axial play		0.020 or less
Dynamic friction torque (N·cm)		1.0 or less
Spacer ball		None
Factory-packed grease		**See Notes 2.**

Recommended support unit

For drive side (Fixed)
WBK06R-11 (round)

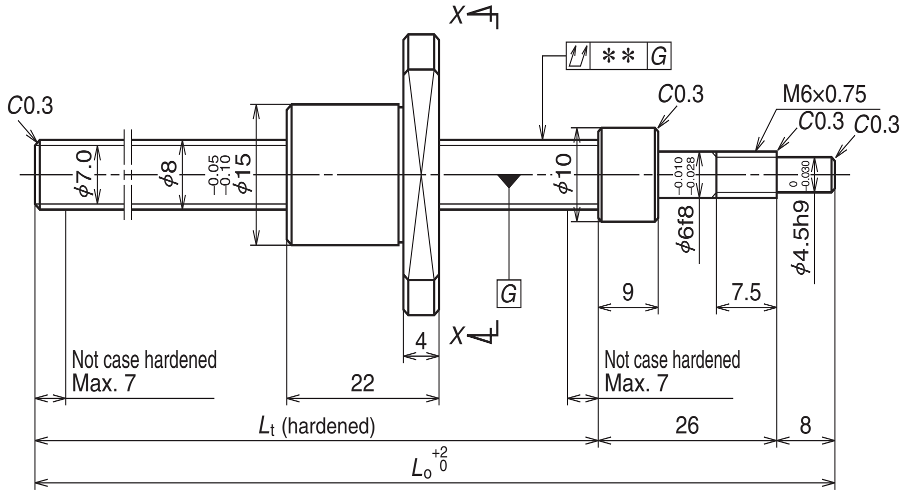
Unit: mm

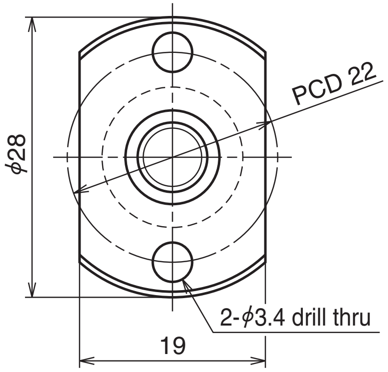
Ball screw No.	Stroke		Screw shaft length		Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min^{-1})
	Nominal	Maximum (L_t-Nut length)	L_t	L_o	Target compensation T	Deviation e_p	Variation υ_{300}			
RMA0801C7S-180	100	130	146	180	0	0.052	0.052	0.060	0.085	3 000
RMA0801C7S-280	200	230	246	280	0	0.085	0.052	0.090	0.12	3 000

Notes: 1. We recommend NSK support bearing kit (page B375).
2. Only rust preventive oil is applied at time of delivery. Please apply lubricant (oil or grease) before use.
See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B335.

Screw shaft ø8

Lead 1.5





View X-X

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}	1 590
Axial play		0.020 or less
Dynamic friction torque (N·cm)		1.0 or less
Spacer ball		None
Factory-packed grease		**See Notes 2.**

Recommended support unit

For drive side (Fixed)
WBK06R-11 (round)

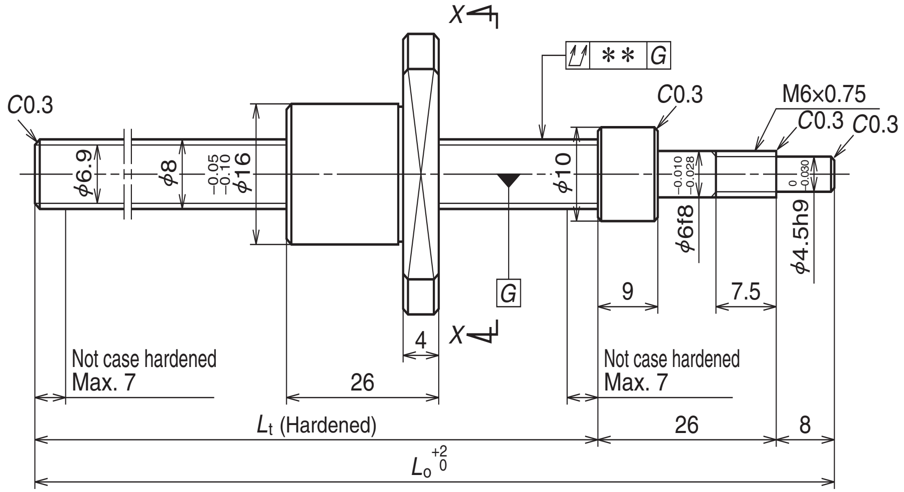
Unit: mm

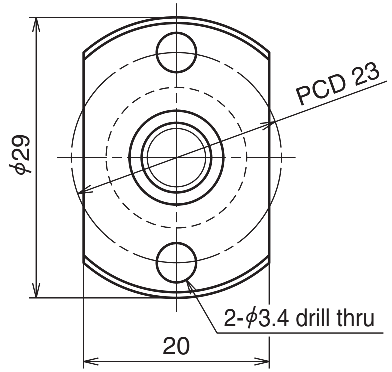
Ball screw No.	Stroke		Screw shaft length		Lead accuracy			Shaft run-out** ∥	Mass (kg)	Permissible rotational speed N (min^{-1})
	Nominal	Maximum (L_t-Nut length)	L_t	L_o	Target compensation T	Deviation e_p	Variation υ_{300}			
RMA0801.5C7S-180	100	124	146	180	0	0.052	0.052	0.060	0.093	3 000
RMA0801.5C7S-280	200	224	246	280	0	0.085	0.052	0.090	0.13	3 000

Notes: 1. We recommend NSK support bearing kit (page B375).
2. Only rust preventive oil is applied at time of delivery. Please apply lubricant (oil or grease) before use.
See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B335.

Screw shaft ø8

Lead 2





View X-X

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	1 070
	Static C_{0a}	1 950
Axial play		0.020 or less
Dynamic friction torque (N·cm)		1.0 or less
Spacer ball		None
Factory-packed grease		**See Notes 2.**

Recommended support unit

For drive side (Fixed)
WBK06R-11 (round)

Unit: mm

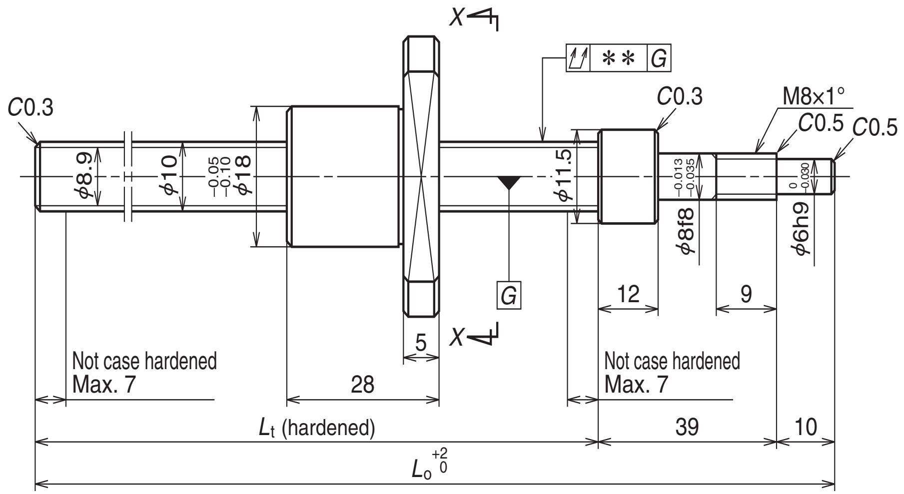
Ball screw No.	Stroke		Screw shaft length		Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min^{-1})
	Nominal	Maximum (L_t-Nut length)	L_t	L_o	Target compensation T	Deviation e_p	Variation υ_{300}			
RMA0802C7S-180	100	120	146	180	0	0.052	0.052	0.060	0.10	3 000
RMA0802C7S-280	200	220	246	280	0	0.085	0.052	0.090	0.14	3 000

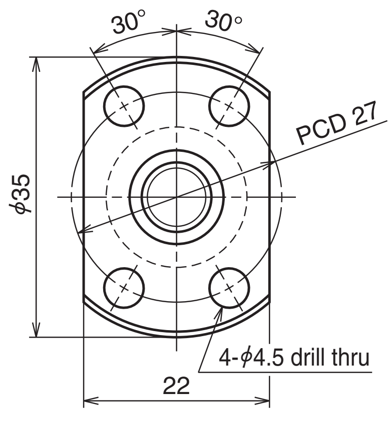
Notes:
1. We recommend NSK support bearing kit (page B375).
2. **Only rust preventive oil is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B335.

Screw shaft ø10

Lead 2

Unit: mm





View *X*-*X*

Ball screw specification		
Shaft dia.xLead / Direction of turn		10 × 2 / Right
Ball recirculation		Deflector
Ball dia. / Ball circle dia.		1.200 / 10.3
Screw shaft root dia.		8.9
Effective turns of balls		1 × 3
Accuracy grade / Axial play code		Ct7 / S
Basic load rating (N)	Dynamic C_a	1 210
	Static C_{0a}	2 510
Axial play		0.020 or less
Dynamic friction torque (N·cm)		1.0 or less
Spacer ball		None
Factory-packed grease		**See Notes 2.**

Recommended support unit

For drive side (Fixed)
WBK08-01A (square)
WBK08-11 (round)

Unit: mm

Ball screw No.	Stroke		Screw shaft length		Lead accuracy			Shaft run-out＊＊ ↗↗	Mass (kg)	Permissible rotational speed N (min^{-1})
	Nominal	Maximum (L_t-Nut length)	L_t	L_o	Target compensation *T*	Deviation e_p	Variation υ_{300}			
RMA1002C7S-250	150	173	201	250	0	0.085	0.052	0.070	0.19	3 000
RMA1002C7S-350	250	273	301	350	0	0.085	0.052	0.100	0.25	3 000

Notes: 1. We recommend NSK support bearing kit (page B375).

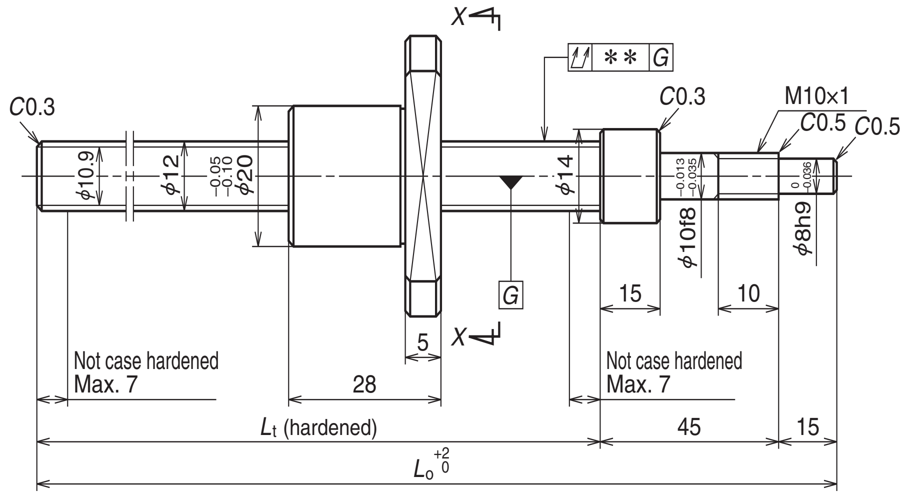
2. Only rust preventive oil is applied at time of delivery. Please apply lubricant (oil or grease) before use.
See page D13 for details.

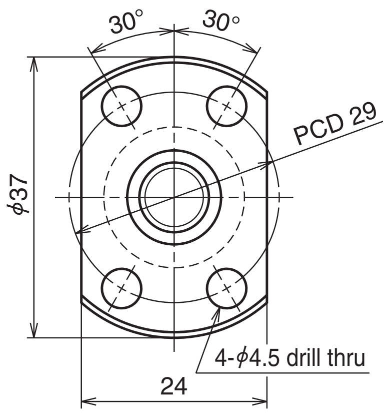
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B335.

Screw shaft ø12

Lead 2

Unit: mm





View *X*-*X*

Ball screw specification		
Shaft dia.xLead / 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	1 350
	Static C_{0a}	3 190
Axial play		0.020 or less
Dynamic friction torque (N·cm)		1.0 or less
Spacer ball		None
Factory-packed grease		**See Notes 2.**

Recommended support unit

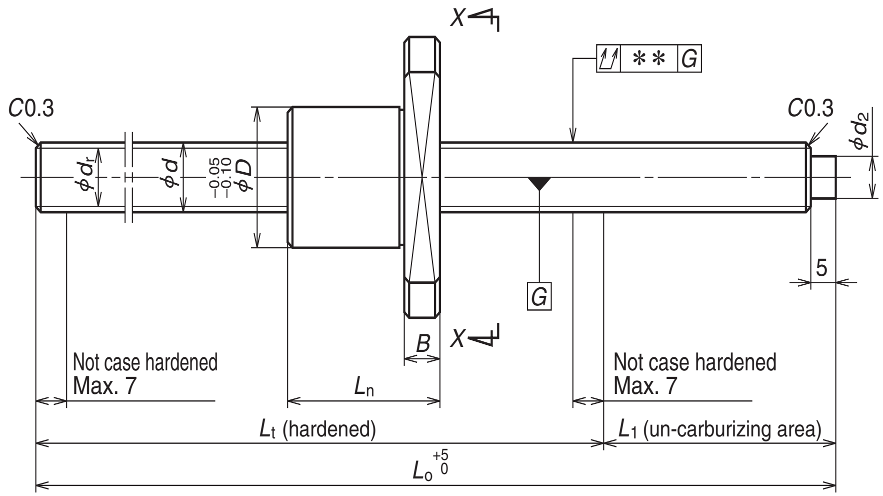
For drive side (Fixed)
WBK10-01A (square)
WBK10-11 (round)

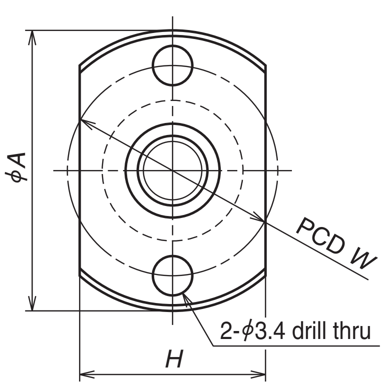
Unit: mm

Ball screw No.	Stroke		Screw shaft length		Lead accuracy			Shaft run-out＊＊ ⌰	Mass (kg)	Permissible rotational speed N (min^{-1})
	Nominal	Maximum (L_t-Nut length)	L_t	L_o	Target compensation T	Deviation e_p	Variation υ_{300}			
RMA1202C7S-250	150	162	190	250	0	0.060	0.052	0.070	0.26	3 000
RMA1202C7S-350	250	262	290	350	0	0.085	0.052	0.100	0.34	3 000

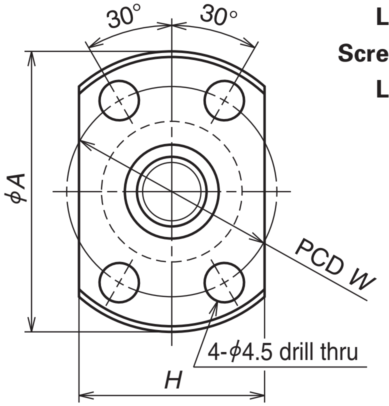
Notes:
1. We recommend NSK support bearing kit (page B375).
2. **Only rust preventive oil is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B335.

Screw shaft ø6
Lead 1
Screw shaft ø8
Lead 1, 1.5, 2
Screw shaft ø10, ø12
Lead 2





View *X-X*
(for screw shaft of 6 and 8 dia.)



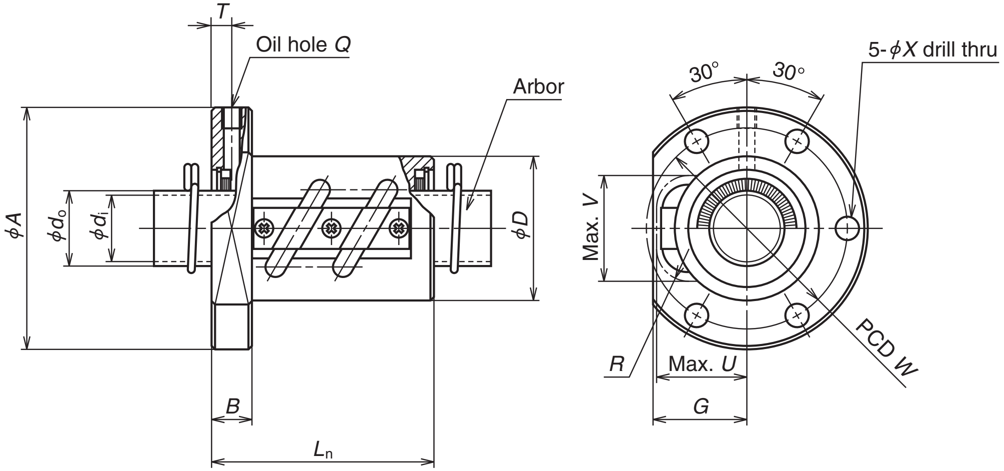
View *X-X*
(for screw shaft of 10 and 12 dia.)

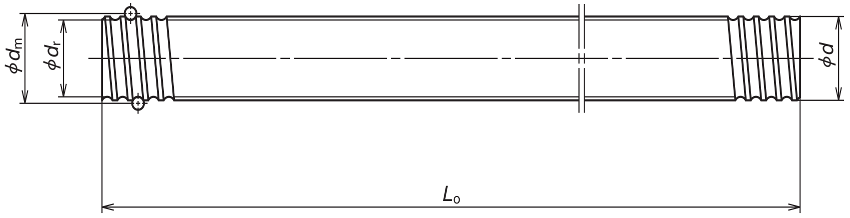
Unit: mm

Ball screw No.	Stroke Max. L_t-L_n	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls	Basic load rating (N)		Axial play Max.
								Dynamic C_a	Static C_{0a}	
RMS0601C7S-300	235	6	1	0.800	6.2	5.3	3	520	925	0.02
RMS0801C7S-300	234	8	1	0.800	8.2	7.3	3	600	1 290	0.02
RMS0801.5C7S-300	228		1.5	1.000	8.3	7.2		810	1 590	
RMS0802C7S-300	224		2	1.200	8.3	7.0		1 070	1 950	
RMS1002C7S-350	262	10	2	1.200	10.3	9.0	3	1 210	2 510	0.02
RMS1202C7S-350	262	12	2	1.200	12.3	11.0	3	1 350	3 190	0.02

Ball screw No.	Nut dimensions						Screw shaft dimensions				Lead accuracy			Shaft run-out**	Mass (Kg)	Permissible rotational speed N (min⁻¹)
	D	A	H	B	L_n	W	Effective thread length L_t	Shaft end L_1	Shaft end d_2	Overall length L_o	Target compensation T	Deviation e_p	Variation υ_{300}			
RMS0601C7S-300	12	24	16	3.5	15	18	250	50	4	300	0	0.085	0.052	0.09	0.075	3 000
RMS0801C7S-300	14	27	18	4	16	21	250	50	6	300	0	0.085	0.052	0.09	0.13	
RMS0801.5C7S-300	15	28	19		22	22									0.14	
RMS0802C7S-300	16	29	20		26	23									0.15	
RMS1002C7S-350	18	35	22	5	28	27	290	60	8	350	0	0.085	0.052	0.10	0.25	
RMS1202C7S-350	20	37	24	5	28	29	290	60	10	350	0	0.085	0.052	0.10	0.35	

Notes:
1. We recommend NSK support unit (page B375) or support kit (page B387).
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** See page D13 for details.
3. Seal is not installed.
4. Permissible rotational speed is determined by d·n value and critical speed. See pages B47 and B335.





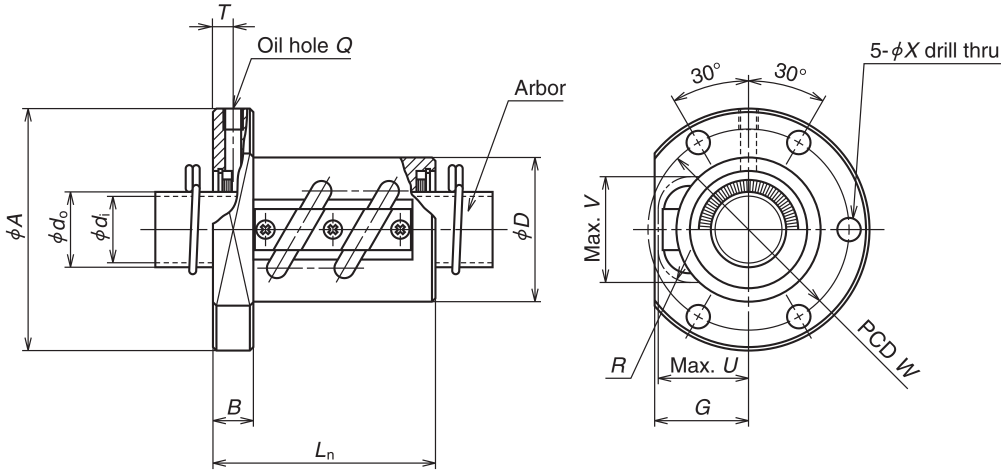
Unit: mm

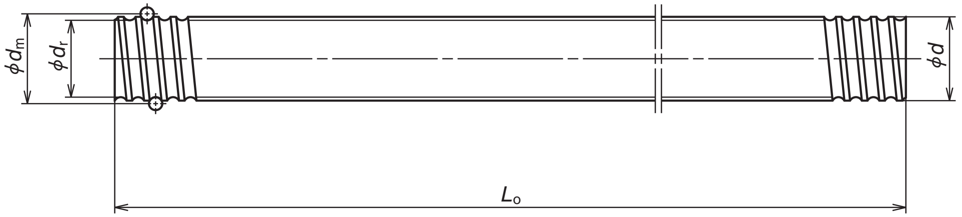
Ball nut No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls	Basic load rating (N)		Axial play Max.	Ball nut dimensions
	d	l	D_w	d_m	d_r	Turns × Circuits	Dynamic C_a	Static C_{0a}		Outside dia. D
RNFTL 1003A3.5	10	3	2.381	10.65	8.1	3.5×1	3 780	6 730	0.10	20
RNFTL 1006A2.5S	10	6	2.381	10.65	8.1	2.5×1	2 830	4 810	0.10	20
RNFTL 1208A2.5S	12	8	2.778	12.65	9.6	2.5×1	3 730	6 560	0.10	25
RNFTL 1404A3.5S	14	4	2.778	14.5	11.5	3.5×1	5 370	10 800	0.10	25
RNFTL 1405A2.5S	14	5	3.175	14.5	11.0	2.5×1	5 260	9 720	0.10	30
RNFTL 1610A2.5 **RNFTL 1610A2.5S**	16	10	3.175	16.75	13.3	2.5×1	5 660	11 500	0.10	30
RNFTL 1808A3.5 **RNFTL 1808A3.5S**	18	8	4.762	18.5	13.6	3.5×1	13 200	25 800	0.15	34
RNFTL 2005A2.5 **RNFTL 2005A2.5S**	20	5	3.175	20.5	17.0	2.5×1	6 360	14 200	0.10	40
RNFTL 2010A2.5 **RNFTL 2010A2.5S**	20	10	4.762	21.25	16.2	2.5×1	10 900	21 800	0.15	40
RNFTL 2505A5 **RNFTL 2505A5S**	25	5	3.175	25.5	22.0	2.5×2	12 800	36 300	0.10	42
RNFTL 2510A2.5 **RNFTL 2510A2.5S**	25	10	6.35	26	19.0	2.5×1	17 500	35 200	0.20	44
RNFTL 2510A5 **RNFTL 2510A5S**						2.5×2	31 800	70 300		44

Ball nut No.	Ball nut dimensions											Nut Mass. (kg)	Arbor		Screw shaft				Shaft mass/m (kg)	Internal spatial volume of nut (cm³)	Standard volume of greas replenishing (cm³)
	Flange			Length	Bolt hole		Oil hole		Projecting tube				Outside dia.	Bore	Standard length			Screw shaft No.			
	A	G	B	L_n	W	X	Q	T	U	V	R		d_0	d_i	L_0						
RNFTL 1003A3.5	40	15	6	34	30	4.5	M3×0.5	3.0	15	15	7	0.092	8.1	6.1	400	800	–	RS1003A··	0.50	–	–
RNFTL 1006A2.5S	40	15	6	36	30	4.5	M3×0.5	3.5	15	15	5	0.095	8.1	6.1	400	800	–	RS1006A··	0.56	1.1	0.6
RNFTL 1208A2.5S	45	19	8	46	35	4.5	M3×0.5	5.5	19	18	7	0.18	9.6	7.6	400	800	–	RS1208A··	0.74	1.8	0.9
RNFTL 1404A3.5S	50	19	10	43	40	4.5	M6×1	5.0	19	20	7	0.20	11.5	9.5	500	1 000	–	RS1404A··	1.02	2.0	1.0
RNFTL 1405A2.5S	50	22	10	45	40	4.5	M6×1	5.0	22	21	8	0.26	11.0	9.0	500	1 000	–	RS1405A··	1.00	2.4	1.2
RNFTL 1610A2.5 **RNFTL 1610A2.5S**	53	23	10	54	41	5.5	M6×1	5.5	23	22.5	8	0.28	13.3	11.3	500	1 000	1 500	RS1610A··	1.37	2.7	1.4
RNFTL 1808A3.5 **RNFTL 1808A3.5S**	63	27	12	58	49	6.6	M6×1	6.0	27	27	8	0.43	13.6	11.6	500	1 000	1 500	RS1808A··	1.60	5.2	2.6
RNFTL 2005A2.5 **RNFTL 2005A2.5S**	60	28	10	46	50	4.5	M6×1	5.0	28	27	10	0.42	17.0	14.6	500	1 000	2 000	RS2005A··	2.17	3.5	1.8
RNFTL 2010A2.5 **RNFTL 2010A2.5S**	67	30	12	59	53	6.6	M6×1	6.0	30	29	12	0.55	16.2	13.8	500	1 000	2 000	RS2010A··	2.18	7.1	3.6
RNFTL 2505A5 **RNFTL 2505A5S**	71	28	12	66	57	6.6	M6×1	6.0	28	31	10	0.62	22.0	19.6	1 000	2 000	2 500	RS2505A··	3.47	6.5	3.3
RNFTL 2510A2.5 **RNFTL 2510A2.5S**	80	34	15	62	62	9	M6×1	7.5	34	37	17	0.75	19.0	16.6	1 000	2 000	2 500	RS2510A··	3.13	13	6.5
RNFTL 2510A5 **RNFTL 2510A5S**	80	34	15	92	62	9	M6×1	7.5	34	37	17									18	9.0

Notes: 1. Protruding portion of tube does not interfere with ball nut housing if its dimensions corresponding to U and V are large enough.
2. Actual screw shaft length may become 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 those with seals are the same as those without.
In ball nut side view drawing, above the center line there is a seal, and beneath it there is no seal.
Seal for those with shaft diameter of 14 mm or less is made of synthetic resin. Seal for those of 16 mm or more is a "Brush" seal.
4. Nut assembly with arbor and screw shaft are separate at time of delivery.
5. Value obtained by diving standard screw shaft length by 100 mm will be entered at end of the part number where marked with ··.
6. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.
7. Internal spatial volume of nut and volume of grease to be replenished are values for ball screws with seals.
Recommended amount for replenishing is approximately 50% of nut’s internal space. For ball screws without seals, apply grease to screw shaft surface or move ball nut by hand while filling them with grease so that grease permeates all areas.
See page D16 for details.

R series RNFTL type





Ball nut No.	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls Turns × Circuits	Basic load rating (N) Dynamic C_a	Basic load rating (N) Static C_{0a}	Axial play Max.	Ball nut dimensions Outside dia. D
RNFTL 2806A2.5 **RNFTL 2806A2.5S**	28	6	3.175	28.5	25.0	2.5×1	7 430	20 300	0.10	50
RNFTL 2806A5 **RNFTL 2806A5S**						2.5×2	13 500	40 600		50
RNFTL 3210A5 **RNFTL 3210A5S**	32	10	6.35	33.75	27.0	2.5×2	35 700	92 200	0.20	55
RNFTL 3610A2.5 **RNFTL 3610A2.5S**	36	10	6.35	37	30.0	2.5×1	21 000	51 000	0.20	60
RNFTL 3610A5 **RNFTL 3610A5S**						2.5×2	38 100	102 000		60
RNFTL 4010A7 **RNFTL 4010A7S**	40	10	6.35	41.75	35.0	3.5×2	53 500	164 000	0.20	65
RNFTL 4512A5 **RNFTL 4512A5S**	45	12	7.144	46.5	39.0	2.5×2	49 600	147 000	0.23	70
RNFTL 5010A7 **RNFTL 5010A7S**	50	10	6.35	51.75	45.0	3.5×2	59 500	205 000	0.20	80
RNFTL 5016A5 **RNFTL 5016A5S**	50	16	9.525	52	42.0	2.5×2	99 900	293 000	0.23	85

Unit: mm

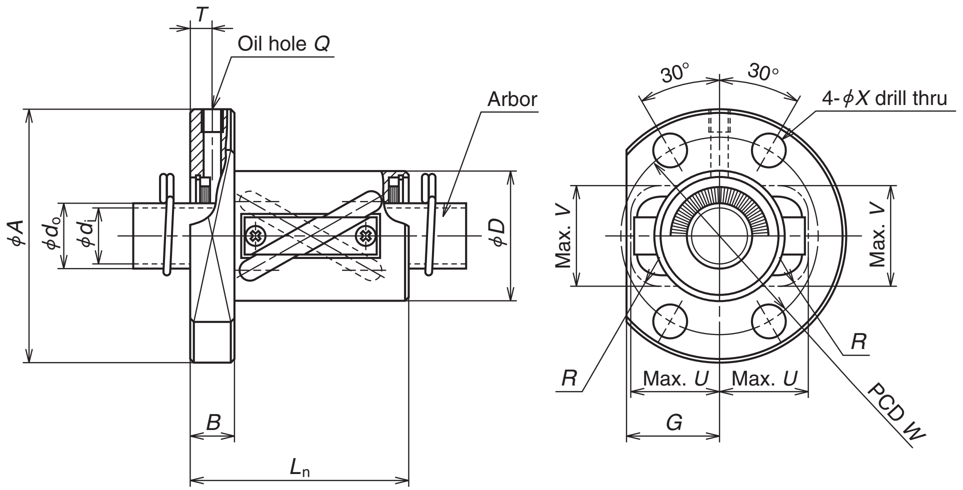
Ball nut dimensions											Nut Mass. (kg)	Arbor		Screw shaft				Shaft mass/m (kg)	Internal spatial volume of nut (cm³)	Standard volume of greas replenishing (cm³)
Flange			Length	Bolt hole		Oil hole		Projecting tube				Outside dia.	Bore	Standard length			Screw shaft No.			
A	G	B	L_n	W	X	Q	T	U	V	R		d_0	d_i	L_o						
79	33	15	55	65	6.6	M6×1	7.5	33	34	10	0.85	25.0	22.6	1 000	2 000	2 500	RS2806A··	4.47	5.9	3.0
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	1 000	2 000	3 000	RS3210A··	5.53	29	15
102	42	18	68	80	11	M6×1	9.0	42	46	17	1.47	30.0	27.6	1 000	2 000	3 000	RS3610A··	6.91	21	11
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	2 000	3 000	4 000	RS4010A··	8.87	42	21
130	47	22	116	100	18	M6×1	11.0	47	55	20	3.07	39.0	35.8	2 000	3 000	4 000	RS4512A··	11.16	49	25
140	52	22	122	110	18	M6×1	11.0	52	59	20	4.06	45.0	41.8	2 000	3 000	4 000	RS5010A··	14.15	53	27
163	57	28	146	125	22	M6×1	14.0	57	63	25	6.42	42.0	38.8	2 000	3 000	4 000	RS5016A··	13.48	94	47

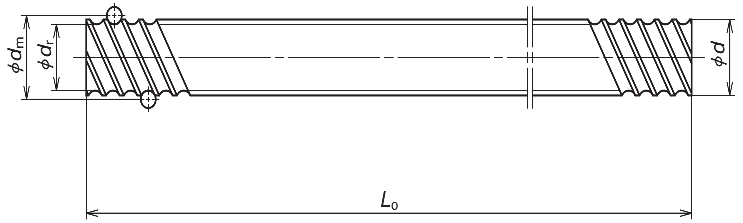
R series

Notes:
1. Protruding portion of tube does not interfere with ball nut housing if its dimensions corresponding to U and V are large enough.
2. Actual screw shaft length may become 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 those with seals are the same as those without.
   In ball nut side view drawing, above the center line there is a seal, and beneath it there is no seal.
   Seal for those with shaft diameter of 14 mm or less is made of synthetic resin. Seal for those of 16 mm or more is a "Brush" seal.
4. Nut assembly with arbor and screw shaft are separate at time of delivery.
5. Value obtained by diving standard screw shaft length by 100 mm will be entered at end of the part number where marked with ··.
6. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.
7. Internal spatial volume of nut and volume of grease to be replenished are values for ball screws with seals.
   Recommended amount for replenishing is approximately 50% of nut's internal space. For ball screws without seals, apply grease to screw shaft surface or move ball nut by hand while filling them with grease so that grease permeates all areas.
   See page D16 for details.

Tube type, Flanged nut (Medium, Hige helix lead)

R series RNFTL type



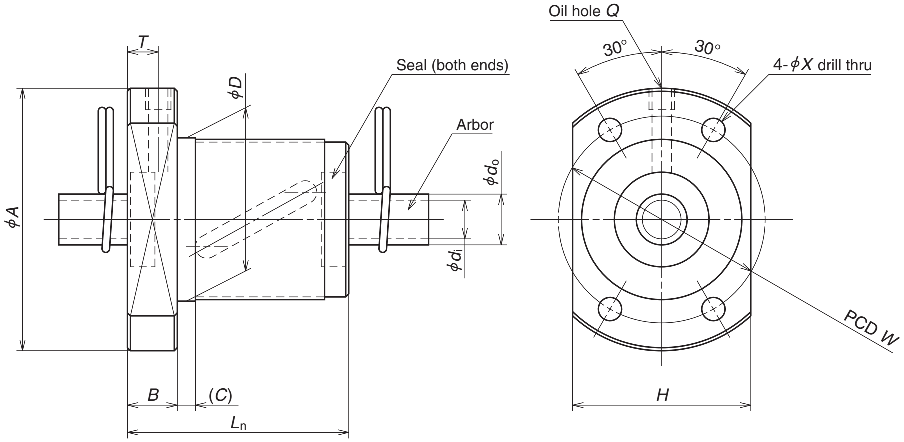


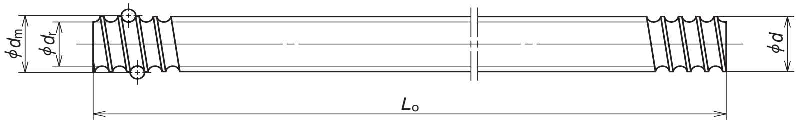
Unit: mm

Ball nut No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls	Basic load rating (N)		Axial play Max.	Ball nut dimensions
						Turns × Circuits	Dynamic	Static		Outside dia.
	d	l	D_w	d_m	d_r		C_a	C_{0a}		D
RNFTL 1212A3	12	12	2.381	12.65	10.1	1.5 × 2	3 360	6 270	0.10	24
RNFTL 1616A3 **RNFTL 1616A3S**	16	16	2.778	16.65	13.6	1.5 × 2	4 880	9 650	0.10	30
RNFTL 2020A3 **RNFTL 2020A3S**	20	20	3.175	20.75	17.3	1.5 × 2	7 010	15 400	0.10	35
RNFTL 2525A3 **RNFTL 2525A3S**	25	25	3.969	26	22.0	1.5 × 2	10 500	24 100	0.12	45
RNFTL 3232A3 **RNFTL 3232A3S**	32	32	4.762	33.25	28.0	1.5 × 2	15 300	37 100	0.15	55
RNFTL 4040A3 **RNFTL 4040A3S**	40	40	6.35	41.75	35.0	1.5 × 2	24 400	61 600	0.20	70

Ball nut No.	Ball nut dimensions											Nut Mass. (kg)	Arbor		Screw shaft				Shaft mass/m (kg)	Internal spatial volume of nut (cm^3)	Standard volume of greas replenishing (cm^3)
	Flange			Length	Bolt hole		Oil hole		Projecting tube				Outside dia.	Bore	Standard length			Screw shaft No.			
	A	G	B	L_n	W	X	Q	T	U	V	R		d_0	d_i	L_o						
RNFTL 1212A3	44	17	8	44	34	4.5	M3 × 0.5	4.0	17	16	5	0.16	10.1	8.1	400	800	–	RS1212A··	0.74	1.7	0.9
RNFTL 1616A3 **RNFTL 1616A3S**	55	22	10	50	43	6.6	M6 × 1	5.0	22	22	7	0.29	13.6	11.6	500	1 000	1 500	RS1616A··	1.37	2.8	1.4
RNFTL 2020A3 **RNFTL 2020A3S**	68	25	12	59	52	9	M6 × 1	6.0	25	27	8	0.49	17.3	14.9	500	1 000	2 000	RS2020A··	2.19	4.9	2.5
RNFTL 2525A3 **RNFTL 2525A3S**	80	31	12	69	63	9	M6 × 1	6.0	31	32	10	0.80	22.0	19.6	1 000	2 000	2 500	RS2525A··	3.43	9.1	4.6
RNFTL 3232A3 **RNFTL 3232A3S**	100	37	15	84	80	11	M6 × 1	7.5	37	40	12	1.46	28.0	25.6	1 000	2 000	3 000	RS3232A··	5.71	19	9.5
RNFTL 4040A3 **RNFTL 4040A3S**	120	46	18	103	95	14	M6 × 1	9.0	46	49	15	2.69	35.0	31.8	2 000	3 000	4 000	RS4040A··	8.82	39	20

Notes:
1. Protruding portion of tube does not interfere with ball nut housing if its dimensions corresponding to U and V are large enough.
2. Actual screw shaft length may become 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 those with seals are the same as those without.
   In ball nut side view drawing, above the center line there is a seal, and beneath it there is no seal.
   Seal for those with shaft diameter of 14 mm or less is made of synthetic resin. Seal for those of 16 mm or more is a "Brush" seal.
4. Nut assembly with arbor and screw shaft are separate at time of delivery.
5. Value obtained by diving standard screw shaft length by 100 mm will be entered at end of the part number where marked with ··.
6. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.
7. Internal spatial volume of nut and volume of grease to be replenished are values for ball screws with seals.
   Recommended amount for replenishing is approximately 50% of nut’s internal space. For ball screws without seals, apply grease to screw shaft surface or move ball nut by hand while filling them with grease so that grease permeates all areas.
   See page D16 for details.





Unit: mm

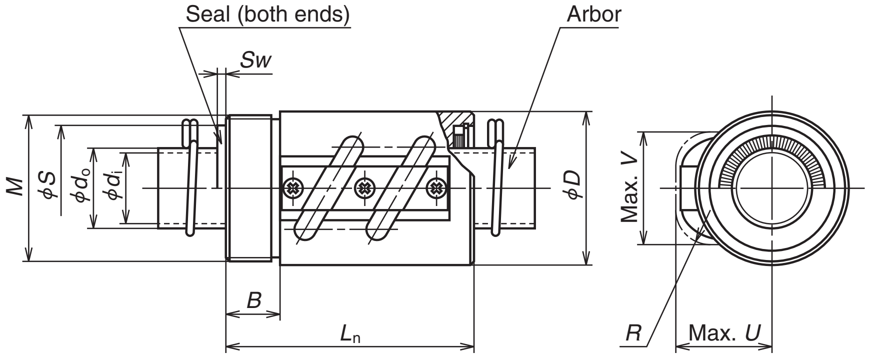
Ball nut No.	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls	Basic load rating (N)		Axial play Max.	Ball nut dimensions
						Turns × Circuits	Dynamic C_a	Static C_{oa}		Outside dia. D
RNFBL 1006A2.5S	10	6	2.381	10.65	8.1	2.5×1	2 830	4 810	0.10	26
RNFBL 1208A2.5S	12	8	2.778	12.65	9.6	2.5×1	3 730	6 560	0.10	29
RNFBL 1404A3.5S	14	4	2.778	14.5	11.5	3.5×1	5 370	10 800	0.10	31
RNFBL 1405A2.5S	14	5	3.175	14.5	11.0	2.5×1	5 260	9 720	0.10	32
RNFBL 1808A3.5S	18	8	4.762	18.5	13.6	3.5×1	13 200	25 800	0.15	50
RNFBL 2005A2.5S	20	5	3.175	20.5	17.0	2.5×1	6 360	14 200	0.10	40
RNFBL 2010A2.5S	20	10	4.762	21.25	16.2	2.5×1	10 900	21 800	0.15	52
RNFBL 2505A2.5S	25	5	3.175	25.5	22.0	2.5×1	7 070	18 200	0.10	43
RNFBL 2505A5S						2.5×2	12 800	36 300		
RNFBL 2510A2.5S	25	10	6.35	26	19.0	2.5×1	17 500	35 200	0.20	60
RNFBL 2510A5S						2.5×2	31 800	70 300		
RNFBL 2806A2.5S	28	6	3.175	28.5	25.0	2.5×1	7 430	20 300	0.10	50
RNFBL 2806A5S						2.5×2	13 500	40 600		
RNFBL 3210A2.5S	32	10	6.35	33.75	27.0	2.5×1	19 700	46 100	0.20	67
RNFBL 3210A5S						2.5×2	35 700	92 200		
RNFBL 3610A2.5S	36	10	6.35	37	30.0	2.5×1	21 000	51 000	0.20	70
RNFBL 3610A5S						2.5×2	38 100	102 000		
RNFBL 4010A5S	40	10	6.35	41.75	35.0	2.5×2	40 100	116 000	0.20	76

Ball nut No.	Ball nut dimensions									Nut Mass. (kg)	Arbor		Screw shaft				Shaft mass/m (kg)	Internal spatial volume of nut (cm³)	Standard volume of greas replenishing (cm³)
	Flange			Length		Bolt hole		Oil hole			Outside dia.	Bore	Standard length			Screw shaft No.			
	A	H	B	Overall length L_n	(C)	W	X	Q	T		d_0	d_i	L_o						
RNFBL 1006A2.5S	42	29	8	36	3	34	4.5	M3×0.5	5.0	0.16	8.1	6.1	400	800	–	RS1006A··	0.56	1.1	0.6
RNFBL 1208A2.5S	45	32	8	44	3	37	4.5	M3×0.5	5.5	0.21	9.6	7.6	400	800	–	RS1208A··	0.81	1.6	0.8
RNFBL 1404A3.5S	50	37	10	40	4	40	4.5	M6×1	5.0	0.25	11.5	9.5	500	1 000	–	RS1404A··	1.02	2.4	1.2
RNFBL 1405A2.5S	50	38	10	40	4	40	4.5	M6×1	5.0	0.26	11.0	9.0	500	1 000	–	RS1405A··	1.00	1.9	1.0
RNFBL 1808A3.5S	80	60	12	61	4	65	6.6	M6×1	6.0	1.00	13.6	11.6	500	1 000	1 500	RS1808A··	1.60	5.8	2.9
RNFBL 2005A2.5S	60	46	10	40	4	50	4.5	M6×1	5.0	0.37	17.0	14.6	500	1 000	2 000	RS2005A··	2.17	2.8	1.4
RNFBL 2010A2.5S	82	64	12	61	5	67	6.6	M6×1	6.0	1.05	16.2	13.8	500	1 000	2 000	RS2010A··	2.18	7.6	3.8
RNFBL 2505A2.5S	67	50	10	40	4	55	5.5	M6×1	5.0	0.40	22.0	19.6	1 000	2 000	2 500	RS2505A··	3.47	3.5	1.8
RNFBL 2505A5S				55						0.50								4.7	2.4
RNFBL 2510A2.5S	96	72	15	66	5	78	9.0	M6×1	7.5	1.52	19.0	16.6	1 000	2 000	2 500	RS2510A··	3.13	14	7.0
RNFBL 2510A5S				96						1.99								19	9.5
RNFBL 2806A2.5S	80	60	12	47	5	65	6.6	M6×1	6.0	0.70	25.0	22.6	1 000	2 000	2 500	RS2806A··	4.47	4.5	2.3
RNFBL 2806A5S				65						0.87								7.6	3.8
RNFBL 3210A2.5S	103	78	15	67	5	85	9.0	M6×1	7.5	1.72	27.0	24.6	1 000	2 000	3 000	RS3210A··	5.53	20	10
RNFBL 3210A5S				97						2.25								28	14
RNFBL 3610A2.5S	110	82	17	69	5	90	11.0	M6×1	8.5	1.97	30.0	27.6	1 000	2 000	3 000	RS3610A··	6.91	21	11
RNFBL 3610A5S				99						2.53								29	15
RNFBL 4010A5S	116	88	17	99	5	96	11.0	M6×1	8.5	2.86	35.0	31.8	2 000	3 000	4 000	RS4010A··	8.87	36	18

Notes: 1. Actual screw shaft length may become slightly longer than nominal length L_0 due to manufacturing tolerance.
2. Nut assembly with arbor and screw shaft are separate at time of delivery.
3. Value obtained by diving standard screw shaft length by 100 mm will be entered at end of the part number where marked with ··.
4. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.
5. Seal for those with shaft diameter of 14 mm or less is made of synthetic resin. Seal for those of 16 mm or more is a "Brush" seal.
6. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.

Ball screws for transfer equipment

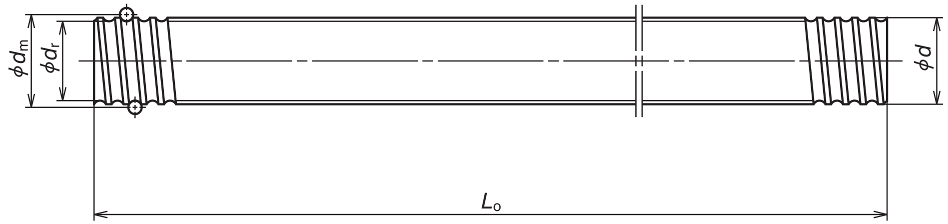
Return tube type, Nut with V-thread, (Fine lead)



Ball nut No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls	Basic load rating (N)		Axial play Max.	Ball nut dimensions
										Outside dia.
	d	l	D_w	d_m	d_r	Turns × Circuits	Dynamic C_a	Static C_{oa}		D
RNCT 1003A3.5	10	3	2.381	10.65	8.1	3.5 × 1	3 780	6 730	0.10	20
RNCT 1404A3.5S	14	4	2.778	14.5	11.5	3.5 × 1	5 370	10 800	0.10	25
RNCT 1405A2.5S	14	5	3.175	14.5	11.0	2.5 × 1	5 260	9 720	0.10	30
RNCT 1808A3.5 **RNCT 1808A3.5S**	18	8	4.762	18.5	13.6	3.5 × 1	13 200	25 800	0.15	34
RNCT 2005A2.5 **RNCT 2005A2.5S**	20	5	3.175	20.5	17.0	2.5 × 1	6 360	14 200	0.10	40
RNCT 2505A5 **RNCT 2505A5S**	25	5	3.175	25.5	22.0	2.5 × 2	12 800	36 300	0.10	42
RNCT 2510A5 **RNCT 2510A5S**	25	10	6.35	26	19.0	2.5 × 2	31 800	70 300	0.20	44
RNCT 2806A5 **RNCT 2806A5S**	28	6	3.175	28.5	25.0	2.5 × 2	13 500	40 600	0.10	50
RNCT 3210A5 **RNCT 3210A5S**	32	10	6.35	33.75	27.0	2.5 × 2	35 700	92 200	0.20	55
RNCT 3610A5 **RNCT 3610A5S**	36	10	6.35	37	30.0	2.5 × 2	38 100	102 000	0.20	60
RNCT 4010A7 **RNCT 4010A7S**	40	10	6.35	41.75	35.0	3.5 × 2	53 500	164 000	0.20	65
RNCT 4512A5 **RNCT 4512A5S**	45	12	7.144	46.5	39.0	2.5 × 2	49 600	147 000	0.23	70
RNCT 5010A7 **RNCT 5010A7S**	50	10	6.35	51.75	45.0	3.5 × 2	59 500	205 000	0.20	80
RNCT 5016A5 **RNCT 5016A5S**	50	16	9.525	52	42.0	2.5 × 2	99 900	293 000	0.23	85

Notes: 1. Protruding portion of tube does not interfere with ball nut housing if its dimensions corresponding to U and V are large enough.
2. Actual screw shaft length may become slightly longer than nominal length L_o due to manufacturing tolerance.
3. Only ball nut part numbers ending “S” are equipped with seals. External dimensions of those with seals are the same as those without.
In ball nut side view drawing, above the center line there is a seal, and beneath it there is no seal.
Seal for those with shaft diameter of 14 mm or less is made of synthetic resin. Seal for those of 16 mm or more is a "Brush" seal.

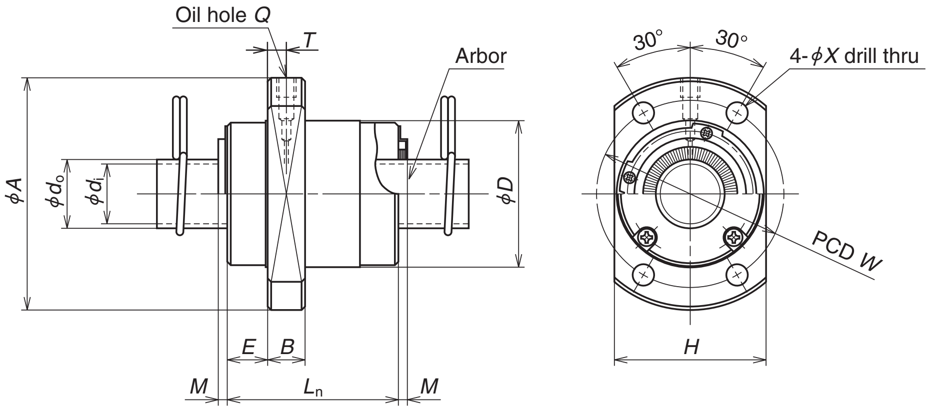
R series RNCT type

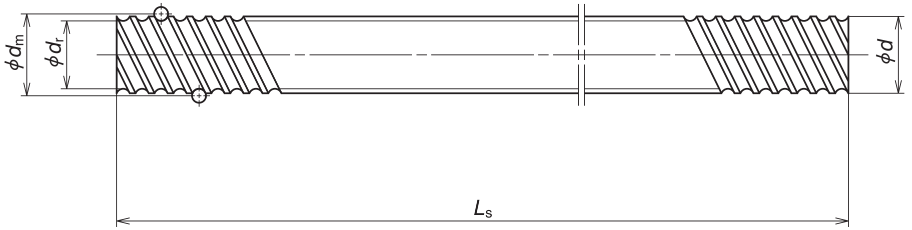


Unit: mm

Ball nut dimensions						Nut Mass. (kg)	Seal dimensions		Arbor		Screw shaft				Shaft mass/m (kg)	Internal spatial volume of nut (cm^3)	Standard volume of greas replenishing (cm^3)
V-thread		Length	Projecting tube				Diameter	Thickness	Outside dia.	Bore	Standard length			Screw shaft No.			
M	B	L_n	U	V	R		S	Sw	d_0	d_i	L_o						
M18 × 1	10	38	15	15	7	0.049	–	–	8.1	6.1	400	800	–	RS1003A··	0.50	–	–
M24 × 1	10	43	19	20	7	0.083	–	–	11.5	9.5	500	1 000	–	RS1404A··	1.02	2.7	1.4
M26 × 1.5	10	45	22	21	8	0.15	–	–	11.0	9.0	500	1 000	–	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	1 000	1 500	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	1 000	2 000	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	1 000	2 000	2 500	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	1 000	2 000	2 500	RS2510A··	3.13	21	1
M45 × 1.5	15	79	33	34	10	0.68	37.5	2.5	25.0	22.6	1 000	2 000	2 500	RS2806A··	4.47	9.7	4.9
M50 × 1.5	18	97	39	42	17	0.79	45.5	2.5	27.0	24.6	1 000	2 000	3 000	RS3210A··	5.53	32	16
M55 × 2	18	98	42	46	17	0.97	50.5	3.0	30.0	27.6	1 000	2 000	3 000	RS3610A··	6.91	32	16
M60 × 2	25	125	44	50	20	1.37	54.5	3.0	35.0	31.8	2 000	3 000	4 000	RS4010A··	8.87	51	26
M65 × 2	30	124	47	55	20	1.42	60.5	3.0	39.0	35.8	2 000	3 000	4 000	RS4512A··	11.16	60	30
M75 × 2	40	140	52	59	20	2.41	64.5	3.0	45.0	41.8	2 000	3 000	4 000	RS5010A··	14.15	76	38
M80 × 2	40	158	57	63	25	3.14	68.5	3.0	42.0	38.8	2 000	3 000	4 000	RS5016A··	13.48	114	57

4. Nut assembly with arbor and screw shaft are separate at time of delivery.
5. Value obtained by diving standard screw shaft length by 100 mm will be entered at end of the part number where marked with ··.
6. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.
7. Internal spatial volume of nut and volume of grease to be replenished are values for ball screws with seals.
Recommended amount for replenishing is approximately 50% of nut’s internal space. For ball screws without seals, apply grease to screw shaft surface or move ball nut by hand while filling them with grease so that grease permeates all areas.
See page D16 for details.





Unit: mm

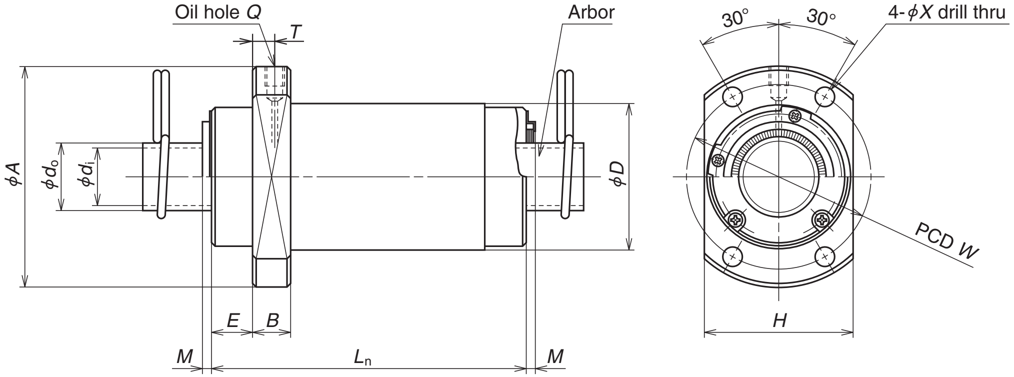
Ball nut No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls	Basic load rating (N)		Axial play Max.	Ball nut dimensions
						Turns × Circuits	Dynamic	Static		Outside dia.
	d	l	D_w	d_m	d_r		C_a	C_{oa}		D
RNFCL 1212A3	12	12	2.381	12.65	10.1	1.7 × 2	3 740	6 640	0.10	26
RNFCL 1212A6						1.7 × 4	6 780	13 300		
RNFCL 1520A3	15	20	3.175	15.5	12.2	1.7 × 2	6 730	12 300	0.10	33
RNFCL 1520A3S										
RNFCL 1616A3	16	16	2.778	16.65	13.5	1.7 × 2	5 430	10 400	0.10	32
RNFCL 1616A3S										
RNFCL 1616A6						1.7 × 4	9 860	20 800		
RNFCL 1616A6S										
RNFCL 2020A3	20	20	3.175	20.75	17.3	1.7 × 2	7 810	16 500	0.10	39
RNFCL 2020A3S										
RNFCL 2020A6						1.7 × 4	14 200	33 000		
RNFCL 2020A6S										
RNFCL 2525A3	25	25	3.969	26	22.0	1.7 × 2	11 700	25 800	0.12	47
RNFCL 2525A3S										
RNFCL 2525A6						1.7 × 4	21 200	51 500		
RNFCL 2525A6S										
RNFCL 3232A3	32	32	4.762	33.25	28.0	1.7 × 2	17 100	40 500	0.15	58
RNFCL 3232A3S										
RNFCL 3232A6						1.7 × 4	31 000	81 000		
RNFCL 3232A6S										
RNFCL 4040A3	40	40	6.35	41.75	35.0	1.7 × 2	27 200	67 900	0.20	73
RNFCL 4040A3S										
RNFCL 4040A6						1.7 × 4	49 300	136 000		
RNFCL 4040A6S										
RNFCL 5050A3	50	50	7.938	52.25	44.0	1.7 × 2	40 600	106 000	0.25	90
RNFCL 5050A3S										
RNFCL 5050A6						1.7 × 4	73 700	212 000		
RNFCL 5050A6S										

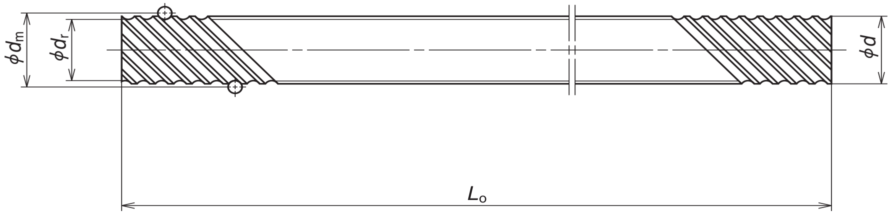
Ball nut No.	Ball nut dimensions										Nut Mass. (kg)	Arbor		Screw shaft				Shaft mass/m (kg)	Internal spatial volume of nut (cm³)	Standard volume of greas replenishing (cm³)
	Flange			Length			Bolt hole		Oil hole			Outside dia.	Bore	Standard length			Screw shaft No.			
	A	H	B	E	L_n	M	W	X	Q	T		d_0	d_i	L_o						
RNFCL 1212A3	44	28	6	9	30	–	35	4.5	M3 × 0.5	3.0	0.12	10.1	8.1	400	800	–	RS1212A· ·	0.74	–	–
RNFCL 1212A6																				
RNFCL 1520A3	51	35	10	11	45	–	42	4.5	M6 × 1	5.0	0.28	12.2	10.2	500	1 000	1 500	RS1520A· ·	1.15	3.3	1.7
RNFCL 1520A3S						3														
RNFCL 1616A3	53	34	10	10	38	–	42	4.5	M6 × 1	5.0	0.23	13.5	11.5	500	1 000	1 500	RS1616A· ·	1.37	2.6	1.3
RNFCL 1616A3S						3														
RNFCL 1616A6						–													2.6	1.3
RNFCL 1616A6S						3														
RNFCL 2020A3	62	41	10	11.5	46	–	50	5.5	M6 × 1	5.0	0.37	17.3	14.9	500	1 000	2 000	RS2020A· ·	2.19	4.4	2.2
RNFCL 2020A3S						3														
RNFCL 2020A6						–													4.9	2.5
RNFCL 2020A6S						3														
RNFCL 2525A3	74	49	12	13	55	–	60	6.6	M6 × 1	6.0	0.62	22.0	19.6	1 000	2 000	2 500	RS2525A· ·	3.43	8.2	4.1
RNFCL 2525A3S						3														
RNFCL 2525A6						–													8.9	4.5
RNFCL 2525A6S						3														
RNFCL 3232A3	92	60	12	16	70	–	74	9	M6 × 1	5.5	1.10	28.0	25.6	1 000	2 000	3 000	RS3232A· ·	5.71	16	8.0
RNFCL 3232A3S						3														
RNFCL 3232A6						–													17	8.5
RNFCL 3232A6S						3														
RNFCL 4040A3	114	75	15	19.5	85	–	93	11	M6 × 1	6.5	2.09	35.0	31.8	2 000	3 000	4 000	RS4040A· ·	8.82	32	16
RNFCL 4040A3S						3.5														
RNFCL 4040A6						–													33	17
RNFCL 4040A6S						3.5														
RNFCL 5050A3	135	92	20	21.5	107	–	112	14	M6 × 1	7.0	3.90	44.0	40.8	2 000	3 000	4 000	RS5050A· ·	13.81	64	32
RNFCL 5050A3S						3.5														
RNFCL 5050A6						–													68	34
RNFCL 5050A6S						3.5														

Notes: 1. Actual screw shaft length may become slightly longer than nominal length L_0 due to manufacturing tolerance.
2. Nut assembly with arbor and screw shaft are separate at time of delivery.
3. Value obtained by diving the standard screw shaft length by 100 mm will be entered at end of the part number where marked with · ·.
4. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.
5. Length of nut becomes longer (2 x M) for those with "brush" seals.
6. Internal spatial volume of nut and volume of grease to be replenished are values for ball screws with seals. Recommended amount for replenishing is approximately 50% of nut's internal space. For ball screws without seals, apply grease to screw shaft surface or move ball nut by hand while filling them with grease so that grease permeates all areas. See page D16 for details.

End cap type, Flanged nut (Ultra high helix lead)

R series RNFCL type





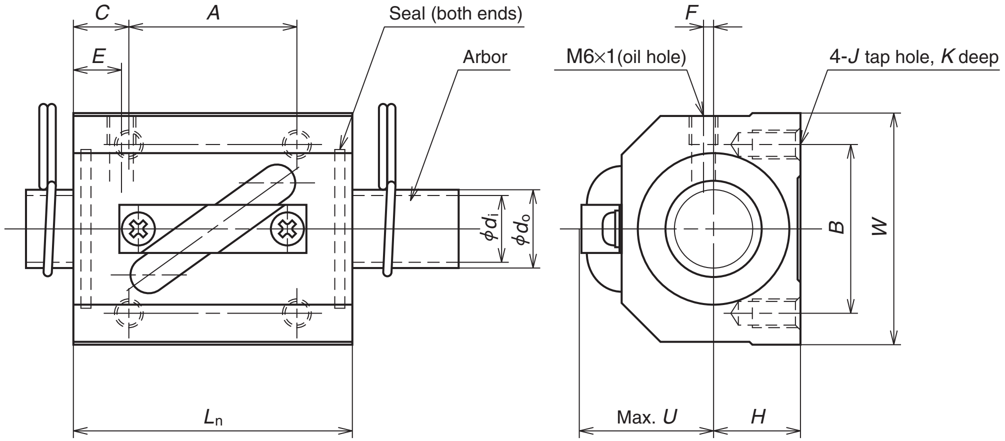
Unit: mm

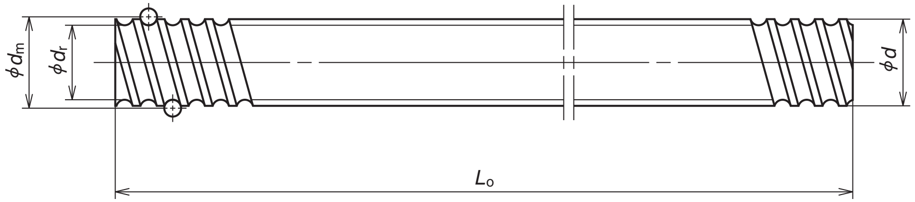
Ball nut No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls	Basic load rating (N)		Axial play	Ball nut dimensions											Nut	Arbor		Screw shaft					Shaft mass/m (kg)	Internal spatial volume of nut (cm^3)	Standard volume of greas replenishing (cm^3)
						Turns × Circuits	Dynamic	Static	Max.	Outside dia.	Flange			Length			Bolt hole		Oil hole		Mass. (kg)	Outside dia.	Bore	Standard length				Screw shaft No.			
	d	l	D_w	d_m	d_r		C_a	C_{oa}		D	A	H	B	E	L_n	M	W	X	Q	T		d_0	d_i	L_o							
RNFCL 1632A2	16	32	2.778	16.65	13.5	0.7 × 4	4 600	8 460	0.10	32	50	34	10	10	34	–	41	4.5	M6 × 1	5.5	0.21	13.5	11.5	500	1 000	1 500	–	RS1632A··	1.34	2.4	1.2
RNFCL 1632A2S																3															
RNFCL 1632A3						1.7 × 2	5 430	10 400							66	–					0.33									3.9	2.0
RNFCL 1632A3S																3															
RNFCL 1632A6						1.7 × 4	9 860	20 800							66	–					0.33									4.1	2.1
RNFCL 1632A6S																3															
RNFCL 2040A2	20	40	3.175	20.75	17.3	0.7 × 4	6 610	13 600	0.10	38	58	40	10	11	41	–	48	5.5	M6 × 1	5.5	0.31	17.3	14.9	500	1 000	1 500	2 000	RS2040A··	2.15	4.1	2.1
RNFCL 2040A2S																3															
RNFCL 2040A3						1.7 × 2	7 810	16 500							81	–					0.53									6.3	3.2
RNFCL 2040A3S																3															
RNFCL 2040A6						1.7 × 4	14 200	33 000							81	–					0.53									7.0	3.5
RNFCL 2040A6S																3															
RNFCL 2550A2	25	50	3.969	26	22.0	0.7 × 4	9 870	21 200	0.12	46	70	48	12	13	50	–	58	6.6	M6 × 1	7.0	0.53	22.0	19.6	1 000	2 000	2 500	–	RS2550A··	3.37	8.4	4.2
RNFCL 2550A2S																3															
RNFCL 2550A3						1.7 × 2	11 700	25 800							100	–					0.91									14	7.0
RNFCL 2550A3S																3															
RNFCL 2550A6						1.7 × 4	21 200	51 500							100	–					0.91									15	7.5
RNFCL 2550A6S																3															
RNFCL 3264A3	32	64	4.762	33.25	28.0	1.7 × 2	17 100	40 500	0.15	58	92	60	12	15.5	126	–	74	9	M6 × 1	7.5	1.76	28.0	25.6	1 000	2 000	3 000	4 000	RS3264A··	5.63	24	12
RNFCL 3264A3S																3															
RNFCL 3264A6						1.7 × 4	31 000	81 000								–														26	13
RNFCL 3264A6S																3															
RNFCL 4080A3	40	80	6.350	41.75	35.0	1.7 × 2	27 200	67 900	0.20	73	114	75	15	19	158	–	93	11	M6 × 1	10.0	3.44	35.0	31.8	2 000	3 000	4 000	5 000	RS4080A··	8.69	52	26
RNFCL 4080A3S																3.5															
RNFCL 4080A6						1.7 × 4	49 300	136 000								–														55	28
RNFCL 4080A6S																3.5															

Notes: 1. Actual screw shaft length may become slightly longer than nominal length L_o due to manufacturing tolerance.
2. Nut assembly with arbor and screw shaft are separate at time of delivery.
3. Value obtained by diving the standard screw shaft length by 100 mm will be entered at end of the part number where marked with ··.
4. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.
5. Length of nut becomes longer (2 x M) for those with "brush" seals.
6. Internal spatial volume of nut and volume of grease to be replenished are values for ball screws with seals. Recommended amount for replenishing is approximately 50% of nut's internal space. For ball screws without seals, apply grease to screw shaft surface or move ball nut by hand while filling them with grease so that grease permeates all areas. See page D16 for details.

Return tube type, Square nut (Fine, Medium lead)

R series RNSTL type





Unit: mm

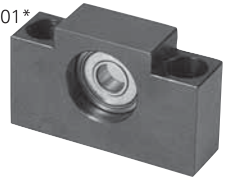
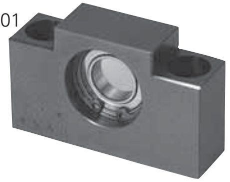
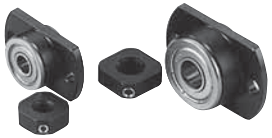
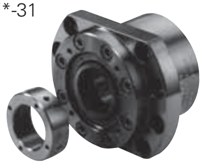
Ball nut No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls	Basic load rating (N)		Axial play Max.	Ball nut dimensions	Ball nut dimensions										Nut Mass. (kg)	Arbor		Screw shaft				Shaft mass/m (kg)	Internal spatial volume of nut (cm³)	Standard volume of greas replenishing (cm³)
						Turns × Circuits	Dynamic	Static		Length	Width	Center height	Bolt hole					Oil hole				Outside dia.	Bore	Standard length			Screw shaft No.			
	d	l	D_w	d_m	d_r		C_a	C_{0a}		L_n	W	H	A	B	C	J	K	E	F	U		d_0	d_i	L_o						
RNSTL 1404A3.5S	14	4	2.778	14.5	11.5	3.5 × 1	5 370	10 800	0.10	38	34	13	22	26	8	M4	7	7	3	20	0.20	11.5	9.5	500	1 000	–	RS1404A··	1.02	1.6	0.8
RNSTL 1405A2.5S	14	5	3.175	14.5	11.0	2.5 × 1	5 260	9 720	0.10	38	34	13	22	26	8	M4	7	7	3	21	0.20	11.0	9.0	500	1 000	–	RS1405A··	1.00	1.8	0.9
RNSTL 1808A3.5S	18	8	4.762	18.5	13.6	3.5 × 1	13 200	25 800	0.15	56	48	17	35	35	10.5	M6	10	8	3	26	0.31	13.6	11.6	500	1 000	1 500	RS1808A··	1.60	3.4	1.7
RNSTL 2005A2.5S	20	5	3.175	20.5	17.0	2.5 × 1	6 360	14 200	0.10	38	48	17	22	35	8	M6	9	6	2	27	0.24	17.0	14.6	500	1 000	2 000	RS2005A··	2.17	2.5	1.3
RNSTL 2010A2.5S	20	10	4.762	21.25	16.2	2.5 × 1	10 900	21 800	0.15	58	48	18	35	35	11.5	M6	10	10	2	28	0.35	16.2	13.8	500	1 000	2 000	RS2010A··	2.18	6.3	3.2
RNSTL 2505A2.5S	25	5	3.175	25.5	22.0	2.5 × 1	7 070	18 200	0.10	35	60	20	22	40	6.5	M8	10	6	0	27	0.31	22.0	19.6	1 000	2 000	2 500	RS2505A··	3.47	2.6	1.3
RNSTL 2510A5S	25	10	6.35	26	19.0	2.5 × 2	31 800	70 300	0.20	94	60	23	60	40	17	M8	12	10	0	32	1.32	19.0	16.6	1 000	2 000	2 500	RS2510A··	3.13	18	9.0
RNSTL 2806A2.5S	28	6	3.175	28.5	25.0	2.5 × 1	7 430	20 300	0.10	42	60	22	18	40	12	M8	12	8	0	32	0.65	25.0	22.6	1 000	2 000	2 500	RS2806A··	4.47	3.5	1.8
RNSTL 2806A5S						2.5 × 2	13 500	40 600		67	60	22	40	40	13.5						1.04								7.0	3.5
RNSTL 3210A2.5S	32	10	6.35	33.75	27.0	2.5 × 1	19 700	46 100	0.20	64	70	26	45	50	9.5	M8	12	10	0	38	1.12	27.0	24.6	1 000	2 000	3 000	RS3210A··	5.53	18	9.0
RNSTL 3210A5S						2.5 × 2	35 700	92 200		94	70	26	60	50	17						1.75								27	14
RNSTL 3610A2.5S	36	10	6.35	37	30.0	2.5 × 1	21 000	51 000	0.20	64	86	29	45	60	9.5	M10	16	11	0	41	1.76	30.0	27.6	1 000	2 000	3 000	RS3610A··	6.91	18	9.0
RNSTL 3610A5S						2.5 × 2	38 100	102 000		96	86	29	60	60	18						2.64								27	14
RNSTL 4512A5S	45	12	7.144	46.5	39.0	2.5 × 2	49 600	147 000	0.23	115	100	36	75	75	20	M12	20	13	0	46	1.22	39.0	35.8	2 000	3 000	4 000	RS4512A··	11.16	47	24

Notes: 1. Actual screw shaft length may become slightly longer than nominal length L_0 due to manufacturing tolerance.
2. Nut assembly with arbor and screw shaft are separate at time of delivery.
3. Value obtained by diving the standard screw shaft length by 100 mm will be entered at end of the part number where marked with ··
4. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.
5. Length of nut becomes longer (2 x M) for those with "Brush" seals.
6. Recommended quantity of grease is about 50% of ball nut's internal space. See page D16 for details.

B-3-1.6 Accessories

Accessories to use with NSK ball screws are available.

Table 1 Support unit categories

Application		Shape	Support side	Bearing in use	Bearing bore, Bearing seat diameter	Page
Small equipment, light load	Square	WBK**-01* 	Fixed support side	Angular contact ball bearing	ϕ6 – ϕ25	B381 –
		WBK**S-01* 	Simple support side	Deep groove ball bearing	ϕ6 – ϕ25	B385 –
		WBK**SF-01 		Deep groove ball bearing	ϕ12, ϕ15 (exclusive for VFA type)	B388
Small equipment, light load	Round	WBK**R-11 (Support kit) 	Fixed support side	Deep groove ball bearing (arranged to have angular contact)	ϕ4, ϕ6 (exclusive for RMA and RMS types)	B387
		WBK**-11* 		Angular contact ball bearing	ϕ6 – ϕ25	B383 –
Machine tools, heavy load	Round	WBK**DF*-31 	Fixed support side	Thrust angular contact ball bearing	ϕ17 – ϕ40	B391 –

1. Classification

Ball screw support units are classified into categories by their shape (**Table 1**). Select the type that best suits your particular needs.

2. Features

●Bearings and seals

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 to the fixed support side used with an angular contact ball bearing. Fine clearance may occur with this seal.

A deep-groove ball bearing with a shield on both sides is used on the simple support side.

●Lock nut is provided.

A lock nut with 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

- WBK: Product code for support unit
- 08: Nominal size code*
- S: Mounting code
  - No code: Fixed support unit
  - S: Simple support unit
  - SF: Simple support unit (for FSS and VFA)
  - R: Fixed support unit (support kit for miniature ball screws)
- 01:
  - 01: Square type
  - 11: Round type
- A:
  - No code or A: For general use
  - B: Low-profile type (only for square type)
  - C: For clean environment use

*) In case of simple support unit, please note that the nominal size code of 12 or less does not strictly represent internal bore of bearing in millimeters. Please refer to the dimensional table for internal bore of bearing.

(For heavy load)

Example: WBK 25 DF - 31

- WBK: Product code for support unit
- 25: Nominal size code (internal bore of bearing)
- DF: 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 the configuration of standard screw shaft ends for NSK standard ball screws with blank shaft ends. For ball screws for transfer equipment, you require optional spacers when mounting fixed support side support units.

(a) Features

●Prompt delivery

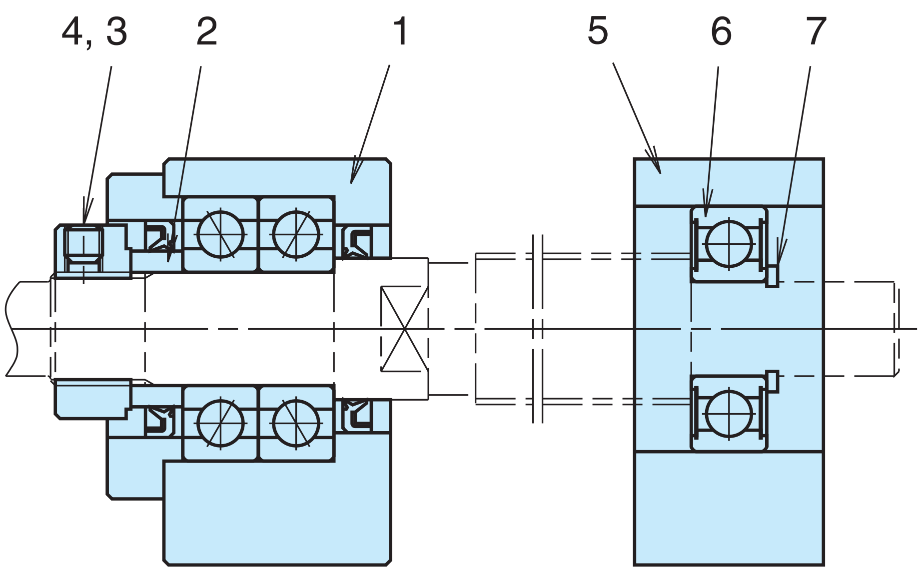
All support units are standard products.

●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 brass pad		

	General support unit
Bearings and grease	Angular contact ball bearings, PS2
Surface treatment	Black oxide
Screws and snap rings	Standard material

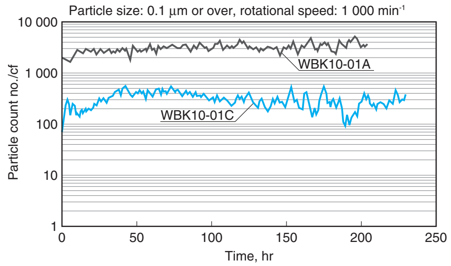
(b) Features of Clean Support Unit

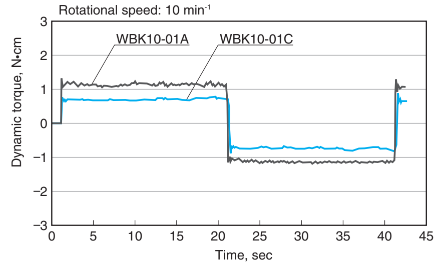
- Outstanding low dust emission
  Clean support unit uses "NSK clean grease LG2" which has a proven feature of low dust emission. It reduces dust emission to 1/10 of general support units.

- Low torque
  It features low torque characteristics because of special bearings. (50% lower than general support unit.)

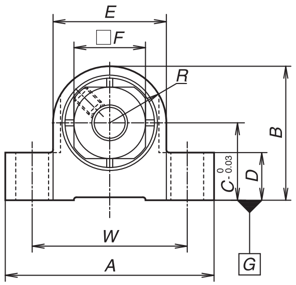
- High antirust specification
  Low temperature chrome plating is applied to bearing housings, retaining plates, locknuts and spacers to improve antirust properties. Moreover, bolts and snap rings are made of stainless steel.
  The table below shows the surface treatment of the bearing housing and material of small parts.

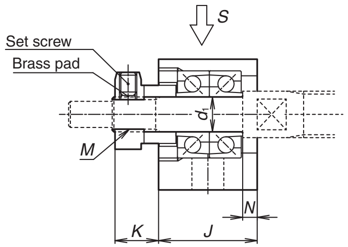
	Clean support unit
Bearing • grease	Special bearings, LG2
Surface treatment	Low temperature chrome plating
Set screw and snap ring material	Stainless steel

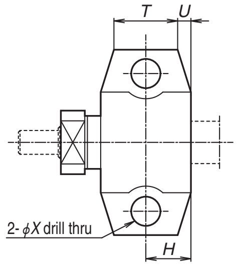


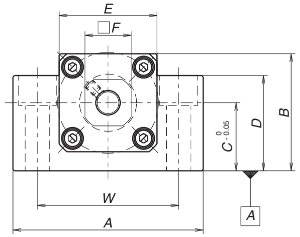


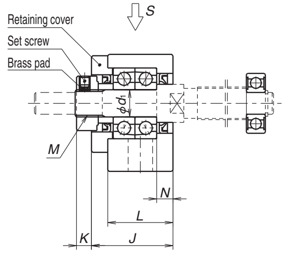
Support Units for Light Load and Small Equipment

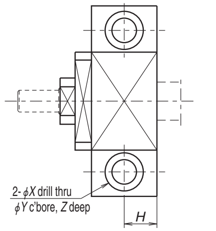




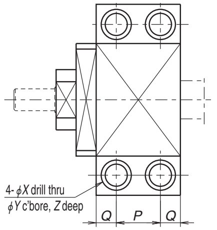








View S (WBK06 – 15)



View S (WBK17 – 25)

Reference No.	Tightening torque (reference) [N·cm]	
	Locknut	Set screw
WBK04-**	100	69 (M3)
WBK06-**	190	69 (M3)
WBK08-**	230	69 (M3)
WBK10-**	280	147 (M4)
WBK12-**	630	147 (M4)
WBK15-**	790	147 (M4)
WBK17-**	910	147 (M4)
WBK20-**	1670	147 (M4)
WBK25-**	2060	490 (M6)

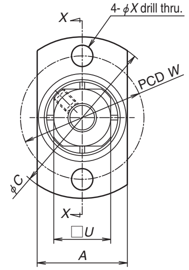
Fixed support side support unit (square type)

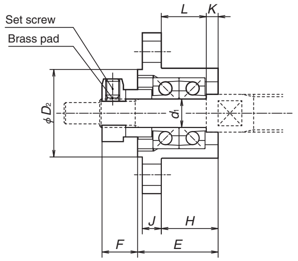
Units: mm

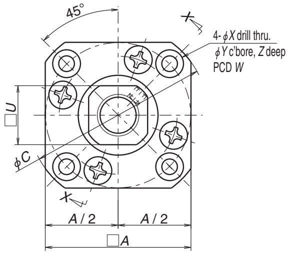
Reference No.	Use	d_1	A	B	C	D	E	F	L	J	K	R	T	U	N	Counterbore dimensions							Mass (kg)	Locknut screw M	Attached bearing for support side
																H	P	Q	W	X	Y	Z			
WBK04-01M	General	4	27	17	10	6	14	10	—	14	5.5	7	9	1.5	2	7	—	—	21	3.5	—	—	0.03	M4×0.5	—
WBK06-01M	General	6	35	22.5	13	8	19	12	—	17	7.5	9.5	12	2.5	2.5	8.5	—	—	26	5.5	—	—	0.05	M6×0.75	—
WBK06-01A[*1]	General	6	42	25	13	20	18	12	20	20	5.5	—	—	—	3.5	10	—	—	30	5.5	9.5	11	0.15	M6×0.75	—
WBK08-01A[*1]	General	8	52	32	17	26	25	14	23	23	7	—	—	—	4	11.5	—	—	38	6.6	11	12	0.25	M8×1	606ZZ
WBK08-01B	Low type		62	31	15.5	31	—		21.5	25.5	4.5				3.5	11			46	9	14	18	0.3		606ZZ
WBK08-01C[*1]	Clean environment		52	32	17	26	25		23	23	7				4	11.5			38	6.6	11	12	0.25		606VV
WBK10-01A	General	10	70	43	25	35	36	17	24	30	5.5	—	—	—	6	12	—	—	52	9	14	11	0.5	M10×1	608ZZ
WBK10-01B	Low type			38	20	38	—															19	0.45		608ZZ
WBK10-01C	Clean environment			43	25	35	36															11	0.5		608VV
WBK12-01A	General	12	70	43	25	35	36	19	24	30	5.5	—	—	—	6	12	—	—	52	9	14	11	0.5	M12×1	6000ZZ
WBK12-01B	Low type			38	20	38	—															19	0.4		6000ZZ
WBK12-01C	Clean environment			43	25	35	36															11	0.5		6000VV
WBK15-01A	General	15	80	50	30	40	41	22	25	31	12	—	—	—	5	12.5	—	—	60	11	17	15	0.7	M15×1	6002ZZ
WBK15-01B	Low type			42	22	42	—															23	0.6		6002ZZ
WBK15-01C	Clean environment			50	30	40	41															15	0.7		6002VV
WBK17-01A	General	17	86	64	39	55	50	24	35	44	7	—	—	—	7	—	19	8	68	9	14	11	1.3	M17×1	6203ZZ
WBK20-01	General	20	95	58	30	45	56	30	42	52	10	—	—	—	10	—	22	10	75	11	17	15	1.4	M20×1	6204ZZ
WBK25-01[*2] **WBK25-01W**[*2]	General	25	105	68	35	25	66	36	48	61	13	—	—	—	14	—	30	9	85	11	—	—	1.9	M25×1.5	6205ZZ

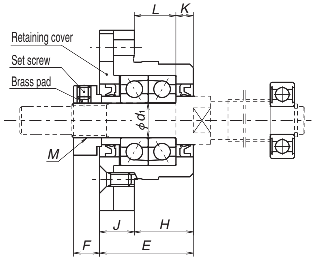
Notes:
1. Use datum surface A for mounting to machine base.
2. Tighten set screw after locknut has been adjusted and tightened.
3. Insert brass pad provided with unit into locknut set screw hole, then insert and tighten the set screw.
4. Deep groove ball bearing and snap ring are also provided for simple support side.
(except WBK04-01M and WBK06-01M)
5. Bearings for WBK04-01M and WBK06-01M are equipped with non-contact metal seal.

[*1] For retaining cover side of WBK06-01A, WBK08-01A, and WBK08-01C, there are no seals.
[*2] WBK25-01W is standard.

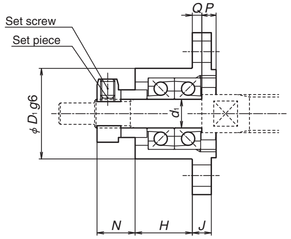


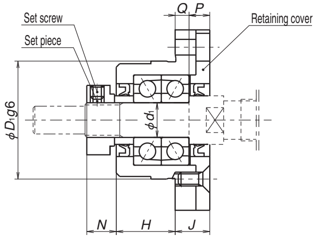






View X-X (example 1)





View X-X (example 2)

Reference No.	Tightening torque (reference) [N·cm]	
	Locknut	Set screw
WBK04-**	100	69 (M3)
WBK06-**	190	69 (M3)
WBK08-**	230	69 (M3)
WBK10-**	280	147 (M4)
WBK12-**	630	147 (M4)
WBK15-**	790	147 (M4)
WBK17-**	910	147 (M4)
WBK20-**	1670	147 (M4)
WBK25-**	2060	490 (M6)

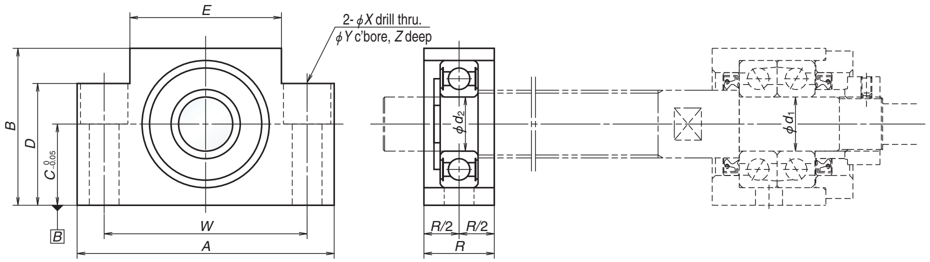
Fixed support side support unit (round type)

Units: mm

Reference No.	Use	d_1	A	C	D_1	D_2	E	H	L	K	F	N	U	P	Q	Counterbore dimensions					Mass (kg)	Locknut screw M	Attached bearing for support side
																J	W	X	Y	Z			
WBK04-11M	General	4	14	26	14	14	13.5	8.5	7	1.5	5.5	6.6	10	2.6	2.4	3	20	3.5	—	—	0.02	M4×0.5	—
WBK06-11M	General	6	19	34	19	18.5	17	12	9.5	2.5	7.5	8	12	3	2	4	26	4.5	—	—	0.04	M6×0.75	—
WBK06-11*	General	6	28	35	22	—	20	13	9.5	3.5	5.5	6.5	12	4.5	2.5	7	28	2.9	5.5	3.5	0.1	M6×0.75	—
WBK08-11B	High-load type	8	42	52	34	—	25.5	15.5	12	3.5	4.5	7	14	6	4	10	42	4.5	8	4	0.2	M8×1	606ZZ
WBK08-11*	General		35	43	28		23	14	10	4	7	8		5		9	35	3.4	6.5		0.15		606ZZ
WBK08-11C*	Clean environment																						606VV
WBK10-11	General	10	42	52	34	—	27	17	12	5	7.5	8.5	17	6	4	10	42	4.5	8	4	0.2	M10×1	608ZZ
WBK10-11C	Clean environment																						608VV
WBK12-11	General	12	44	54	36	—	27	17	12	5	7.5	8.5	19	6	4	10	44	4.5	8	4	0.25	M12×1	6000ZZ
WBK12-11C	Clean environment																						6000VV
WBK15-11	General	15	52	63	40	—	32	17	11	6	12	14	22	8	7	15	50	5.5	9.5	6	0.4	M15×1	6002ZZ
WBK15-11C	Clean environment																						6002VV
WBK20-11	General	20	68	85	57	—	52	30	20	10	10	14	30	14	8	22	70	6.6	11	10	1.1	M20×1	6204ZZ
WBK25-11	General	25	79	98	63	—	57	30	20	10	13	20	36	17	10	27	80	9	15	13	1.5	M25×1.5	6205ZZ

Notes:
1. Tighten set screw after locknut has been adjusted and tightened.
2. Insert brass pad provided with unit into locknut set screw hole, then insert and tighten the set screw.
3. Deep groove ball bearing and snap ring are also provided for simple support side. (except WBK04-01M and WBK06-01M)
4. Bearings for WBK04-01M and WBK06-01M are equipped with non-contact metal seal.

*For retaining cover side of WBK06-01A, WBK08-01A, and WBK08-01C, there are no seals.



Simple support side support unit (square type)

Units: mm

Reference No.	Use	d_2	A	B	C	D	E	R	Counterbore 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
WBK12SF-01B	Low type	12	62	31	15.5	31	—	18	46			18	0.2
WBK15S-01	General	15	80	50	30	40	41	20	60	9	14	11	0.45
WBK15S-01B	Low type			42	22	42	—					23	0.4
WBK15S-01C	Clean environment			50	30	40	41					11	0.45
WBK15SF-01B	Low type		70	38	20	38	—	18	52			19	0.3
WBK17S-01	General	17	86	64	39	55	50	23	68	9	14	11	0.8
WBK20S-01	General	20	95	58	30	45	56	26	75	11	17	15	0.8
WBK20SF-01B	Low type		80	42	22	42	—	22	60			23	0.4
WBK25S-01[*] **WBK25S-01W**[*]	General	25	105	68	35	25	66	30	85	11	—	—	0.9
WBK25SF-01			95	58	30	45	56	22	75	11	17	15	0.55

Notes: 1. Use datum surface B for mounting to machine base.
∗) WBK25-01W is standard.

Specifications of support unit

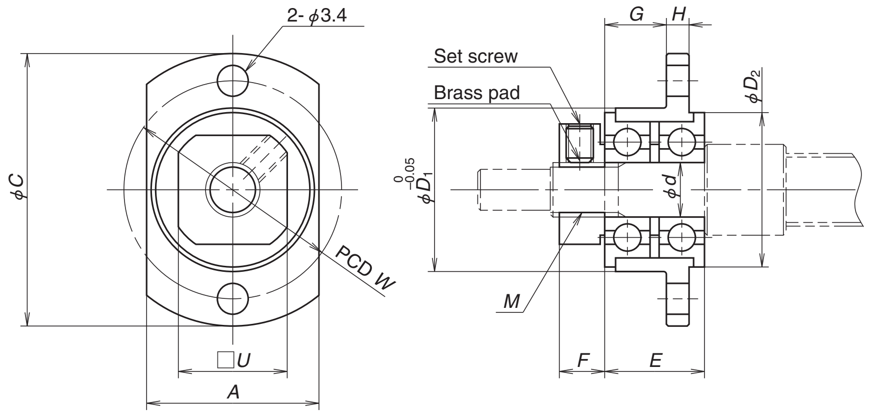
Fixed support side support unit						Simple support side support unit		
Reference No.	Use	Axial direction			Maximum starting torque [N·cm]	Reference No.	Bearing reference No.	Radial direction Basic dynamic load rating C [N]
		Basic dynamic load rating Ca [N]	Load limit [N]	Rigidity [N/μm]				
WBK04-01M	General	1 470	464	39	0.2	—	—	—
WBK04-11M	General	1 470	464	39	0.2	—	—	—
WBK06-01A	General	2 670	1 040	28	0.49	—	—	—
WBK06-01M	General	2 760	854	60	0.35	—	—	—
WBK06-11	General	2 670	1 040	28	0.49	—	—	—
WBK06-11M	General	2 760	854	60	0.35	—	—	—
WBK08-01A	General	4 400	1 450	49	0.88	**WBK08S-01**	606ZZ	2 260
WBK08-01B	Low type	6 600	2 730	94	1.9	**WBK08S-01B**	606ZZ	2 260
						WBK12SF-01B[*1]	6801ZZ	1 920
WBK08-01C	Clean environment	3 100	1 100	36	0.52	**WBK08S-01C**	606VV	2 260
WBK08-11	General	4 400	1 450	49	0.88	**WBK08S-01**	606ZZ	2 260
WBK08-11B	Low type	6 600	2 730	94	1.9	—	606ZZ	2 260
WBK08-11C	Clean environment	3 100	1 100	36	0.52	**WBK08S-01C**	606VV	2 260
WBK10-01A	General	6 600	2 730	94	1.9	**WBK10S-01**	608ZZ	3 300
						WBK12SF-01[*2]	6001ZZ	5 100
WBK10-01B	Low type	6 600	2 730	94	1.9	—	608ZZ	3 300
WBK10-01C	Clean environment	4 250	1 364	50	1.1	**WBK10S-01C**	608VV	3 300
WBK10-11	General	6 600	2 730	94	1.9	**WBK10S-01**	608ZZ	3 300
WBK10-11C	Clean environment	4 250	1 364	50	1.1	**WBK10S-01C**	608VV	3 300
WBK12-01A	General	7 100	3 040	104	2.1	**WBK12S-01**	6000ZZ	4 550
						WBK15SF-01[*2]	6902ZZ	4 350
WBK12-01B	Low type	7 100	3 040	104	2.1	**WBK12S-01B**	6000ZZ	4 550
						WBK15SF-01B[*1]	6902ZZ	4 350
WBK12-01C	Clean environment	4 700	2 443	57	1.2	**WBK12S-01C**	6000VV	4 550
WBK12-11	General	7 100	3 040	104	2.1	**WBK12S-01**	6000ZZ	4 550
WBK12-11C	Clean environment	4 700	2 443	57	1.2	**WBK12S-01C**	6000VV	4 550
WBK15-01A	General	7 600	3 380	113	2.4	**WBK15S-01**	6002ZZ	5 600
WBK15-01B	Low type	7 600	3 380	113	2.4	**WBK15S-01B**	6002ZZ	5 600
						WBK20SF-01B[*1]	6804ZZ	4 000
WBK15-01C	Clean environment	5 100	2 757	63	1.3	**WBK15S-01C**	6002VV	5 600
WBK15-11	General	7 600	3 380	113	2.4	**WBK15S-01**	6002ZZ	5 600
WBK15-11C	Clean environment	5 100	2 757	63	1.3	**WBK15S-01C**	6002VV	5 600
WBK17-01A	General	13 400	5 800	120	3.5	**WBK17S-01**	6203ZZ	9 550
WBK20-01	General	17 900	8 240	155	6.2	**WBK20S-01**	6204ZZ	12 800
						WBK25SF-01[*1]	6005ZZ	10 100
WBK20-11	General	17 900	8 240	155	6.2	**WBK20S-01**	6204ZZ	12 800
WBK25-01	General	20 200	10 000	192	7.2	**WBK25S-01**	6205ZZ	14 000
WBK25-11	General	20 200	10 000	192	7.2	**WBK25S-01**	6205ZZ	14 000
WBK04R-11	General	615	490	6.5	0.59	—	—	—
WBK06R-11	General	1 280	930	9	0.59	—	—	—

∗1: Exclusive for FSS type.
∗2: Exclusive for VFA type.

Support kits for ball screws for transfer equipment

Support kits are for RMA type ball screw.

In case of RMA1002 or larger rolled ball screws, please use support units for general use.



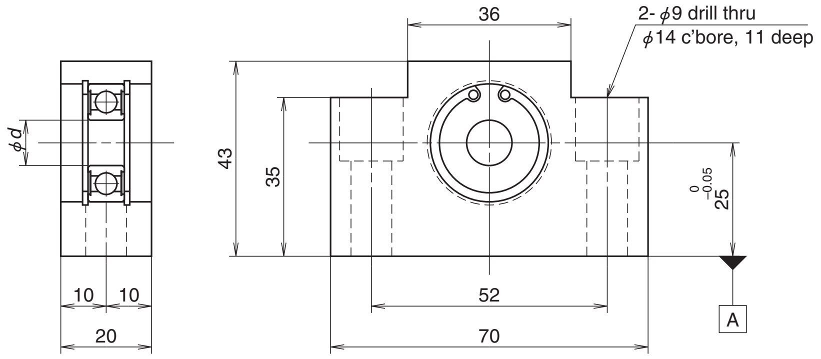
Units: mm

Reference No.	*A*	*C*	*d*	D_1	D_2	*E*	*F*	*G*	*H*	*W*	*U*	*M*	Mass (kg)
WBK04R-11	14	25	4	13	12.5	9	5	5	2.5	19	10	M4×0.5	0.13
WBK06R-11	19	30	6	18	17	11	5	6.8	2.5	24	12	M6×0.75	0.23

Reference No.	Applicable ball screw	Locknut tightening torque (reference) [N·cm]	Set screw tightening torque (reference) [N·cm]
WBK04R-11	RMA0601	100	38 (M2.5)
WBK06R-11	RMA0801 RMA0801.5 RMA0802	190	69 (M3)

Notes:
1. Oscillate bearings slowly so that they fall into place in which run-out of mounting surface is minimal, and then tighten locknut.
2. Support kit is on provisional shaft (bolt) during shipping.
3. When securing support unit on shaft, insert brass pad that is provided with support unit into lock nut hole, and then tighten set screw.

Simple support side support units for VFA type ball screws



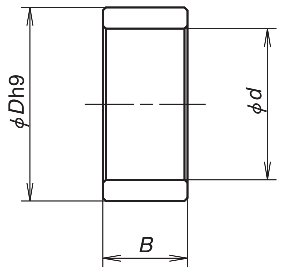
Units: mm

Reference no.	*d*	Mass (kg)	Applicable ball screw
WBK12SF-01*	12	0.3	VFA1210
WBK15SF-01*	15	0.3	VFA1510 VFA1520

Notes:
1. Use datum surface A for mounting to machine base.
2. This type of simple side support unit is made exclusively for NSK VFA ball screws. This unit simply supports outer diameter of screw shaft.
3. See page B386 for the reference numbers of bearings and radial direction basic dynamic load ratings.

Spacer

When using a fixed support unit, it may require an optional spacer to have an effective shoulder surface at where the ball thread is threaded to the end of the shoulder. This is common for the R series for transporting ball screws.

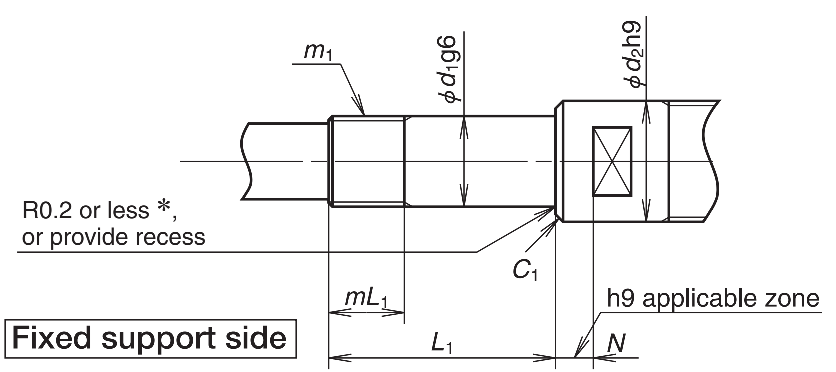


Units: mm

Reference No.	Internal diameter, *d*	Outside diameter, *D*	Width *B*	Mass (g)	Applicable support unit
WBK06K	6	9.5	5.0	2	WBK06-∗∗
WBK08K	8	11.5	5.5	2	WBK08-∗∗
WBK10K	10	14.5	5.5	4	WBK10-∗∗
WBK12K	12	15.0	5.6	3	WBK12-∗∗
WBK15K	15	19.5	10.0	10	WBK15-∗∗
WBK17K	17	24.4	7.0	13	WBK17-∗∗
WBK20K	20	25.5	11.0	17	WBK20-∗∗
WBK25K	25	32.0	14.0	34	WBK25-∗∗

Screw shaft end configuration

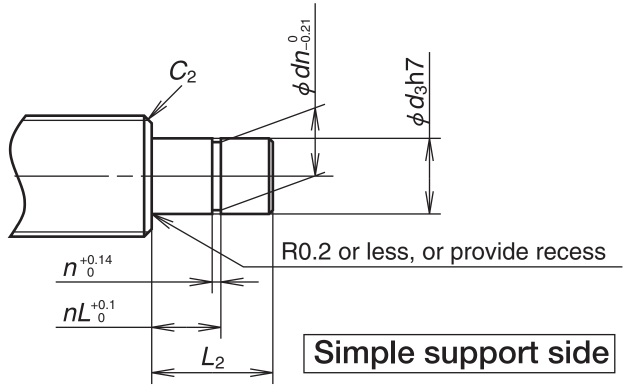
Dimensions of the shaft end configurations for light load and small equipment support units are shown in the table below. When using a spacer with a ball screw for transporting equipment, add the width of the spacer (B from the table of spacer dimensions on page B388) to L_1 dimension below.



Radius marked with * above is 0.15 or less for WBK04R-11 and WBK06R-11.

Units: mm

Fixed support side							
Reference No.	Bearing journal		Locknut thread		Sealing part		Chamfer
	d_1	L_1	m_1	mL_1	d_2	N	C_1
WBK06-＊＊	6	22.5	M6×0.75	7	9.5	3.5	0.2
WBK08-＊＊	8	27	M8×1	9	11.5	4	0.2
WBK10-＊＊	10	30	M10×1	10	14	6	0.2
WBK12-＊＊	12	30	M12×1	10	15	6	0.2
WBK15-＊＊	15	40	M15×1	15	19.5	5	0.3
WBK17-＊＊	17	46	M17×1	17	24	7	0.3
WBK20-＊＊	20	53	M20×1	16	25	10	0.3
WBK25-＊＊	25	62	M25×1.5	20	32	14	0.5
WBK04R-11	4	15	M4×0.5	7.5	—	—	0.3
WBK06R-11	6	17	M6×0.75	7.5	—	—	0.3



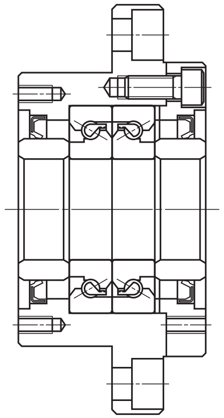
Units: mm

Simple support side						
Reference No.	Bearing journal		Snap ring groove			Chamfer
	d_3	L_2	n	dn	nL	C_2
————	—	—	—	—	—	—
WBK08S-＊＊	6	9	0.8	5.7	6.8	0.2
WBK10S-＊＊	8	10	0.9	7.6	7.9	0.2
WBK12S-＊＊	10	22	1.15	9.6	9.15	0.5
WBK15S-＊＊	15	25	1.15	14.3	10.15	0.5
WBK17S-＊＊	17	16	1.15	16.2	13.15	0.5
WBK20S-＊＊	20	19	1.35	19	15.35	0.5
WBK25S-＊＊	25	20	1.35	23.9	16.35	0.5

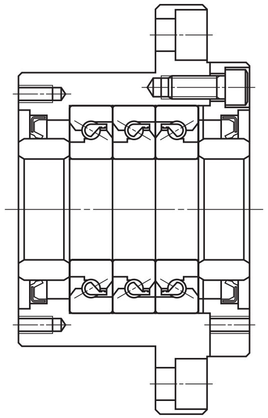
(2) Dimensions of support unit for ball screws for heavy-load/machine tools

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.

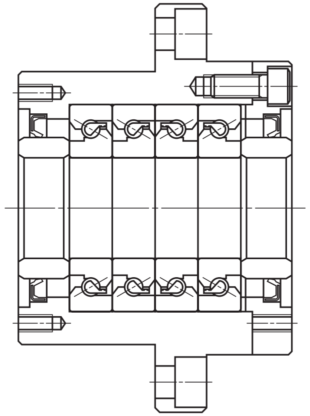
There are three bearing combinations as shown below.



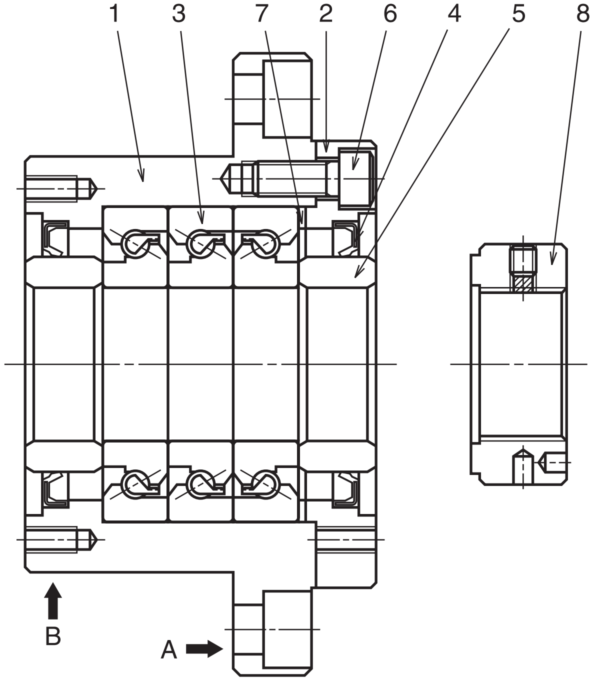
DF combination



DFD combination



DFF combination

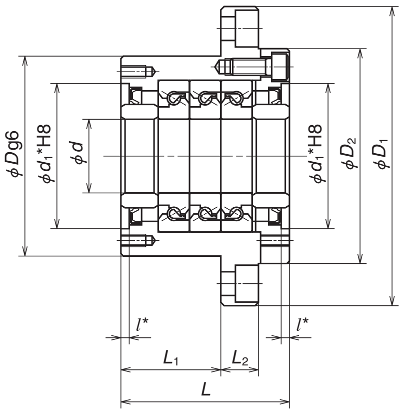


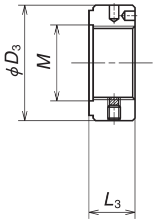
Parts list

Part No.	Part name	Quantity
1	Housing	1
2	Retaining cover	1
3	High accuracy thrust angular contact ball bearing	One set
4	Dust seal	2
5	Collar	2
6	Preload bolt	6 or 8
7	Shim	One set
8	Lock nut	1

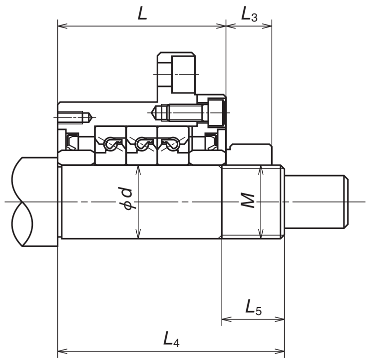
Notes:

1. Surface A and B are the datum surfaces to mount a support unit to machine housing.
2. NSK support units are precisely preloaded and adjusted. Do not disassemble the components 1, 2, 3, 4, 5, 6 and 7.
3. Grease is packed into the bearings.
4. Lock nut 8 is exclusively prepared for ball screws. End surface of nut is in strict control being precisely perpendicular to the V thread. Secure lock nut using set screw.
   Lock nut is also available as accessory. (See page B395.) See page B399 as well for high-precision thrust angular contact ball bearings (TAC Series).





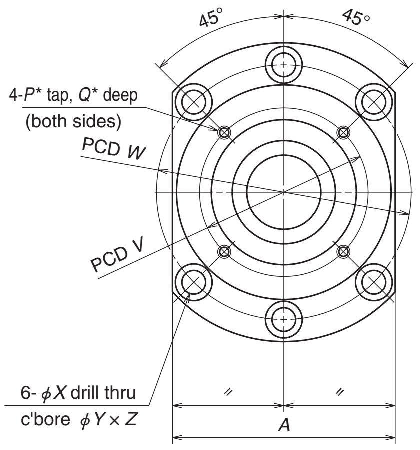
Lock nut



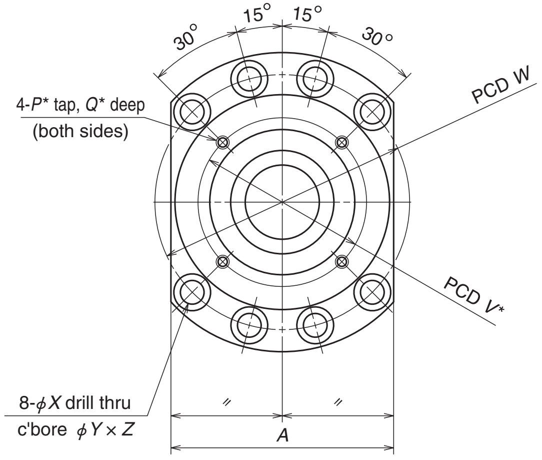
Dimensions of bearing seat

Support unit No.	Support unit																
	d	D	D_1	D_2	L	L_1	L_2	A	W	X	Y	Z	d_1*	l*	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 35DFF-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 40DFF-31					96	48											

Notes: 1. Rigidity
Values in the table are theoretical values obtained from the elastic deformation between ball groove and 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.



Bearing bore $d \leq 30$



Bearing bore $d \geq 35$

Unit: mm

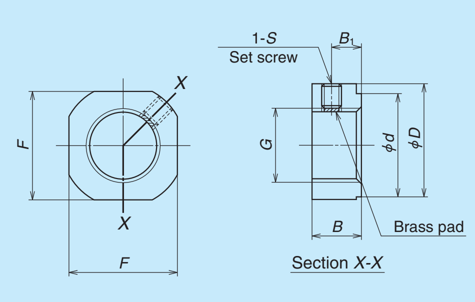
Support unit No.	Basic dynamic load rating C_a (N)	Permissible axial load (N)	Preload (N)	Axial rigidity (N/μm)	Maximum Starting torque (N · cm)	Lock nut			Mass (kg)	Bearing seat for unit		
						M	D_3	L_3		d	L_4	L_5
WBK 17DF-31	21 900	26 600	2 150	750	19	M17×1	37	18	1.9	17	81	23
WBK 20DF-31	21 900	26 600	2 150	750	19	M20×1	40	18	1.9	20	81	23
WBK 25DF-31	28 500	40 500	3 150	1 000	29	M25×1.5	45	20	3.1	25	89	26
WBK 25DFD-31	46 500	81 500	4 300	1 470	39				3.4		104	
WBK 30DF-31	29 200	43 000	3 350	1 030	30	M30×1.5	50	20	3.0	30	89	26
WBK 30DFD-31	47 500	86 000	4 500	1 520	40				3.3		104	
WBK 35DF-31	31 000	50 000	3 800	1 180	34	M35×1.5	55	22	3.4	35	92	30
WBK 35DFD-31	50 500	100 000	5 200	1 710	45				4.3		107	
WBK 35DFF-31	50 500	100 000	7 650	2 350	59				5.0		122	
WBK 40DF-31	31 500	52 000	3 900	1 230	36	M40×1.5	60	22	3.6	40	92	30
WBK 40DFD-31	51 500	104 000	5 300	1 810	47				4.2		107	
WBK 40DFF-31	51 500	104 000	7 850	2 400	61				4.7		122	

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 bearing. It is not necessary to apply grease before use.
6. Allowable axial load is 0.7 times of load limit.

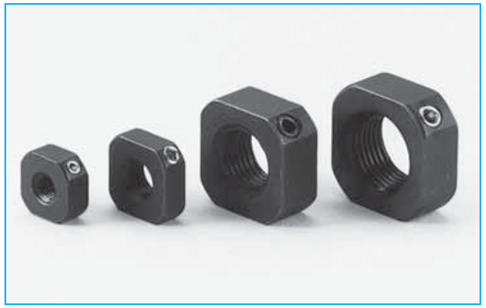
In addition to the support units, NSK has other components for ball screws as shown below.

(3) Lock nuts

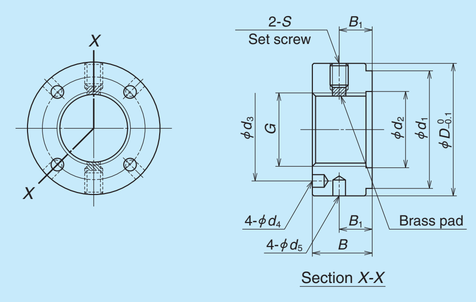
Ball screw support bearings must be installed with minimum inclination against ball screw center. NSK lock nuts exclusive for ball screw support bearings help to reduce this inclination.



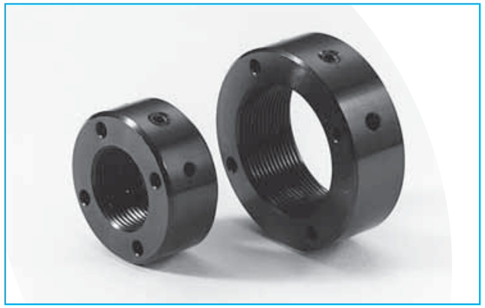
A Type Shapes and dimensions



A Type lock nuts



S Type Shapes and dimensions



S Type lock nuts

A Type lock nuts

Unit: mm

Lock nut reference No.	G	D	F	B	d	B_1	S	Tightening torque (N · cm) (for reference)	Set screw tightening torque (reference) [N · cm]	Mass (g)
WBK06L-01	M6×0.75	14.5	12	5	10	2.75	M3, with a brass pad	190	69 (M3)	3.8
WBK08L-01	M8×1	17	14	6.5	13	4	M3, with a brass pad	230	69 (M3)	6.4
WBK10L-01	M10×1	20	17	8	16	5	M4, with a brass pad	280	147 (M4)	11.2
WBK12L-01	M12×1	22	19	8	17	5	M4, with a brass pad	630	147 (M4)	12.8
WBK15L-01	M15×1	25	22	10	21	6	M4, with a brass pad	790	147 (M4)	20.0
WBK17L-01	M17×1	29	24	13	24	8	M4, with a brass pad	910	147 (M4)	33.1
WBK20L-01	M20×1	35	30	13	26	8	M4, with a brass pad	1670	147 (M4)	50.0
WBK25L-01	M25×1.5	42	36	16	34	10	M6, with a brass pad	2060	490 (M6)	87.0

Note: Insert brass pad and then tighten securing set screw.

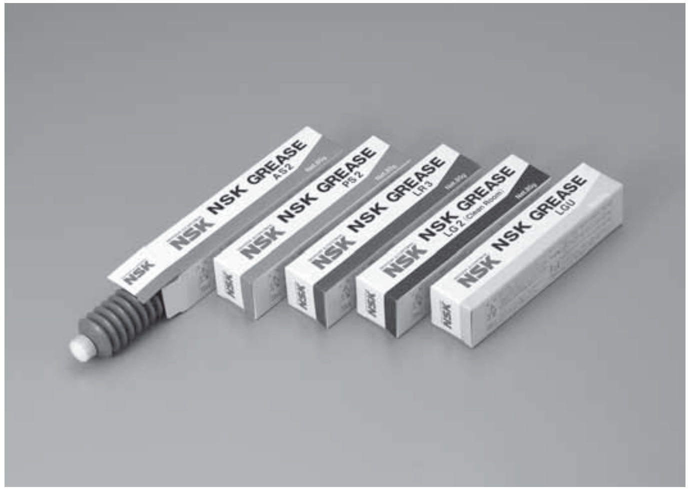
S Type lock nuts

Unit: mm

Lock nut reference No.	G	$D^{0}_{-0.1}$	B	d_1	d_2	d_3	d_4	d_5	B_1	S	Tightening torque (N · cm) (for reference)	Set screw tightening torque (reference) [N · cm]	Mass (g)
WBK17L-31	M17×1	37	18	30	18	27	4.3	4	10	M6	4 100	490 (M6)	108.4
WBK20L-31	M20×1	40	18	30	21	30	4.3	4	10	M6	4 500	490 (M6)	119.0
WBK25L-31	M25×1.5	45	20	40	26	35	4.3	4	11	M6	8 500	490 (M6)	125.2
WBK30L-31	M30×1.5	50	20	40	31	40	4.3	5	11	M6	10 100	490 (M6)	182.0
WBK35L-31	M35×1.5	55	22	50	36	45	4.3	5	12	M6	13 800	490 (M6)	235.0
WBK40L-31	M40×1.5	60	22	50	41	50	4.3	5	12	M6	15 500	490 (M6)	255.6

(4) Grease unit

NSK has numerous grease types that are exclusive for ball screw lubrication. They come in bellows-shaped tubes, which can be attached to a hand grease pump quickly. For details of grease types, see page D13 and for a hand grease pump and nozzles, see page D19.



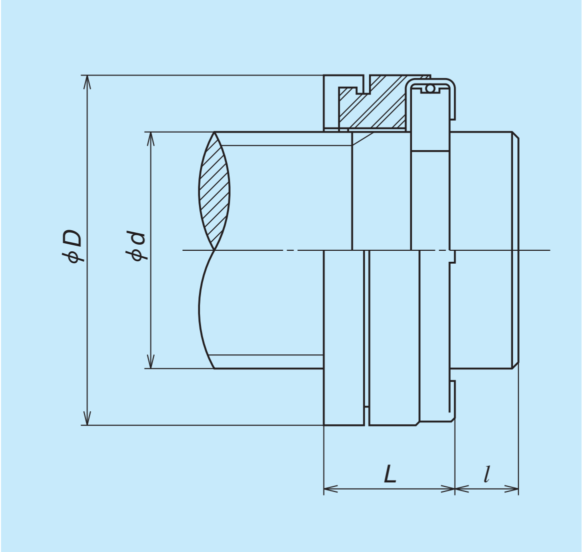
NSK greases

Lubricant greases

Name	Use	Base oil viscosity mm^2/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 (made-to-order)

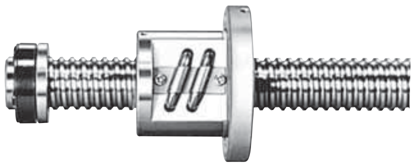
A travel stopper is installed in some cases to prevent the ball nut from overrunning to the end of ball thread due to a malfunction of the safety system of the equipment or by a human error. NSK has several series of shock-absorbing travel stoppers. The travel stopper is not sold as a single item since it is not for general use. Also, a travel stopper cannot be used for ball screw with the end cap type ball recirculation system, because the stopper would come directly into contact with the component for ball recirculation. Please request NSK for the installation of the travel stoppers when ordering a ball screw.



Unit: mm

Stopper No.	Applicable shaft dia. d	Outer dia. D	Length L	Shaft end width (Min.) l
BSR 20	20	32	16	5
BSR 25	25	38	16	5
BSR 32	32	46	20	6
BSR 40	40	60	22	6
BSR 50	50	72	24	7
BSR 63	63	85	25	7

Note: This stopper is patented by NSK Ltd.



Shock-absorbing travel stopper

Thrust Angular Contact Ball Bearings for Ball Screw

(1) Features

This is highly rigid and accurate ball screw support bearing often used for the machine tools driving mechanism.

(a) High axial rigidity

High-rigidity achieved by higher contact angle at 60 degrees and an increased number of smaller-diameter balls.

(b) Small friction torque

Friction torque is far less than that of tapered or cylindrical roller bearing. This contributes to accurate rotation by a smaller driving power.

(c) Pre-adjusted axial play

Combination bearings are already adjusted to a suitable preload. Universal combination bearing (SU) furnishes certain preload for all combinations (DB, DF, and other).

(d) 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.

(e) Easy handling

Inner and outer rings are inseparable, and are easy to handle.

(f) Superb polyamide resin retainer

Uses polyamide resin retainer which is superb to friction and furnishes high precision rotations.

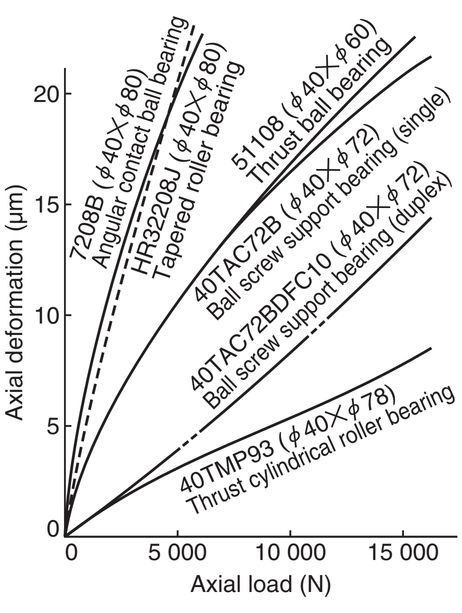


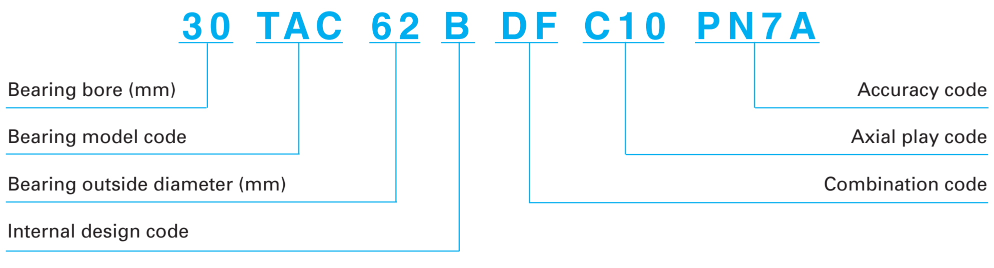
Fig. 1 Axial rigidity of various bearings

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



Note: 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) Combinations of bearings

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:

● **Combined bearings**

Bearings are adjusted as a single combined set. Since the bearing alignment is pre-set, there is no interchangeability between the bearing set.

● **Universal combination bearing (SU)**

Single bearings are manufactured under strict control of component accuracy so that they can be universally assembled as a combination of ball screw support bearing set.

(a) Combined bearings

- **Fig. 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.

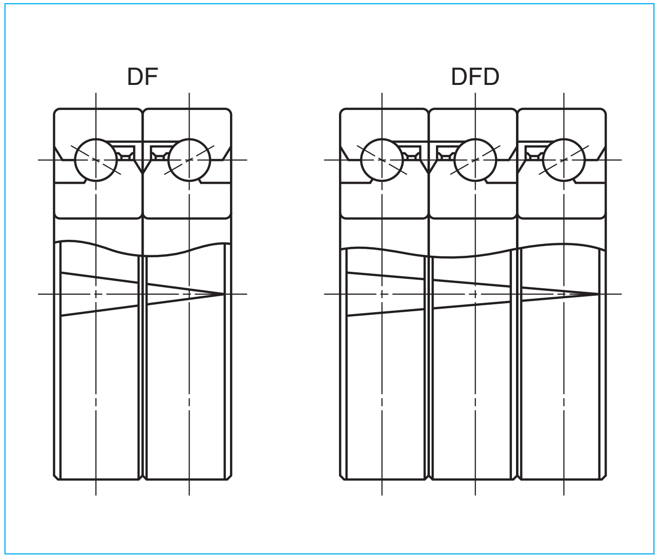


Fig. 2 Examples of combination and "V" mark

(b) Universal combination bearing (SU)

- Unlike the above case, the marks on the outside surface of bearings 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.

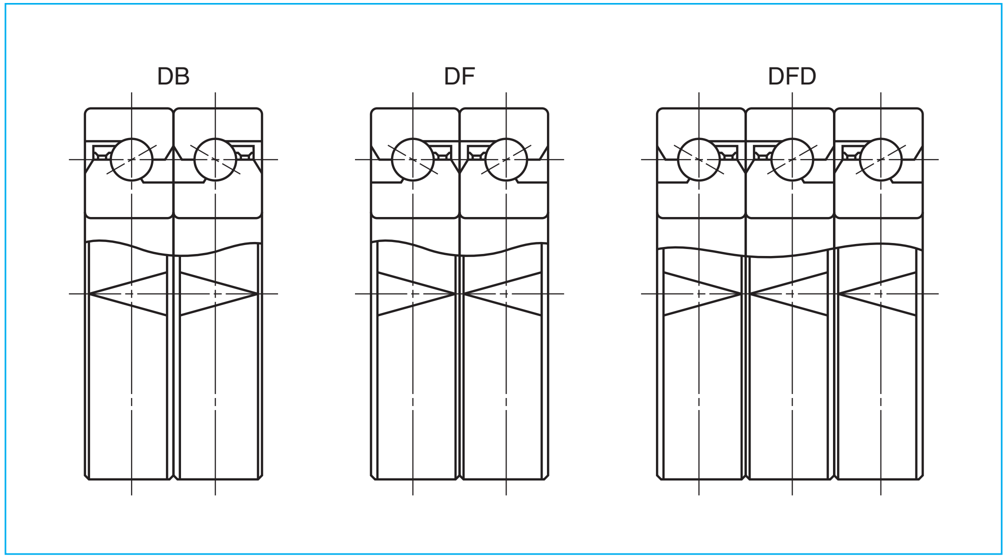


Fig. 3 Example of universal combination (SU) and "V" mark

(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

(a) 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 No.	Duplex combination DF				Triplex combination DFD				Quadruplet combination DFF			
	Axial play code	Preload (N)	Rigidity (N/μm)	Starting torque (N · m)	Axial play code	Preload (N)	Rigidity (N/μm)	Starting torque (N · m)	Axial play code	Preload (N)	Rigidity (N/μm)	Starting torque (N · m)
15TAC 47B	C10	2 150	750	0.14	C10	2 950	1 080	0.20	C10	4 300	1 470	0.29
17TAC 47B	C10	2 150	750	0.14	C10	2 950	1 080	0.20	C10	4 300	1 470	0.29
20TAC 47B	C10	2 150	750	0.14	C10	2 950	1 080	0.20	C10	4 300	1 470	0.29
25TAC 62B	C10	3 150	1 000	0.23	C10	4 300	1 470	0.31	C10	6 250	1 960	0.46
30TAC 62B	C10	3 350	1 030	0.24	C10	4 500	1 520	0.33	C10	6 650	2 010	0.49
35TAC 72B	C10	3 800	1 180	0.28	C10	5 200	1 710	0.37	C10	7 650	2 350	0.55
40TAC 72B	C10	3 900	1 230	0.28	C10	5 300	1 810	0.38	C10	7 850	2 400	0.57
40TAC 90B	C10	5 000	1 320	0.48	C10	6 750	1 960	0.65	C10	10 300	2 650	0.96
45TAC 75B	C10	4 100	1 270	0.29	C10	5 600	1 910	0.40	C10	8 250	2 550	0.59
45TAC 100B	C10	5 900	1 520	0.58	C10	8 050	2 210	0.78	C10	11 800	3 000	1.16
50TAC 100B	C10	6 100	1 570	0.60	C10	8 250	2 300	0.80	C10	12 300	3 100	1.18
55TAC 100B	C10	6 100	1 570	0.60	C10	8 250	2 300	0.80	C10	12 300	3 100	1.18
55TAC 120B	C10	6 650	1 810	0.64	C10	9 100	2 650	0.86	C10	13 200	3 550	1.27
60TAC 120B	C10	6 650	1 810	0.64	C10	9 100	2 650	0.86	C10	13 200	3 550	1.27

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 PN7B
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

Note: The tolerance of the outer ring width is the same as that of the inner ring width of the same bearing.

(b) Fits
Table 5 shows recommended values of the tolerance of shaft and housing bore.

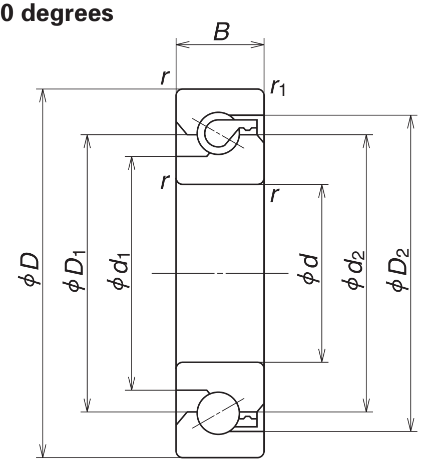
Table 5 Tolerance of shaft bearing seat and housing bore

Unit: μm

Size of shaft or housing bore (mm)		Tolerance of shaft bearing seat h5		Tolerance of housing hole H6	
over	or less	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

TACB

Nominal contact angle 60 degrees



Dynamic equivalent load $P_a = XF_r + F_a$

Bearing configuration		Duplex		Triplex			Quadruplet		
Combination code		DF	DT	DFD		DTD	DFT	DFF	DFT
Number of the row that receives axial load		One row	Two rows	One row	Two rows	Three rows	One row	Two rows	Three rows
$e = 2.17$									
$F_a/F_r \leq e$	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^{-1})			Basic dynamic load rating C_a			Permissible axial load			Mass
d	D	B	r Min.	r_1 Min.	d_1	d_2	D_1	D_2	Grease lubrication	Oil lubrication	Bearing No.	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)	(kg) (Reference)
15	47	15	1	0.6	27.2	34	34	39.6	6 000	8 000	**15TAC 47B**	21 900	35 500	47 500	26 600	53 000	79 500	0.144
17	47	15	1	0.6	27.2	34	34	39.6	6 000	8 000	**17TAC 47B**	21 900	35 500	47 500	26 600	53 000	79 500	0.144
20	47	15	1	0.6	27.2	34	34	39.6	6 000	8 000	**20TAC 47B**	21 900	35 500	47 500	26 600	53 000	79 500	0.135
25	62	15	1	0.6	37	45	45	50.7	4 500	6 000	**25TAC 62B**	28 500	46 500	61 500	40 500	81 500	122 000	0.252
30	62	15	1	0.6	39.5	47	47	53.2	4 300	5 600	**30TAC 62B**	29 200	47 500	63 000	43 000	86 000	129 000	0.224
35	72	15	1	0.6	47	55	55	60.7	3 600	5 000	**35TAC 72B**	31 000	50 500	67 000	50 000	100 000	150 000	0.310
40	72	15	1	0.6	49	57	57	62.7	3 600	4 800	**40TAC 72B**	31 500	51 500	68 500	52 000	104 000	157 000	0.275
40	90	20	1	0.6	57	68	68	77.2	3 000	4 000	**40TAC 90B**	59 000	95 500	127 000	89 500	179 000	269 000	0.674
45	75	15	1	0.6	54	62	62	67.7	3 200	4 300	**45TAC 75B**	33 000	53 500	71 000	57 000	114 000	170 000	0.270
45	100	20	1	0.6	64	75	75	84.2	2 600	3 600	**45TAC 100B**	61 500	100 000	133 000	99 000	198 000	298 000	0.842
50	100	20	1	0.6	67.5	79	79	87.7	2 600	3 400	**50TAC 100B**	63 000	102 000	136 000	104 000	208 000	310 000	0.778
55	100	20	1	0.6	67.5	79	79	87.7	2 600	3 400	**55TAC 100B**	63 000	102 000	136 000	104 000	208 000	310 000	0.714
55	120	20	1	0.6	82	93	93	102.2	2 200	3 000	**55TAC 120B**	67 500	109 000	145 000	123 000	246 000	370 000	1.23
60	120	20	1	0.6	82	93	93	102.2	2 200	3 000	**60TAC 120B**	67 500	109 000	145 000	123 000	246 000	370 000	1.16

Notes: 1. Values are based on a standard preload (C10).

2. "Row" means the quantity of bearings that receive axial load.
"Two rows" means two bearings are receiving axial load.

B-3-2 Dimension Table and Reference Number of Standard Nut Ball Screws

B-3-2.1 End Deflector Type Ball Screws

This product is being applied for a patent.

1. Features

●Low and less offensive noise

The average noise level is reduced by more than 6 dB compared with our existing products. At low-speed rotation, the ball screws are nearly silent, while their noise is unprecedentedly low at high-speed rotation.

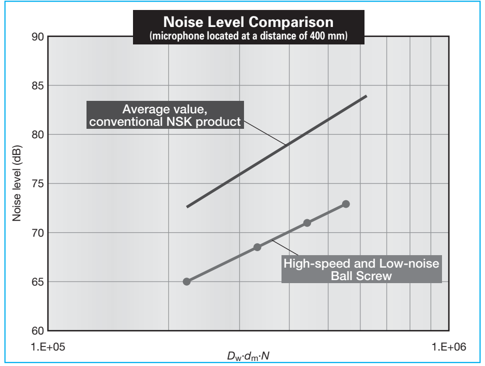


Fig. 1 Comparison of noise level

●High-speed operation

Realizes the d·n of 180 000, outstanding for ball screws and far surpassing the 100 000 d·n performance of existing return tube type products. For high-lead ball screws, high-speed operation at over 200 m/min is also possible.

●Compact

The external diameter of the ball nut is 30% smaller than our existing models. Compact configurations are possible for low-profile XY tables as well as for other devices and equipment.

●Grease fitting provided as standard equipment

The ball screws with shaft diameters equal to or less than ø25 are equipped with a grease fitting (M5 × 0.8) as a standard. Lubrication ports are provided in 2 places for ease of maintenance. The ball screws can be easily connected to an integrated lubrication system.

2. Specifications

(1) Ball recirculation system

Fig. 2 shows the structure of the end-deflector recirculation system.

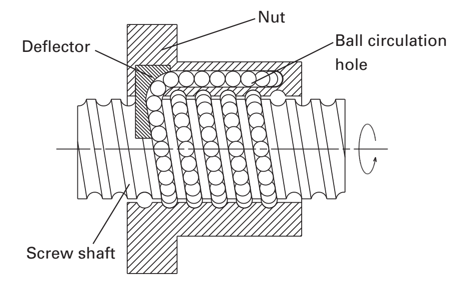


Fig. 2 Structure of end-deflector recirculation system

(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 (preloaded); T, 0.005 mm or less; S, 0.020 mm or less; N, 0.050 mm or less

(3) Allowable d·n value and the criterion of maximum rotational speed

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
Standard of rotational speed : 5 000 min^{-1}

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Seal

A compact and thin plastic seal is used. Nut outside diameter is compact 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 B80) and "Handling Precautions"(page B99).

4. Product categories

End deflector type ball screws have the model as follows.

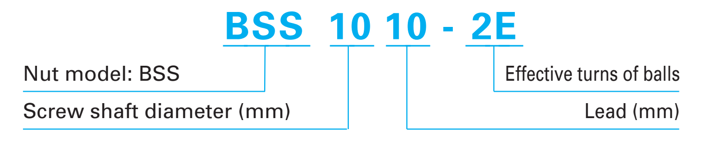
Table 2 End-deflector type ball screw product categories

Nut model	Shape	Flang shape	Nut shape	Preload system
BSS		Circular Ⅱ, Ⅲ	Circular	Non-preload, Slight axial play
				P-preload (light preload)

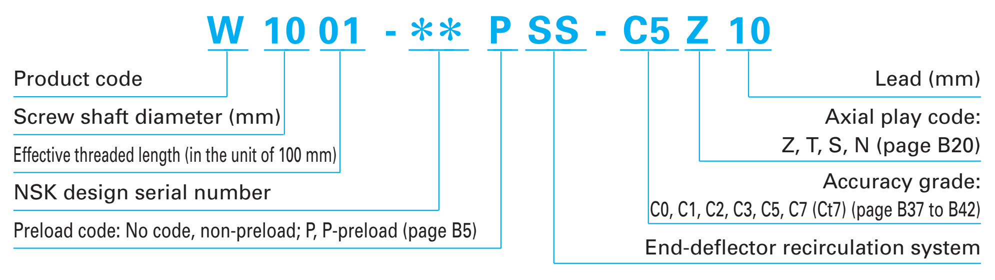
5. Structure of model number and reference number

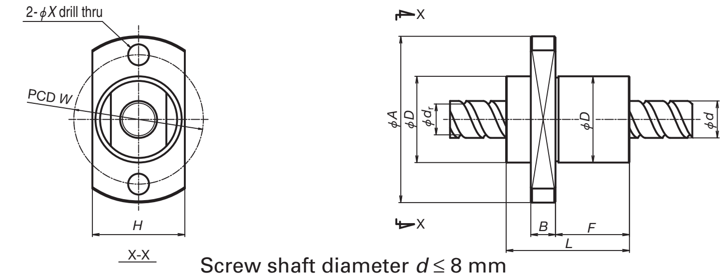
The following describe the structure of "Model number" and "Reference number for ball screw".

◇Model number

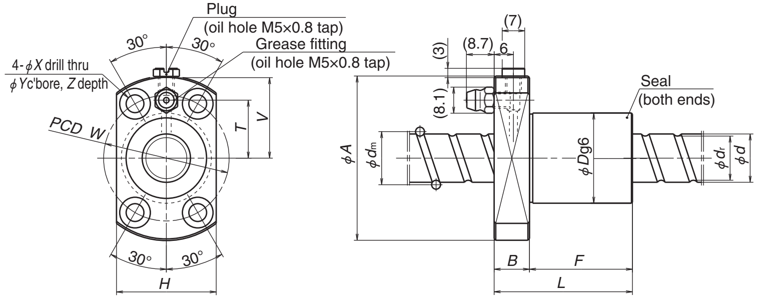


◇Reference number for ball screw

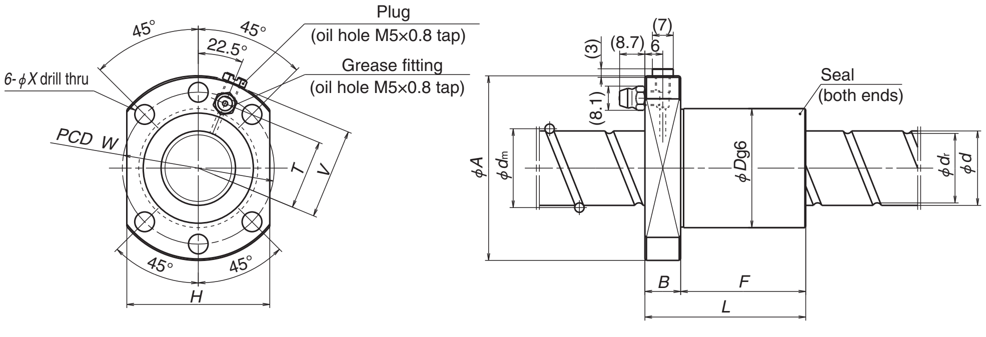




Screw shaft diameter $d \leq 8$ mm



Screw shaft diameter $d \leq 20$ mm



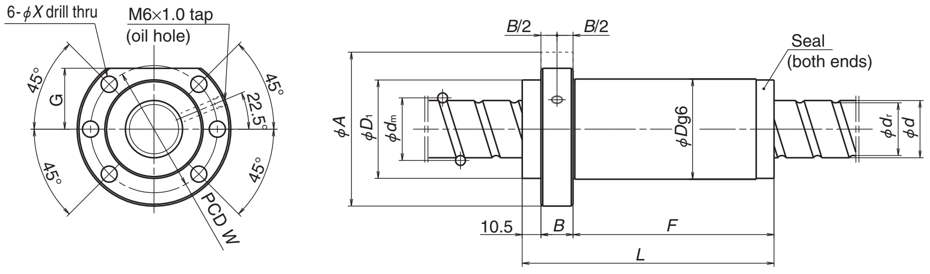
Screw shaft diameter $d = 25$ mm

Unit: mm

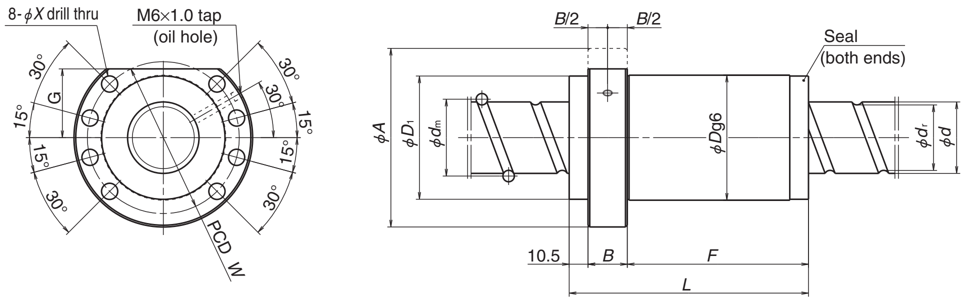
Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls	Basic load rating (N) Dynamic	Basic load rating (N) Static	Axial rigidity K	Nut entire length	Nut diameter	Flange diameter	Flange width	Nut length	Flange dimension		Bolt hole PCD	Bolt hole dimension			Oil hole distance
	d	l	D_w	d_m	d_r		C_a	C_{0a}	(N/μm)	L	D	A	B	F	H	V	W	X	Y	Z	T
BSS0608-2E	6	8	1.2	6.2	4.9	2	550	715	24	16	14	27	4	8	15 (10)	—	21	3.4	—	—	—
BSS0608-4E		8				4	1 180	1 760	55	24				16							
BSS0612-2E		12				2	550	715	22	20				12							
BSS0612-4E		12				4	1 180	1 760	51	32				24							
BSS0810-2E	8	10	1.588	8.3	6.6	2	910	1 260	31	18	18	31	4	10	19 (13)	—	25	3.4	—	—	—
BSS0810-4E		10				4	1 950	3 080	72	28				20							
BSS0815-2E		15				2	910	1 260	29	22				14							
BSS0815-4E		15				4	1 950	3 080	68	37				29							
BSS1005-3E	10	5	2.000	10.3	8.2	3	2 930	4 790	126	29	23	43	11	18	26	21	33	4.5	8	4.5	14
BSS1010-2E		10				2	1 970	3 010	77	32				21							
BSS1205-3E	12	5	2.000	12.3	10.2	3	3 200	5 860	146	30	24	44	11	19	27	21.5	34	4.5	8	4.5	14.5
BSS1210-3E		10				3	3 200	5 860	142	43				32							
BSS1220-2E		20				2	2 150	3 610	83	50				39							
BSS1230-2E		30				2	2 150	3 610	75	70				59							
BSS1505-3E	15	5	2.778	15.5	12.6	3	5 460	10 200	183	30	28	51	11	19	31	25	39	5.5	9.5	5.5	18
BSS1510-3E		10	2.778		12.6	3	5 460	10 200	181	43	28	51		32	31	25	39				18
BSS1520-2E		20	3.175		12.2	2	5 070	8 730	127	51	32	55		40	33	27	43				20
BSS1530-2E		30	3.175		12.2	2	5 070	8 730	116	71	32	55		60	33	27	43				20
BSS2005-3E	20	5	3.175	20.5	17.2	3	8 790	18 500	268	31	36	62	13	18	38	30.5	49	6.6	11	6.5	23.5
BSS2010-3E		10				3	8 790	18 500	268	45				32							
BSS2020-2E		20				2	5 900	11 700	167	54				41							
BSS2030-2E		30				2	5 900	11 700	159	74				61							
BSS2040-2E		40				2	5 900	11 700	147	92				79							
BSS2060-2E		60				2	5 900	11 700	128	129				116							
BSS2505-3E	25	5	3.175	25.5	22.2	3	9 760	23 600	325	32	40	62	12	20	48	30.5	51	6.6	—	—	23.5
BSS2510-4E		10				4	12 800	32 300	437	56				44							
BSS2520-2E		20				2	6 560	14 600	203	54				42							
BSS2525-2E		25				2	6 560	14 600	197	63				51							
BSS2530-2E		30				2	6 560	14 600	194	74				62							
BSS2550-2E		50				2	6 560	14 600	177	114				102							

Note: 1) The axial rigidity *K* 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_a).
For ball screws with shaft diameters less than ø25, the standard Compact FA PSS type can be available.

2) Dimensions in parentheses are for flat nut configurations.



Screw shaft diameter d = 32 mm



Screw shaft diameter $d \geq$ 36 mm

Unit: mm

Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls	Basic load rating (N)		Axial rigidity	Nut entire length	Nut diameter	Seal section diameter	Flange diameter	Flange width	Nut length	Notched flange	Bolt hole PCD	Bolt hole dimension
							Dynamic	Static	K									
	d	l	D_w	d_m	d_r		C_a	C_{0a}	(N/μm)	L	D	D_1	A	B	F	G	W	X
BSS3205-4E	32	5	3.175	32.5	29.2	4	14 200	41 400	534	55	56	55	86	12	32.5	34	71	9
BSS3210-6E		10	5.556	33	27.2	6	43 300	111 000	865	104				18	75.5			
BSS3212-5E		12	5.556	33	27.2	5	36 700	90 800	716	103				18	74.5			
BSS3216-5E		16	5.556	33	27.2	5	36 700	90 800	716	122				18	93.5			
BSS3220-5E		20	5.556	33	27.2	5	36 700	90 800	708	141				18	112.5			
BSS3232-2E		32	5.556	33	27.2	2	15 300	32 400	261	94				18	65.5			
BSS3264-2E		64	5.556	33	27.2	2	15 300	32 400	232	153				18	124.5			
BSS3605-3E	36	5	3.175	36.5	33.2	3	11 400	34 100	433	50	65	64	95	12	27.5	36	80	9
BSS3610-6E		10	6.35	37	30.4	6	55 200	142 000	970	109				22	76.5			
BSS3612-6E		12	6.35	37	30.4	6	55 200	142 000	967	120				22	87.5			
BSS3616-6E		16	6.35	37	30.4	6	55 200	142 000	961	143				22	110.5			
BSS3620-6E		20	6.35	37	30.4	6	55 200	142 000	959	166				22	133.5			
BSS4010-5E	40	10	6.35	41	34.4	5	49 300	130 000	875	99	70	69	100	22	66.5	38.5	85	9
BSS4012-5E		12				5	49 300	130 000	873	108					75.5			
BSS4016-5E		16				5	49 300	130 000	875	127					94.5			
BSS4020-5E		20				5	49 300	130 000	868	146					113.5			
BSS4025-4E		25				4	40 100	103 000	686	145					112.5			
BSS4030-3E		30				3	30 600	74 000	505	134					101.5			
BSS4040-2E		40				2	20 600	46 600	319	110					77.5			
BSS4080-2E		80				2	20 600	46 600	286	184					151.5			
BSS4510-5E	45	10	6.35	46	39.4	5	51 400	146 000	961	99	75	74	110	22	66.5	43	93	11
BSS4512-5E		12				5	51 400	146 000	959	108					75.5			
BSS4516-5E		16				5	51 400	146 000	955	127					94.5			
BSS4520-5E		20				5	51 400	146 000	950	146					113.5			
BSS4525-5E		25				5	51 400	146 000	954	170					137.5			
BSS4530-4E		30				4	41 800	116 000	752	164					131.5			
BSS5010-4E	50	10	6.35	51	44.4	4	44 600	129 000	836	89	82	81	118	22	56.5	46	100	11
BSS5012-4E		12				4	44 600	129 000	944	96					63.5			
BSS5016-4E		16				4	44 600	129 000	832	111					78.5			
BSS5020-4E		20				4	44 600	129 000	837	126					93.5			
BSS5025-4E		25				4	44 600	129 000	828	145					112.5			
BSS5030-4E		30				4	44 600	129 000	821	164					131.5			
BSS5050-2E		50				2	22 800	58 300	383	130					97.5			
BSS50100-2E		100				2	22 800	58 300	342	224					191.5			

Note: The axial rigidity K 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_a).

B-3-2.2 Return Tube Type Ball Screws

1. Features

Return tube type is a standard way of ball recirculation system for ball screws. It has various combinations of shaft diameter and lead.

2. Specifications

(1) Ball recirculation system

The structure of return tube recirculation system is shown below.

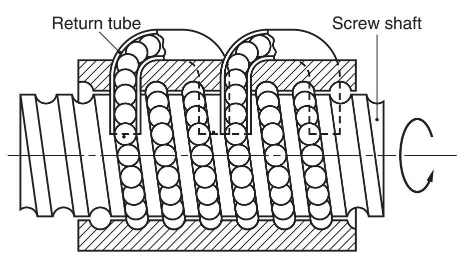


Fig.1 Structure of return tube recirculation system

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 (preloaded); T, 0.005 mm or less; S, 0.020 mm or less; N, 0.050 mm or less

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are shown in **Table 1**. Please consult NSK for other grades.

(3) Allowable d·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 measures must be taken for the high-speed ball screws respectively.

Allowable d·n value :
Standard specification ; 70 000 or less
High-speed specification; 100 000 or less
Standard of rotational speed : 3 000 min^{-1}

Note: Please also review the critical speed. Refer to "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Option

A type equipped with NSK K1 lubrication unit is also available.

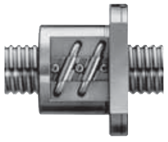
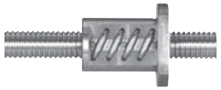
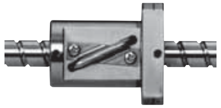
(5) Other specifications

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.

Table 2 Return tube type ball screws product categories

Nut model	Shape	Flange shape	Nut shape	Preload system
SFT		Flanged d=16mm or under Rectangle d=20mm or over Circular Ⅰ, Ⅱ	Circle dia.	Non-preload, Slight axial play
PFT				P-preload (light preload) Spacer ball 1:1
ZFT		Flanged Circular Ⅰ, Ⅱ	Circle dia.	Z-preload (medium preload)
DFT		Flanged Circular Ⅰ, Ⅱ	Circular	D-preload (medium preload) (heavy preload)
LSFT		Flanged d=20mm or under Rectangle d=25mm or over Circular Ⅱ	d=20mm or under Circular d=25mm or over Tube-projecting type	Non-preload, Slight axial play
LPFT				P-preload (light preload) Spacer ball 1:1
LDFT		Flanged Circular Ⅱ	Circular	D-preload (medium preload) (heavy preload)

4. Structure of model number and reference number

The followings describe the structure of "Model number" and "Reference number for ball screw".

◇ Model number

SFT 14 05 - 2.5

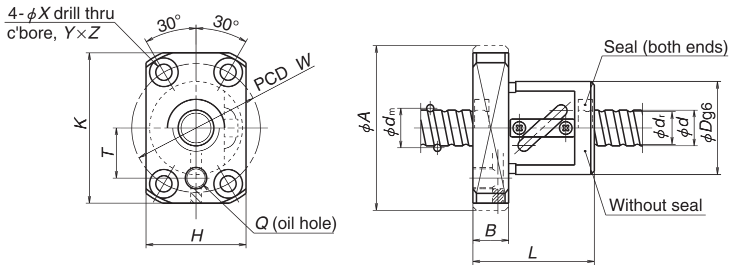
Nut model:
SFT, PFT, ZFT, DFT
LSFT, LPFT, LDFT
Screw shaft diameter (mm)
Lead (mm)
Effective turns of balls (Note)

Note: In case of Z-preload, the number here is twice as large as the effective turns of balls.

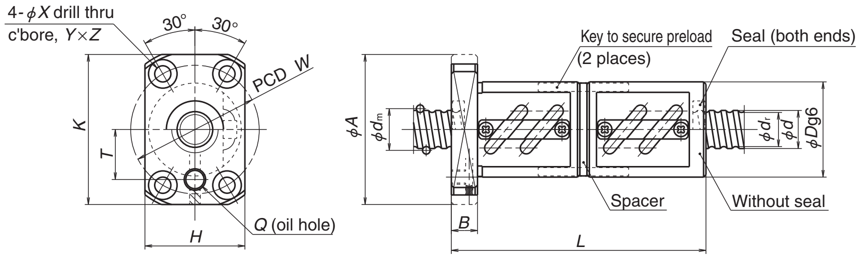
◇ Reference number for ball screw

W 14 01 - ** P - C3 Z 5

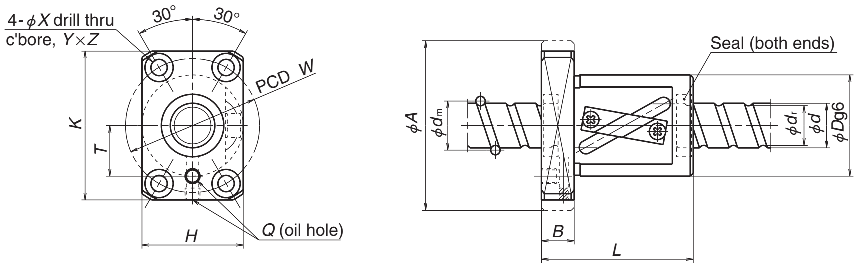
Product code
Screw shaft diameter (mm)
Effective threaded length (in the unit of 100 mm)
NSK design serial number
Preload code:
No code, non-preload; P, P-preload
Z, Z-preload; D, D-preload (page B5)
Lead (mm)
Axial play code:
Z, T, S, N (page B20)
Accuracy grade code:
C0, C1, C2, C3, C5, C7 (Ct7)
(page B37 to B42)



PFT, SFT



DFT

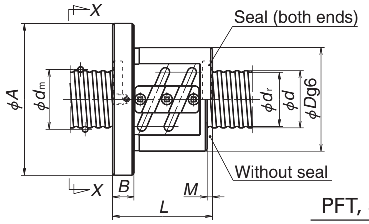


LPFT, LSFT

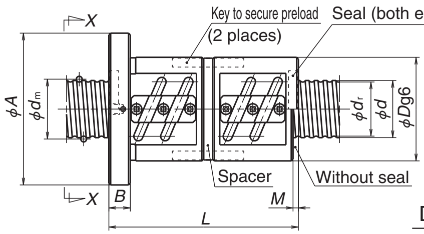
Unit: mm

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 × Circuits	Basic load rating (N)		Axial rigidity K (N/μm)	Ball nut dimensions											
								Dynamic C_a	Static C_{0a}		Nut entire length L	Nut diameter D	Flanged diameter A	Flanged width B	Rectangle flanged diameter H	K	Bolt hole dimension X	Y	Z	Bolt hole PCD W	Oil hole length T	Oil hole Q
∗ **PFT 1004-2.5**	P	10	4	2.000	10.3	8.2	2.5×1	1 730	2 230	76	34	26	46	10	28	42	4.5	8	4.5	36	14	M6×1
SFT 1004-2.5	Clearance							2 740	4 450	90												
PFT 1204-2.5	P	12	4	2.381	12.3	9.8	2.5×1	2 370	3 160	89	38	30	50	10	32	45	4.5	8	4.5	40	15	M6×1
PFT 1204-3	P						1.5×2	2 770	3 790	106	44											
SFT 1204-2.5	Clearance						2.5×1	3 760	6 310	106	38											
SFT 1204-3	Clearance						1.5×2	4 390	7 580	126	44											
∗ **PFT 1205-2.5**	P		5	2.381	12.3	9.8	2.5×1	2 370	3 160	89	40	30	50	10	32	45	4.5	8	4.5	40	15	M6×1
PFT 1205-3	P						1.5×2	2 770	3 790	106	48											
SFT 1205-2.5	Clearance						2.5×1	3 760	6 310	106	40											
SFT 1205-3	Clearance						1.5×2	4 390	7 580	126	48											
∗ **LPFT 1210-2.5**	P		10	2.381	12.5	10.0	2.5×1	2 360	3 240	90	50	30	50	10	32	45	4.5	8	4.5	40	15	M6×1
LSFT 1210-2.5	Clearance							3 750	6 480	110												
∗ **PFT 1405-2.5**	P	14	5	3.175	14.5	11.2	2.5×1	4 280	5 840	116	40	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
SFT 1405-2.5	Clearance						2.5×1	6 790	11 700	140	40											
PFT 1405-5	P						2.5×2	7 770	11 700	225	55											
SFT 1405-5	Clearance						2.5×2	12 300	23 400	274	55											
∗ **LPFT 1408-2.5**	P		8	3.175	14.5	11.2	2.5×1	4 280	5 840	120	46	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
LSFT 1408-2.5	Clearance							6 790	11 700	140												
∗ **LPFT 1510-2.5**	P	15	10	3.175	15.5	12.2	2.5×1	4 450	6 380	127	51	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
LSFT 1510-2.5	Clearance							7 070	12 800	150												
PFT 1604-3	P	16	4	2.381	16.3	13.8	1.5×2	3 170	5 150	135	45	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
SFT 1604-2.5	Clearance						2.5×1	4 300	8 530	134	38	34			34							
DFT 1604-2.5	D						2.5×1	4 300	8 530	263	70	36			36							
PFT 1604-5	P						2.5×2	4 920	8 530	215	50	34			34							
SFT 1604-3	Clearance						1.5×2	5 040	10 300	160	45	34			34							
DFT 1604-3	D						1.5×2	5 040	10 300	315	85	36			36							

Notes: 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 20 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.
4. The axial rigidity *K* 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.
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 ∗ (asterisk) are available in the FA type standard ball screws with finished shaft end.
7. Preload system: P, Oversize ball preload; D, Double nut preload (See page B5.)

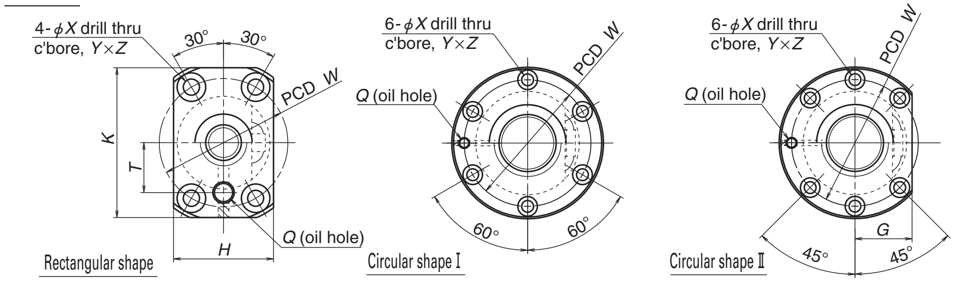


PFT, SFT



DFT

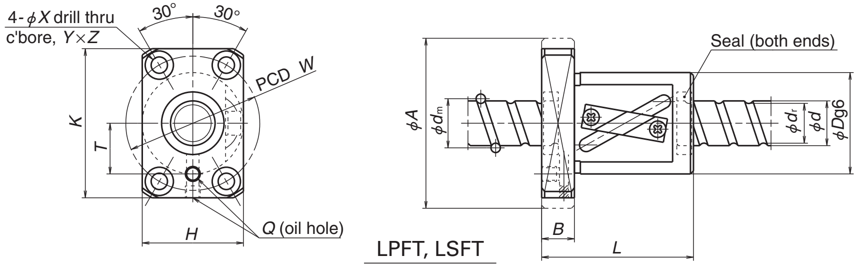
View X-X



Rectangular shape

Circular shape I

Circular shape II

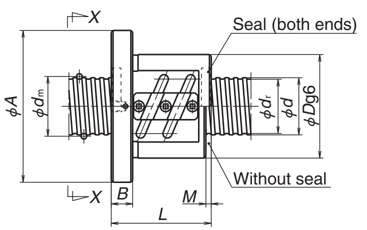


LPFT, LSFT

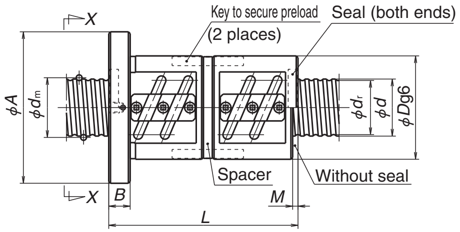
Unit: mm

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 × Circuits	Basic load rating (N) Dynamic C_a	Basic load rating (N) Static C_{0a}	Axial rigidity K (N/μm)	Ball nut dimensions: Nut entire length L	Nut diameter D	Flanged diameter A	Flanged width B	Notched flange G	Rectangle flanged diameter H	Rectangle flanged diameter K	Seal dimension M	Bolt hole dimension X	Bolt hole dimension Y	Bolt hole dimension Z	Bolt hole PCD W	Oil hole length T	Oil hole Q
PFT 1605-3	P	16	5	3.175	16.5	13.2	1.5×2	5 400	8 100	158	52	40	63	11	—	40	55	—	5.5	9.5	5.5	51	20	M6×1
SFT 1605-2.5	Clearance						2.5×1	7 330	13 500	158	42													
DFT 1605-2.5	D						2.5×1	7 330	13 500	311	77													
PFT 1605-5	P						2.5×2	8 380	13 500	258	57													
SFT 1605-3	Clearance						1.5×2	8 570	16 200	188	52													
DFT 1605-3	D						1.5×2	8 570	16 200	370	97													
SFT 1605-5	Clearance						2.5×2	13 300	27 000	307	57													
DFT 1605-5	D						2.5×2	13 300	27 000	603	107													
PFT 1606-2.5	P		6	3.175	16.5	13.2	2.5×1	4 620	6 750	133	44	40	63	11	—	40	55	—	5.5	9.5	5.5	51	20	M6×1
SFT 1606-2.5	Clearance						2.5×1	7 330	13 500	158	44													
DFT 1606-2.5	D						2.5×1	7 330	13 500	311	86													
SFT 1606-3	Clearance						1.5×2	8 570	16 200	188	56													
DFT 1606-3	D						1.5×2	8 570	16 200	370	110													
∗ **LPFT 1616-1.5**	P		16	3.175	16.75	13.4	1.5×1	3 600	5 410	110	56	40	63	12	—	40	55	—	5.5	9.5	5.5	51	17	M6×1
LSFT 1616-1.5	Clearance							4 710	8 110	100														
SFT 2004-2.5	Clearance	20	4	2.381	20.3	17.8	2.5×1	4 740	10 700	160	37	40	63	11	24	—	—	3	5.5	9.5	5.5	51	—	M6×1
DFT 2004-2.5	D						2.5×1	4 740	10 700	315	69													
∗ **PFT 2004-5**	P						2.5×2	5 420	10 700	260	49													
SFT 2004-5	Clearance						2.5×2	8 600	21 500	309	49													
DFT 2004-5	D						2.5×2	8 600	21 500	608	93													
PFT 2005-3	P		5	3.175	20.5	17.2	1.5×2	6 060	10 300	191	52	44	67	11	26	—	—	3	5.5	9.5	5.5	55	—	M6×1
SFT 2005-2.5	Clearance						2.5×1	8 230	17 100	190	41													
DFT 2005-2.5	D						2.5×1	8 230	17 100	376	76													
∗ **PFT 2005-5**	P						2.5×2	9 410	17 100	311	56													
SFT 2005-3	Clearance						1.5×2	9 620	20 600	227	52													
DFT 2005-3	D						1.5×2	9 620	20 600	446	97													
SFT 2005-5	Clearance						2.5×2	14 900	34 300	370	56													
DFT 2005-5	D						2.5×2	14 900	34 300	726	106													

Notes:
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. Seals are equipped as a standard for LSFT and LPFT of shaft diameter 20 mm or smaller. The outside dimensions are the same as those of without seals.
4. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.
5. The axial rigidity K 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.
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 ∗ (asterisk) are available in the FA or SA type standard ball screws with finished shaft end.
8. Preload system: P, Oversize ball preload; D, Double nut preload (See page B5.)

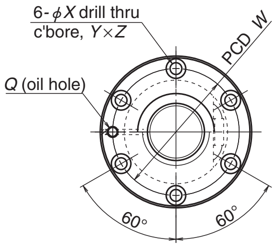


PFT, ZFT, SFT

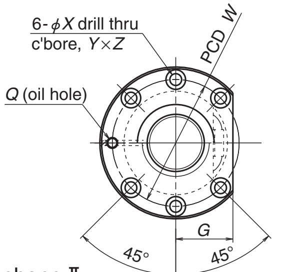


DFT

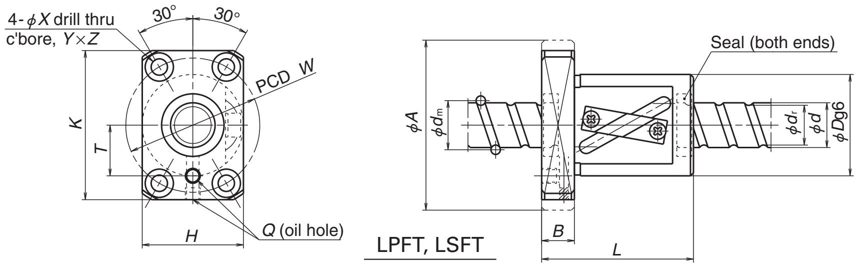
View X-X



Circular shape I



Circular shape II



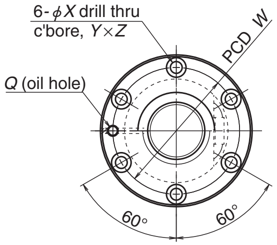
LPFT, LSFT

Unit: mm

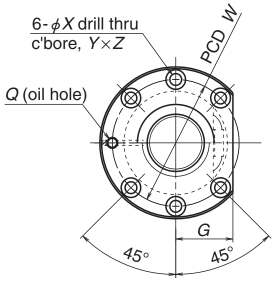
Model No.	Preload system	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity K (N/μm)	Ball nut dimensions													
								Dynamic	Static		Nut entire length	Nut diameter	Flanged diameter	Flanged width	Notched flange	Rectangle flanged diameter		Seal dimension	Bolt hole dimension			Bolt hole PCD	Oil hole length	Oil hole
		d	l	D_w	d_m	d_r		C_a	C_{0a}		L	D	A	B	G	H	K	M	X	Y	Z	W	T	Q
PFT 2006-2.5	P	20	6	3.969	20.5	16.4	2.5×1	6 900	10 500	164	44	48	71	11	27	—	—	3	5.5	9.5	5.5	59	—	M6×1
PFT 2006-3	P						1.5×2	8 080	12 700	195	56													
SFT 2006-2.5	Clearance						2.5×1	11 000	21 100	195	44													
DFT 2006-2.5	D						2.5×1	11 000	21 100	384	86													
SFT 2006-3	Clearance						1.5×2	12 800	25 300	232	56													
DFT 2006-3	D						1.5×2	12 800	25 300	456	110													
PFT 2008-2.5	P		8	3.969	20.5	16.4	2.5×1	6 900	10 500	164	54	48	75	13	28	—	—	5	6.6	11	6.5	61	—	M6×1
SFT 2008-2.5	Clearance						2.5×1	11 000	21 100	195	54													
DFT 2008-2.5	D						2.5×1	11 000	21 100	384	102													
SFT 2008-3	Clearance						1.5×2	12 800	25 300	232	64													
DFT 2008-3	D						1.5×2	12 800	25 300	456	120													
* **LPFT 2010-2.5**	P		10	3.969	21.0	16.9	2.5×1	6 800	10 800	169	54	46	74	13	—	46	66	—	6.6	11	6.5	59	24	M6×1
LSFT 2010-2.5	Clearance							10 900	21 700	202														
LPFT 2016-2.5	P		16	3.969	21.0	16.9	2.5×1	6 880	10 800	169	72	46	74	13	—	46	66	—	6.6	11	6.5	59	24	M6×1
LSFT 2016-2.5	Clearance							10 900	21 700	202														
* **LPFT 2020-1.5**	P		20	3.969	21.0	16.9	1.5×1	5 370	8 450	137	63	46	74	13	—	46	66	—	6.6	11	6.5	59	24	M6×1
LSFT 2020-1.5	Clearance							7 040	12 700	127														
SFT 2504-2.5	Clearance	25	4	2.381	25.3	22.8	2.5×1	5 270	13 600	193	36	46	69	11	26	—	—	3	5.5	9.5	5.5	57	—	M6×1
ZFT 2504-5	Z						2.5×1	5 270	13 600	379	48													
* **PFT 2504-5**	P						2.5×2	6 020	13 600	312	48													
SFT 2504-5	Clearance						2.5×2	9 560	27 200	374	48													
ZFT 2504-10	Z						2.5×2	9 560	27 200	735	72													
PFT 2505-3	P		5	3.175	25.5	22.2	1.5×2	6 730	12 800	223	52	50	73	11	28	—	—	3	5.5	9.5	5.5	61	—	M6×1
SFT 2505-2.5	Clearance						2.5×1	9 130	21 900	231	40							3						
ZFT 2505-5	Z						2.5×1	9 130	21 900	454	55							3						
* **PFT 2505-5**	P						2.5×2	10 400	21 900	372	55							3						
SFT 2505-3	Clearance						1.5×2	10 700	25 700	271	52							3						
DFT 2505-3	D						1.5×2	10 700	25 700	532	102							3						
PFT 2505-7.5	P						2.5×3	14 800	32 800	544	70							—						
SFT 2505-5	Clearance						2.5×2	16 600	43 700	447	55							3						
ZFT 2505-10	Z						2.5×2	16 600	43 700	876	85							3						
SFT 2505-7.5	Clearance						2.5×3	23 500	65 600	654	70							—						

Notes: 1. Nut flange for shaft diameter 20 mm or larger comes in circular shape I and circular shape II. 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. Seals are equipped as a standard for LSFT and LPFT of shaft diameter 20 mm or smaller. The outside dimensions are the same as those of without seals.
4. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.
5. The axial rigidity K 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.
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 * (asterisk) are available in the FA or SA type standard ball screws with finished shaft end.
8. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (See page B5.)

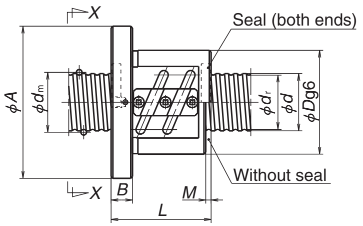
View *X-X*



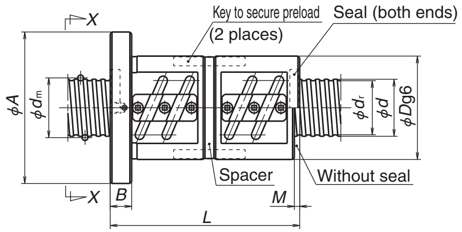
Circular shape I



Circular shape II



PFT, ZFT, SFT

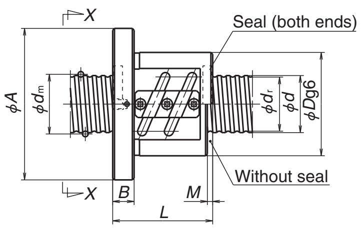


DFT

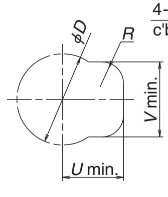
Unit: mm

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 × Circuits	Basic load rating (N)		Axial rigidity K (N/μm)	Ball nut dimensions										
								Dynamic C_a	Static C_{0a}		Nut entire length L	Nut diameter D	Flanged diameter A	Flanged width B	Notched flange G	Seal dimension M	Bolt hole dimension			Bolt hole PCD W	Oil hole Q
																	X	Y	Z		
PFT 2506-3	P	25	6	3.969	25.5	21.4	1.5×2	9 070	16 100	235	56	53	76	11	29	3	5.5	9.5	5.5	64	M6×1
SFT 2506-2.5	Clearance						2.5×1	12 300	26 800	235	44										
ZFT 2506-5	Z						2.5×1	12 300	26 800	462	62										
* **PFT 2506-5**	P						2.5×2	14 100	26 800	383	62										
SFT 2506-3	Clearance						1.5×2	14 400	32 100	280	56										
DFT 2506-3	D						1.5×2	14 400	32 100	551	110										
SFT 2506-5	Clearance						2.5×2	22 300	53 500	456	62										
ZFT 2506-10	Z						2.5×2	22 300	53 500	896	98										
PFT 2508-2.5	P		8	4.762	25.5	20.5	2.5×1	9 940	16 000	203	56	58	85	13	32	5	6.6	11	6.5	71	M6×1
PFT 2508-3	P						1.5×2	11 600	19 000	234	69										
SFT 2508-2.5	Clearance						2.5×1	15 800	32 000	242	56										
ZFT 2508-5	Z						2.5×1	15 800	32 000	476	80										
SFT 2508-3	Clearance						1.5×2	18 500	38 100	286	69										
DFT 2508-3	D						1.5×2	18 500	38 100	562	133										
PFT 2510-2.5	P		10	4.762	25.5	20.5	2.5×1	9 940	16 000	203	67	58	85	15	32	8	6.6	11	6.5	71	M6×1
ZFT 2510-3	Z						1.5×1	10 200	19 000	291	81										
PFT 2510-3	P						1.5×2	11 600	19 000	234	81										
SFT 2510-2.5	Clearance						2.5×1	15 800	32 000	242	67										
DFT 2510-2.5	D						2.5×1	15 800	32 000	475	127										
SFT 2510-3	Clearance						1.5×2	18 500	38 100	286	81										
DFT 2510-3	D						1.5×2	18 500	38 100	562	151										
SFT 2510-3.5	Clearance						3.5×1	21 100	44 200	330	77										
DFT 2510-3.5	D						3.5×1	21 100	44 200	649	147										

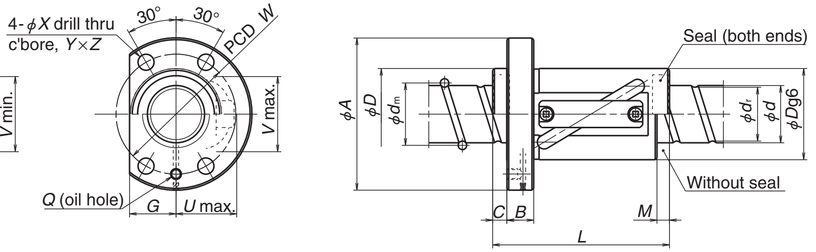
Notes:
1. Nut flange for shaft diameter 20 mm or larger comes in circular shape I and circular shape II. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, ZFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.
4. The axial rigidity *K* 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.
5. For PFT, the basic load ratings differ from the other models as the spacer balls are installed.
6. The models marked with * (asterisk) are available in the SA type standard ball screws with finished shaft end.
7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (See page B5.)



PFT, ZFT, SFT

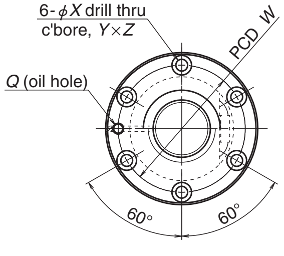


Housing hole and its clearance

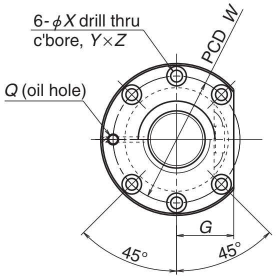


LPFT, LSFT

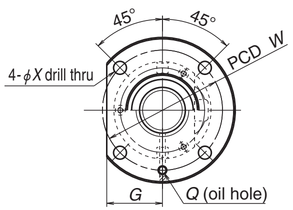
View X-X

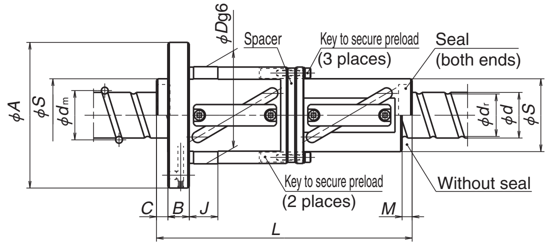


Circular shape Ⅰ



Circular shape Ⅱ





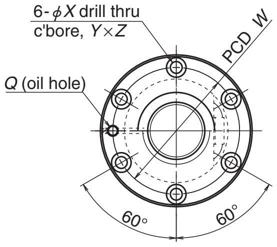
LDFT

Unit: mm

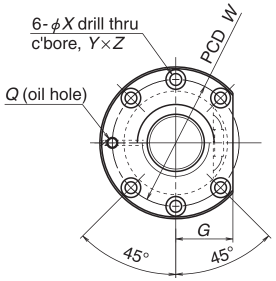
Model No.	Preload system	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls Turns × Circuits	Basic load rating (N) Dynamic C_a	Basic load rating (N) Static C_{0a}	Axial rigidity K (N/μm)	Nut entire length L	Ball nut dimensions: Nut diameter D	Nut diameter S	Flanged diameter A	Flanged width B	Notched flange G	Tube projecting type U	Tube projecting type V	Tube projecting type R	Seal dimension M	Seal dimension C	Diameter g6 J	Bolt hole dimension X	Bolt hole dimension Y	Bolt hole dimension Z	Bolt hole PCD W	Oil hole Q
LPFT 2516-2.5	P	25	16	4.762	26.25	21.3	2.5×1	9 900	16 400	210	84	44	—	71	12	23	31	35	12	6	8	—	6.6	—	—	57	M6×1
LPFT 2516-3	P						1.5×2	11 600	19 100	247	100	44	—	71		23	31	35	12			—				57	
LSFT 2516-2.5	Clearance						2.5×1	15 700	32 800	250	84	44	—	71		23	31	35	12			—				57	
LDFT 2516-2.5	D						2.5×1	15 700	32 800	490	152	62	44	89		34	—	—	—			18				75	
LSFT 2516-3	Clearance						1.5×2	18 400	38 200	295	100	44	—	71		23	31	35	12			—				57	
LDFT 2516-3	D						1.5×2	18 400	38 200	577	181	62	44	89		34	—	—	—			18				75	
* LPFT 2520-2.5	P		20	4.762	26.25	21.3	2.5×1	9 900	16 400	210	96	44	—	71	12	23	31	35	12	7	8	—	6.6	—	—	57	M6×1
LPFT 2520-3	P						1.5×2	11 600	19 100	247	116	44	—	71		23	31	35	12			—				57	
LSFT 2520-2.5	Clearance						2.5×1	15 700	32 800	250	96	44	—	71		23	31	35	12			—				57	
LDFT 2520-2.5	D						2.5×1	15 700	32 800	490	177	62	44	89		34	—	—	—			18				75	
LSFT 2520-3	Clearance						1.5×2	18 400	38 200	295	116	44	—	71		23	31	35	12			—				57	
LDFT 2520-3	D						1.5×2	18 400	38 200	577	217	62	44	89		34	—	—	—			18				75	
* LPFT 2525-1.5	P		25	4.762	26.25	21.3	1.5×1	6 380	9 540	127	90	44	—	71	12	23	32	34	12	10	10	—	6.6	—	—	57	M6×1
LDFT 2525-1.5	D							10 100	19 100	308	166	62	44	89		34	—	—	—			18				75	
LSFT 2525-1.5	Clearance							10 100	19 100	157	90	44	—	71		23	32	34	12			—				57	
SFT 2805-2.5	Clearance	28	5	3.175	28.5	25.2	2.5×1	9 600	24 400	252	41	55	—	85	12	31	—	—	—	3	—	—	6.6	11	6.5	69	M6×1
ZFT 2805-5	Z						2.5×1	9 600	24 400	495	56																
PFT 2805-5	P						2.5×2	11 000	24 400	410	56																
SFT 2805-5	Clearance						2.5×2	17 400	48 800	487	56																
* ZFT 2805-10	Z						2.5×2	17 400	48 800	959	86																

Notes: 1. Nut flange for shaft diameter 20 mm or larger comes in circular shape I and circular shape II. 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.
5. The axial rigidity K 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.
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 * (asterisk) are available in the FA or SA type standard ball screws with finished shaft end.
8. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (See page B5.)

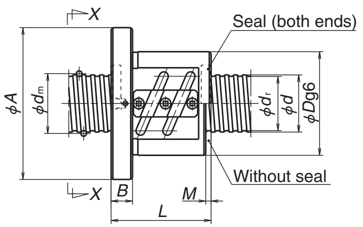
View *X*-*X*



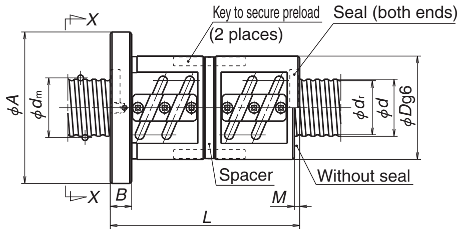
Circular shape I



Circular shape II



PFT, ZFT, SFT



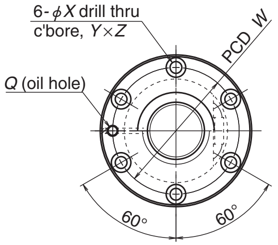
DFT

Unit: mm

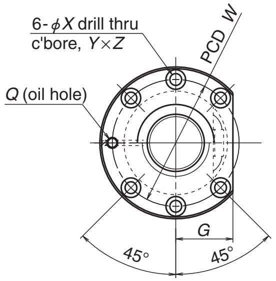
Model No.	Preload system	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls	Basic load rating (N)		Axial rigidity	Ball nut dimensions										
		d	*l*	D_w	d_m	d_r	Turns × Circuits	Dynamic C_a	Static C_{0a}	*K* (N/μm)	Nut entire length *L*	Nut diameter *D*	Flanged diameter *A*	Flanged width *B*	Notched flange *G*	Seal dimension *M*	Bolt hole dimension			Bolt hole PCD *W*	Oil hole *Q*
																	X	*Y*	*Z*		
PFT 2806-3	P	28	6	3.175	28.5	25.2	1.5×2	7 080	14 600	252	57	55	85	12	31	3	6.6	11	6.5	69	M6×1
SFT 2806-2.5	Clearance						2.5×1	9 600	24 400	252	45										
ZFT 2806-5	Z						2.5×1	9 600	24 400	495	63										
∗ **PFT 2806-5**	P						2.5×2	11 000	24 400	410	63										
SFT 2806-3	Clearance						1.5×2	11 200	29 300	300	57										
DFT 2806-3	D						1.5×2	11 200	29 300	590	111										
SFT 2806-5	Clearance						2.5×2	17 400	48 800	487	63										
∗ **ZFT 2806-10**	Z						2.5×2	17 400	48 800	959	99										
PFT 2810-2.5	P		10	4.762	28.5	23.5	2.5×1	10 500	18 000	220	68	60	94	15	36	7	9	14	8.5	76	M6×1
ZFT 2810-3	Z						1.5×1	10 800	21 500	320	82										
PFT 2810-3	P						1.5×2	12 300	21 500	265	82										
SFT 2810-2.5	Clearance						2.5×1	16 700	36 100	265	68										
DFT 2810-2.5	D						2.5×1	16 700	36 100	522	128										
SFT 2810-3	Clearance						1.5×2	19 500	43 000	314	82										
DFT 2810-3	D						1.5×2	19 500	43 000	618	152										
SFT 3204-2.5	Clearance	32	4	2.381	32.3	29.8	2.5×1	5 800	17 500	234	37	54	81	12	31	3	6.6	11	6.5	67	M6×1
ZFT 3204-5	Z						2.5×1	5 800	17 500	461	49										
PFT 3204-5	P						2.5×2	6 630	17 500	382	49										
SFT 3204-5	Clearance						2.5×2	10 500	35 100	454	49										
ZFT 3204-10	Z						2.5×2	10 500	35 100	892	73										
PFT 3205-3	P		5	3.175	32.5	29.2	1.5×2	7 490	16 800	281	53	58	85	12	32	3	6.6	11	6.5	71	M6×1
SFT 3205-2.5	Clearance						2.5×1	10 200	28 000	281	41										
ZFT 3205-5	Z						2.5×1	10 200	28 000	552	56										
∗ **PFT 3205-5**	P						2.5×2	11 600	28 000	455	56										
SFT 3205-3	Clearance						1.5×2	11 900	33 600	333	53										
DFT 3205-3	D						1.5×2	11 900	33 600	655	103										
PFT 3205-7.5	P						2.5×3	16 500	42 100	672	71										
SFT 3205-5	Clearance						2.5×2	18 500	56 100	543	56										
∗ **ZFT 3205-10**	Z						2.5×2	18 500	56 100	1 070	86										
SFT 3205-7.5	Clearance						2.5×3	26 200	84 100	799	71										
DFT 3205-7.5	D						2.5×3	26 200	84 100	1 572	136										

Notes: 1. Nut flange for shaft diameter 20 mm or larger comes in circular shape I and circular shape II. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, ZFT, 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.
4. The axial rigidity *K* 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.
5. For PFT, the basic load ratings differ from the other models as the spacer balls are installed.
6. The models marked with ∗ (asterisk) are available in the SA type standard ball screws with finished shaft end.
7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (See page B5.)

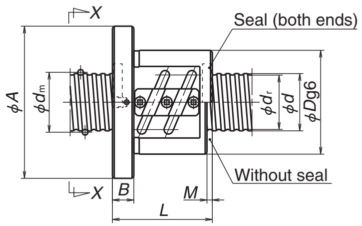
View *X-X*



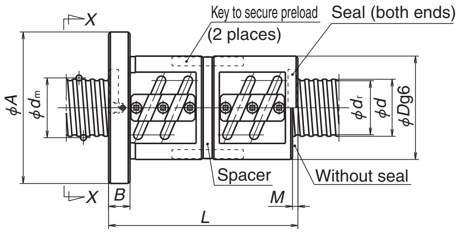
Circular shape Ⅰ



Circular shape Ⅱ



PFT, ZFT, SFT



DFT

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 × Circuits	Basic load rating (N)		Axial rigidity *K* (N/μm)	Ball nut dimensions										
								Dynamic C_a	Static C_{0a}		Nut entire length *L*	Nut diameter *D*	Flanged diameter *A*	Flanged width *B*	Notched flange *G*	Seal dimension *M*	Bolt hole dimension			Bolt hole PCD *W*	Oil hole *Q*
																	X	*Y*	*Z*		
PFT 3206-3	P	32	6	3.969	32.5	28.4	1.5×2	10 000	20 600	285	57	62	89	12	34	3	6.6	11	6.5	75	M6×1
SFT 3206-2.5	Clearance						2.5×1	13 600	34 700	287	45										
ZFT 3206-5	Z						2.5×1	13 600	34 700	563	63										
PFT 3206-5	P						2.5×2	15 500	34 700	468	63										
SFT 3206-3	Clearance						1.5×2	15 900	41 200	339	57										
DFT 3206-3	D						1.5×2	15 900	41 200	666	111										
SFT 3206-5	Clearance						2.5×2	24 700	69 400	555	63										
* **ZFT 3206-10**	Z						2.5×2	24 700	69 400	1 090	99										
PFT 3208-3	P		8	4.762	32.5	27.5	1.5×2	12 900	24 800	294	71	66	100	15	38	5	9	14	8.5	82	M6×1
SFT 3208-2.5	Clearance						2.5×1	17 500	41 000	292	58					5					
ZFT 3208-5	Z						2.5×1	17 500	41 000	573	82					5					
PFT 3208-5	P						2.5×2	20 000	41 000	470	82					5					
SFT 3208-3	Clearance						1.5×2	20 400	49 500	349	71					5					
ZFT 3208-6	Z						1.5×2	20 400	49 500	686	111					5					
SFT 3208-5	Clearance						2.5×2	31 700	82 000	565	82					5					
DFT 3208-5	D						2.5×2	31 700	82 000	1 102	154					5					
ZFT 3208-10	Z						2.5×2	31 700	82 000	1 102	130					—					
PFT 3210-2.5	P		10	6.35	33.0	26.4	2.5×1	16 100	27 000	255	70	74	108	15	41	7	9	14	8.5	90	M6×1
ZFT 3210-3	Z						1.5×1	16 400	32 400	365	87					7					
PFT 3210-3	P						1.5×2	18 800	32 400	303	87					7					
SFT 3210-2.5	Clearance						2.5×1	25 500	54 000	302	70					7					
* **ZFT 3210-5**	Z						2.5×1	25 500	54 000	594	100					7					
PFT 3210-5	P						2.5×2	29 200	54 000	494	100					7					
SFT 3210-3	Clearance						1.5×2	29 900	64 800	360	87					7					
DFT 3210-3	D						1.5×2	29 900	64 800	707	167					7					
SFT 3210-3.5	Clearance						3.5×1	34 100	77 000	422	80					7					
DFT 3210-3.5	D						3.5×1	34 100	77 000	829	150					7					
SFT 3210-5	Clearance						2.5×2	46 300	108 000	585	100					7					
* **DFT 3210-5**	D						2.5×2	46 300	108 000	1 156	190					7					
ZFT 3210-10	Z						2.5×2	46 300	108 000	1 156	160					—					
PFT 3212-2.5	P		12	6.35	33.0	26.4	2.5×1	16 100	27 000	255	81	74	108	18	41	9	9	14	8.5	90	M6×1
ZFT 3212-3	Z						1.5×1	16 400	32 400	365	97										
PFT 3212-3	P						1.5×2	18 800	32 400	303	97										
SFT 3212-2.5	Clearance						2.5×1	25 500	54 000	302	81										
DFT 3212-2.5	D						2.5×1	25 500	54 000	603	153										
SFT 3212-3	Clearance						1.5×2	29 900	64 800	360	97										
DFT 3212-3	D						1.5×2	29 900	64 800	707	181										

Notes: 1. Nut flange for shaft diameter 20 mm or larger comes in circular shape I and circular shape II. Select a flange that is suitable for the space available for nut installation.

2. If there is no seal for PFT, ZFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".

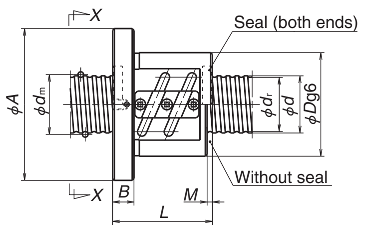
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.

4. The axial rigidity *K* 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.

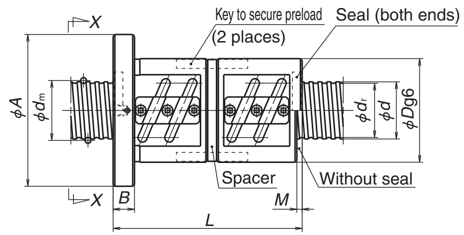
5. For PFT, the basic load ratings differ from the other models as the spacer balls are installed.

6. The models marked with * (asterisk) are available in the SA type standard ball screws with finished shaft end.

7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (See page B5.)

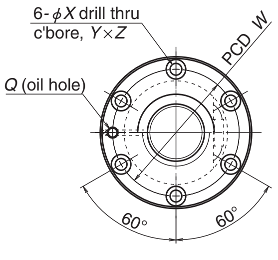


PFT, ZFT, SFT

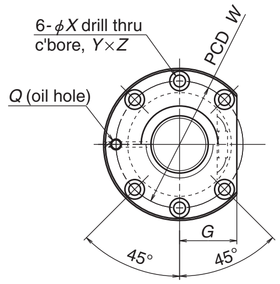


DFT

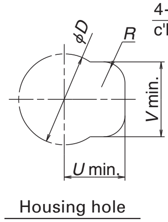
View *X*-*X*



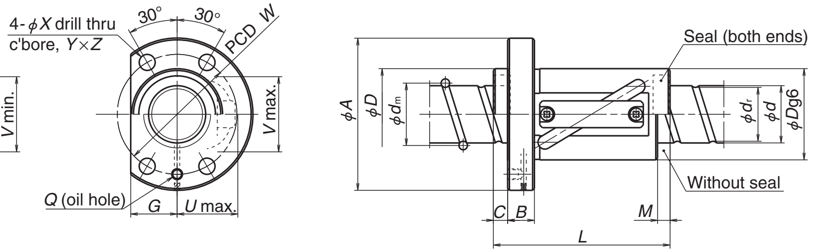
Circular shape I



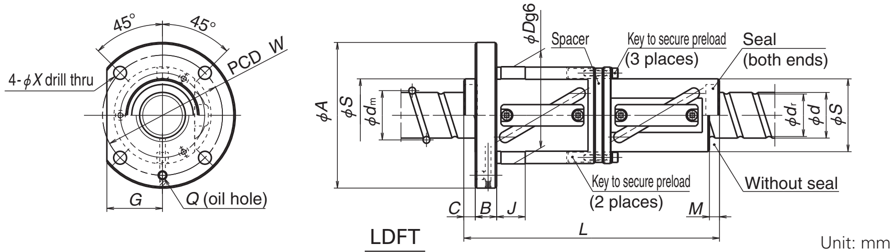
Circular shape II



Housing hole and its clearance



LPFT, LSFT



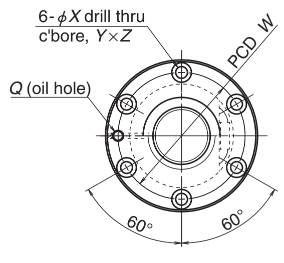
LDFT

Unit: mm

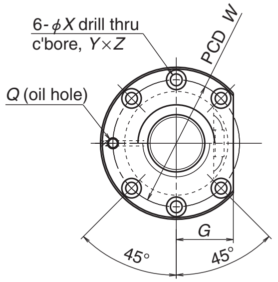
Model No.	Preload system	Shaft dia. *d*	Lead *l*	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls Turns × Circuits	Basic load rating (N) Dynamic C_a	Basic load rating (N) Static C_{0a}	Axial rigidity *K* (N/μm)	Nut entire length *L*	Ball nut dimensions: Nut diameter *D*	Nut diameter *S*	Flanged diameter *A*	Flanged width *B*	Notched flange *G*	Tube projecting type *U*	Tube projecting type *V*	Tube projecting type *R*	Seal dimension *M*	Seal dimension *C*	Diameter g6 *J*	Bolt hole dimension *X*	Bolt hole dimension *Y*	Bolt hole dimension *Z*	Bolt hole PCD *W*	Oil hole *Q*
LPFT 3220-2.5	P	32	20	4.762	33.25	28.3	2.5×1	11 300	20 900	251	99	51	—	85	15	26	34	42	12	7	8	—	9	—	—	67	M6×1
LPFT 3220-3	P						1.5×2	13 200	24 800	297	119	51	—	85		26	34	42	12			—				67	
LSFT 3220-2.5	Clearance						2.5×1	17 900	41 800	300	99	51	—	85		26	34	42	12			—				67	
LDFT 3220-2.5	D						2.5×1	17 900	41 800	604	179	68	51	102		39	—	—	—			20				84	
LSFT 3220-3	Clearance						1.5×2	21 000	49 600	360	119	51	—	85		26	34	42	12			—				67	
LDFT 3220-3	D						1.5×2	21 000	49 600	708	219	68	51	102		39	—	—	—			20				84	
* **LPFT 3225-2.5**	P		25	4.762	33.25	28.3	2.5×1	11 300	20 900	251	117	51	—	85	15	26	34	42	12	10	10	—	9	—	—	67	M6×1
LPFT 3225-3	P						1.5×2	13 200	24 800	297	142	51	—	85		26	34	42	12			—				67	
LSFT 3225-2.5	Clearance						2.5×1	17 900	41 800	300	117	51	—	85		26	34	42	12			—				67	
LDFT 3225-2.5	D						2.5×1	17 900	41 800	604	218	68	51	102		39	—	—	—			20				84	
LSFT 3225-3	Clearance						1.5×2	21 000	49 600	360	142	51	—	85		26	34	42	12			—				67	
LDFT 3225-3	D						1.5×2	21 000	49 600	708	268	68	51	102		39	—	—	—			20				84	
* **LPFT 3232-1.5**	P		32	4.762	33.25	28.3	1.5×1	7 280	12 400	161	109	51	—	85	15	26	34	42	12	13	12	—	9	—	—	67	M6×1
LSFT 3232-1.5	Clearance							11 500	24 800	190	109	51	—	85		26	34	42	12			—				67	
LDFT 3232-1.5	D							11 500	24 800	376	205	68	51	102		39	—	—	—			20				84	
ZFT 3605-5	Z	36	5	3.175	36.5	33.2	2.5×1	10 700	31 700	607	59	65	—	100	15	38	—	—	—	3	—	—	9	14	8.5	82	M6×1
PFT 3605-5	P						2.5×2	12 200	31 700	504	59																
PFT 3605-7.5	P						2.5×3	17 300	47 500	740	74																
SFT 3605-5	Clearance						2.5×2	19 400	63 300	597	59																
ZFT 3605-10	Z						2.5×2	19 400	63 300	1 170	89																
SFT 3605-7.5	Clearance						2.5×3	27 500	95 000	878	74																
DFT 3605-7.5	D						2.5×3	27 500	95 000	1 730	139																

Notes:
1. Nut flange for shaft diameter 20 mm or larger comes in circular shape I and circular shape II. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, ZFT, SFT, and DFT 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.
5. The axial rigidity *K* 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.
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 * (asterisk) are available in the FA type standard ball screws with finished shaft end.
8. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (See page B5.)

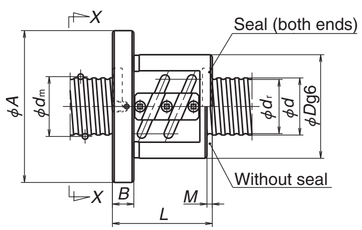
View *X-X*



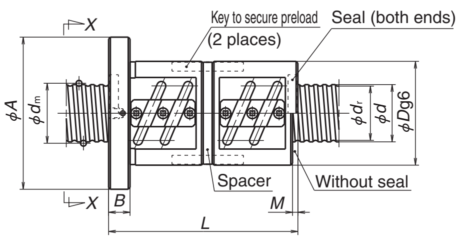
Circular shape I



Circular shape II



PFT, ZFT, SFT



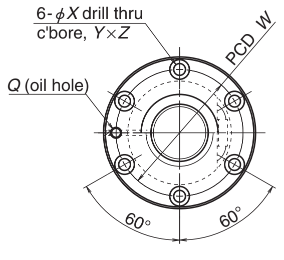
DFT

Unit: mm

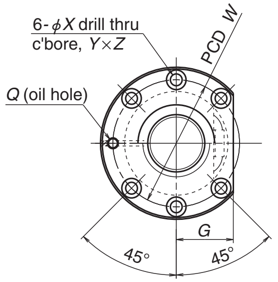
Model No.	Preload system	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls	Basic load rating (N)		Axial rigidity	Ball nut dimensions						Bolt hole dimension			Bolt hole PCD	Oil hole
		d	l	D_w	d_m	d_r	Turns × Circuits	Dynamic C_a	Static C_{0a}	K (N/μm)	Nut entire length L	Nut diameter D	Flanged diameter A	Flanged width B	Notched flange G	Seal dimension M	X	Y	Z	W	Q
ZFT 3606-5	Z	36	6	3.969	36.5	32.4	2.5×1	14 600	39 300	625	66	65	100	15	38	3	9	14	8.5	82	M6×1
PFT 3606-5	P						2.5×2	16 700	39 300	518	66										
PFT 3606-7.5	P						2.5×3	23 700	58 900	763	84										
SFT 3606-5	Clearance						2.5×2	26 500	78 500	615	66										
ZFT 3606-10	Z						2.5×2	26 500	78 500	1 210	102										
SFT 3606-7.5	Clearance						2.5×3	37 600	118 000	905	84										
DFT 3606-7.5	D						2.5×3	37 600	118 000	1 780	162										
PFT 3610-2.5	P		10	6.35	37.0	30.4	2.5×1	17 100	30 600	278	73	75	120	18	45	7	11	17.5	11	98	M6×1
ZFT 3610-3	Z						1.5×1	17 500	36 800	404	90					7					
PFT 3610-3	P						1.5×2	20 000	36 800	327	90					7					
SFT 3610-2.5	Clearance						2.5×1	27 200	61 300	334	73					7					
ZFT 3610-5	Z						2.5×1	27 200	61 300	657	103					7					
PFT 3610-5	P						2.5×2	31 100	61 300	537	103					7					
SFT 3610-3	Clearance						1.5×2	31 800	73 500	397	90					7					
DFT 3610-3	D						1.5×2	31 800	73 500	781	170					7					
PFT 3610-7.5	P						2.5×3	43 700	96 000	782	133					—					
SFT 3610-5	Clearance						2.5×2	49 300	123 000	647	103					7					
DFT 3610-5	D						2.5×2	49 300	123 000	1 259	193					7					
ZFT 3610-10	Z						2.5×2	49 300	123 000	1 259	163					—					
SFT 3610-7.5	Clearance						2.5×3	69 900	184 000	945	133					—					
PFT 4005-3	P	40	5	3.175	40.5	37.2	1.5×2	8 210	21 200	337	56	67	101	15	39	3	9	14	8.5	83	Rc1/8
SFT 4005-2.5	Clearance						2.5×1	11 100	35 300	336	44										
ZFT 4005-5	Z						2.5×1	11 100	35 300	661	59										
PFT 4005-5	P						2.5×2	12 700	35 300	548	59										
SFT 4005-3	Clearance						1.5×2	13 000	42 400	399	56										
DFT 4005-3	D						1.5×2	13 000	42 400	785	106										
PFT 4005-7.5	P						2.5×3	18 100	53 000	806	74										
SFT 4005-5	Clearance						2.5×2	20 200	70 600	649	59										
* **ZFT 4005-10**	Z						2.5×2	20 200	70 600	1 280	89										
SFT 4005-7.5	Clearance						2.5×3	28 700	106 000	956	74										
DFT 4005-7.5	D						2.5×3	28 700	106 000	1 870	139										
ZFT 4006-5	Z		6	3.969	40.5	36.4	2.5×1	15 200	43 800	679	66	70	104	15	40	3	9	14	8.5	86	Rc1/8
PFT 4006-5	P						2.5×2	17 400	43 800	564	66										
SFT 4006-3	Clearance						1.5×2	17 800	52 600	411	60										
DFT 4006-3	D						1.5×2	17 800	52 600	807	114										
PFT 4006-7.5	P						2.5×3	24 600	65 700	827	84										
SFT 4006-5	Clearance						2.5×2	27 600	87 600	668	66										
ZFT 4006-10	Z						2.5×2	27 600	87 600	1 320	102										
SFT 4006-7.5	Clearance						2.5×3	39 100	131 000	984	84										
DFT 4006-7.5	D						2.5×3	39 100	131 000	1 940	162										

Notes:
1. Nut flange for shaft diameter 20 mm or larger comes in circular shape I and circular shape II. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, ZFT, 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.
4. The axial rigidity *K* 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.
5. For PFT, the basic load ratings differ from the other models as the spacer balls are installed.
6. The models marked with * (asterisk) are available in the SA type standard ball screws with finished shaft end.
7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (See page B5.)

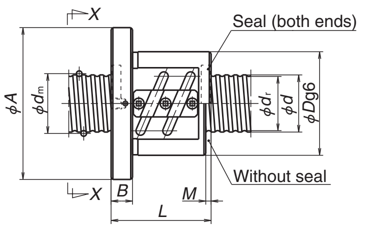
View X-X



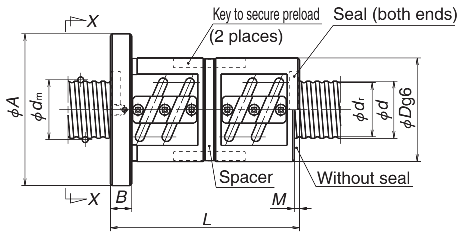
Circular shape Ⅰ



Circular shape Ⅱ



PFT, ZFT, SFT

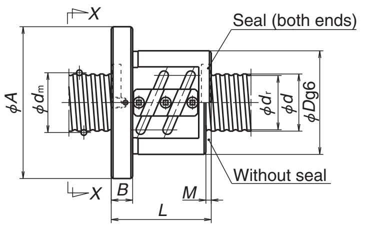


DFT

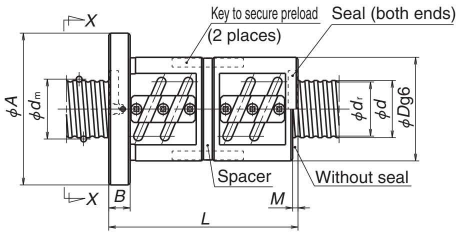
Unit: mm

Model No.	Preload system	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls	Basic load rating (N)		Axial rigidity	Ball nut dimensions										
							Turns × Circuits	Dynamic	Static		Nut entire length	Nut diameter	Flanged diameter	Flanged width	Notched flange	Seal dimension	Bolt hole dimension			Bolt hole PCD	Oil hole
		d	l	D_w	d_m	d_r		C_a	C_{0a}	K (N/μm)	L	D	A	B	G	M	X	Y	Z	W	Q
PFT 4008-3	P	40	8	4.762	40.5	35.5	1.5×2	14 200	31 300	352	71	74	108	15	41	5	9	14	8.5	90	Rc1/8
SFT 4008-2.5	Clearance						2.5×1	19 200	51 600	349	58										
ZFT 4008-5	Z						2.5×1	19 200	51 600	687	82										
PFT 4008-5	P						2.5×2	22 000	51 600	570	82										
SFT 4008-3	Clearance						1.5×2	22 500	62 600	418	71										
DFT 4008-3	D						1.5×2	22 500	62 600	822	135										
SFT 4008-5	Clearance						2.5×2	34 900	103 000	675	82										
ZFT 4008-10	Z						2.5×2	34 900	103 000	1 330	130										
PFT 4010-2.5	P		10	6.35	41	34.4	2.5×1	18 000	34 300	307	73	82	124	18	47	7	11	17.5	11	102	Rc1/8
PFT 4010-3	P						1.5×2	21 100	41 100	366	90					7					
SFT 4010-2.5	Clearance						2.5×1	28 600	68 600	365	73					7					
ZFT 4010-5	Z						2.5×1	28 600	68 600	717	103					7					
PFT 4010-5	P						2.5×2	32 800	68 600	595	103					7					
SFT 4010-3	Clearance						1.5×2	33 500	82 300	434	90					7					
ZFT 4010-6	Z						1.5×2	33 500	82 300	854	140					7					
ZFT 4010-7	Z						3.5×1	38 300	96 000	988	123					7					
SFT 4010-3.5	Clearance						3.5×1	38 300	96 000	503	83					7					
PFT 4010-7	P						3.5×2	43 700	96 000	813	123					—					
SFT 4010-5	Clearance						2.5×2	52 000	137 000	706	103					7					
* **DFT 4010-5**	D						2.5×2	52 000	137 000	1 376	193					7					
ZFT 4010-10	Z						2.5×2	52 000	137 000	1 376	163					—					
SFT 4010-7	Clearance						3.5×2	69 400	192 000	976	123					—					
PFT 4012-2.5	P		12	7.144	41.5	34.1	2.5×1	21 200	38 800	310	81	86	128	18	48	9	11	17.5	11	106	Rc1/8
SFT 4012-2.5	Clearance						2.5×1	33 600	77 500	373	81					9					
ZFT 4012-5	Z						2.5×1	33 600	77 500	733	117					9					
PFT 4012-5	P						2.5×2	38 400	77 500	600	117					9					
PFT 4012-7.5	P						2.5×3	54 400	116 000	872	153					—					
SFT 4012-5	Clearance						2.5×2	61 000	155 000	722	117					9					
* **DFT 4012-5**	D						2.5×2	61 000	155 000	1 404	225					9					
ZFT 4012-10	Z						2.5×2	61 000	155 000	1 404	189					—					
SFT 4012-7.5	Clearance						2.5×3	86 400	233 000	1 054	153					—					
ZFT 4016-3	Z		16	7.144	41.5	34.1	1.5×1	21 700	46 500	451	118	86	128	22	48	14	11	17.5	11	106	Rc1/8
SFT 4016-2.5	Clearance						2.5×1	33 600	77 500	373	102										
DFT 4016-2.5	D						2.5×1	33 600	77 500	733	182										
SFT 4016-3	Clearance						1.5×2	39 300	93 100	440	118										
DFT 4016-3	D						1.5×2	39 300	93 100	872	214										

Notes: 1. Nut flange for shaft diameter 20 mm or larger comes in circular shape I and circular shape II. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, ZFT, 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.
4. The axial rigidity K 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.
5. For PFT, the basic load ratings differ from the other models as the spacer balls are installed.
6. The models marked with ∗ (asterisk) are available in the SA type standard ball screws with finished shaft end.
7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (See page B5.)

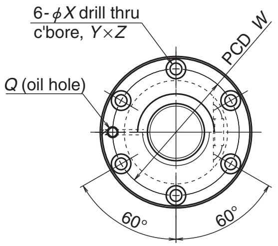


ZFT, SFT

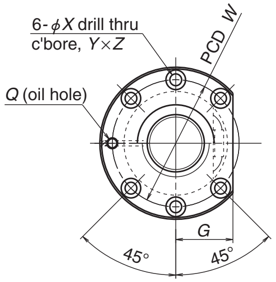


DFT

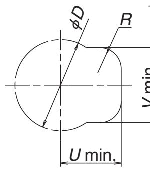
View X-X



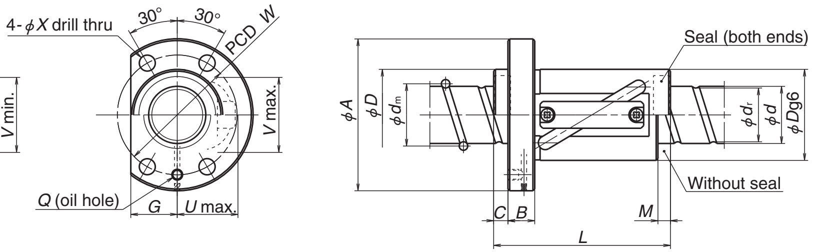
Circular shape I



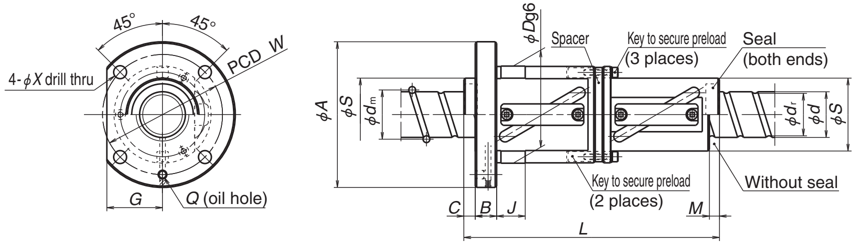
Circular shape II



Housing hole and its clearance



LPFT, LSFT



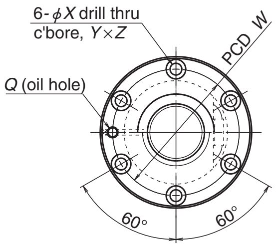
LDFT

Unit: mm

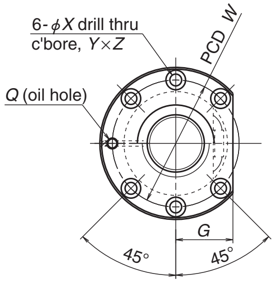
Model No.	Preload system	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity	Nut entire length	Ball nut dimensions															
								Dynamic	Static			Nut diameter		Flanged diameter	Flanged width	Notched flange	Tube projecting type			Seal dimension		Diameter g6	Bolt hole dimension			Bolt hole PCD	Oil hole
		d	l	D_w	d_m	d_r		C_a	C_{0a}	K (N/μm)	L	D	S	A	B	G	U	V	R	M	C	J	X	Y	Z	W	Q
LPFT 4025-2.5	P	40	25	6.35	41.75	35.1	2.5×1	18 000	35 000	315	123	64	—	106	18	33	42	52	15	10	10	—	11	—	—	84	Rc1/8
LPFT 4025-3	P						1.5×2	21 000	41 200	347	148	64	—	106		33	42	52	15			—				84	
LSFT 4025-2.5	Clearance						2.5×1	28 500	70 000	375	123	64	—	106		33	42	52	15			—				84	
LDFT 4025-2.5	D						2.5×1	28 500	70 000	737	223	84	64	126		48	—	—	—			22				104	
LSFT 4025-3	Clearance						1.5×2	33 400	82 400	444	148	64	—	106		33	42	52	15			—				84	
LDFT 4025-3	D						1.5×2	33 400	82 400	873	273	84	64	126		48	—	—	—			22				104	
LPFT 4032-2.5	P		32	6.35	41.75	35.1	2.5×1	18 000	35 000	315	146	64	—	106	18	33	42	52	15	13	12	—	11	—	—	84	Rc1/8
LSFT 4032-2.5	Clearance							28 500	70 000	375	146	64	—	106		33	42	52	15			—				84	
LDFT 4032-2.5	D							28 500	70 000	737	274	84	64	126		48	—	—	—			22				104	
LPFT 4040-1.5	P		40	6.35	41.75	35.1	1.5×1	11 600	20 600	199	133	64	—	106	18	33	42	52	15	16	14	—	11	—	—	84	Rc1/8
LSFT 4040-1.5	Clearance							18 400	41 200	237	133	64	—	106		33	42	52	15			—				84	
LDFT 4040-1.5	D							18 400	41 200	465	253	84	64	126		48	—	—	—			22				104	
ZFT 4510-5	Z	45	10	6.35	46.0	39.4	2.5×1	29 900	77 300	784	103	88	—	132	18	50	—	—	—	7	—	—	11	17.5	11	110	Rc1/8
PFT 4510-7	P						3.5×2	45 600	109 000	887	123									—							
PFT 4510-7.5	P						2.5×3	48 400	116 000	950	133									—							
SFT 4510-5	Clearance						2.5×2	54 200	155 000	772	103									7							
DFT 4510-5	D						2.5×2	54 200	155 000	1 520	193									7							
SFT 4510-7	Clearance						3.5×2	72 400	218 000	1 064	123									—							
SFT 4510-7.5	Clearance						2.5×3	76 800	232 000	1 140	133									7							
DFT 4510-7.5	D						2.5×3	76 800	232 000	2 230	253									7							
SFT 4512-2.5	Clearance		12	7.144	46.5	39.1	2.5×1	35 400	88 500	412	83	90	—	132	18	50	—	—	—	8	—	—	11	17.5	11	110	Rc1/8
ZFT 4512-5	Z						2.5×1	35 400	88 500	811	119																
SFT 4512-5	Clearance						2.5×2	64 200	177 000	798	119																
DFT 4512-5	D						2.5×2	64 200	177 000	1 570	227																

Notes:
1. Nut flange for shaft diameter 20 mm or larger comes in circular shape I and circular shape II. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for ZFT, SFT, and DFT 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.
5. The axial rigidity *K* 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.
6. For 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 (See page B5.)

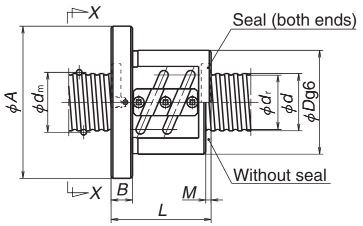
View X-X



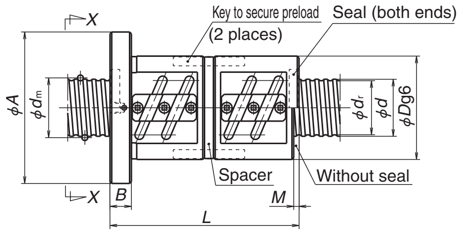
Circular shape Ⅰ



Circular shape Ⅱ



ZFT, SFT

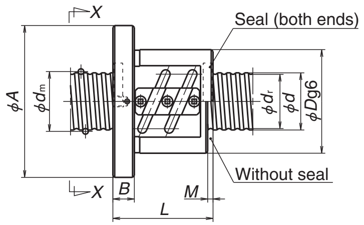


DFT

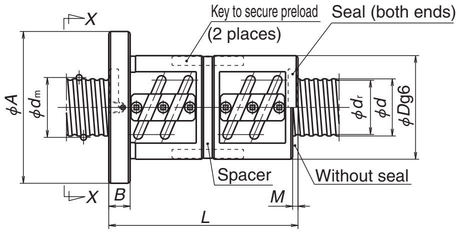
Unit: mm

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 × Circuits	Basic load rating (N)		Axial rigidity K (N/μm)	Ball nut dimensions										
								Dynamic C_a	Static C_{0a}		Nut entire length L	Nut diameter D	Flanged diameter A	Flanged width B	Notched flange G	Seal dimension M	Bolt hole dimension			Bolt hole PCD W	Oil hole Q
																	X	Y	Z		
SFT 5005-3	Clearance	50	5	3.175	50.5	47.2	1.5×2	14 200	52 500	472	58	80	114	15	43	3	9	14	8.5	96	Rc1/8
ZFT 5005-6	Z						1.5×2	14 200	52 500	930	83										
SFT 5005-4.5	Clearance						1.5×3	20 200	78 800	696	68										
ZFT 5005-9	Z						1.5×3	20 200	78 800	1 360	103										
SFT 5006-3	Clearance		6	3.969	50.5	46.4	1.5×2	19 500	65 100	486	62	84	118	15	45	3	9	14	8.5	100	Rc1/8
DFT 5006-3	D						1.5×2	19 500	65 100	956	116					3					
PFT 5006-7.5	P						2.5×3	27 000	81 900	988	86					—					
SFT 5006-5	Clearance						2.5×2	30 300	109 000	794	68					3					
ZFT 5006-10	Z						2.5×2	30 300	109 000	1 562	104					3					
SFT 5006-7.5	Clearance						2.5×3	42 900	164 000	1 170	86					3					
DFT 5006-7.5	D						2.5×3	42 900	164 000	2 300	164					3					
SFT 5008-3	Clearance		8	4.762	50.5	45.5	1.5×2	25 000	77 400	496	74	87	129	18	49	5	11	17.5	11	107	Rc1/8
DFT 5008-3	D						1.5×2	25 000	77 400	975	138										
SFT 5008-5	Clearance						2.5×2	38 700	131 000	815	85										
ZFT 5008-10	Z						2.5×2	38 700	131 000	1 600	133										
SFT 5008-7.5	Clearance						2.5×3	54 900	197 000	1 200	109										
DFT 5008-7.5	D						2.5×3	54 900	197 000	2 350	205										
SFT 5010-2.5	Clearance		10	6.35	51.0	44.4	2.5×1	31 800	87 400	440	73	93	135	18	51	7	11	17.5	11	113	Rc1/8
ZFT 5010-5	Z						2.5×1	31 800	87 400	866	103					7					
SFT 5010-3	Clearance						1.5×2	37 200	103 000	517	90					7					
DFT 5010-3	D						1.5×2	37 200	103 000	1 010	170					7					
ZFT 5010-7	Z						3.5×1	42 500	122 000	1 190	123					7					
PFT 5010-7.5	P						2.5×3	51 500	131 000	1 039	133					—					
SFT 5010-5	Clearance						2.5×2	57 700	175 000	853	103					7					
* **ZFT 5010-10**	Z						2.5×2	57 700	175 000	1 677	163					7					
SFT 5010-7.5	Clearance						2.5×3	81 800	262 000	1 250	133					7					
DFT 5010-7.5	D						2.5×3	81 800	262 000	2 460	253					7					
SFT 5012-2.5	Clearance		12	7.938	51.5	43.2	2.5×1	42 800	107 000	449	87	100	146	22	55	8	14	20	13	122	Rc1/8
ZFT 5012-5	Z						2.5×1	42 800	107 000	883	123					8					
SFT 5012-5	Clearance						2.5×2	77 600	214 000	869	123					8					
DFT 5012-5	D						2.5×2	77 600	214 000	1 718	231					8					
ZFT 5012-10	Z						2.5×2	77 600	214 000	1 718	195					—					
SFT 5016-2.5	Clearance		16	7.938	51.5	43.2	2.5×1	42 800	107 000	449	104	100	146	22	55	14	14	20	13	122	Rc1/8
ZFT 5016-5	Z					43.2	2.5×1	42 800	107 000	883	152					14		20	13		
PFT 5016-7.5	P					44.4	2.5×3	69 300	161 000	1 066	200					—		17.5	11		
SFT 5016-5	Clearance					43.2	2.5×2	77 600	214 000	869	152					14		20	13		
DFT 5016-5	D					43.2	2.5×2	77 600	214 000	1 710	280					14		20	13		
SFT 5016-7.5	Clearance					43.2	2.5×3	110 000	321 000	1 286	200					—		17.5	11		
ZFT 5020-3	Z		20	7.938	51.5	43.2	1.5×1	27 600	64 300	542	147	100	146	28	55	17	14	20	13	122	Rc1/8
SFT 5020-2.5	Clearance						2.5×1	42 800	107 000	449	127										
DFT 5020-2.5	D						2.5×1	42 800	107 000	883	227										
SFT 5020-3	Clearance						1.5×2	50 000	129 000	534	147										
DFT 5020-3	D						1.5×2	50 000	129 000	1 050	267										

Notes: 1. Nut flange for shaft diameter 20 mm or larger comes in circular shape I and circular shape II. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for ZFT, 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.
4. The axial rigidity *K* 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.
5. The models marked with ∗ (asterisk) are available in the SA type standard ball screws with finished shaft end.
6. Preload system: Z, Offset preload; D, Double nut preload (See page B5.)

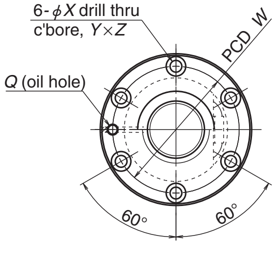


ZFT, SFT

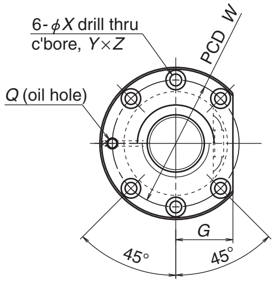


DFT

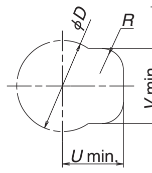
View *X-X*



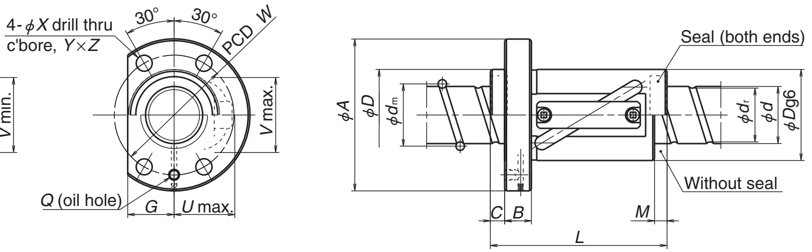
Circular shape I



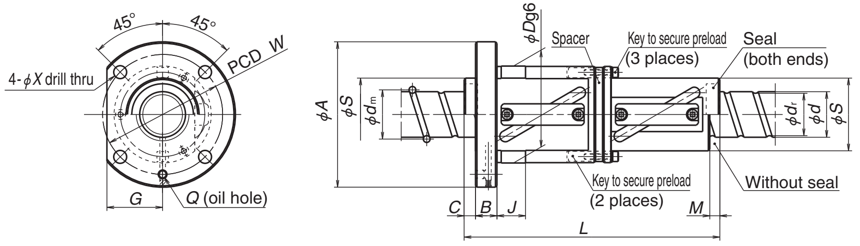
Circular shape II



Housing hole and its clearance



LPFT, LSFT



LDFT

Unit: mm

Model No.	Preload system	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity	Nut entire length	Ball nut dimensions															
								Dynamic	Static			Nut diameter		Flanged diameter	Flanged width	Notched flange	Tube projecting type			Seal dimension		Diameter g6	Bolt hole dimension			Bolt hole PCD	Oil hole
		d	*l*	D_w	d_m	d_r		C_a	C_{0a}	*K* (N/μm)	*L*	*D*	*S*	*A*	*B*	*G*	*U*	*V*	*R*	*M*	*C*	*J*	*X*	*Y*	*Z*	*W*	*Q*
LPFT 5025-2.5	P	50	25	7.938	52.25	44	2.5×1	26 900	54 700	388	129	80	—	126	22	41	52	64	19	11	11	—	14	—	—	102	Rc1/8
LPFT 5025-3	P						1.5×2	31 400	66 500	450	154	80	—	126		41	52	64	19			—				102	
LSFT 5025-2.5	Clearance						2.5×1	42 700	109 000	462	129	80	—	126		41	52	64	19			—				102	
LDFT 5025-2.5	D						2.5×1	42 700	109 000	905	229	106	80	152		56	—	—	—			25				128	
LSFT 5025-3	Clearance						1.5×2	49 900	133 000	547	154	80	—	126		41	52	64	19			—				102	
LDFT 5025-3	D						1.5×2	49 900	133 000	1 070	279	106	80	152		56	—	—	—			25				128	
LPFT 5032-2.5	P		32	7.938	52.25	44	2.5×1	26 900	54 700	388	151	80	—	126	22	41	52	64	19	14	12	—	14	—	—	102	Rc1/8
LPFT 5032-3	P						1.5×2	31 400	66 500	450	183	80	—	126		41	52	64	19			—				102	
LSFT 5032-2.5	Clearance						2.5×1	42 700	109 000	462	151	80	—	126		41	52	64	19			—				102	
LDFT 5032-2.5	D						2.5×1	42 700	109 000	905	279	106	80	152		56	—	—	—			25				128	
LSFT 5032-3	Clearance						1.5×2	49 900	133 000	547	183	80	—	126		41	52	64	19			—				102	
LDFT 5032-3	D						1.5×2	49 900	133 000	1 070	343	106	80	152		56	—	—	—			25				128	
LPFT 5040-2.5	P		40	7.938	52.25	44	2.5×1	26 900	54 700	388	178	80	—	126	22	41	52	64	19	17	14	—	14	—	—	102	Rc1/8
LSFT 5040-2.5	Clearance							42 700	109 000	462	178	80	—	126		41	52	64	19			—				102	
LDFT 5040-2.5	D							42 700	109 000	922	338	106	80	152		56	—	—	—			25				128	
LPFT 5050-1.5	P		50	7.938	52.25	44	1.5×1	17 300	33 200	245	161	80	—	126	22	41	52	64	19	21	16	—	14	—	—	102	Rc1/8
LSFT 5050-1.5	Clearance							27 500	66 500	290	161	80	—	126		41	52	64	19			—				102	
LDFT 5050-1.5	D							27 500	66 500	572	312	106	80	152		56	—	—	—			25				128	
ZFT 5510-5	Z	55	10	6.35	56.0	49.4	2.5×1	32 800	96 100	929	103	102	—	144	18	54	—	—	—	7	—	—	11	17.5	11	122	Rc1/8
SFT 5510-5	Clearance						2.5×2	59 500	192 000	916	103																
ZFT 5510-10	Z						2.5×2	59 500	192 000	1 800	163																
DFT 5510-5	D						2.5×2	59 500	192 000	1 800	193																
SFT 5510-7.5	Clearance						2.5×3	84 300	288 000	1 350	133																
DFT 5510-7.5	D						2.5×3	84 300	288 000	2 650	253																

Notes: 1. Nut flange for shaft diameter 20 mm or larger comes in circular shape I and circular shape II. Select a flange that is suitable for the space available for nut installation.

2. If there is no seal for ZFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".

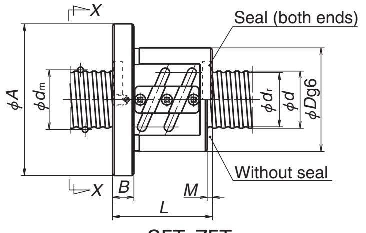
3. If there is no seal for LSFT and LDFT of shaft diameter 25 mm or larger, the nut length "L" is shortened by dimension "M" and "C".

4. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.

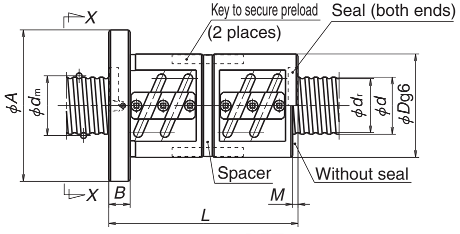
5. The axial rigidity *K* in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.

6. For 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 (See page B5.)

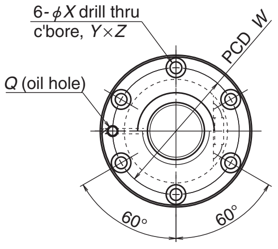


SFT, ZFT

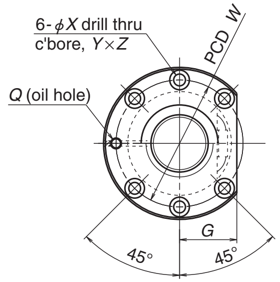


DFT

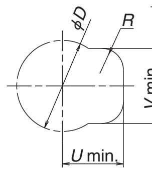
View X-X



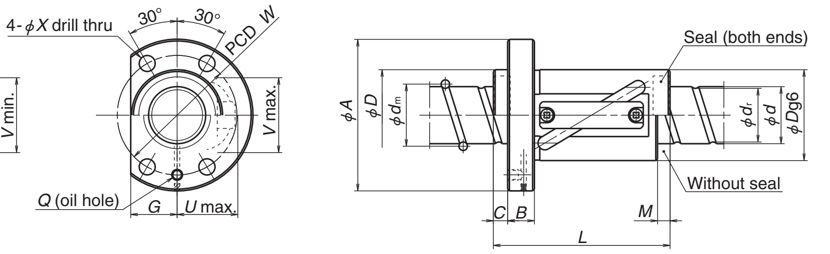
Circular shape I



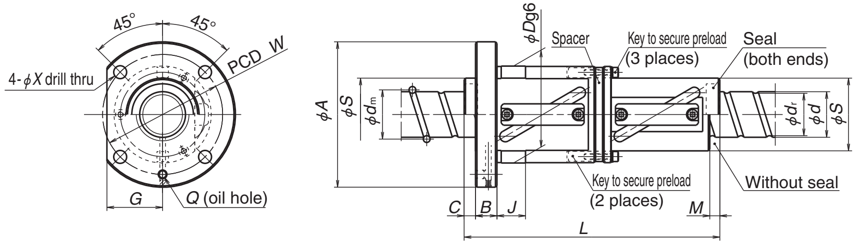
Circular shape II



Housing hole and its clearance



LPFT, LSFT



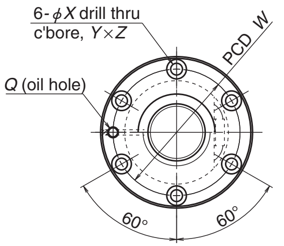
LDFT

Unit: mm

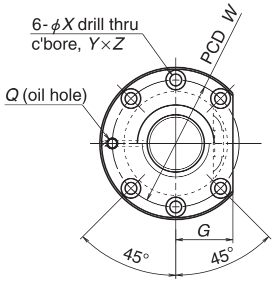
Model No.	Preload system	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls Turns × Circuits	Basic load rating (N) Dynamic C_a	Basic load rating (N) Static C_{0a}	Axial rigidity K (N/μm)	Nut entire length L	Ball nut dimensions: Nut diameter D	Nut diameter S	Flanged diameter A	Flanged width B	Notched flange G	Tube projecting type U	Tube projecting type V	Tube projecting type R	Seal dimension M	Seal dimension C	Diameter g6 J	Bolt hole dimension X	Bolt hole dimension Y	Bolt hole dimension Z	Bolt hole PCD W	Oil hole Q
SFT 6310-2.5	Clearance	63	10	6.35	64.0	57.4	2.5×1	34 800	111 000	528	77	108	—	154	22	58	—	—	—	7	—	—	14	20	13	130	Rc1/8
ZFT 6310-5	Z						2.5×1	34 800	111 000	1 038	107									7							
PFT 6310-7.5	P						2.5×3	56 400	166 000	1 250	137									—							
SFT 6310-5	Clearance						2.5×2	63 200	221 000	1 020	107									7							
ZFT 6310-10	Z						2.5×2	63 200	221 000	2 000	167									7							
SFT 6310-7.5	Clearance						2.5×3	89 500	332 000	1 500	137									7							
DFT 6310-7.5	D						2.5×3	89 500	332 000	2 950	257									7							
ZFT 6312-5	Z		12	7.938	64.5	56.2	2.5×1	47 400	137 000	1 060	123	115	—	161	22	61	—	—	—	8	—	—	14	20	13	137	Rc1/8
SFT 6312-2.5	Clearance						2.5×1	47 400	137 000	542	87																
SFT 6312-5	Clearance						2.5×2	86 000	273 000	1 050	123																
DFT 6312-5	D						2.5×2	86 000	273 000	2 060	231																
SFT 6316-2.5	Clearance		16	9.525	65.0	55.2	2.5×1	79 500	228 000	713	110	122	—	180	28	69	—	—	—	—	—	—	18	26	17.5	150	Rc1/8
DFT 6316-2.5	D						2.5×1	79 500	228 000	1 400	206																
PFT 6316-5	P						2.5×2	90 900	228 000	1 136	158																
SFT 6316-5	Clearance						2.5×2	144 000	455 000	1 380	158																
DFT 6316-5	D						2.5×2	144 000	455 000	2 710	302																
SFT 6320-2.5	Clearance		20	9.525	65.0	55.2	2.5×1	79 500	228 000	713	127	122	—	180	28	69	—	—	—	17	—	—	18	26	17.5	150	Rc1/8
DFT 6320-2.5	D						2.5×1	79 500	228 000	1 400	227									17							
PFT 6320-5	P						2.5×2	90 900	228 000	1 132	187									—							
SFT 6320-5	Clearance						2.5×2	144 000	455 000	1 380	187									17							
DFT 6320-5	D						2.5×2	144 000	455 000	2 710	347									17							
LPFT 6340-2.5	P		40	7.938	65.25	57	2.5×1	30 600	69 500	466	178	97	—	144	22	49	58	77	19	15	14	—	14	—	—	120	Rc1/8
LPFT 6340-3	P						1.5×2	35 800	82 500	551	218	97	—	144		49	58	77	19			—				120	
LSFT 6340-2.5	Clearance						2.5×1	48 500	139 000	560	178	97	—	144		49	58	77	19			—				120	
LDFT 6340-2.5	D						2.5×1	48 500	139 000	1 100	339	122	97	168		62	—	—	—			29				144	
LSFT 6340-3	Clearance						1.5×2	56 800	165 000	667	218	97	—	144		49	58	77	19			—				120	
LDFT 6340-3	D						1.5×2	56 800	165 000	1 310	419	122	97	168		62	—	—	—			29				144	
LPFT 6350-1.5	P		50	7.938	65.25	57	1.5×1	19 700	41 200	285	161	97	—	144	22	49	58	77	19	19	16	—	14	—	—	120	Rc1/8
LPFT 6350-2.5	P						2.5×1	30 600	69 500	478	211	97	—	144		49	58	77	19			—				120	
LSFT 6350-1.5	Clearance						1.5×1	31 300	82 500	346	161	97	—	144		49	58	77	19			—				120	
LDFT 6350-1.5	D						1.5×1	31 300	82 500	678	311	122	97	168		62	—	—	—			29				144	
LSFT 6350-2.5	Clearance						2.5×1	48 500	139 000	560	211	97	—	144		49	58	77	19			—				120	
LDFT 6350-2.5	D						2.5×1	48 500	139 000	1 120	411	122	97	168		62	—	—	—			29				144	

Notes: 1. Nut flange for shaft diameter 20 mm or larger comes in circular shape I and circular shape II. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for ZFT, SFT, and DFT 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.
5. The axial rigidity *K* 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.
6. For 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 (See page B5.)

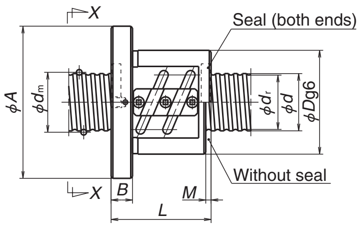
View *X-X*



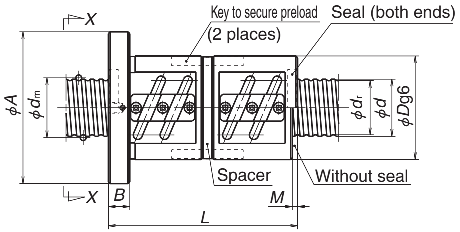
Circular shape Ⅰ



Circular shape Ⅱ



SFT



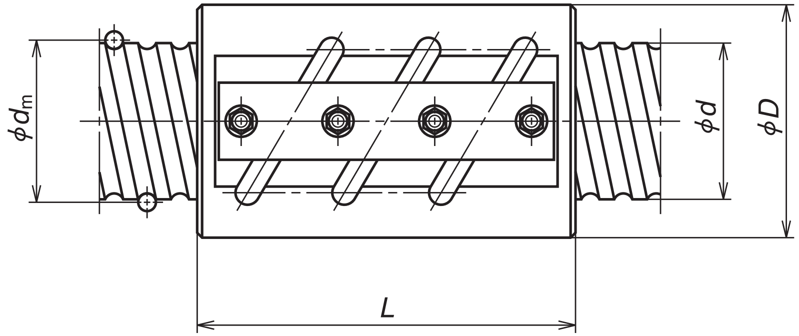
DFT

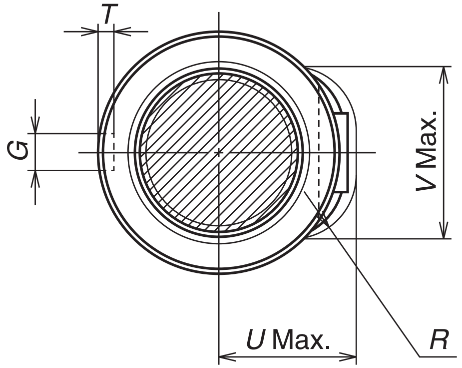
Unit: mm

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	Basic load rating (N)		Axial rigidity K (N/μm)	Ball nut dimensions										
							Turns × Circuits	Dynamic C_a	Static C_{0a}		Nut entire length L	Nut diameter D	Flanged diameter A	Flanged width B	Notched flange G	Seal dimension M	Bolt hole dimension			Bolt hole PCD W	Oil hole Q
																	X	Y	Z		
SFT 8010-5	Clearance	80	10	6.35	81.0	74.4	2.5×2	70 500	282 000	1 240	107	130	176	22	66	7	14	20	13	152	Rc1/8
DFT 8010-5	D						2.5×2	70 500	282 000	2 430	197										
SFT 8010-7.5	Clearance						2.5×3	99 800	424 000	1 830	137										
DFT 8010-7.5	D						2.5×3	99 800	424 000	3 590	257										
SFT 8012-5	Clearance		12	7.938	81.5	73.2	2.5×2	96 000	350 000	1 280	123	136	182	22	68	8	14	20	13	158	Rc1/8
DFT 8012-5	D						2.5×2	96 000	350 000	2 500	231										
SFT 8012-7.5	Clearance						2.5×3	136 000	526 000	1 880	159										
DFT 8012-7.5	D						2.5×3	136 000	526 000	3 690	303										
SFT 8016-5	Clearance		16	9.525	82.0	72.2	2.5×2	162 000	582 000	1 680	158	143	204	28	77	10	18	26	17.5	172	Rc1/8
DFT 8016-5	D						2.5×2	162 000	582 000	3 300	302										
SFT 8016-7.5	Clearance						2.5×3	230 000	874 000	2 470	206										
DFT 8016-7.5	D						2.5×3	230 000	874 000	4 850	398										
SFT 8020-5	Clearance		20	9.525	82.0	72.2	2.5×2	162 000	582 000	1 680	187	143	204	28	77	17	18	26	17.5	172	Rc1/8
DFT 8020-5	D						2.5×2	162 000	582 000	3 300	347										
SFT 8020-7.5	Clearance						2.5×3	230 000	874 000	2 470	247										
DFT 8020-7.5	D						2.5×3	230 000	874 000	4 850	467										
SFT 10012-5	Clearance	100	12	7.938	101.5	93.2	2.5×2	105 000	441 000	1 530	129	160	220	28	82	8	18	26	17.5	188	Rc1/8
DFT 10012-5	D						2.5×2	105 000	441 000	2 990	237										
SFT 10012-7.5	Clearance						2.5×3	149 000	662 000	2 250	165										
DFT 10012-7.5	D						2.5×3	149 000	662 000	4 400	309										
SFT 10016-5	Clearance		16	9.525	102	92.2	2.5×2	176 000	737 000	2 010	162	170	243	32	91	10	22	32	21.5	205	Rc1/8
DFT 10016-5	D						2.5×2	176 000	737 000	3 930	306										
SFT 10016-7.5	Clearance						2.5×3	250 000	1 100 000	2 950	210										
DFT 10016-7.5	D						2.5×3	250 000	1 100 000	5 790	402										
SFT 10020-5	Clearance		20	9.525	102	92.2	2.5×2	176 000	737 000	2 010	191	170	243	32	91	17	22	32	21.5	205	Rc1/8
DFT 10020-5	D						2.5×2	176 000	737 000	3 930	351										
SFT 10020-7.5	Clearance						2.5×3	250 000	1 100 000	2 950	251										
DFT 10020-7.5	D						2.5×3	250 000	1 100 000	5 780	471										
SFT 12516-5	Clearance	125	16	9.525	127	117.2	2.5×2	195 000	918 000	2 390	170	200	290	36	109	10	26	39	25.5	243	Rc1/8
DFT 12516-5	D						2.5×2	195 000	918 000	4 690	314										
SFT 12516-7.5	Clearance						2.5×3	277 000	1 380 000	3 520	218										
DFT 12516-7.5	D						2.5×3	277 000	1 380 000	6 890	410										
SFT 12520-5	Clearance		20	9.525	127	117.2	2.5×2	195 000	918 000	2 390	199	200	290	36	109	12	26	39	25.5	243	Rc1/8
DFT 12520-5	D						2.5×2	195 000	918 000	4 690	379										
SFT 12520-7.5	Clearance						2.5×3	277 000	1 380 000	3 520	259										
DFT 12520-7.5	D						2.5×3	277 000	1 380 000	6 890	499										

Notes: 1. Nut flange for shaft diameter 20 mm or larger comes in circular shape I and circular shape II. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for 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.
4. The axial rigidity *K* 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.
5. Preload system: D; Double nut preload (See page B5.)

Nut model: GSCT (non-preload)





Unit: mm

Model No.	Axial play	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls Turns × Circuits	Basic load rating (N)		Nut dimensions							
								Dynamic	Static	Nut entire length	Nut diameter	Key dimension		Tube projecting dimension			Seal dimension
	(Max.)	d	l	D_w	d_m	d_r		C_a	C_{0a}	L	D	G	T	U	V	R	(MS)
GSCT14025-5	0.25	140	25	15.875	143	126.0	2.5×2	272 000	1 400 000	200	210	32	11	115	154	50	40
GSCT14025-7.5							2.5×3	362 000	2 090 000	275							
GSCT14032-5	0.35		32	22.225	144	121.0	2.5×2	428 000	1 920 000	252	220			135	163	60	48
GSCT14032-7.5							2.5×3	568 000	2 880 000	348							
GSCT14040-5	0.35		40	22.225	144	121.0	2.5×2	428 000	1 920 000	306	220			135	163	60	58
GSCT14040-7.5							2.5×3	568 000	2 880 000	426							
GSCT14050-5	0.40		50	25.4	145	119.0	2.5×2	518 000	2 190 000	377	225			141	167	70	70
GSCT14050-7.5							2.5×3	688 000	3 290 000	527							
GSCT16032-5	0.35	160	32	22.225	164	141.0	2.5×2	458 000	2 210 000	252	245	36	12	141	180	60	48
GSCT16032-7.5							2.5×3	608 000	3 310 000	348							
GSCT16040-5	0.35		40	22.225	164	141.0	2.5×2	458 000	2 210 000	306	245			141	180	60	58
GSCT16040-7.5							2.5×3	608 000	3 310 000	426							
GSCT16050-5	0.40		50	25.4	165	139.0	2.5×2	544 000	2 560 000	377	250			147	185	70	70
GSCT16050-7.5							2.5×3	722 000	3 840 000	527							
GSCT20032-5	0.35	200	32	22.225	204	181.0	2.5×2	509 000	2 820 000	252	295	45	15	162	216	70	48
GSCT20032-7.5							2.5×3	676 000	4 230 000	348							
GSCT20040-5	0.35		40	22.225	204	181.0	2.5×2	509 000	2 820 000	306	295			162	216		58
GSCT20040-7.5							2.5×3	676 000	4 230 000	426							
GSCT20050-5	0.40		50	25.4	205	179.0	2.5×2	604 000	3 200 000	377	300			168	221		70
GSCT20050-7.5							2.5×3	802 000	4 800 000	527							
GSCT25040-5	0.40	250	40	25.4	255	229.0	2.5×2	662 000	4 000 000	312	355	50	17	194	266	70	58
GSCT25040-7.5							2.5×3	879 000	6 000 000	432							
GSCT25050-5	0.51		50	31.75	256	223.0	2.5×2	825 000	5 000 000	385	370			206	274	90	70
GSCT25050-7.5							2.5×3	1 100 000	7 500 000	535							

Notes: 1. Precision grade is equivalent to Ct10 grade of JIS B1192 (see page B37).
2. The entire nut length (L) is the size without seal. The size with a seal is longer by the size of "MS."

B-3-2.3 Deflector Type Ball Screws

1. Features

The deflector type has the smallest ball nut compared to the other recirculation systems, and suitable for fine lead operation.

2. Specifications

(1) Ball recirculation system

It has a small ball nut outside diameter, and suits for small lead ball screws. **Fig.1** shows the structure of the deflector recirculation system.

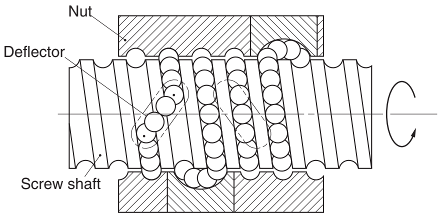


Fig. 1 Structure of deflector recirculation system

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 (preloaded); T, 0.005 mm or less S, 0.020 mm or less; N, 0.050 mm or less

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are shown in **Table 1**. Please consult NSK for other grades.

(3) Allowable d·n value and the criterion of maximum rotational speed

The allowable d·n value and criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below. Basic measure must be taken for the high speed ball screws respectively.

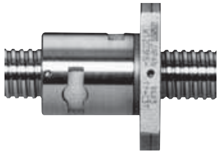
Allowable d·n value:
Standard specification ; 84 000 or less
High-speed specification; 100 000 or less
Standard of rotational speed : 3 000 min^{-1}

Note: Please also review the critical speed. Refer to "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Other specifications

Please consult NSK for other specifications not listed in the dimension tables.

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 CircularⅠ, 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)

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.
This product is being applied for a patent.

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 B80) and "Handling Precautions" (page B99).

5. Structure of model number and reference number

The followings describe the structure of "Model number" and "Reference number for ball screw".

◇Model number

SFD 40 08 - 4

Nut model:
SFD, ZFD, DFD
MSFD, MPFD
Screw shaft diameter (mm)
Effective turns of balls (Note)
Lead (mm)

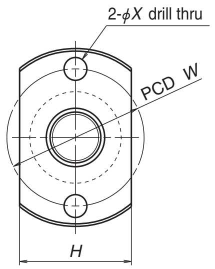
Note: In case of ZFD, the number here is twice as large as the effective turns of balls.

◇Reference number for ball screw

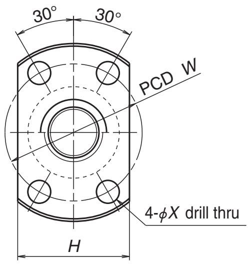
W 40 08 - ＊＊ D Y - C3 Z 5

Product code
Screw shaft diameter (mm)
Effective threaded length (in the unit of 100 mm)
NSK design serial number
Preload code:
No code, non-preload;
Z, Z-preload; D, D-preload; P, P-preload (page B5)
Lead (mm)
Axial play code:
Z, T, S, N (page B20)
Accuracy grade code:
C0, C1, C2, C3, C5, C7(Ct7) (page B37 to B42)
Deflector recirculation system

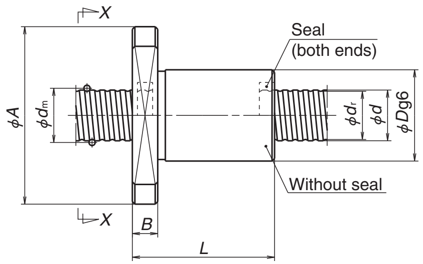
View *X-X*



Lead *l* = 0.5 mm



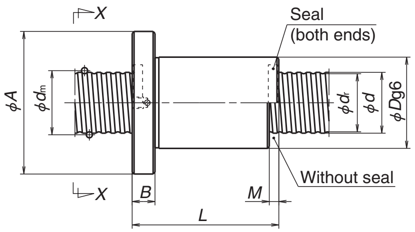
Lead *l* > 1 mm



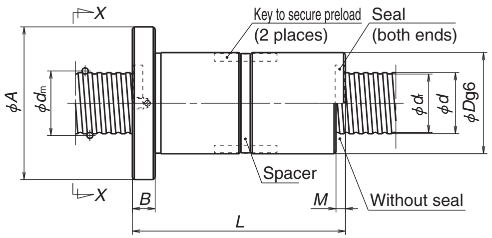
Unit: mm

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 × Circuits	Basic load rating (N) Dynamic C_a	Basic load rating (N) Static C_{0a}	Axial rigidity K (N/μm)	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
MSFD 0400.5-3	Clearance	4	0.5	0.400	4.1	3.6	1×3	170	280	30	13	10	22	3	11	3.4	16
MPFD 0400.5-3	P									47							
MSFD 0401-2	Clearance		1	0.800	4.2	3.2	1×2	315	370	22	12	10	20	3	14	2.9	15
∗ **MPFD 0401-2**	P									34							
MSFD 0600.5-3	Clearance	6	0.5	0.400	6.1	5.6	1×3	205	430	42	13	12	24	3	13	3.4	18
MPFD 0600.5-3	P									66							
MSFD 0601-3	Clearance		1	0.800	6.2	5.2	1×3	575	925	49	15	12	24	3.5	16	3.4	18
∗ **MPFD 0601-3**	P									76							
MSFD 0602-3	Clearance		2	0.800	6.2	5.2	1×3	575	925	49	17	13	25	4	17	3.4	19
MPFD 0602-3	P									76							
MSFD 0800.5-3	Clearance	8	0.5	0.400	8.1	7.6	1×3	230	595	54	13	14	27	3	15	3.4	21
MPFD 0800.5-3	P									85							
MSFD 0801-3	Clearance		1	0.800	8.2	7.2	1×3	670	1 290	64	16	14	27	4	18	3.4	21
∗ **MPFD 0801-3**	P									99							
MSFD 0801.5-3	Clearance		1.5	1.000	8.3	7.0	1×3	1 080	1 980	76	22	15	28	4	19	3.4	22
∗ **MPFD 0801.5-3**	P									117							
MSFD 0802-3	Clearance		2	1.200	8.3	6.9	1×3	1 320	2 210	73	26	16	29	4	20	3.4	23
∗ **MPFD 0802-3**	P									113							
MSFD 1001-3	Clearance	10	1	0.800	10.2	9.2	1×3	745	1 660	77	16	16	29	4	20	3.4	23
MPFD 1001-3	P									120							
MSFD 1002-3	Clearance		2	1.200	10.3	8.9	1×3	1 490	2 850	91	28	18	35	5	22	4.5	27
∗ **MPFD 1002-3**	P									138							
MSFD 1002.5-3	Clearance		2.5	1.588	10.4	8.6	1×3	2 130	3 640	90	32	19	36	5	23	4.5	28
∗ **MPFD 1002.5-3**	P									140							
MSFD 1201-3	Clearance	12	1	0.800	12.2	11.2	1×3	795	1 980	88	16	18	31	4	22	3.4	25
MPFD 1201-3	P									137							
MSFD 1202-3	Clearance		2	1.200	12.3	10.9	1×3	1 660	3 620	108	28	20	37	5	24	4.5	29
∗ **MPFD 1202-3**	P									168							
MSFD 1202.5-3	Clearance		2.5	1.588	12.4	10.6	1×3	2 360	4 540	107	32	21	38	5	25	4.5	30
∗ **MPFD 1202.5-3**	P									167							
MSFD 1203-3	Clearance		3	2.000	12.5	10.2	1×3	3 120	5 420	107	36	22	39	5	26	4.5	31
MPFD 1203-3	P									166							
MSFD 1402-3	Clearance	14	2	1.200	14.3	12.9	1×3	1 780	4 270	122	29	22	41	6	26	5.5	32
MPFD 1402-3	P									191							
MSFD 1403-3	Clearance		3	2.000	14.5	12.2	1×3	3 400	6 490	127	37	24	43	6	28	5.5	34
MPFD 1403-3	P									196							

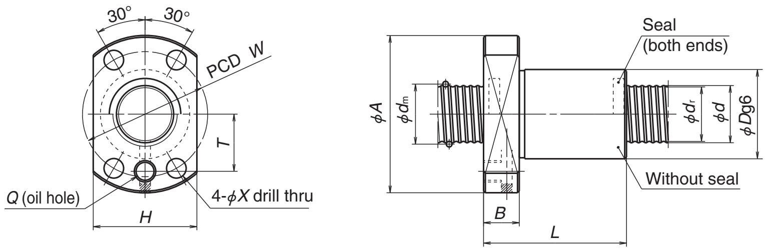
Notes:
1. If the shaft OD is less than 6 mm or the lead is less than 1 mm, a seal is not installed in the nut. (See page B68 for dust protection.)
2. Ball nuts with shaft diameters under 14 mm do not have oil holes.
3. Right turn screw is standard. Please consult NSK for left turn screw.
4. The axial rigidity *K* 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.
5. The models marked with ∗ (asterisk) are available in the MA type standard ball screw with finished shaft end.
6. Preload system: P; Oversize ball preload (See page B5.)



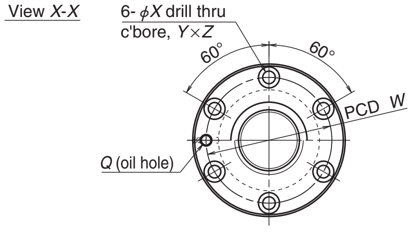
SFD, ZFD



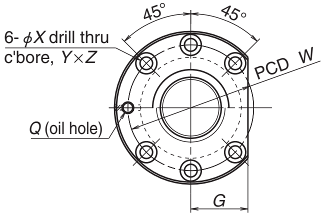
DFD



MSFD, MPFD



Circular shape I



Circular shape II

Unit: mm

Model No.	Preload system	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls	Basic load rating (N)		Axial rigidity	Ball nut dimensions												
		d	l	D_w	d_m	d_r	Turns × Circuits	Dynamic C_a	Static C_{0a}	K (N/μm)	Nut entire length L	Nut diameter D	Flanged diameter A	Flanged width B	Notched flange G	Notched flange H	Seal dimension M	Bolt hole dimension X	Bolt hole dimension Y	Bolt hole dimension Z	Bolt hole PCD W	Oil hole dimension T	Oil hole Q
MSFD 1602-4	Clearance	16	2	1.588	16.4	14.6	1×4	3 510	8 450	185	40	25	44	10	—	29	—	5.5	—	—	35	16	M6×1
* **MPFD 1602-4**	P									288													
MSFD 1602.5-4	Clearance		2.5	1.588	16.4	14.6	1×4	3 510	8 450	185	44	25	44	10	—	29	—	5.5	—	—	35	16	M6×1
* **MPFD 1602.5-4**	P									288													
MSFD 2002-4	Clearance	20	2	1.588	20.4	18.6	1×4	3 910	10 900	225	40	30	49	10	—	34	—	5.5	—	—	40	18.5	M6×1
MPFD 2002-4	P									351													
SFD 2005-3	Clearance		5	3.175	20.75	17.4	1×3	8 620	17 500	196	46	35	58	11	22.5	—	5	5.5	9.5	5.5	46	—	M6×1
ZFD 2005-6	Z						1×3	8 620	17 500	382	66	35	58		22.5						46		
SFD 2005-4	Clearance						1×4	11 000	23 300	255	51	35	58		22.5						46		
DFD 2005-4	D						1×4	11 000	23 300	509	91	41	64		25						52		
SFD 2006-3	Clearance		6	3.969	21	16.9	1×3	11 100	20 600	196	52	35	58	11	22.5	—	6	5.5	9.5	5.5	46	—	M6×1
ZFD 2006-6	Z						1×3	11 100	20 600	382	76	35	58		22.5						46		
SFD 2006-4	Clearance						1×4	14 300	27 500	255	60	35	58		22.5						46		
DFD 2006-4	D						1×4	14 300	27 500	498	108	42	65		25						53		
MSFD 2502-4	Clearance	25	2	1.588	25.4	23.6	1×4	4 310	13 900	273	40	36	55	10	—	40	—	5.5	—	—	46	21.5	M6×1
MPFD 2502-4	P									425													
SFD 2505-3	Clearance		5	3.175	25.75	22.4	1×3	9 790	22 900	245	46	40	63	11	24	—	5	5.5	9.5	5.5	51	—	M6×1
* **ZFD 2505-6**	Z						1×3	9 790	22 900	480	66	40	63		24						51		
SFD 2505-4	Clearance						1×4	12 500	30 500	323	51	40	63		24						51		
DFD 2505-4	D						1×4	12 500	30 500	630	91	46	69		26						57		
SFD 2506-3	Clearance		6	3.969	26	21.9	1×3	12 900	27 300	245	52	40	63	11	24	—	6	5.5	9.5	5.5	51	—	M6×1
ZFD 2506-6	Z						1×3	12 900	27 300	470	76	40	63		24						51		
SFD 2506-4	Clearance						1×4	16 500	36 500	323	60	40	63		24						51		
DFD 2506-4	D						1×4	16 500	36 500	626	108	47	70		27						58		
ZFD 2510-4	Z		10	4.762	26.25	21.3	1×2	11 400	21 400	323	88	42	69	15	26	—	10	6.6	11	6.5	55	—	M6×1
SFD 2510-3	Clearance						1×3	16 100	32 000	245	80	42	69		26						55		
DFD 2510-3	D						1×3	16 100	32 000	479	140	47	74		28						60		

Notes: 1. Nut 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.

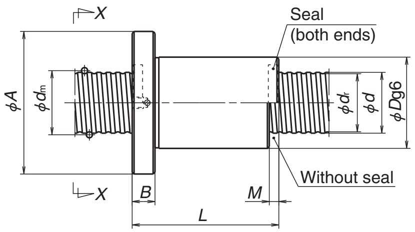
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw. Please consult NSK for MSFD and MPFD.

4. The axial rigidity *K* 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.

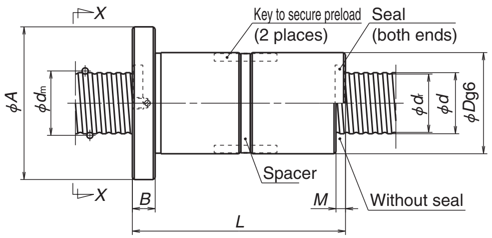
5. It is recommended to use with seals when the shaft diameter is 16 mm or over and an oil hole is provided on the ball nut.

6. The models marked with * (asterisk) are available in the MA type standard ball screw with finished shaft end.

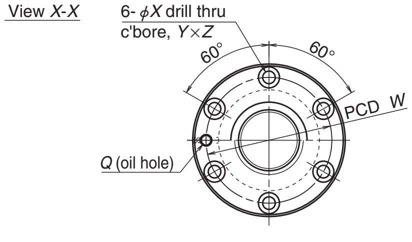
7. Preload system: Z, Offset preload; P, Oversize ball preload; D, Double nut preload (See page B5.)



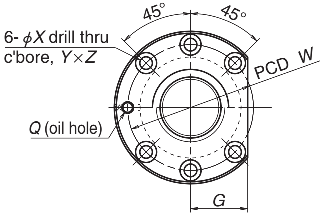
SFD, ZFD



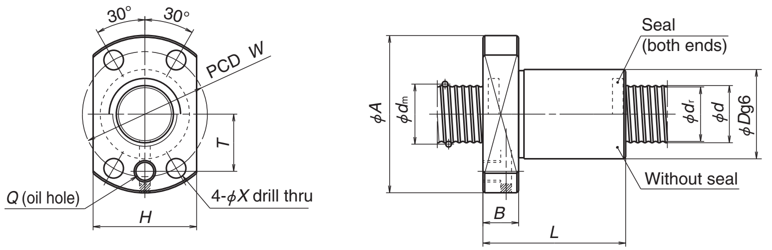
DFD



Circular shape I



Circular shape II

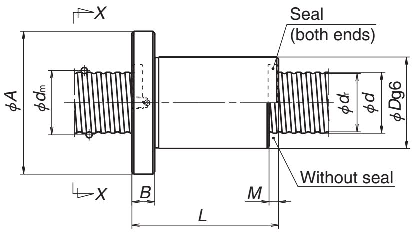


MSFD, MPFD

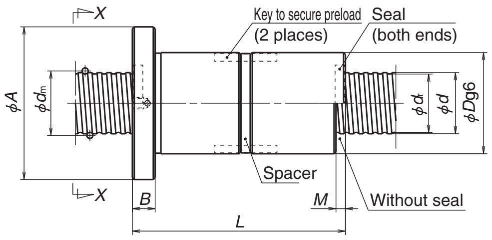
Unit: mm

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 × Circuits	Basic load rating (N)		Axial rigidity K (N/μm)	Ball nut dimensions												
								Dynamic C_a	Static C_{0a}		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			
MSFD 3202-6	Clearance	32	2	1.588	32.4	30.6	1×6	6 790	27 200	494	50	42	65	10	—	46	—	6.6	—	—	54	26.5	M6×1
MPFD 3202-6	P									769													
SFD 3205-3	Clearance		5	3.175	32.75	29.4	1×3	11 100	30 500	304	47	48	75	12	29	—	5	6.6	11	6.5	61	—	M6×1
ZFD 3205-6	Z						1×3	11 100	30 500	598	67	48	75		29						61		
SFD 3205-4	Clearance						1×4	14 200	40 700	409	52	48	75		29						61		
* **ZFD 3205-8**	Z						1×4	14 200	40 700	784	77	48	75		29						61		
SFD 3205-6	Clearance						1×6	20 200	61 000	588	62	48	75		29						61		
DFD 3205-6	D						1×6	20 200	61 000	1 160	112	53	80		30						66		
SFD 3206-3	Clearance		6	3.969	33	28.9	1×3	15 000	37 500	314	53	48	75	12	29	—	6	6.6	11	6.5	61	—	M6×1
ZFD 3206-6	Z						1×3	15 000	37 500	608	77	48	75		29						61		
SFD 3206-4	Clearance						1×4	19 200	49 900	412	61	48	75		29						61		
ZFD 3206-8	Z						1×4	19 200	49 900	804	90	48	75		29						61		
SFD 3206-6	Clearance						1×6	27 200	74 900	598	73	48	75		29						61		
DFD 3206-6	D						1×6	27 200	74 900	1 190	133	54	81		31						67		
SFD 3208-3	Clearance		8	4.762	33.25	28.3	1×3	18 300	41 800	304	67	50	84	15	32	—	8	9	14	8.5	66	—	M6×1
ZFD 3208-6	Z						1×3	18 300	41 800	588	99												
SFD 3208-4	Clearance						1×4	23 500	55 800	392	76												
ZFD 3208-8	Z						1×4	23 500	55 800	774	116												
SFD 3210-3	Clearance		10	6.35	33.75	27.1	1×3	25 900	52 800	300	80	54	88	15	34	—	10	9	14	8.5	70	—	M6×1
* **ZFD 3210-6**	Z						1×3	25 900	52 800	588	120												
SFD 3210-4	Clearance						1×4	33 200	70 300	392	90												
DFD 3210-4	D						1×4	33 200	70 300	773	160												

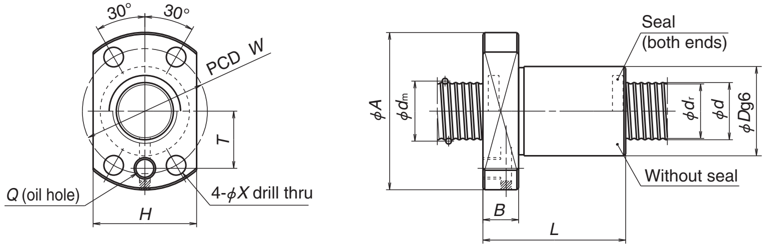
Notes: 1. Nut comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for SFD, ZFD, and DFD, the nut length "L" is shortened by dimension "M". For MSFD and MPFD, the nut length 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 and MPFD.
4. The axial rigidity *K* 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.
5. It is recommended to use with seals when the shaft diameter is 16 mm or over and an oil hole is provided on the ball nut.
6. The models marked with ∗ (asterisk) are available in the SS type standard ball screw with finished shaft end.
7. Preload system: Z, Offset preload; P, Oversize ball preload; D, Double nut preload (See page B5.)



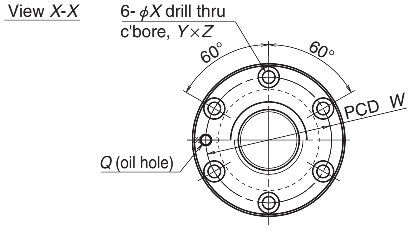
SFD, ZFD



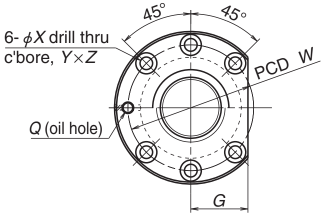
DFD



MSFD, MPFD



Circular shape Ⅰ

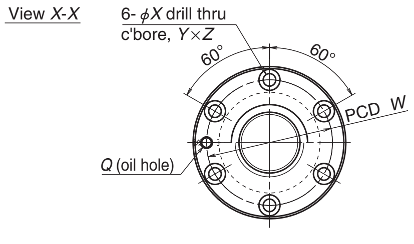


Circular shape Ⅱ

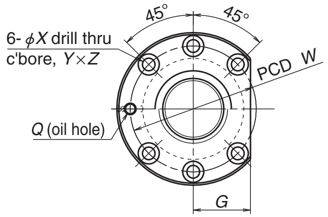
Unit: mm

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 × Circuits	Basic load rating (N)		Axial rigidity K (N/μm)	Ball nut dimensions												
								Dynamic C_a	Static C_{0a}		Nut entire length L	Nut diameter D	Flanged diameter A	Flanged width B	Notched flange G	Notched flange H	Seal dimension M	Bolt hole dimension X	Y	Z	Bolt hole PCD W	Oil hole dimension T	Oil hole Q
MSFD 4002-6	Clearance	40	2	1.588	40.4	38.6	1×6	7 380	33 900	588	50	51	74	10	—	55	—	6.6	—	—	63	31	M6×1
MPFD 4002-6	P									916													
SFD 4005-4	Clearance		5	3.175	40.75	37.4	1×4	15 800	52 300	490	55	56	90	15	34	—	5	9	14	8.5	72	—	Rc1/8
ZFD 4005-8	Z						1×4	15 800	52 300	960	80												
SFD 4005-6	Clearance						1×6	22 400	78 400	725	65												
ZFD 4005-12	Z						1×6	22 400	78 400	1 410	101												
SFD 4006-4	Clearance		6	3.969	41.0	36.9	1×4	21 300	63 500	490	64	56	90	15	34	—	6	9	14	8.5	72	—	Rc1/8
ZFD 4006-8	Z						1×4	21 300	63 500	970	93												
SFD 4006-6	Clearance						1×6	30 100	95 300	725	76												
ZFD 4006-12	Z						1×6	30 100	95 300	1 431	118												
SFD 4008-4	Clearance		8	4.762	41.25	36.3	1×4	27 200	75 200	500	76	60	94	15	36	—	8	9	14	8.5	76	—	Rc1/8
ZFD 4008-8	Z						1×4	27 200	75 200	990	116	60	94		36						76		
SFD 4008-6	Clearance						1×6	38 500	113 000	735	93	60	94		36						76		
DFD 4008-6	D						1×6	38 500	113 000	1 460	168	62	96		37						78		
SFD 4010-3	Clearance		10	6.35	41.75	35.1	1×3	30 000	70 000	372	83	62	104	18	40	—	10	11	17.5	11	82	—	Rc1/8
ZFD 4010-6	Z						1×3	30 000	70 000	735	123												
SFD 4010-4	Clearance						1×4	38 400	93 300	490	93												
ZFD 4010-8	Z						1×4	38 400	93 300	970	143												
SFD 5005-4	Clearance	50	5	3.175	50.75	47.4	1×4	17 500	66 800	593	55	66	100	15	38	—	5	9	14	8.5	82	—	Rc1/8
ZFD 5005-8	Z						1×4	17 500	66 800	1 170	80												
SFD 5005-6	Clearance						1×6	24 800	100 000	872	65												
ZFD 5005-12	Z						1×6	24 800	100 000	1 720	101												
SFD 5006-4	Clearance		6	3.969	51.0	46.9	1×4	23 600	81 700	598	64	66	100	15	38	—	6	9	14	8.5	82	—	Rc1/8
ZFD 5006-8	Z						1×4	23 600	81 700	1 190	93												
SFD 5006-6	Clearance						1×6	33 500	122 000	892	76												
ZFD 5006-12	Z						1×6	33 500	122 000	1 750	118												

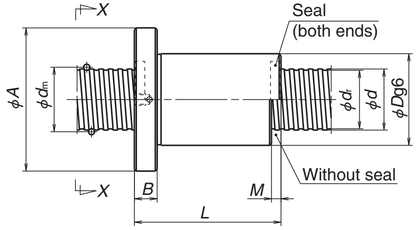
Notes:
1. Nut comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for SFD, ZFD, and DFD, the nut length "L" is shortened by dimension "M". For MSFD and MPFD, the nut length 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 and MPFD.
4. The axial rigidity K 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.
5. It is recommended to use with seals when the shaft diameter is 16 mm or over and an oil hole is provided on the ball nut.
6. Preload system: Z, Offset preload; P, Oversize ball preload; D, Double nut preload (See page B5.)



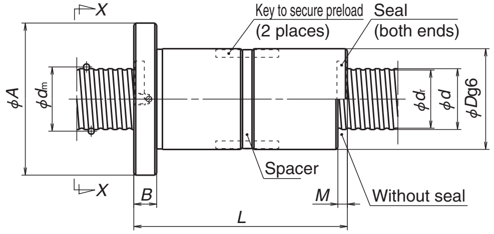
Circular shape Ⅰ



Circular shape Ⅱ



SFD, ZFD

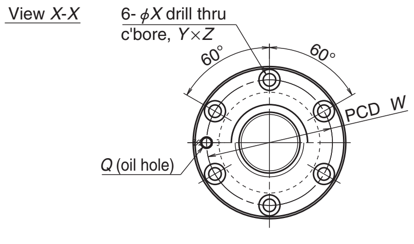


DFD

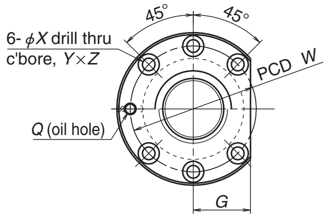
Unit: mm

Model No.	Preload system	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity	Ball nut dimensions										
								Dynamic	Static		Nut entire length	Nut diameter	Flanged diameter	Flanged width	Notched flange	Seal dimension	Bolt hole dimension			Bolt hole PCD	Oil hole
		d	l	D_w	d_m	d_r		C_a	C_{0a}	K (N/μm)	L	D	A	B	G	M	X	Y	Z	W	Q
SFD 5008-4	Clearance	50	8	4.762	51.25	46.3	1×4	29 900	94 800	598	79	70	112	18	43	8	11	17.5	11	90	Rc1/8
ZFD 5008-8	Z						1×4	29 900	94 800	1 180	119	70	112		43					90	
SFD 5008-6	Clearance						1×6	42 400	142 000	887	96	70	112		43					90	
DFD 5008-6	D						1×6	42 400	142 000	1 740	171	72	114		44					92	
SFD 5010-3	Clearance		10	6.35	51.75	45.1	1×3	34 100	91 600	461	83	72	114	18	44	10	11	17.5	11	92	Rc1/8
ZFD 5010-6	Z						1×3	34 100	91 600	914	123										
SFD 5010-4	Clearance						1×4	43 600	122 000	608	93										
ZFD 5010-8	Z						1×4	43 600	122 000	1 200	143										
SFD 5010-6	Clearance						1×6	61 800	183 000	902	114										
DFD 5010-6	D						1×6	61 800	183 000	1 770	205										
SFD 5012-3	Clearance		12	7.938	52.25	44	1×3	44 800	109 000	461	99	75	121	22	47	12	14	20	13	97	Rc1/8
ZFD 5012-6	Z						1×3	44 800	109 000	906	147										
SFD 5012-4	Clearance						1×4	57 300	146 000	608	111										
DFD 5012-4	D						1×4	57 300	146 000	1 200	195										
SFD 5020-3	Clearance		20	7.938	52.25	44	1×3	44 800	109 000	461	146	75	121	28	47	20	14	20	13	97	Rc1/8
DFD 5020-3	D							44 800	109 000	908	253										
SFD 6306-4	Clearance	63	6	3.969	64.0	59.9	1×4	26 100	104 000	735	67	80	122	18	47	6	11	17.5	11	100	Rc1/8
ZFD 6306-8	Z						1×4	26 100	104 000	1 430	96										
SFD 6306-6	Clearance						1×6	36 900	157 000	1 180	79										
ZFD 6306-12	Z						1×6	36 900	157 000	2 110	121										
SFD 6308-4	Clearance		8	4.762	64.25	59.3	1×4	33 600	124 000	745	79	82	124	18	47	8	11	17.5	11	102	Rc1/8
ZFD 6308-8	Z						1×4	33 600	124 000	1 460	119	82	124		47					102	
SFD 6308-6	Clearance						1×6	47 600	186 000	1 100	96	82	124		47					102	
DFD 6308-6	D						1×6	47 600	186 000	2 150	175	85	127		48					105	
SFD 6310-4	Clearance		10	6.35	64.75	58.1	1×4	49 700	163 000	764	97	85	131	22	50	10	14	20	13	107	Rc1/8
ZFD 6310-8	Z						1×4	49 700	163 000	1 510	147										
SFD 6310-6	Clearance						1×6	70 500	244 000	1 130	118										
DFD 6310-6	D						1×6	70 500	244 000	2 210	214										
ZFD 6312-6	Z		12	7.938	65.25	57	1×3	50 800	143 000	1 120	147	90	136	22	52	12	14	20	13	112	Rc1/8
SFD 6312-4	Clearance						1×4	65 100	191 000	755	111										
DFD 6312-4	D						1×4	65 100	191 000	1 480	195										
SFD 6312-6	Clearance						1×6	92 200	286 000	1 110	136										
DFD 6312-6	D						1×6	92 200	286 000	2 180	248										
SFD 6320-3	Clearance		20	9.525	65.75	56	1×3	83 700	232 000	735	146	95	153	28	59	20	18	26	17.5	123	Rc1/8
DFD 6320-3	D									1 440	253										

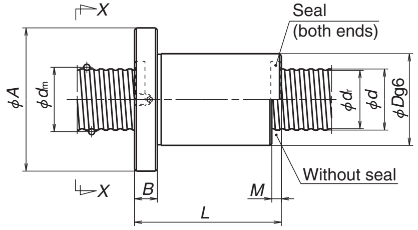
Notes:
1. Nut comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal the nut length "L" is shortened by dimension "M".
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.
4. The axial rigidity K 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.
5. It is recommended to use with seals when the shaft diameter is 16 mm or over and an oil hole is provided on the ball nut.
6. Preload system: Z, Offset preload; D, Double nut preload (See page B5.)



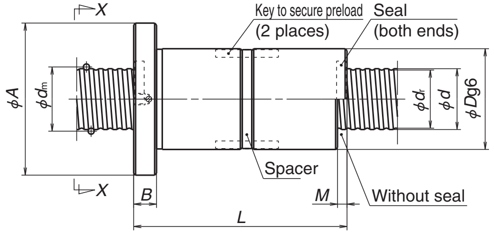
Circular shape Ⅰ



Circular shape Ⅱ



SFD



DFD

Unit: mm

Model No.	Preload system	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls	Basic load rating (N)		Axial rigidity	Ball nut dimensions										
							Turns × Circuits	Dynamic	Static		Nut entire length	Nut diameter	Flanged diameter	Flanged width	Notched flange	Seal dimension	Bolt hole dimension			Bolt hole PCD	Oil hole
		d	l	D_w	d_m	d_r		C_a	C_{0a}	K (N/μm)	L	D	A	B	G	M	X	Y	Z	W	Q
SFD 8010-4	Clearance	80	10	6.35	81.75	75.1	1×4	55 100	209 000	931	97	105	151	22	57	10	14	20	13	127	Rc1/8
DFD 8010-4	D						1×4	55 100	209 000	1 840	172										
SFD 8010-6	Clearance						1×6	78 000	314 000	1 370	118										
DFD 8010-6	D						1×6	78 000	314 000	2 710	214										
SFD 8012-4	Clearance		12	7.938	82.25	74	1×4	74 000	254 000	941	111	110	156	22	59	12	14	20	13	132	Rc1/8
DFD 8012-4	D						1×4	74 000	254 000	1 860	195										
SFD 8012-6	Clearance						1×6	105 000	381 000	1 392	136										
DFD 8012-6	D						1×6	105 000	381 000	2 730	248										
SFD 8020-3	Clearance		20	9.525	82.75	73	1×3	96 600	313 000	931	146	115	173	28	66	20	18	26	17.5	143	Rc1/8
DFD 8020-3	D						1×3	96 600	313 000	1 830	253										
SFD 8020-4	Clearance						1×4	124 000	417 000	1 230	168										
DFD 8020-4	D						1×4	124 000	417 000	2 410	297										
SFD 10010-6	Clearance	100	10	6.35	101.75	95.1	1×6	86 200	401 000	1 670	118	125	171	22	64	10	14	20	13	147	Rc1/8
DFD 10010-6	D									3 270	214										
SFD 10012-6	Clearance		12	7.938	102.25	94	1×6	117 000	490 000	1 680	142	130	188	28	71	12	18	26	17.5	158	Rc1/8
DFD 10012-6	D									3 320	254										
SFD 10020-4	Clearance		20	9.525	102.75	93	1×4	136 000	526 000	1 470	172	135	205	32	79	20	22	32	21.5	169	Rc1/8
DFD 10020-4	D									2 890	301										

Notes 1. Nut 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 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.
4. The axial rigidity K 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 non-preload, 10% with D-preload, and 5% with P-preload. Refer to "Technical Description" (page B37) if the axial load and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.
5. It is recommended to use with seals when the shaft diameter is 16 mm or over and an oil hole is provided on the ball nut.
6. Preload system: D; Double nut preload (See page B5.)

B-3-2.4 End Cap Type Ball Screws

1. Features

The 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) Ball recirculation system

The structure of end cap recirculation system is shown in **Fig. 1**.

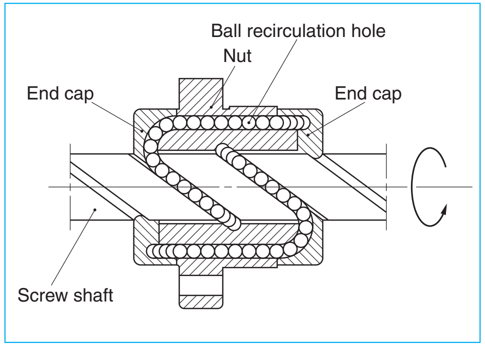


Fig. 1 Structure of end cap recirculation system

(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.

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 (preloaded); T, 0.005 mm or less; S, 0.020 mm or less; N, 0.050 mm or less

(3) Allowable d·n value and the criterion of maximum rotational speed.

The allowable d·n value and criterion of maximum rotational speed are shown below. Please consult NSK for high-speed specification. Basic measure must be taken for the high speed ball screws respectively.

Allowable d·n value:
Standard specification ; 80 000 or less
High-speed specification; 100 000 or less
Standard of rotational speed : 3 000 min^{-1}

※Please also review the critical speed. Refer to "Technical Description: Permissible Rotational Speed" (page B47) for details.

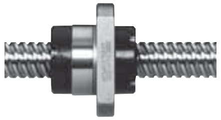
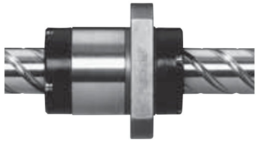
(4) Other specifications

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.

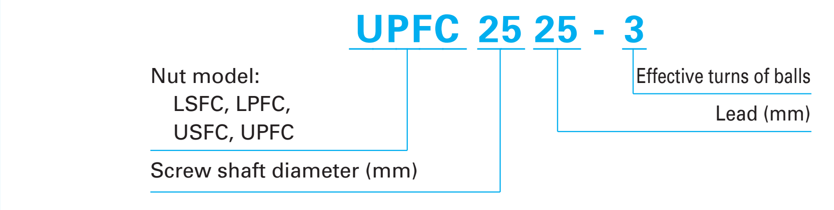
- Cut the ball groove through to the shaft end.
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove "dr" specified on the dimension table.

Special bearings which have higher-load carrying capacity are available.
For general precautions regarding ball screws, refer to "Design Precautions" (page B80) and "Handling Precautions" (page B99).

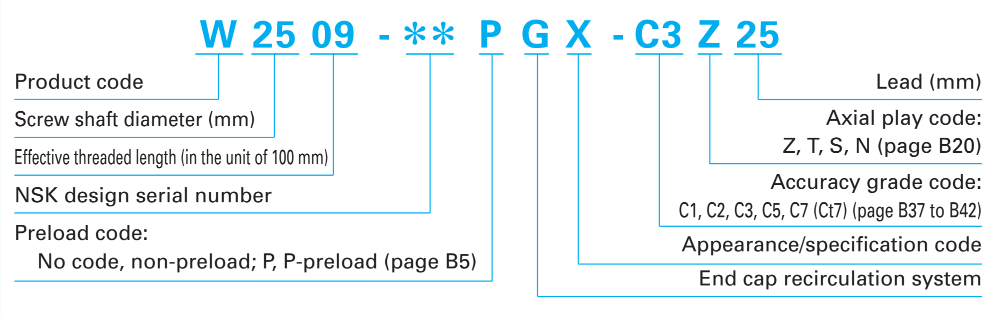
5. Example of model number in dimension tables

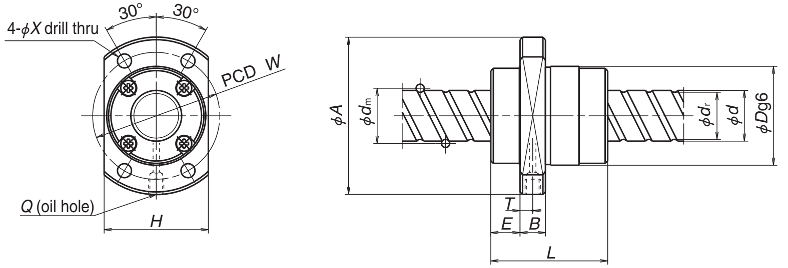
The followings describe the structure of "Model number" and "Reference number for ball screw".

◇Model number

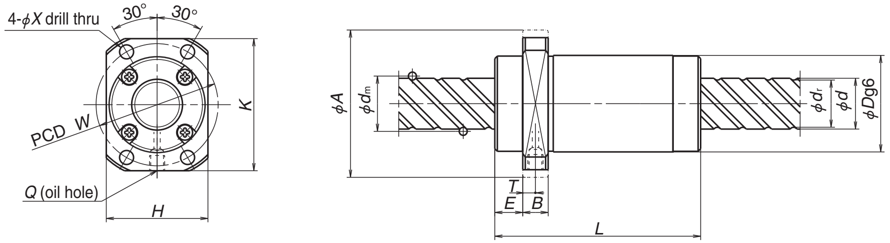


◇Reference number for ball screw





LSFC, LPFC



USFC, UPFC

Unit: mm

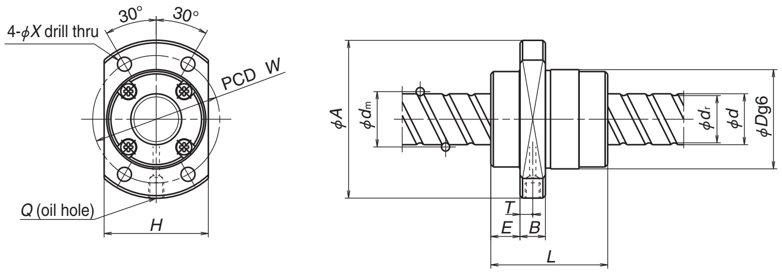
Model No.	Preload system	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls Turns × Circuits	Basic load rating (N)		Axial rigidity K	Ball nut dimensions										
								Dynamic	Static		Nut entire length	Nut diameter	Flanged diameter	Flanged width	Flanged dimension		End cap dimension	Bolt hole dimension	Bolt hole PCD	Oil hole	Oil hole position
		d	l	D_w	d_m	d_r		C_a	C_{0a}	(N/μm)	L	D	A	B	H	K	E	X	W	Q	T
USFC 1220-1.5	Clearance	12	20	2.381	12.5	9.9	1.7×1	2 690	4 420	66	44	26	44	10	28	40	9	4.5	35	M6×1	5
UPFC 1220-1.5	P									103											
USFC 1520-1.5	Clearance	15	20	3.175	15.5	12.2	1.7×1	5 070	8 730	97	45	34	55	10	36	50	11	5.5	45	M6×1	5
* **UPFC 1520-1.5**	P									151											
USFC 1540-1	Clearance		40	3.175	15.75	12.2	0.7×2	3 860	6 050	62	40	32	53	10	33	48	12	5.5	43	M6×1	5
UPFC 1540-1	P						0.7×2	3 860	6 050	97											
USFC 1540-2	Clearance						0.7×4	7 000	12 100	121											
UPFC 1540-2	P						0.7×4	7 000	12 100	188											
LSFC 1616-3	Clearance	16	16	2.778	16.65	13.7	1.7×2	6 380	12 500	172	38	32	53	10	34	—	10	4.5	42	M6×1	5
LPFC 1616-3	P						1.7×2	6 380	12 500	268											
LSFC 1616-6	Clearance						1.7×4	11 600	25 000	334											
LPFC 1616-6	P						1.7×4	11 600	25 000	520											
USFC 1632-1	Clearance		32	3.175	16.75	13.4	0.7×2	4 000	6 690	74	34	34	55	10	36	50	10.5	5.5	45	M6×1	5
* **UPFC 1632-1**	P						0.7×2	4 000	6 690	116	34										
USFC 1632-3	Clearance						1.7×2	8 580	17 000	176	66										
UPFC 1632-3	P						1.7×2	8 580	17 000	273	66										
USFC 1632-6	Clearance						1.7×4	15 600	34 100	340	66										
UPFC 1632-6	P						1.7×4	15 600	34 100	530	66										
USFC 1650-1	Clearance		50	3.175	16.75	13.4	0.7×2	4 000	6 690	65	50	34	55	10	36	50	12	5.5	45	M6×1	5
UPFC 1650-1	P						0.7×2	4 000	6 690	102											
USFC 1650-2	Clearance						0.7×4	7 260	13 400	126											
UPFC 1650-2	P						0.7×4	7 260	13 400	197											
LSFC 2020-3	Clearance	20	20	3.175	20.75	17.4	1.7×2	9 620	21 000	238	46	39	62	10	41	—	11.5	5.5	50	M6×1	5
LPFC 2020-3	P						1.7×2	9 620	21 000	370											
LSFC 2020-6	Clearance						1.7×4	17 500	42 000	462											
LPFC 2020-6	P						1.7×4	17 500	42 000	718											
USFC 2040-1	Clearance		40	3.175	20.75	17.4	0.7×2	4 490	8 640	89	41	38	58	10	40	52	11	5.5	48	M6×1	5.5
* **UPFC 2040-1**	P						0.7×2	4 490	8 640	138	41										
USFC 2040-3	Clearance						1.7×2	9 620	21 000	211	81										
UPFC 2040-3	P						1.7×2	9 620	21 000	328	81										
USFC 2040-6	Clearance						1.7×4	17 500	42 000	409	81										
UPFC 2040-6	P						1.7×4	17 500	42 000	636	81										
USFC 2060-1	Clearance		60	3.175	20.75	17.4	0.7×2	4 490	8 640	78	58	38	58	10	40	52	12.3	5.5	48	M6×1	5
UPFC 2060-1	P						0.7×2	4 490	8 640	121											
USFC 2060-2	Clearance						0.7×4	8 140	17 300	151											
UPFC 2060-2	P						0.7×4	8 140	17 300	235											

Notes: 1. For the LSFC and USFC type ball screws, the axial rigidity *K* in the table above is the theoretical values obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a). For the LPFC and UPFC type, the rigidity is the theoretical value when the preload is 10% of the basic dynamic load rating (C_a) and an axial load is applied to it. Refer to the "Technical Description" (page B37) if the rigidity and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.

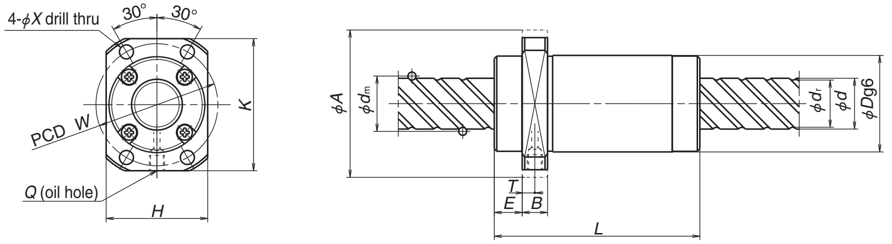
2. The right turn screw is the standard. Please consult NSK for the left turn screw.

3. The models marked with * (asterisk) are available in the FA type standard ball screws with finished shaft end.

4. Preload system: P; Oversize ball preload (See page B5.)



LSFC, LPFC



USFC, UPFC

Unit: mm

Model No.	Preload system	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls	Basic load rating (N)		Axial rigidity	Ball nut dimensions										
											Nut entire length	Nut diameter	Flanged diameter	Flanged width	Flanged dimension		End cap dimension	Bolt hole dimension	Bolt hole PCD	Oil hole	Oil hole position
		d	l	D_w	d_m	d_r	Turns × Circuits	Dynamic C_a	Static C_{0a}	K (N/μm)	L	D	A	B	H	K	E	X	W	Q	T
LSFC 2525-3	Clearance	25	25	3.969	26.0	21.9	1.7×2	14 400	32 800	293	55	47	74	12	49	—	13	6.6	60	M6×1	6
LPFC 2525-3	P						1.7×2	14 400	32 800	456											
LSFC 2525-6	Clearance						1.7×4	26 100	65 600	568											
LPFC 2525-6	P						1.7×4	26 100	65 600	883											
USFC 2550-1	Clearance		50	3.969	26.0	21.9	0.7×2	6 700	13 500	109	50	46	70	12	48	63	13	6.6	58	M6×1	7
* **UPFC 2550-1**	P						0.7×2	6 700	13 500	170	50										
USFC 2550-3	Clearance						1.7×2	14 400	32 800	264	100										
UPFC 2550-3	P						1.7×2	14 400	32 800	412	100										
USFC 2550-6	Clearance						1.7×4	26 100	65 600	512	100										
UPFC 2550-6	P						1.7×4	26 100	65 600	796	100										
USFC 2580-1	Clearance		80	3.969	26.0	21.9	0.7×2	6 700	13 500	94	75	46	70	12	48	63	14.5	6.6	58	M6×1	6
UPFC 2580-1	P						0.7×2	6 700	13 500	147											
USFC 2580-2	Clearance						0.7×4	12 200	27 000	184											
UPFC 2580-2	P						0.7×4	12 200	27 000	285											
LSFC 3232-3	Clearance	32	32	4.762	33.25	28.3	1.7×2	21 000	51 600	366	70	58	92	12	60	—	16	9	74	M6×1	5.5
LPFC 3232-3	P						1.7×2	21 000	51 600	570											
LSFC 3232-6	Clearance						1.7×4	38 100	103 000	709											
LPFC 3232-6	P						1.7×4	38 100	103 000	1 104											
USFC 3264-1	Clearance		64	4.762	33.25	28.3	0.7×2	9 800	20 900	143	62	58	92	12	60	82	15.5	9	74	M6×1	7.5
UPFC 3264-1	P						0.7×2	9 800	20 900	222	62										
USFC 3264-3	Clearance						1.7×2	21 000	51 600	329	126										
UPFC 3264-3	P						1.7×2	21 000	51 600	512	126										
USFC 3264-6	Clearance						1.7×4	38 100	103 000	636	126										
UPFC 3264-6	P						1.7×4	38 100	103 000	991	126										
LSFC 4040-3	Clearance	40	40	6.350	41.75	35.2	1.7×2	33 500	86 500	455	85	73	114	15	75	—	19.5	11	93	M6×1	6.5
LPFC 4040-3	P						1.7×2	33 500	86 500	708											
LSFC 4040-6	Clearance						1.7×4	60 800	173 000	880											
LPFC 4040-6	P						1.7×4	60 800	173 000	1 370											
LSFC 5050-3	Clearance	50	50	7.938	52.25	44.1	1.7×2	50 000	135 000	560	107	90	135	20	92	—	21.5	14	112	M6×1	7
LPFC 5050-3	P						1.7×2	50 000	135 000	871											
LSFC 5050-6	Clearance						1.7×4	90 800	270 000	1 084											
LPFC 5050-6	P						1.7×4	90 800	270 000	1 688											

Notes: 1. For the LSFC and USFC type ball screws, the axial rigidity *K* in the table above is the theoretical values obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a). For the LPFC and UPFC type, the rigidity is the theoretical value when the preload is 10% of the basic dynamic load rating (C_a) and an axial load is applied to it. Refer to the "Technical Description" (page B37) if the rigidity and preload differ from the conditions above, or when the deformation of the ball nut body must be considered.

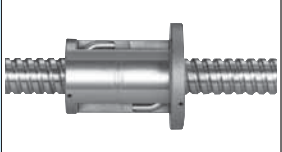
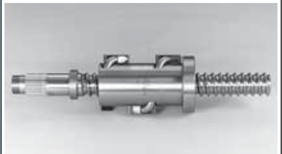
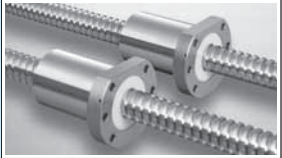
2. The right turn screw is the standard. Please consult NSK for the left turn screw.

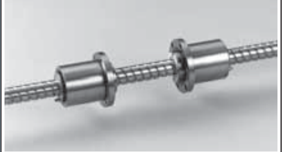
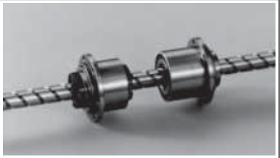
3. The models marked with ∗ (asterisk) are available in the FA type standard ball screws with finished shaft end.

4. Preload system: P; Oversize ball preload (See page B5.)

B-3-3 Dimension Table and Reference Number of Application-Oriented Ball Screws

◇Features and application examples of application-oriented ball screws

Applications		Shape	Features	Applications	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 centers High-speed combined machine tools Die mold processing machine	B473
	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 centers High-speed combined machine tools Die mold processing machines	B477
Small Lathes	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 lathes Multi-axis lathes Small machining centers	B483
High-Load Drives	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 machines Servo press machines Press brake Bending machines	B487
	HTF-SRD Type		High-load capacity High-speed operation by large screw lead: 1 600 mm/sec Improved durability by NSK S1	Clamping axis of injection molding machines Die cast machines Punch presses Lifting and lowering devices	B491
	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 machines Press machines Press fitting machines Lifting and lowering machines	B495
Contaminated Environments	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 machines Laser cutting machines Graphite milling machines Tire molding machines Transfer equipment	B507
Twin-Drive Systems	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 centers Combined machine tools Large-size machine tools	B511

Applications		Shape	Features	Applications	Page
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 machines High-precision combined machine tools High-precision machining centers High-precision lathes	B512
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 machines Laser cutting machines Electronic component mounting devices Liquid crystal display transfer equipment Transfer equipment	B517
Robots	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 robots Electronic-component mounting systems	B525
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 machines Woodworking machines Laser cutting machines Semiconductor/Liquid crystal display manufacturing equipment Food processing/Medical equipment	B537

B-3-3.1 HMD Type for High-Speed Machine Tools

This product is being applied for a patent. The newly developed ball recirculation components, the end-deflector and middle-deflector, have greatly contributed for the substantial improvements in the maximum rotational speed and noise level compared to the HMC type.

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.

● 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 HMD type.

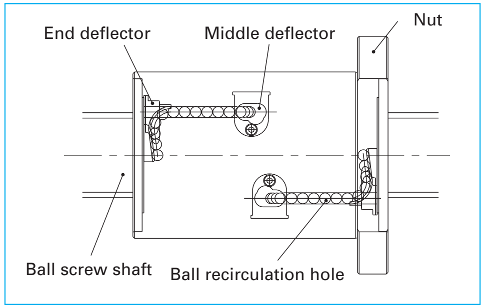


Fig. 1 Structure of middle-deflector recirculation system

(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)

(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^{-1}

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Options

● For twin-drive systems (See page B511.)

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 (See page B512.)

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 B80) and "Handling Precautions" (page B99).

4. Product categories

The HMD type has a model as follows.

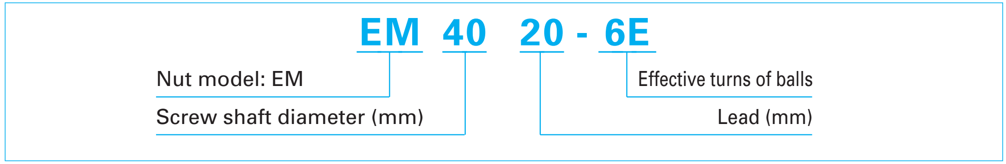
Table 2 HMD type product categories

Nut model	Shape	Flange shape	Nut shape	Preload system
EM		Flanged Circular Ⅱ	Circular	Z-Preload (medium preload)

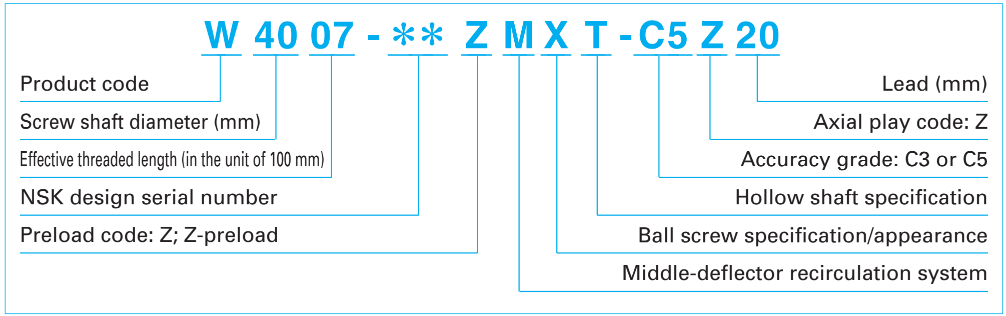
5. Structure of model number and reference number

The followings describe the structure of "Model number" and "Reference number for ball screw".

◇Model number



◇Reference number for ball screw

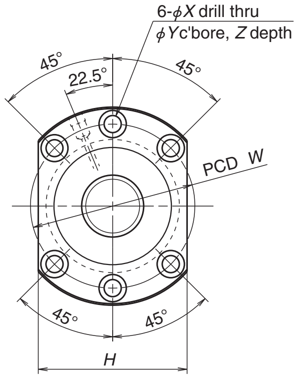


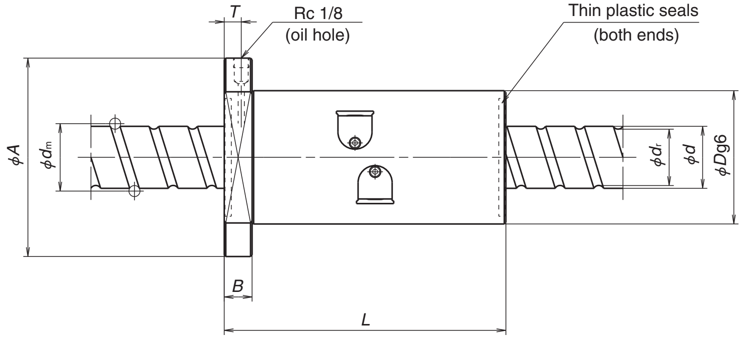
6. Handling Precautions

Maximum operating temperature: 80°C

If using NSK K1, operating temperature should not exceed 50°C. Refer to "Designing Precautions" (page B80).

HMD Type for high-speed machine tools





Unit: mm

Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Basic load rating (N)		Axial rigidity	Ball nut dimensions								Bolt hole PCD	Oil hole position	Max. feeding speed
						Dynamic	Static		Nut length	Nut dia.	Flange dia.	Flange width	Flange size	Bolt hole size					
	d	l	D_w	d_m	d_r	C_a	C_{0a}	K (N/μm)	L	D	A	B	H	X	Y	Z	W	T	(m/min)
EM4016-4E	40	16	7.144	41.5	34.1	57 100	130 000	1 020	160	86	128	18	96	11	17.5	11	106	11	64
EM4020-6E		20	6.350	41	34.4	66 900	165 000	1 340	150										80
EM4025-6E		25	7.144	41.5	34.1	79 100	191 000	1 370	182										100
EM4030-6E		30	7.144	41.5	34.1	79 100	191 000	1 350	213										120
EM4516-4E	45	16	7.144	46.5	39.1	59 600	145 000	1 060	160	92	134	18	102	11	17.5	11	112	11	56
EM4520-6E		20	6.350	46	39.4	69 100	186 000	1 470	150										70
EM4525-6E		25	7.144	46.5	39.1	82 500	213 000	1 510	182										88
EM5016-4E	50	16	7.144	51.5	44.1	61 800	160 000	1 150	160	98	140	18	107	11	17.5	11	118	11	51
EM5020-6E		20	6.350	51	44.4	73 200	206 000	1 600	150										64
EM5025-6E		25	7.144	51.5	44.1	85 600	235 000	1 620	182										80
EM5030-6E		30	7.144	51.5	44.1	85 600	235 000	1 630	213										96
EM6316-4E	63	16	9.525	65	55.2	111 000	339 000	1 600	170	122	180	28	138	18	26	17.5	150	14	40

Notes: 1. The right turn screw is the standard. Please consult NSK for left turn screws.
2. Rigidity listed under the column K is the value when a 5% of basic dynamic load rating is applied as the preload.

B-3-3.2 HMC Type for High-Speed Machine Tools

This product is being applied for a patent.

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.

2. Specifications

(1) Ball recirculation system

The ball recirculation circuits and grooves are suited for high-speed operation. Structure of recirculation system is shown in **Fig. 1**.

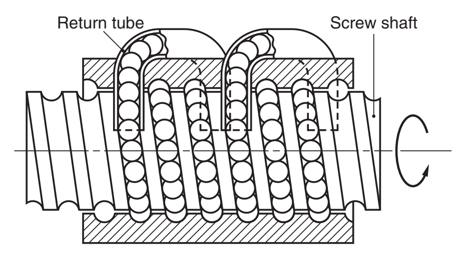


Fig. 1 Structure of return tube recirculation system

(2) Accuracy grades and axial play

Standard accuracy grades and axial play are shown in **Table 1**. Please consult NSK for other grade.

Table 1 Accuracy grades and axial play

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 (See page B511.)

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 (See page B512.)

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.

● For a vertical axis ball screw

For a vertical axis ball screw, which constantly supports the load of vertical axis system, a high load capacity ball screw is required. A high load capacity type with compact design is available for the nut models Ⅱ and Ⅲ in the dimension tables. 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; 100 000 or less
HZF, HDF; 135 000 or less

Criterion of maximum rotational speed: 3 750 min^{-1}

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

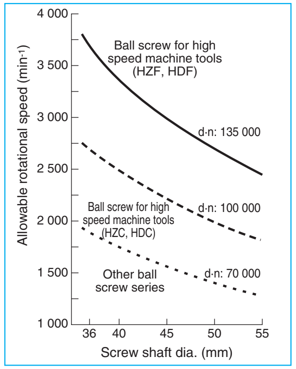


Fig. 2 Comparison of permissible rotational speed

(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.

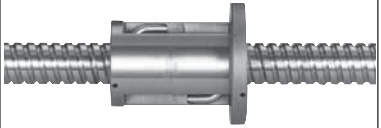
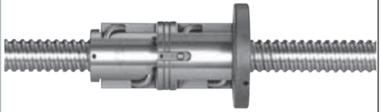
3. Design precautions

For general precautions regarding ball screws, refer to "Design Precautions" (page B80) and "Handling Precautions" (page B99).

4. Product categories

HMC type has two different preload systems with several models (**Table 2**).

Table 2 HMC type product categories

Nut model	Shape	Flange shape	Preload system
HZC HZF		Flanged Circular Ⅰ	Z-preload (medium preload)
HDC HDF		Flanged Circular Ⅰ	D-preload (medium preload)

7. Structure of model number and reference number

The followings describe the structure of "Model number" and "Reference number for ball screw".

◇Model number

HZF 36 16 - 5

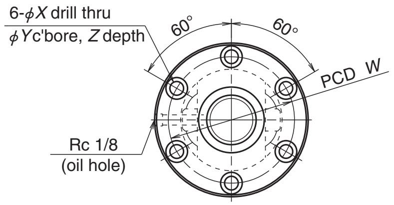
Nut model: HZC, HZF, HDC, HDF
Screw shaft diameter (mm)
Effective turns of balls
Lead (mm)

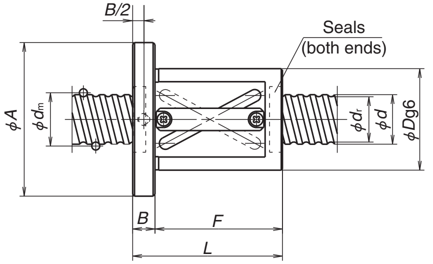
◇Reference number for ball screw

W 36 05 - ** Z X T - C5 Z 16

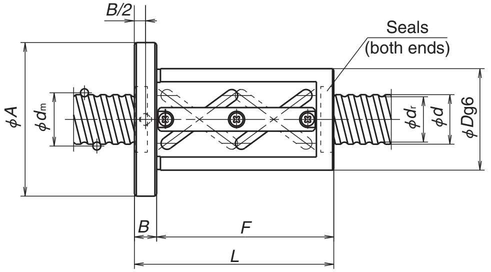
Product code
Screw shaft diameter (mm)
Effective threaded length (in the unit of 100 mm)
Design serial number
Preload code : Z, Z-prelord; D, D-preload (page B5)
Lead (mm)
Axial play code: Z (page B20)
Accuracy grade: C3, C5 (page B37 to B42)
Hollow shaft ball screw
Appearance/specification code

HMC Type for high-speed machine tools





Nut model Ⅰ (offset preload)

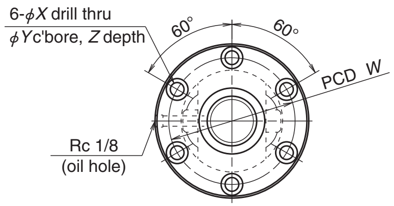


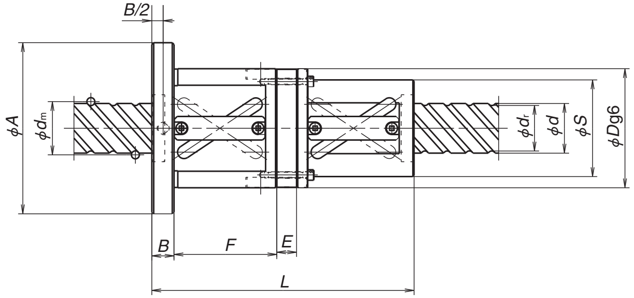
Nut model Ⅱ (offset preload)

Unit: mm

Model No.	Shaft dia. d	Lead l	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/μm)		Ball nut dimensions									Max. feeding speed (m/min)
												Nut entire length	Nut dia.	Flange dia.	Flange width	Nut length	Bolt hole demensions			Bolt hole PCD	
								Dynamic C_a	Static C_{0a}	5% C_a	10% C_a	L	D	A	B	F	X	Y	Z	W	
HZF3616-5	36	16	4.7625	36.5	31.7	5	Ⅱ	40 200	102 000	1 130	1 420	134	78	120	18	116	11	17.5	11	98	60
HZC3616-5													71	113						91	44
HZF3620-3.5		20	6.35	37	30.6	3.5	Ⅰ	44 000	98 500	830	1 050	121	94	136	18	103	11	17.5	11	114	75
HZC3620-3.5													78	120						98	56
HZF4016-5	40	16	4.7625	40.5	35.7	5	Ⅱ	41 200	112 000	1 230	1 550	134	79	121	18	116	11	17.5	11	99	54
HZC4016-5													76	118						96	40
HZF4020-3.5		20	6.35	41	34.6	3.5	Ⅰ	46 100	107 000	900	1 130	121	96	138	18	103	11	17.5	11	116	67
HZC4020-3.5													82	124						102	50
HZF4020-5						5	Ⅱ	62 600	153 000	1 260	1 590	161	96	138		143				116	67
HZC4020-5													82	124						102	50
HZF4516-5	45	16	4.7625	45.5	40.7	5	Ⅱ	43 800	127 000	1 340	1 690	134	82	124	18	116	11	17.5	11	102	48
HZF4516-7.5						7.5		62 100	191 000	1 960	2 470	187		128	22	165	14	20	13	104	
HZF4520-3.5		20	6.35	46	39.6	3.5	Ⅰ	47 600	120 000	990	1 240	122	98	140	18	104	11	17.5	11	118	60
HZC4520-3.5													88	130						108	44
HZF4520-5						5	Ⅱ	64 700	170 000	1 380	1 740	162	98	140		144				118	60
HZC4520-5													88	130						108	44
HZF4525-3.5		25	7.1438	46.5	39.3	3.5	Ⅰ	56 800	137 000	1 010	1 280	141	101	143	18	123	11	17.5	11	121	75
HZC4525-3.5													92	134						112	56
HZF5020-3.5	50	20	6.35	51	44.6	3.5	Ⅰ	50 400	133 000	1 080	1 360	122	101	143	18	104	11	17.5	11	121	54
HZC5020-3.5													95	137						115	40
HZF5020-5						5	Ⅱ	68 500	191 000	1 520	1 910	162	101	143		144				121	54
HZC5020-5													95	137						115	40
HZF5025-3.5		25	7.1438	51.5	44.3	3.5	Ⅰ	58 900	152 000	1 100	1 390	141	103	145	18	123	11	17.5	11	123	67
HZC5025-3.5													98	140						118	50
HZF5025-5						5	Ⅱ	80 100	216 000	1 540	1 940	191	103	145		173				123	67
HZC5025-5													98	140						118	50
HZF5030-3.5		30	7.1438	51.5	44.3	3.5	Ⅰ	58 900	152 000	1 100	1 390	159	103	145	18	141	11	17.5	11	123	81
HZC5030-3.5													98	140						118	60
HZF5520-3.5	55	20	6.35	56	49.6	3.5	Ⅰ	51 600	145 000	1 150	1 450	122	103	145	18	104	11	17.5	11	123	49
HZF5520-5						5	Ⅱ	70 200	208 000	1 630	2 050	162				144					
HZF5525-3.5		25	7.1438	56.5	49.3	3.5	Ⅰ	62 600	165 000	1 190	1 560	141	105	147	18	123	11	17.5	11	125	61
HZF5525-5						5	Ⅱ	85 000	238 000	1 680	2 120	191				173					
HZF5530-3.5		30	7.1438	56.5	49.3	3.5	Ⅰ	62 600	165 000	1 190	1 560	159	105	147	18	141	11	17.5	11	125	73

Notes: 1. Ball screws of 32 or 36 mm lead have triple start threads. Others have double start threads.
2. Rigidity listed under the column 5%Ca is the value when a 5% of basic dynamic load rating is applied as the preload. Similarly, those listed under the column 10%Ca means a 10% of basic dynamic load rating is applied.





Nut model Ⅲ (double nut spacer, preload)
(the figure indicates use of double start threads)

Unit: mm

Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls	Nut model	Basic load rating (N)		Axial rigidity K (N/μm)		Ball nut dimensions											Max. feeding speed (m/min)
	d	l	D_w	d_m	d_r			Dynamic C_a	Static C_{0a}	5% C_a	10% C_a	Nut entire length L	Nut dia. D	Nut dia. S	Flange dia. A	Flange width B	Nut length F	Spacer dimensions E	Bolt hole size X	Bolt hole size Y	Bolt hole size Z	Bolt hele PCD W	
HDF3620-5	36	20	6.35	37	30.6	5	Ⅲ	59 800	138 000	1 160	1 460	191	94	76	136	18	77	5	11	17.5	11	114	75
HDC3620-5													78	60	120							98	56
HDF4025-5	40	25	7.1438	41.5	34.3	5	Ⅲ	74 000	175 000	1 320	1 660	228.5	98	80	140	18	91	13.5	11	17.5	11	118	84
HDC4025-5													86	68	128							106	63
HDF4030-5		30	7.1438	41.5	34.3	5	Ⅲ	74 000	175 000	1 320	1 660	248	98	80	140	18	104	8	11	17.5	11	118	101
HDC4030-5													86	68	128							106	75
HDF4032-7.5		32	6.35	41	34.6	7.5	Ⅲ	88 700	230 000	1 920	2 420	265	96	78	142	22	109	11	14	20	13	118	108
HDC4032-7.5													82	64	128							106	80
HDF4036-4.5		36	6.35	41	34.6	4.5	Ⅲ	57 200	138 000	1 170	1 480	200	96	78	138	18	83	4	11	17.5	11	116	120
HDF4525-5	45	25	7.1438	46.5	39.3	5	Ⅲ	77 200	197 000	1 430	1 800	228.5	101	83	143	18	91	13.5	11	17.5	11	121	75
HDC4525-5													92	74	134							112	56
HDF4530-5		30	7.1438	46.5	39.3	5	Ⅲ	77 200	197 000	1 430	1 800	248	101	83	143	18	104	8	11	17.5	11	121	90
HDC4530-5													92	74	134							112	67
HDF4532-7.5		32	6.35	46	39.6	7.5	Ⅲ	91 700	256 000	2 090	2 630	266	98	80	144	22	109	11	14	20	13	120	96
HDC4532-7.5													88	70	134							110	71
HDF4536-4.5		36	6.35	46	39.6	4.5	Ⅲ	59 100	155 000	1 280	1 620	200	98	80	140	18	83	4	11	17.5	11	118	108
HDF5030-5	50	30	7.1438	51.5	44.3	5	Ⅲ	80 100	216 000	1 540	1 940	249	103	85	145	18	104	8	11	17.5	11	123	81
HDC5030-5													98	80	140							118	60
HDF5032-7.5		32	6.35	51	44.6	7.5	Ⅲ	97 100	286 000	2 270	2 860	266	101	83	147	22	109	11	14	20	13	123	86
HDC5032-7.5													95	77	141							117	64
HDF5530-5	55	30	7.1438	56.5	49.3	5	Ⅲ	85 000	238 000	1 680	2 120	249	105	87	147	18	104	8	11	17.5	11	125	73
HDF5532-7.5		32	6.35	56	49.6	7.5	Ⅲ	99 500	313 000	2 420	3 050	266	103	85	149	22	109	11	14	20	13	125	78

Notes: 1. Ball screws of 32 or 36 mm lead have triple start threads. Others have double start threads.
2. Rigidity listed under the column 5%Ca is the value when a 5% of basic dynamic load rating is applied as the preload. Similarly, those listed under the column 10%Ca means a 10% of basic dynamic load rating is applied.

B-3-3.3 BSL™ Type for Miniature Lathes

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) Ball recirculation system

End-deflector recirculation system has features of high-speed, low-noise operation and compact ball nut. The structure of recirculation system is shown in **Fig.1**.

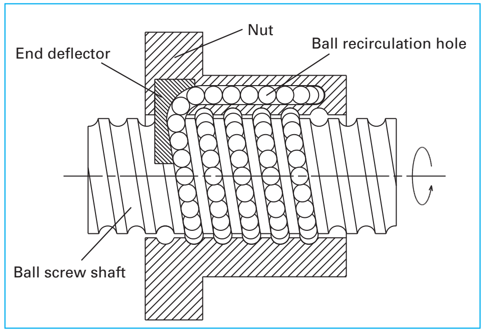


Fig. 1 Structure of end-deflector recirculation system

(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)

(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^{-1}

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) 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 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.

Special bearings which have higher-load carrying capacity are available.

For general precautions regarding ball screws, refer to "Design Precautions" (page B80) and "Handling Precautions" (page B99).

4. Product categories

The BSL type has a model as follows.

Table 2 BSL type product categories

Nut model	Shape	Flange shape	Preload system
BSL		Circular Ⅲ	P-Preload (Slight preload)

5. Structure of model number and reference number

The followings describe the structure of "Model number" and "Reference number for ball screw".

◇Model number

BSL 20 05

Nut model: BSL
Screw shaft diameter (mm)
Lead (mm)

◇Reference number for ball screw

W 20 05 - ＊＊ P SS - C5 Z 5

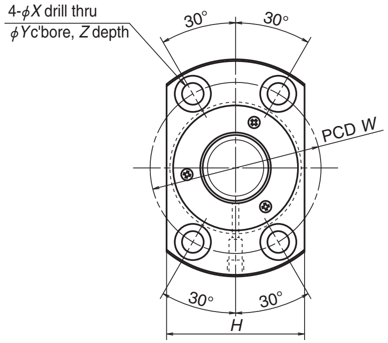
Product code
Screw shaft diameter (mm)
Effective threaded length (in the unit of 100 mm)
NSK design serial number
Preload code: P; P-preload (page B5)
Lead (mm)
Axial play code: Z (page B20)
Accuracy grade: C5 (page B37 to B42)
End-deflector recirculation system

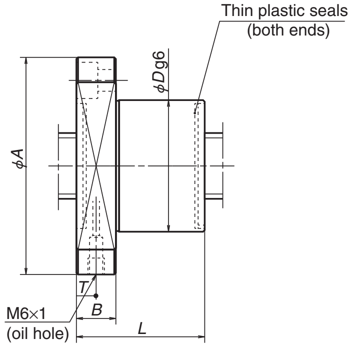
6. Handling Precautions

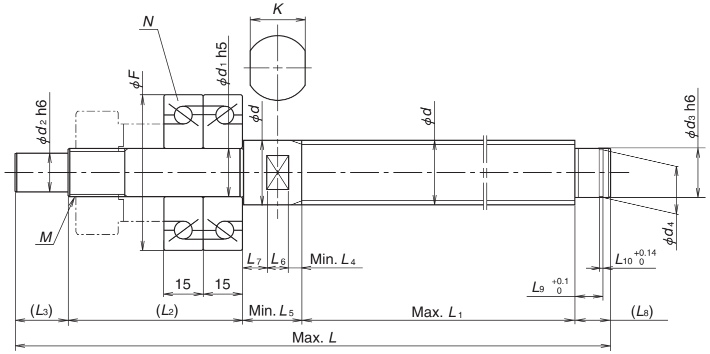
Maximum operating temperature: 80°C

If using NSK K1, operating temperature should not exceed 50°C. Refer to "Designing Precautions" (page B80).

BSL™ Type for small lathes







Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Basic load rating (N)		Ball nut dimensions										
						Dynamic	Static	External dimensions					Bolt hole dimensions				Oil hole	
	d	l	D_w	d_m	d_r	C_a	C_{0a}	D	A	H	B	L	W	X	Y	Z	T	d_1
BSL2005	20	5	3.175	20.5	17.2	8 920	16 300	36	63	38	12	37	49	6.6	11	6.5	6.5	15
BSL2006		6	3.969	20.5	16.4	11 900	20 000	40	65	42		45	51				6.7	
BSL2505	25	5	3.175	25.5	22.2	9 900	20 500	40	65	42	12	38	51	6.6	11	6.5	7.1	20
BSL2506		6	3.969	25.5	21.4	13 300	25 200	43	69	45		44	55				6.3	
BSL2508		8	4.762	25.5	20.5	17 100	30 100	46	72	48		55	58				6.5	
BSL2510		10	4.762	25.5	20.5	17 100	30 100	46	72	48		65	58				6	
BSL3210	32	10	6.35	33	26.4	27 700	51 300	61	93	63	18	68	76	9	14	8.5	10	25
BSL3212		12										77						

Notes: 1. The right turn screw is the standard. Please consult NSK for left turn screw.
2. Shaft dimensions are for reference.

Unit: mm

Model No.	Shaft configuration and dimensions (reference)																			
	Shaft dimension																Exclusive bearing N		Basic dynamic load rating	Permissible axial load
	d_2	d_3	d_4	L (max.)	L_1 (max.)	L_2	L_3	L_4 (min.)	L_5 (min.)	L_6	L_7	L_8	L_9	L_{10}	K	M	Bearing reference number	F	C_a	(N)
BSL2005	12	15	$14.3^{\,0}_{-0.11}$	500	500	66	20	3	20	8	9	14	10.15	1.15	17	M15×1.0	15TAC47B	47	21 900	26 600
BSL2006								4	21											
BSL2505	15	20	$19^{\,0}_{-0.21}$	700	700	71	27	3	27	10	14	19	15.35	1.35	22	M20×1.0	20TAC62B	62	28 500	40 500
BSL2506								4	28											
BSL2508								5	29											
BSL2510								5	29											
BSL3210	20	25	$23.9^{\,0}_{-0.21}$	1 000	800	71	33	6	33	12	15	20	16.35	1.35	27	M25×1.5	25TAC62B	62	28 500	40 500
BSL3212								7	34											

3. Shaft length L_1 and shaft entire length L are the maximum length.
When L becomes the same length as the L_1, the thread is all screw specification.

B-3-3.4.1 HTF-SRC Type for High-Load Drives

1. Features

● High-speed operation and low noise

The SRC recirculation system contributes to more than twice the feed speed (d·n value: 140 000 and 160 000) and the noise level of less than 8 to 10 dB (half to 1/3 of noise) compared with the HTF type.

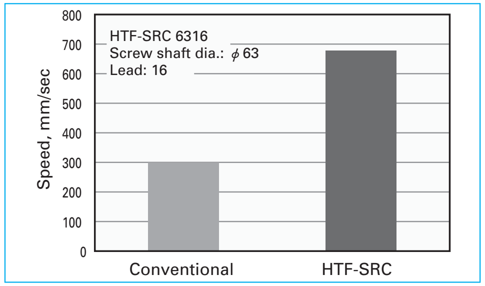


Fig. 1 Feed speed comparison

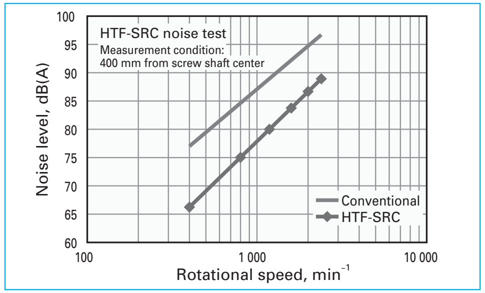


Fig. 2 Noise level comparison

2. Specifications

(1) Ball recirculation system

The SRC recirculation system picks up balls in the direction they are moving, and thus contributed to high-speed, low-noise operation. Structure of the recirculation system is as follows.

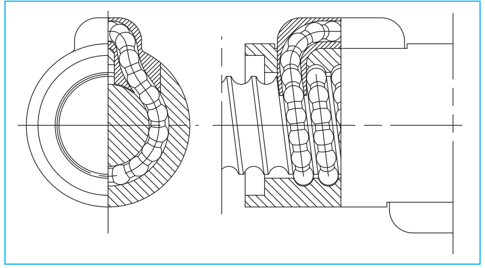


Fig. 3 Structure of SRC recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	Ct7
Axial play	S,0.020 mm or less; N,0.050 mm or less

(3) Allowable d·n value and the criterion of maximum rotational speed

Allowable d·n value and the criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Table 2 Allowable d·n value and the criterion of maximum rotational speed

Lead	14, 16 mm	20, 25 mm
Allowable d·n value	160 000 or less	140 000 or less
Criterion of maximum rotational speed	4 225 min^{-1}	

d·n value: shaft dia. d [mm] × rotational speed n [min^{-1}]

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Ball retaining piece NSK S1™

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 (See page B505).

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 B80) and "Handling Precautions" (page B99).

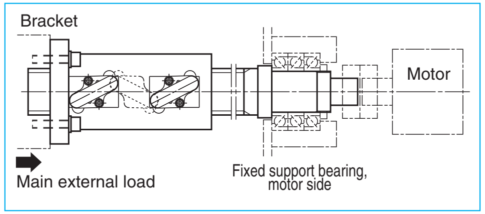


Fig. 4 Recommended installing direction of high-load drive ball screw

4. Product categories

The HTF-SRC type has a model as follows.

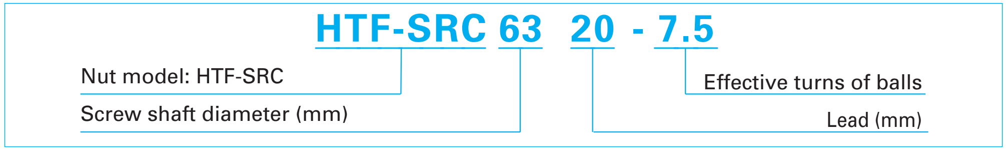
Table 3 HTF-SRC type product categories

Nut model	Shape	Flange shape	Preload system
HTF-SRC		Flanged Circular I	Non-preload Slight axial play

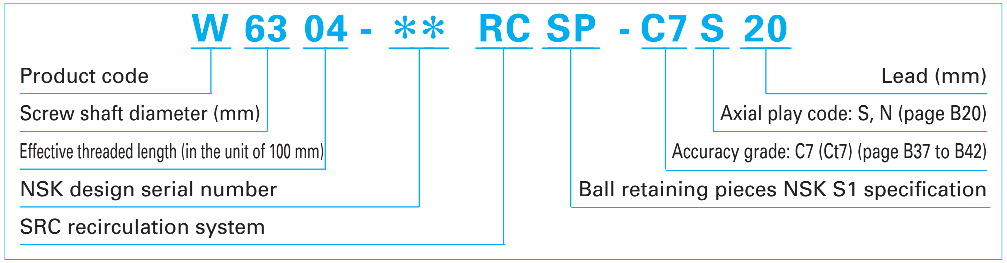
5. Structure of model number and reference number

The followings describe the structure of "Model number" and "Reference number for ball screw".

◇Model number



◇Reference number for ball screw

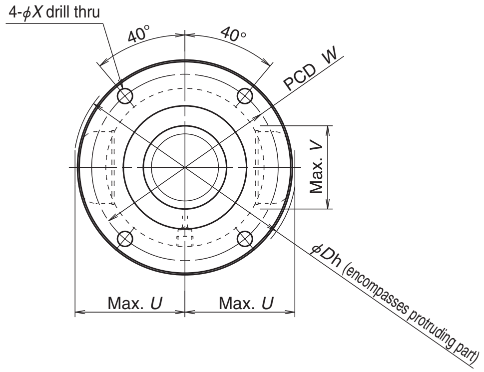


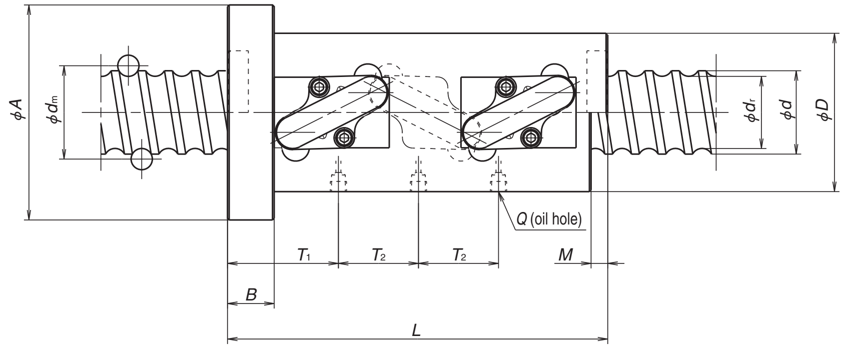
6. Handling Precautions

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.

HTF-SRC Type for high-load drives





Model No.	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls Turns × Circuits	Basic load rating (kN)		Allowable axial load (kN)
							Dynamic C_a	Static C_{0a}	
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	1 050	119.7
HTF-SRC6316-10.5						3.5×3	450	1 450	167.6
HTF-SRC6320-7.5		20	15.875	65.5	49	2.5×3	457	1 280	147.1
HTF-SRC6325-10.5		25	15.875	65.5	49	3.5×3	600	1 770	170.0
HTF-SRC8016-10.5	80	16	12.7	82	69	3.5×3	501	1 870	221.3
HTF-SRC8020-10.5		20	15.875	82.5	66	3.5×3	671	2 300	267.4
HTF-SRC8025-7.5		25	19.05	83	63	2.5×3	632	1 960	221.1
HTF-SRC10020-10.5	100	20	15.875	102.5	86	3.5×3	749	2 910	345.9
HTF-SRC10025-10.5		25	19.05	103	83		964	3 430	408.4
HTF-SRC12020-7.5	120	20	15.875	122.5	106	2.5×3	621	2 550	304.6
HTF-SRC12025-10.5		25	19.05	123	103	3.5×3	1 040	4 200	498.0

Unit: mm

Model No.	Ball nut dimensions													Max. feeding speed (mm/sec)
	Nut length L	Nut dia. D	Flange dia. A	Flange width B	Seal width M	Bolt hole PCD W	Bolt hole size X	Protruding tube dimensions			Oil hole Q	Oil hole position		
								U	V	Dh		T_1	T_2	
HTF-SRC5014-7.5	202	80	114	28	10	97	9	54.5	46	111	M6×1	69	42	750
HTF-SRC5016-7.5	228	95	129			112		66	50	134	Rc1/8	74.5	48	860
HTF-SRC6316-7.5	228	105	139	28	10	122	9	72.5	50	148	Rc1/8	74.5	48	680
HTF-SRC6316-10.5	276												64	
HTF-SRC6320-7.5	279	117	157	32	12	137	11	80	62	163		90	60	740
HTF-SRC6325-10.5	405	117	157	32	12	137	11	81.5	61	167		101.75	100	930
HTF-SRC8016-10.5	278	120	154	32	10	137	9	80	60	165	Rc1/8	78.5	64	540
HTF-SRC8020-10.5	339	130	170	32	12	150	11	88	64	180		90	80	590
HTF-SRC8025-7.5	347	145	185	40	17	165	11	99.5	73	202		111.75	75	730
HTF-SRC10020-10.5	339	145	185	32	12	165	11	97	78	199	Rc1/8	90	80	470
HTF-SRC10025-10.5	422	159	199	40	17	179		108	79	220		111.75	100	590
HTF-SRC12020-7.5	287	173	213	40	12	193	11	109.5	88	229	Rc1/8	98	60	390
HTF-SRC12025-10.5	421				17			116	92	238		111.25	100	490

Notes: 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 (See page B488). If your mounting conditions differ from those provided, please consult NSK.

B-3-3.4.2 HTF-SRD Type for High-Load Drives

This product is being applied for a patent.

1. Features

● High-speed operation and low noise

Used with end deflectors, HTF-SRD type ball screws achieve the maximum feed speed of 1 600 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) Ball recirculation system

End-deflector recirculation system has features of high-speed, low-noise operation, and compact ball nut. The structure of recirculation parts are as follows.

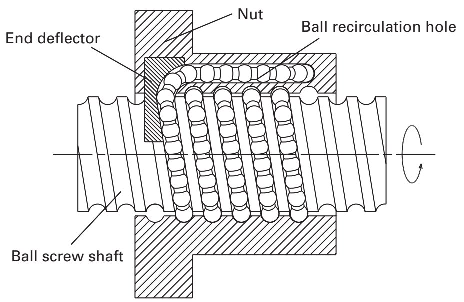


Fig. 1 Structure of End-deflector recirculation system

(2) Accuracy grade and axial play

The available standard accuracy 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	120 000 or less
Criterion of maximum rotational speed	2 400 min^{-1}

d·n value: shaft dia. d [mm] × rotational speed n [min^{-1}]

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Ball retaining piece NSK S1™

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.

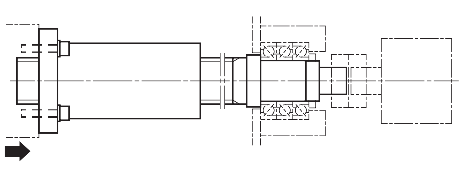


Fig. 2 Recommended installing direction of high-load drives ball screw

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 (see page B505).

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 B80) and "Handling Precautions" (page B99).

4. Product categories

The HTF-SRD type has a model as follows.

Table 3 HTF-SRD type product categories

Nut model	Shape	Flange shape	Preload system
HTF-SRD		Circular Ⅲ	Non-preload Slight axial play

5. Structure of model number and reference number

The followings describe the structure of "Model number" and "Reference number for ball screw".

◇Model number

HTF-SRD 50 40 - 6E

Nut model: HTF-SRD
Screw shaft diameter (mm)
Lead (mm)
Effective turns of balls

◇Reference number for ball screw

W 50 18 - ** SS SP X - C7 N 40

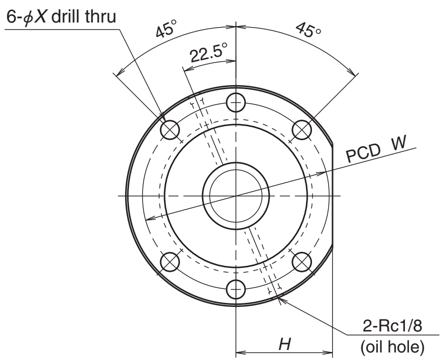
Product code
Screw shaft diameter (mm)
Effective threaded length (in the unit of 100 mm)
NSK design serial number
End-deflector recirculation system
Ball retaining pieces NSK S1 specification
Ball screw specification/appearance
Accuracy grade: C7 (Ct7) (page B37 to B42)
Axial play code: S, N (page B20)
Lead (mm)

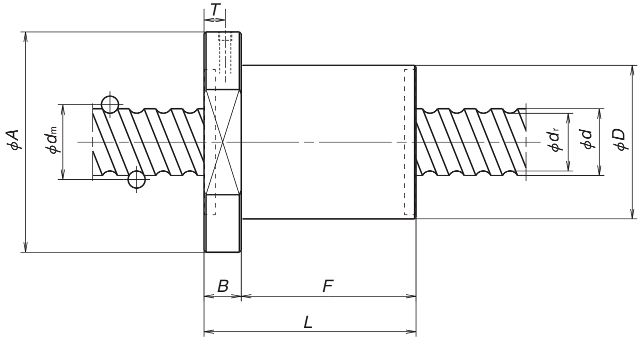
6. Handling Precautions

Maximum operating temperature: 70°C
(at outside diameter of ball nut)

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.

HTF-SRD Type for high-load drives





Unit: mm

Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls	Basic load rating (kN)		Allowable axial load	Ball nut dimensions									Max. feeding speed (mm/sec)
							Dynamic	Static		Nut entire length	Nut dia.	Flange dia.	Notch size	Flange width	Nut length	Bolt hole PCD	Bolt hole size	Oil hole position	
	d	l	D_w	d_m	d_r		C_a	C_{0a}	(kN)	L	D	A	H	B	F	W	X	T	
HTF-SRD5040-6E	50	40	12.7	52	39	6	195	491	67.6	159	115	165	72.5	28	131	140	14	16	1 600
HTF-SRD5040-8E						8	255	679	92	199					171				
HTF-SRD6332-4E	63	32	15.875	65.5	49	4	233	590	72.6	176	140	190	85	32	144	165	14	18	1 000
HTF-SRD6340-6E		40				6	291	768	106.3	163		200	90		131	170	18		1 250
HTF-SRD6340-8E						8	381	1 060	144.7	203					171				
HTF-SRD8050-6E	80	50	19.05	83	63	6	401	1 180	163.7	194	175	250	110	40	154	210	22	18	1 250
HTF-SRD8050-8E						8	526	1 630	224.1	244					204				
HTF-SRD10060-6E	100	60	19.05	103	83	6	467	1 490	211.5	225	195	270	122	40	185	235	22	20	1 200
HTF-SRD10060-8E						8	612	2 060	288	285					245				
HTF-SRD12070-6E	120	70	19.05	123	103	6	504	1 810	259.4	260	210	285	130	50	210	250	22	25	1 160
HTF-SRD12070-8E						8	660	2 520	352	330					280				

Notes:
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 (See page B491). If your mounting conditions differ from those provided, please consult NSK.

B-3-3.4.3 HTF Type for High-Load Drives

This product is being applied for a patent.

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) Ball recirculation system

Structure of recirculation system is shown in **Fig. 1**.

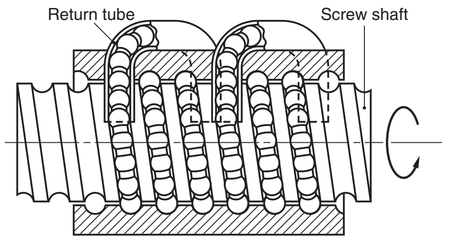


Fig. 1 Structure of return tube recirculation system

(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 d·n value	Standard specification	70 000 or less	70 000 or less	50 000 or less
	High-speed specification	10 0000 or less	–	–
Criterion of maximum rotational speed		3 125 min^{-1}		

d•n value: shaft dia. d [mm] × rotational speed n [min^{-1}]

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Ball retaining piece NSK S1™

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 drives.

The HTF 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 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. (See page B505).

For general precautions regarding ball screws, refer to "Design Precautions" (page B80) and "Handling Precautions" (page B99).

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

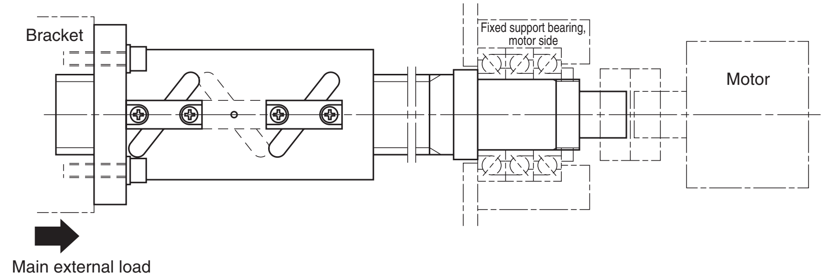


Fig. 2 Recommended installing direction of ball screws for high-load drives

5. Structure of model number and reference number

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇Model number

HTF 63 20 - 7.5

Nut model: HTF

Screw shaft diameter (mm)

Effective turns of balls

Lead (mm)

◇Reference number for ball screw

W 63 18 - ✻✻ **SP - C7 N 20**

Product code

Screw shaft diameter (mm)

Effective threaded length (in the unit of 100 mm)

Design serial number

Lead (mm)

Axial play code: S, N (page B20)

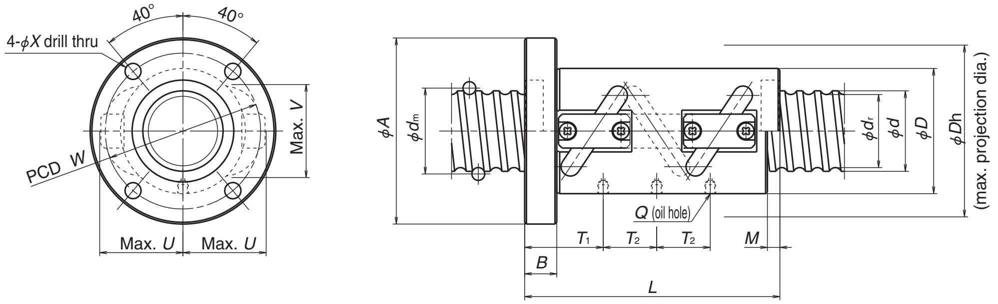
Accuracy grade: C7 (Ct7) (page B37 to B42)

Ball retaining pieces NSK S1 specification

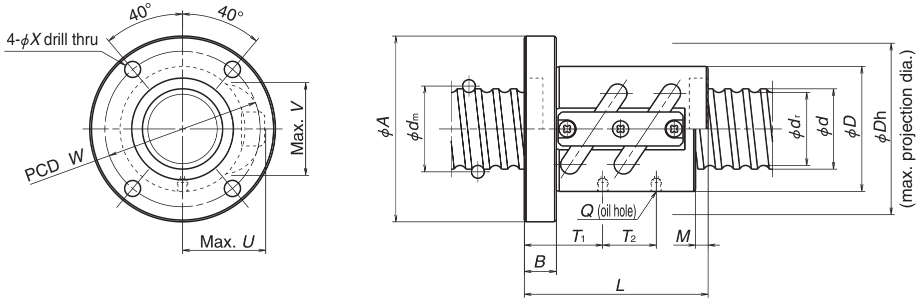
6. Handling precautions

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



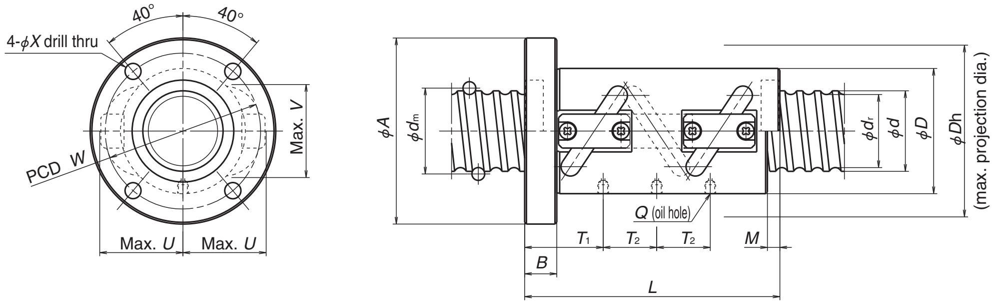
Nut model II

Unit: mm

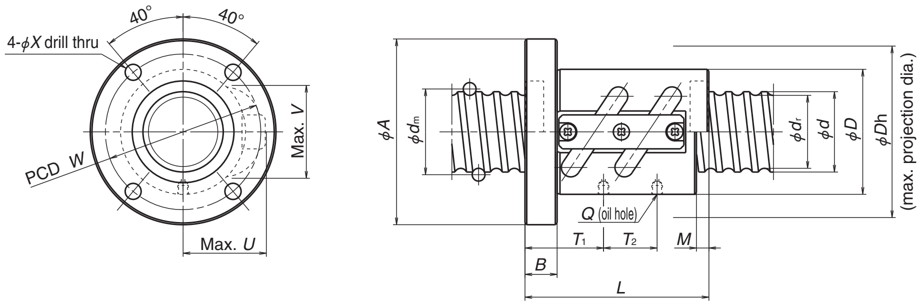
Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls Turns × Circuits	Nut model	Basic load rating (kN)		Permissible axial load (kN)	Ball nut dimensions													Max. feeding speed (mm/sec)
	d	l	D_w	d_m	d_r			Dynamic C_a	Static C_{0a}		Nut length L	Nut appearance D	Flange appearance A	Flange width B	Seal dimensions M	Bolt hole PCD W	Bolt hole size X	Tube projecting size U	V	Dh	Oil hole Q	Oil hole positions T_1	T_2	
HTF3210-5	32	10	7.144	33	25.6	2.5×2	II	71	169	20.3	103	58	92	18	7	75	9	40.5	42	82	M6×1	36.5	30	520
HTF3610-5	36	10	7.144	37	29.6	2.5×2	II	76.9	191	23.4	103	62	96	18	7	79	9	43	45	87	M6×1	36.5	30	460
HTF3612-5		12	7.938	37.25	29			90	228	28.3	123	66	100	22	8	83		46.5	46	94		44	36	550
HTF4010-7.5	40	10	7.144	41	33.6	2.5×3	I	120	344	39.6	143	66	100	18	7	83	9	45	48	91	M6×1	46.5	30	410
HTF4012-7.5		12	7.938	41.25	33			147	422	48	171	70	104	22	8	87		47.5	50	96		56	36	500
HTF4510-7.5	45	10	7.144	46	38.6	2.5×3	I	127	386	45.3	143	70	104	18	7	87	9	47	52	95	M6×1	46.5	30	370
HTF4512-7.5		12	7.938	46.25	38			156	473	55	171	72	106	22	8	89		49.5	54	100		56	36	440
HTF5010-7.5	50	10	7.144	51	43.6	2.5×3	I	133	435	51	143	75	109	18	7	92	9	49	57	99	M6×1	46.5	30	330
HTF5012-7.5		12	7.938	51.25	43			164	525	62	171	77	111	22	8	94		52	59	105	M6×1	56	36	400
HTF5014-7.5		14	9.525	51.5	41.7			211	623	73.1	200	80	114	28	10	97		55.5	61	112	M6×1	66.5	42	460
HTF5016-7.5		16	12.700	52	39			306	818	91.1	223	95	129	28	10	112		68	66	137	Rc1/8	73	48	530
HTF5510-7.5	55	10	7.144	56	48.6	2.5×3	I	139	477	55.7	143	80	114	18	7	97	9	51.5	62	104	M6×1	46.5	30	300
HTF5512-7.5		12	7.938	56.25	48			171	586	69.1	171	82	116	22	8	99		54.5	63	110	M6×1	56	36	360
HTF5514-7.5		14	9.525	56.5	46.7			216	696	81.2	200	85	119	28	10	102		57.5	65	116	M6×1	66.5	42	420
HTF5516-7.5		16	12.700	57	44			319	922	101.9	223	99	133	28	10	116		70	70	141	Rc1/8	73	48	480
HTF6312-7.5	63	12	7.938	64.25	56	2.5×3	I	181	668	80.3	171	92	126	22	8	109	9	58.5	70	118	M6×1	56	36	310
HTF6314-7.5		14	9.525	64.5	54.7	2.5×3		233	800	93.5	200	94	128	28	10	111	9	61.5	72	124	M6×1	66.5	42	370
HTF6316-7.5		16	12.700	65	52	2.5×3		343	1 050	119.7	223	105	139	28	10	122	9	72.5	76	146	Rc1/8	73	48	420
HTF6316-10.5						3.5×3		450	1 450	167.6	271												64	
HTF6320-7.5		20	15.875	66	49	2.5×3		457	1 320	147.3	273	117	157	32	12	137	11	83.5	81	168	Rc1/8	88	60	520

Notes: 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.
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 (see page B496). If your mounting conditions differ from those provided, please consult NSK.

HTF Type for high-load drives



Nut model I



Nut model II

Unit: mm

Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls Turns × Circuits	Nut model	Basic load rating (kN)		Permissible axial load (kN)	Ball nut dimensions													Max. feeding speed (mm/sec)
	d	l	D_w	d_m	d_r			Dynamic C_a	Static C_{0a}		Nut length L	Nut appearance D	Flange appearance A	Flange width B	Seal dimensions M	Bolt hole PCD W	Bolt hole size X	Tube projecting size U	V	Dh	Oil hole Q	Oil hole positions T_1	T_2	
HTF8014-7.5	80	14	9.525	81.5	71.7	2.5×3	I	261	1 020	121.9	200	116	150	28	10	133	9	72	87	146	M6×1	66.5	42	290
HTF8016-7.5		16	12.7	82	69	2.5×3		382	1 340	159	227	120	154	32	10	137	9	80	92	161	Rc1/8	77	48	330
HTF8016-10.5						3.5×3		501	1 870	221.3	275												64	
HTF8020-7.5		20	15.875	83	66	2.5×3		511	1 690	192.6	273	130	170	32	12	150	11	89.5	96	181	Rc1/8	88	60	410
HTF8020-10.5						3.5×3		670	2 300	272.4	333												80	
HTF8025-7.5		25	19.05	84	64	2.5×3		663	2 020	228.3	338	145	185	40	17	165	11	102	100	206	Rc1/8	109.25	75	360
HTF10016-7.5	100	16	12.7	102	89	2.5×3	I	423	1 710	202.3	227	145	185	32	10	165	11	91	109	184	Rc1/8	77	48	260
HTF10020-7.5		20	15.875	103	86	2.5×3		571	2 140	248.6	273	145	185	32	12	165		97.5	114	196		88	60	330
HTF10025-7.5		25	19.05	104	84	2.5×3		734	2 550	293.2	338	159	199	40	17	179		108.5	118	219		109.25	75	290
HTF10025-10.5						3.5×3		962	3 490	409.1	413												100	
HTF12016-7.5	120	16	12.7	122	109	2.5×3	I	457	2 050	248.9	227	173	213	32	10	193	11	104	126	210	Rc1/8	77	48	220
HTF12020-7.5		20	15.875	123	106	2.5×3		620	2 550	304.7	281			40	12			111	131	223		96	60	270
HTF12025-7.5		25	19.05	124	104	2.5×3		792	3 080	358.2	338			40	17			116	135	233		109.25	75	240
HTF12025-10.5						3.5×3		1 040	4 200	505.7	413												100	
HTF14020-7.5	140	20	15.875	143	126	2.5×3	I	663	3 000	360.9	281	204	250	40	12	226	14	122.5	148	248	Rc1/8	96	60	230
HTF14025-7.5		25	19.05	144	124			842	3 610	423.1	338	204	250	40	17	226	14	127.5	153	258		109.25	75	200
HTF14030-7.5		30	22.225	144	121			1 050	4 110	487.1	411	222	282	50	22	252	18	139	160	281		134.5	90	170
HTF14032-7.5		32	25.4	144	118			1 270	4 740	549.3	465	222	296	70	22	259	22	148	163	299		166.5	96	190
HTF16025-7.5	160	25	19.05	164	144	2.5×3	I	909	4 140	495.3	338	234	280	40	17	256	14	138	173	279	Rc1/8	109.25	75	180
HTF16030-7.5		30	22.225		141			1 120	4 760	564.3	411		294	50	22	264	18	148	177	299		134.5	90	150
HTF16032-7.5		32	25.4		138			1 330	5 370	636	465		308	70	22	271	22	152	181	307		166.5	96	160
HTF20030-7.5	200	30	22.225	204	181	2.5×3	I	1 240	5 960	718.8	411	290	350	50	22	320	18	178	212	359	Rc1/8	134.5	90	120
HTF20032-7.5		32	25.4		178			1 470	6 840	809.4	465		364	70		327	22	182	215	367		166.5	96	130

Notes: 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.
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 (see page B496). If your mounting conditions differ from those provided, please consult NSK.

NSK Technical Data Sheet for NSK High-Load Drive Ball Screws

Made-to-order ball screw

Company name:	Date:
Section:	Person in charge:
Address:	

NSK sales office

Name of machine*1 : *Electric injection molding machine; 30-ton capacity* Application*2 : *Clamping axis*

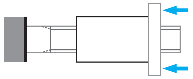
Drawing/rough sketch attached?: ☐ Yes ☑ No

∗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)

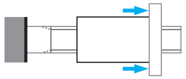
1. Use conditions

Operating conditions	☑ Shaft rotation — Moving nut ☐ Shaft rotation — Moving shaft ☐ Nut rotation — Moving nut ☐ Nut rotation — Moving shaft	☑ Normal operation ☐ Back drive operation ☐ Oscillation	Degree of vibration/impact	☐ Smooth operation without impact ☑ Normal operation ☐ Operation associated with impact or vibration
Direction of load*3	☐ C-C ☑ T-T ☐ T-C ☐ C-T ☐ Other (Refer to figures below.)		Mounting orientation	☑ Horizontal ☐ Vertical (Indicate the direction of gravity.)
Lubricant	☑ Grease ☐ Oil	(Brand name: *High-load grease with an extreme pressure additive* Maker:)	How to replenish lubricant	☑ Grease gun ☐ Automatic (cm³/ cycles)
Request for oil hole	☑ NSK recommended ☐ Your request			
Necessity of seals	☑ Yes ☐ No		NSK S1 necessary?	☑ NSK recommended ☐ Not necessary
Environment	Temperature (*40* deg)	Particles / ☐ Yes (Size of particle : a) -0.1, b) over 0.1-0.3, c) over 0.3- , d) Ingredient:) ☑ No particle.		
Surface treatment	☑ Not required ☐ Low-temperature chrome plating ☐ Fluoride low-temperature chrome plating ☐ Other			
Quantity in mass-production	/Month /Year /Lot		Quantity used per machine	*1* pcs./machine

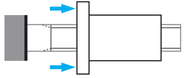
∗3 Please specify loading direction code on the figures below. (Shaft fixed: ▮, Main load: ⬅)



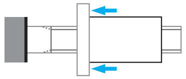
C-C
(NSK recommended)



T-T
(NSK recommended)



T-C



C-T

2. Specifications

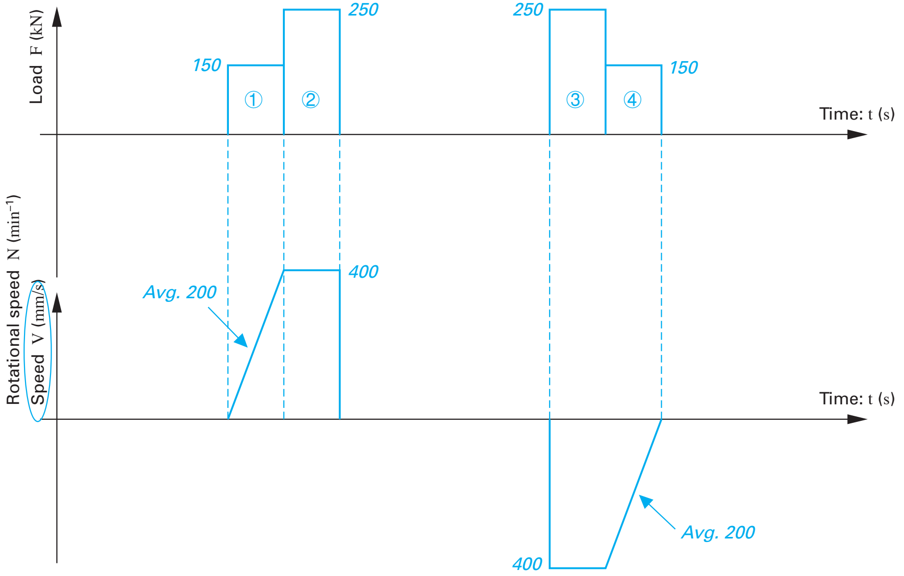
Shaft diameter	*ϕ 140* mm	Lead	*32* mm	Accuracy grade	*Ct7*	Axial play	*0.050 or less* mm max.
Nut model No.	*HTF 14032-7.5-S1*	Effective turns of balls	*2.5 × 2*	Direction of turn	*right*	Thread length /Overall shaft length	*1000* / *1500*

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 Screws

3. Load chart



	Axial load* F (kN)	Rotational speed or Average speed N (min⁻¹)	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 Screws

Made-to-order ball screw

Company name: Date:
Section: Person in charge:
Address:

NSK sales office

Name of machine*1 : ______________________ Application*2 : ______________

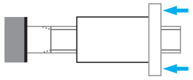
Drawing/rough sketch attached?: ☐ Yes ☐ No

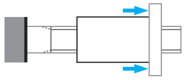
*1 Please specify capacity of the machine in case of injection molding machine or press.
*2 If the application is injection molding machine, please indicate the axis. (Examples: injection axis and clamping axis)

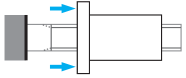
1. Use conditions

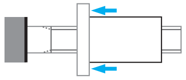
Operating conditions	☐ Shaft rotation — Moving nut ☐ Shaft rotation — Moving shaft ☐ Nut rotation — Moving nut ☐ Nut rotation — Moving shaft ☐ Normal operation ☐ Back drive operation ☐ Oscillation	Degree of vibration/impact	☐ Smooth operation without impact ☐ Normal operation ☐ Operation associated with impact or vibration
Direction of load*3	☐ C-C ☐ T-T ☐ T-C ☐ C-T ☐ Other (Refer to figures below.)	Mounting orientation	☐ Horizontal ☐ Vertical (Indicate the direction of gravity.)
Lubricant	☐ Grease (Brand name: ☐ Oil Maker:)	How to replenish lubricant	☐ Grease gun ☐ Automatic (cm³/ cycles)
Request for oil hole	☐ NSK recommended ☐ Your request		
Necessity of seals	☐ Yes ☐ No	NSK S1 necessary?	☐ NSK recommended ☐ Not necessary
Environment	Temperature (deg)	Particles / ☐ Yes (Size of particle : a) -0.1, b) over 0.1-0.3, c) over 0.3- , d) Ingredient:) ☐ No particle.	
Surface treatment	☐ Not required ☐ Low-temperature chrome plating ☐ Fluoride low-temperature chrome plating ☐ Other		
Quantity in mass-production	/Month /Year /Lot	Quantity used per machine	pcs./machine

*3 Please specify loading direction code on the figures below. (Shaft fixed: ▮, Main load: ←)


C-C
(NSK recommended)


T-T
(NSK recommended)


T-C


C-T

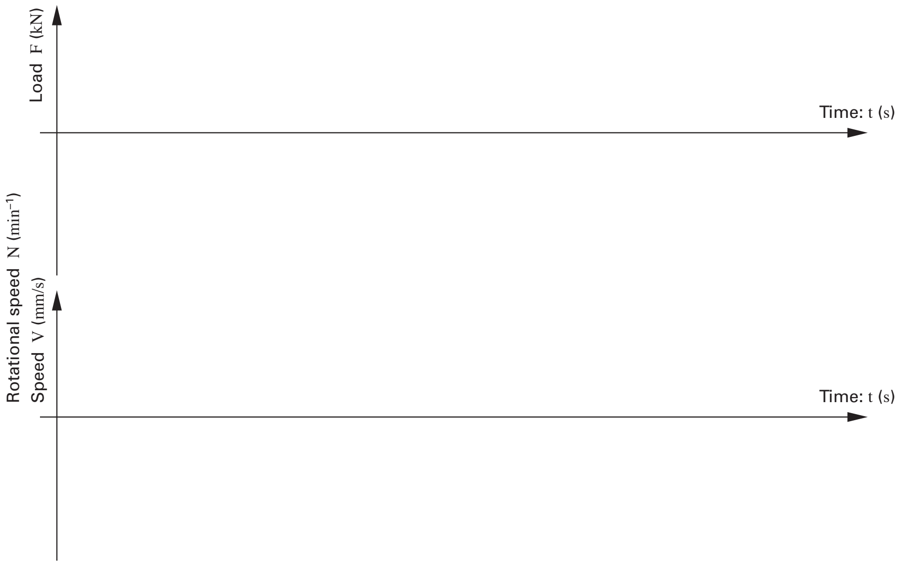
2. Specifications

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 Screws

3. Load chart



	Axial load* F (kN)	Rotational speed or Average speed N (min^{-1})	 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 → Planning to check endurance (Date:)
→ 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-3-3.5 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.

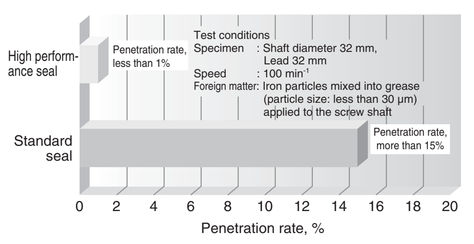
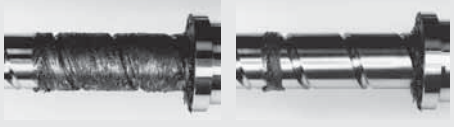


Fig. 1 Particle penetration rate



Before passage through high performance seal

After passage through high performance seal

All contaminants adhering to the screw shaft are swept away after passage through high performance seals.

Fig. 2 Contamination before and after particle penetration test

● Long life

High performance seals extend ball screw durability under severely contaminated environments with iron powder.

Extreme durability tests under contaminated environments show the durability of the VSS type extends more than four times longer than our existing type with a standard seal.

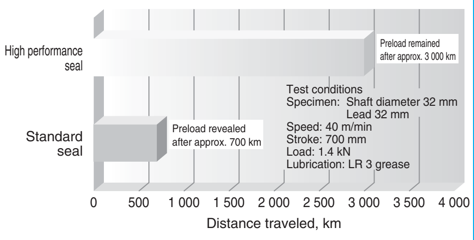


Fig. 3 Extreme durability test results using iron particles

● 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) Ball 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**.

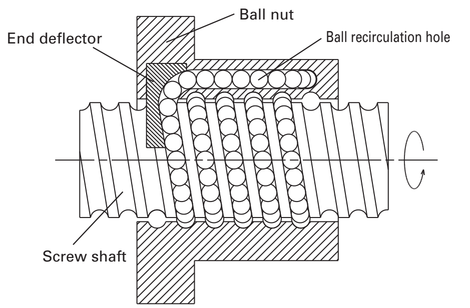


Fig. 4 Structure of end deflector recirculation system

(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: 150 000 or less

Criterion of maximum rotational speed: 3 000 min^{-1}

Note: Please also review critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) High performance seal

High performance seal (Japanese 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 B80) and "Handling Precautions" (page B99).

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. Structure of model number and reference number

The followings describe the structure of "Model number" and "Reference number for ball screw".

◇Model number

VSS 32 10 - 6E

Nut model: VSS
Screw shaft diameter (mm)
Lead (mm)
Effective turns of balls

◇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 (page B5)
End-deflector recirculation system
High performance seal V1
Accuracy grade: C5 (page B37 to B42)
Axial play: Z, T, S (page B20)
Lead (mm)

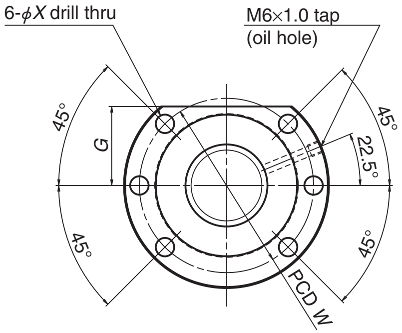
6. Handling Precautions

Maximum operating temperature: 50˚C

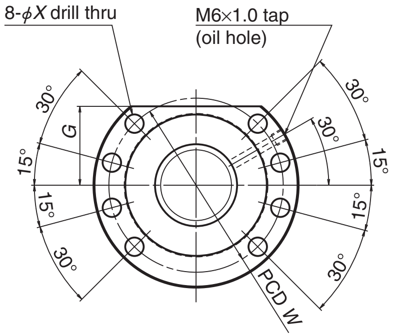
Maximum momentary operating temperature: 80˚C

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.

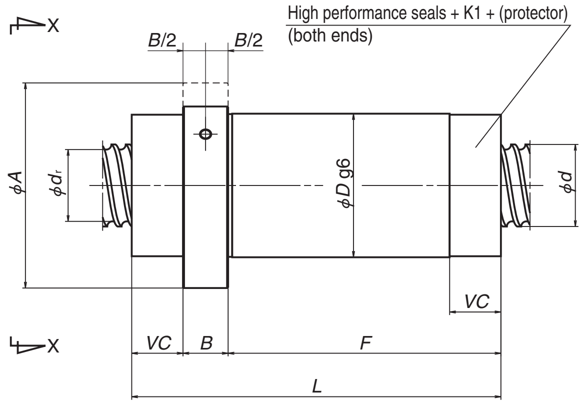
View *X*-*X*



Screw shaft diameter *d* = 32 mm



Screw shaft diameter *d* ≥ 40 mm



Unit: mm

Model No.	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls	Basic load rating (N) Dynamic C_a	Static C_{0a}	Axial rigidity K (N/μm)	Ball nut dimensions: Nut entire length L	Nut outside diameter D	Flange outside diameter A	Flange width B	Nut length F	Notch size G	Seal installation dimensions VC	Bolt hole PCD W	Bolt hole dimensions X	Maximum shaft length
VSS3210-6E	32	10	5.5563	33	27.2	6	43 300	111 000	682	132	56	86	18	89.5	34	24.5	71	9	2 800
VSS3216-5E		16				5	36 700	90 800	563	150				107.5					
VSS3220-5E		20				5	36 700	90 800	561	169				126.5					
VSS3232-4E		32				4	25 000	58 300	387	122				79.5					
VSS4040-4E	40	40	6.35	41	34.4	4	33 600	83 900	472	144	70	100	22	94	38.5	27.5	85	9	3 800
VSS5050-4E	50	50	6.35	51	44.4	4	37 300	105 000	559	164	82	118	22	114.5	46	27.5	100	11	5 000

Notes: 1. The right hand screw is the standard. For specifications on left hand screws, contact NSK.

2. 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 B37) if axial load and preload differs from the conditions above, or when considering change in the deformation of the ball nut itself.

3. 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).

B-3-3.6 TW Series for Twin-Drive Systems

(1) Features

Variations in the lead accuracy and preload torque between two ball screws, which consist of a unit of TW Series, are controlled, resulting improved travel accuracy and ball screw operating lifetime. **Fig. 1** shows measured variation in lead accuracy while **Fig. 2** displays an example of variation in thermal expansion between the two ball screws. **Fig. 3** is a schematic diagram comparing the travel accuracy between 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 1 200 mm/min (shaft dia. 40 mm, lead 30 mm, rotational speed 4 000 min^{-1}).

(2) Specifications

Table 1 Specifications of twin-drive systems

Recirculation systems	End-deflector recirculation system, Return tube system, Deflector system
Shaft dia.	ϕ32 – 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 B512) for more details.

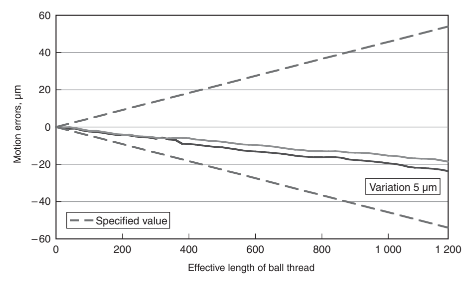
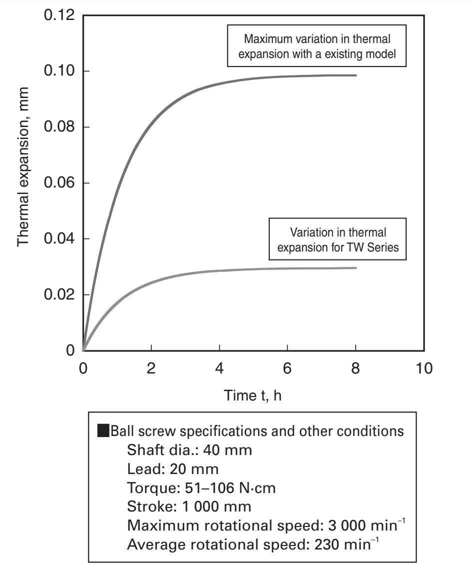


Fig. 1 Example of measured variation in lead accuracy



■Ball screw specifications and other conditions
Shaft dia.: 40 mm
Lead: 20 mm
Torque: 51–106 N·cm
Stroke: 1 000 mm
Maximum rotational speed: 3 000 min^{-1}
Average rotational speed: 230 min^{-1}

Fig. 2 Calculation example of the variation of thermal expansion

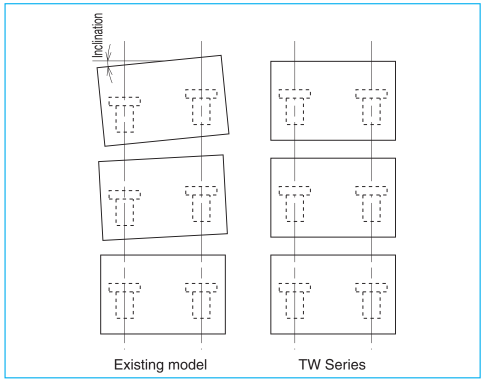


Fig. 3 Schematic diagram of travel accuracy

B-3-3.7 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 B391) and seal unit (page B515) to standardized shaft end. This makes designing of mounting ball screw easy.

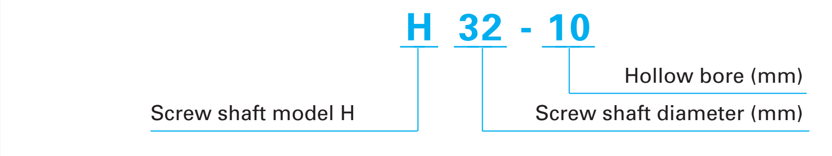
NSK also provides nut cooling ball screws. The level of temperature rise for nut cooling ball screw is equal to the hollow shaft ball screw thanks to the optimized nut internal design for cooling.

Since the nut which is mounted to the table is cooled, it has an effect of blocking the heat from ball screw to the processing table. Furthermore, using with the follow shaft ball screw makes even more precise temperature control possible as the screw shaft and nut are cooled simultaneously.

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 3 000 mm, contact NSK. For general precautions regarding ball screw, refer to "Design Precautions" (page B80) and "Handling precautions" (page B99).

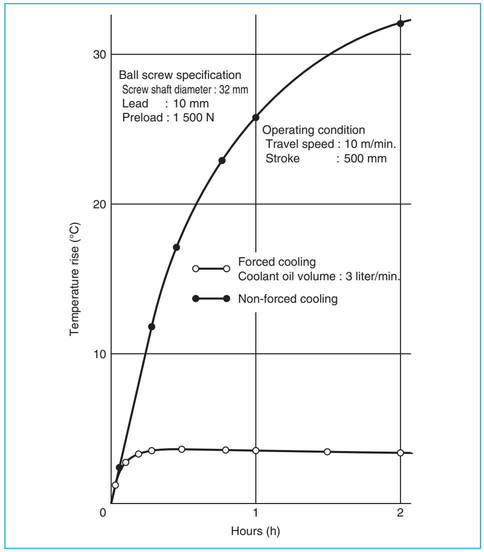
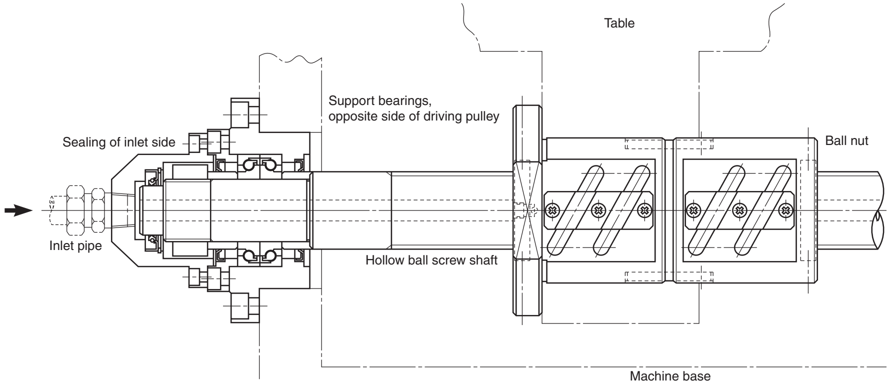
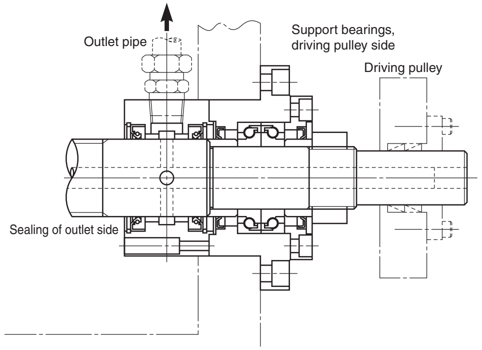
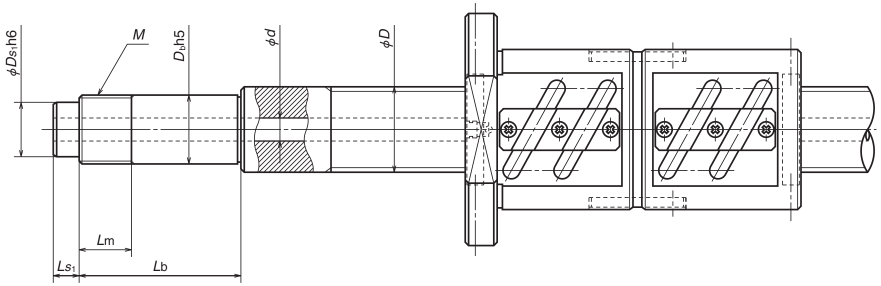


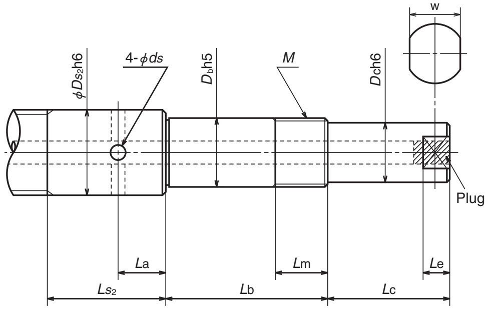
Fig. 1 Effect of forced cooling by hollow shaft ball screw

4. Installation example and standard dimensions









Unit: mm

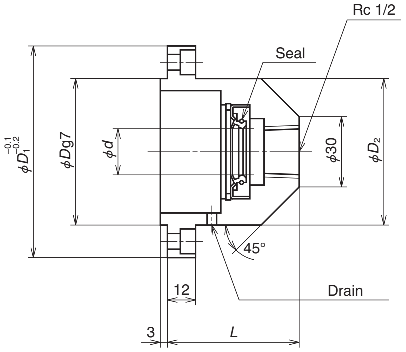
Model No.	Screw shaft		Bearing seat				Sealing						Drive side		Spanner flats		Applicable support unit	Used bearing	Equipped seal unit	
	Diameter	Hollow	Diameter	Lock nut			Inlet		Outlet										Shaft end	Shaft outer surface
	D	d	Db	M	Lm	Lb	Ds_1	Ls_1	Ds_2	Ls_2	La	ds	Dc	Lc	w	Le				
H32-10	32	10	25	M25×1.5	26	89 104 119	20	15	32	60	25	6	20	40	17	8	WBK25DF-31 WBK25DFD-31	25TAC62BDFC10PN7A 25TAC62BDFDC10PN7A (25TAC62BDFFC10PN7A)	WSK20A-01	WSK32B-01
H40-12	40	12	30	M30×1.5	26	89 104 119	25	15	40	60	25	7	25	50	22	10	WBK30DF-31 WBK30DFD-31	30TAC62BDFC10PN7A 30TAC62BDFDC10PN7A (30TAC62BDFFC10PN7A)	WSK25A-01	WSK40B-01
H50-15	50	15	40	M40×1.5	30	92 107 122	32	15	50	65	27	8	35	70	30	13	WBK40DF-31 WBK40DFD-31 WBK40DFF-31	40TAC72BDFC10PN7A 40TAC72BDFDC10PN7A 40TAC72BDFFC10PN7A	WSK32A-01	WSK50B-01

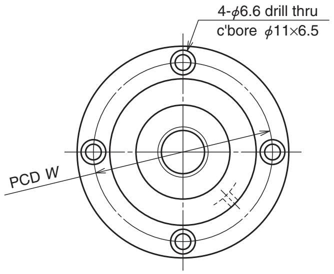
Notes: Please consult NSK for other models.

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)

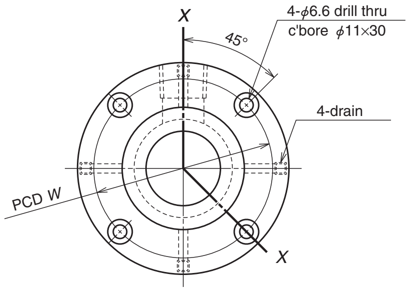


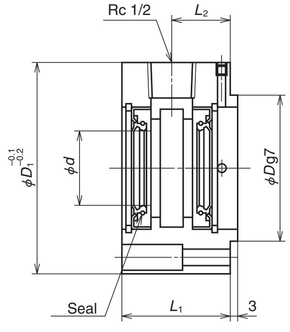


Unit: mm

Reference No.	d	D	D_1	D_2	L	W	Fixing bolt
WSK20A-01	20	57	85	57	56	70	M6
WSK25A-01	25	57	85	57	56	70	M6
WSK32A-01	32	69	95	67	61	80	M6

B Type
(for shaft outer surface)





Section X-X

Unit: mm

Reference No.	d	D	D_1	L_1	L_2	W	Fixing bolt
WSK32B-01	32	57	85	46	25	70	M6
WSK40B-01	40	57	85	46	25	70	M6
WSK50B-01	50	69	95	49	27	80	M6

◇ **Handling precautions**

- Use NSK support unit (high load capacity for machine tools on page B391) for installation in order to maintain the eccentricity between screw shaft and seal unit.
- Apply grease to the lip section for protection at the time of installation to the ball screw.
- Make certain that the drain holes (one for A Type, four for B Type) of the seal unit directly face downward when the unit is installed.

B-3-3.8 ND Series for Nut-Rotatable Drives

• 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.

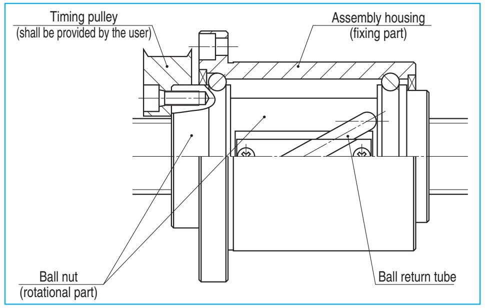


Fig. 1 Ball nut structure

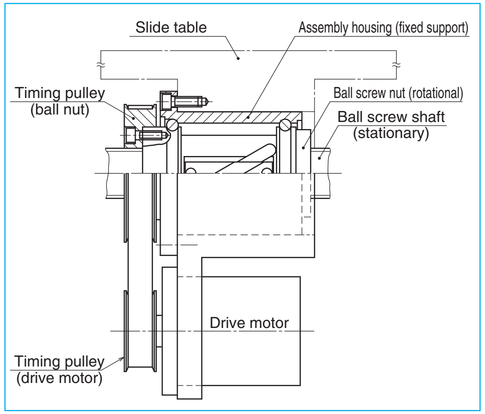


Fig. 2 Example of installation to the table

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) Ball recirculation system

The structure of return tube recirculation system is shown below.

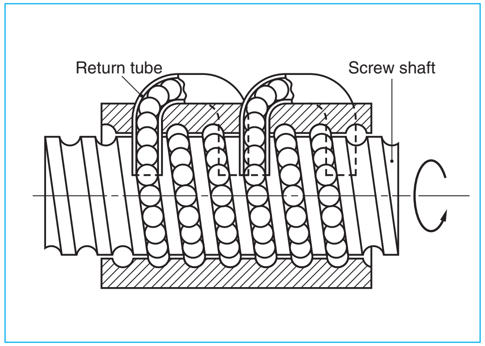


Fig. 3 Structure of ball return tube recirculation system

(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 B47).

Table 3 Allowable d•n value and the criterion of maximum rotational speed

Allowable d·n value	Standard specification	70 000 or less
	High-speed specification	100 000 or less
Criterion of maximum rotational speed	3 000 min^{-1}	

d·n value: shaft dia. d [mm] × rotational speed n [min^{-1}]

● Critical speed n_c

As shown **Fig. 4**, calculate unsupported length (mm) of L_1, L_2, and L_3 (assumed that the nut section is a fixed support.) **Table 4** shows the coefficients "f" of each shaft end mounting condition.

$$n_c = f \cdot \frac{d_r}{L_i^2} \times 10^7 \ (\text{min}^{-1}) \qquad (\text{Ⅲ-1})$$

d_r: Screw shaft root diameter (See the dimension table.)
L_i: Unsupported length (mm) (See **Fig. 4**)
f : Factor determined by the ball screw shaft end mounting condition

Table 4

Shaft end mounting condition	f
Fixed -- Fixed support	21.9
Fixed -- Simple support	15.1
Fixed -- Free support	3.4

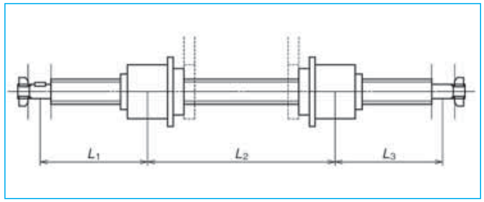


Fig. 4 Installation example

5. Design precautions

One end of the screw thread should be cut-through to the end. Also, if the nut must be removed from the screw shaft, the user should have an arbor to prevent the balls from falling out during this process. (NSK manufactures arbors on request.)
For general precautions regarding ball screws, refer to "Design Precautions" (page B80) and "Handling Precautions" (page B99).

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.

Notes: 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 interchageability 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.

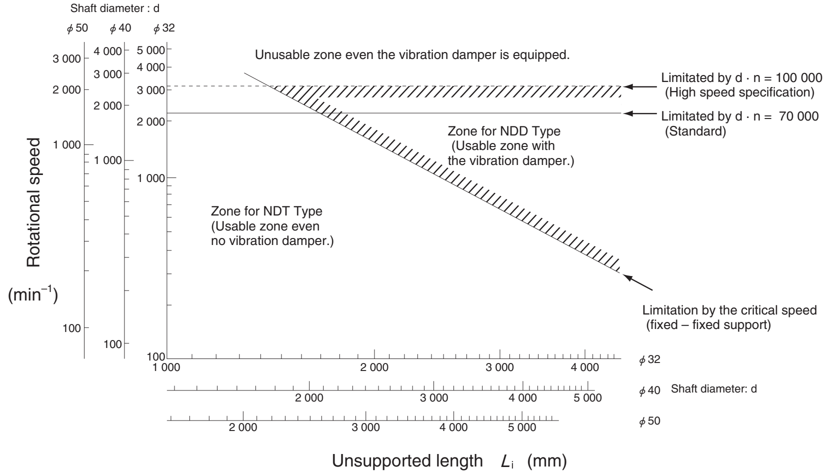


Fig. 5 Compartmentalization between NDT and NDD types to rotational speed and unsupported length

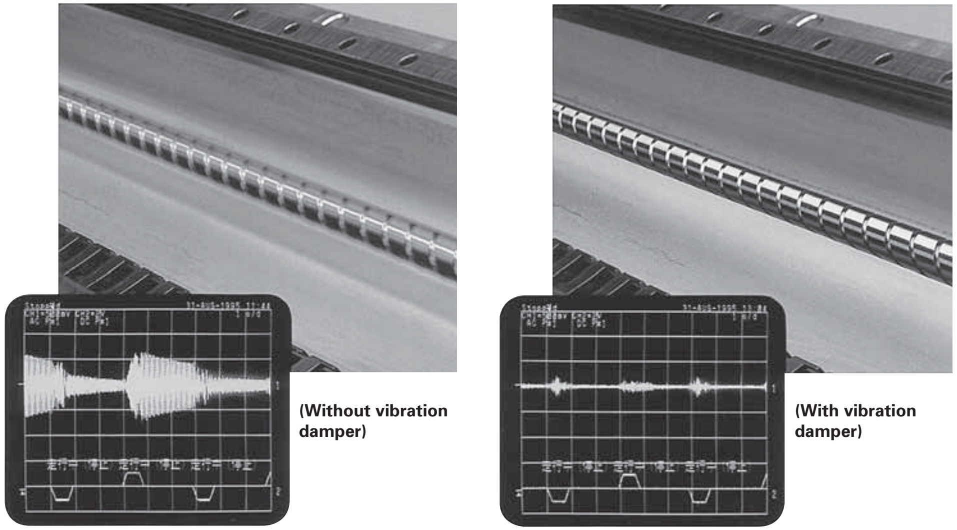

(Without vibration damper)
(With vibration damper)

Fig. 6 Vibration of screw shaft when nut is rotating

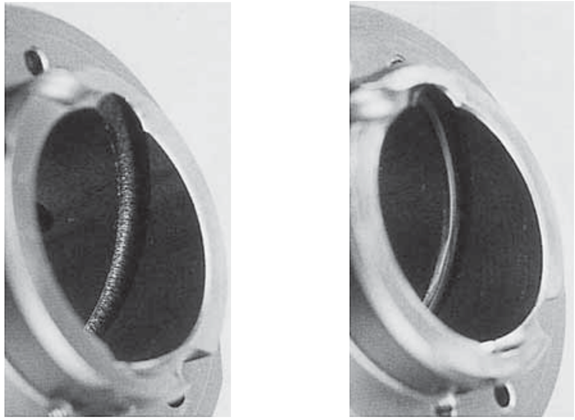

(Without vibration damper)
(With vibration damper)

Fig. 7 Effect of vibration damper (results of endurance test)

Calculation example of permissible rotational speed

[Calculation example]
Assume a system which moves two nuts on a shaft as shown below.
Does this system operate appropriately if: both ends of the ball screw (shaft diameter 40 mm/ lead 40 mm) are fixed, and the travel speed is at 60 m/min?

[Answer]
The rotational speed n (min^{-1}) when the lead of the ball screw is 40 mm, and the travel speed is at 60 m/min is:

$$n = \frac{60 \times 10^3}{40} = 1\,500\ (\text{min}^{-1})$$

● Calculate d • n value
As the d • n value of standard specification is 7 000, therefore, the permissible rotational speed is;

$$n \leq \frac{70\,000}{40} = 1\,750\ (\text{min}^{-1})$$

● Calculate critical speed
The maximum unsupported length comes between Nut A and B.

L_2 = 3 300 (mm)
f = 21.9 (Fixed-Fixed)
Root diameter: d_r = 35.1 (mm)

Therefore, the permissible rotational speed is;

$$n \leq \frac{21.9 \times 35.1}{3\,300^2} \times 10^7 = 706\ (\text{min}^{-1})$$

The calculation indicates that the d • 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 1 500 min^{-1}.

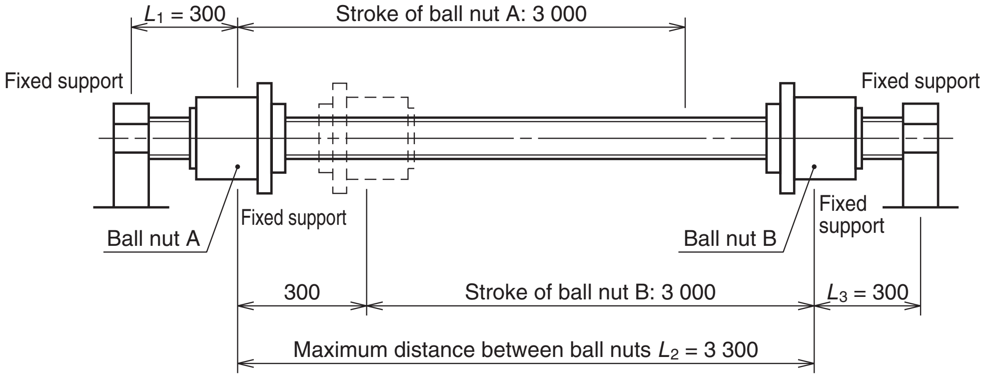
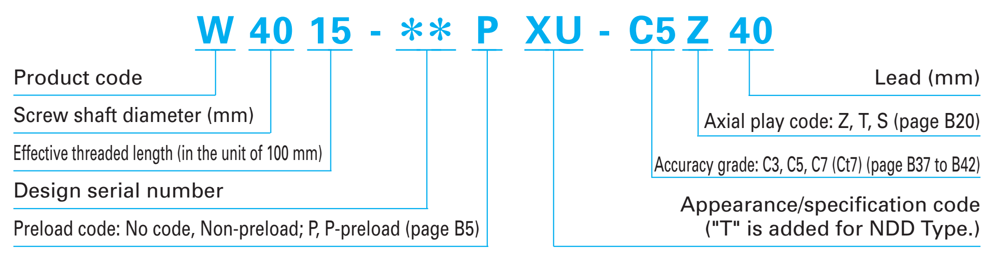


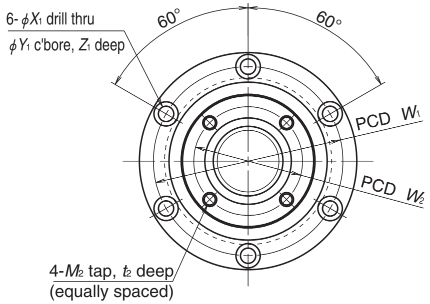
Fig. 8 Calculation example of permissible rotational speed

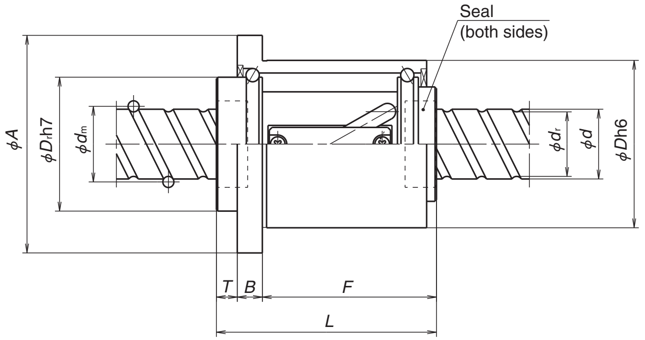
Structure of reference number

The followings describe the structure of "Reference number for ball screw".

◇Reference number for ball screw







Unit: mm

Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Effective turns of balls Turns × Circuits	Basic load rating (N)		Moment of inertia, ball nut	Ball nut mass	Ball nut dimensions													Tap hole PCD
	d	l	D_w	d_m	d_r		Dynamic C_a	Static C_{0a}	J (kg·cm^2)	W (kg)	Nut entire length L	Nut outside diameter D	Flange outside diameter A	Flange width B	Nut length F	Projection tube dimensions D_1	T	Bolt hole dimensions X_1	Y_1	Z_1	Bolt hole PCD W_1	Tap hole dimensions M_2	t_2	W_2
NDT **NDD** **3220-2.5**	32	20	4.762	33.25	28.3	2.5×1	17 900	41 800	6.2	2.9	107	78	105	12	83	60	12	6.6	11	6.5	91	M6	12	50
NDT **NDD** **3225-2.5**		25	4.762	33.25	28.3	2.5×1	17 900	41 800	6.7	3.2	120	78	105	12	96	60	12	6.6	11	6.5	91	M6	12	50
NDT **NDD** **3232-1.5**		32	4.762	33.25	28.3	1.5×1	11 500	24 800	6.2	2.9	107	78	105	12	83	60	12	6.6	11	6.5	91	M6	12	50
NDT **NDD** **3232-3**						1.5×2	18 900	44 600																
NDT **NDD** **4025-2.5**	40	25	6.35	41.75	35.1	2.5×1	28 500	70 000	19.3	6.0	136	100	133	15	106	76	15	9	14	8.5	116	M8	16	62
NDT **NDD** **4032-1.5**		32	6.35	41.75	35.1	1.5×1	18 400	41 200	18.0	5.5	122	100	133	15	92	76	15	9	14	8.5	116	M8	16	62
NDT **NDD** **4032-3**						1.5×2	30 100	74 100																
NDT **NDD** **4040-1.5**		40	6.35	41.75	35.1	1.5×1	18 400	41 200	19.2	6.0	136	100	133	15	106	76	15	9	14	8.5	116	M8	16	62
NDT **NDD** **4040-3**						1.5×2	30 100	74 100																
NDT **NDD** **5025-2.5**	50	25	7.938	52.25	44.0	2.5×1	42 700	109 000	45.7	8.5	140	120	156	18	107	96	15	11	17.5	11	136	M10	18	78
NDT **NDD** **5032-2.5**		32	7.938	52.25	40.0	2.5×1	42 700	109 000	48.9	9.4	158	120	156	18	125	96	15	11	17.5	11	136	M10	18	78
NDT **NDD** **5040-1.5**		40	7.938	52.25	44.0	1.5×1	27 500	66 500	45.5	8.5	140	120	156	18	107	96	15	11	17.5	11	136	M10	18	78
NDT **NDD** **5040-3**						1.5×2	44 900	120 000																
NDT **NDD** **5050-1.5**		50	7.938	52.25	44.0	1.5×1	27 500	66 500	48.7	9.4	158	120	156	18	125	96	15	11	17.5	11	136	M10	18	78
NDT **NDD** **5050-3**						1.5×2	44 900	120 000																

Notes:
1. The right hand screw is the standard. Consult NSK for the left hand screws.
2. Seals are standard equipment.

B-3-3.9 ∑ Series for Robots

1. Features

∑ 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.

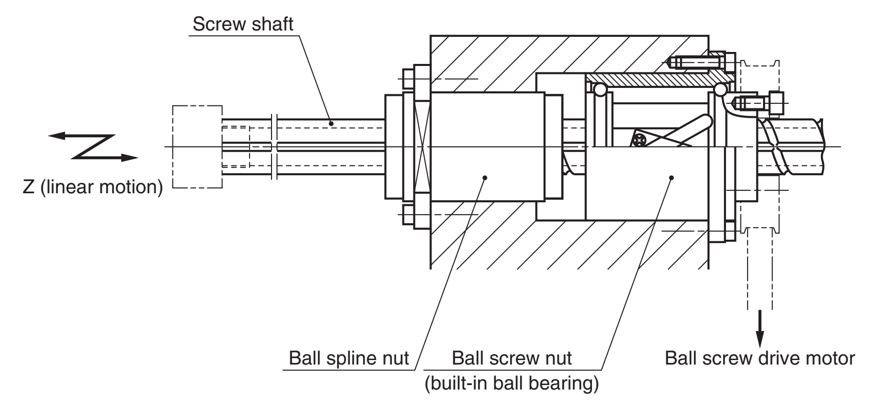


Fig. 2 Example structure of single Z axis unit

2. Functions

As shown in **Fig. 1**, the ball screw nut and a spline nut are rotated independently to control rotation value. Thereby the shaft can move in any direction -- linear and rotational. **Table 1** shows the relationship between power input and output.

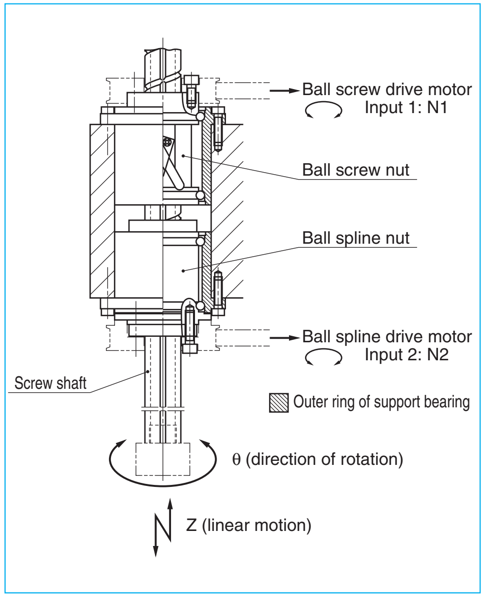


Fig. 1 Example structure of Z axis plus θ axis actuator

Table 1 Power input and output of ∑ Series

Shaft movement (output)		Input		
Z (up-down movement) (mm/min)	θ (rotational movement) (min^{-1})	① Ball screw (min^{-1})	② Spline (min^{-1})	Notes
Up, down $N1\times l$	Stop 0	Rotate N1	Stop 0	–
Stop 0	Rotate N2	Rotate N1	Rotate N2	N1 = N2
Up, down $N2\times l$	Rotate N2	Stop 0	Rotate N2	–
Up, down $\lvert N1-N2\rvert\times l$	Rotate N2	Rotate N1	Rotate N2	N1≠N2

3. Specifications

(1) Ball recirculation system

A structure of return tube recirculation system is shown below.

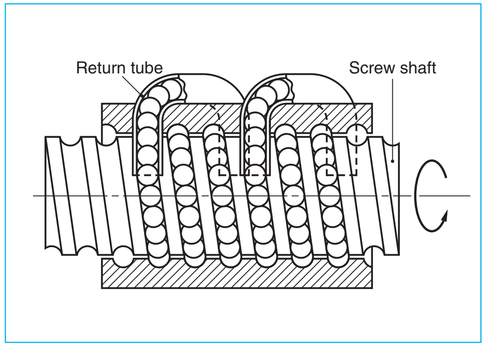


Fig. 3 Structure of return tube recirculation system

(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: 70 000 or less

Criterion of maximum rotational speed: 3 000 min^{-1}

Note: Please also review the critical speed.

For details, see "Technical Description: Permissible Rotational Speed" (page B47).

(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 θ (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 B80) and "Precautions in Handling" (page B99).

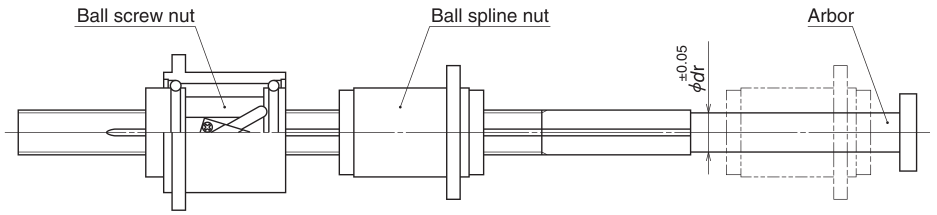
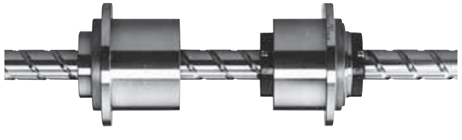
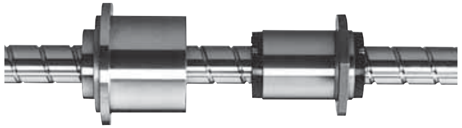
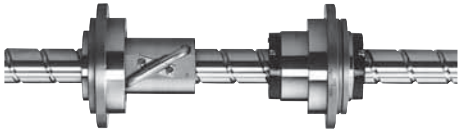
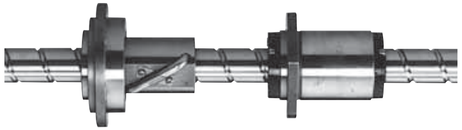


Fig. 4 Removing spline nut

5. Product categories

Σ 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 Σ Series product categories

Model	Appearance	Size	Structure (Movement)
Σ		Standard	Z+θ Unit
ΣZ		Standard	Z Unit
ΣC		Compact	Z+θ Unit
ΣCZ		Compact	Z Unit

6. Load rating and life

The relationship between load rating of the ball spline section and life is the same as 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.

θ : 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.

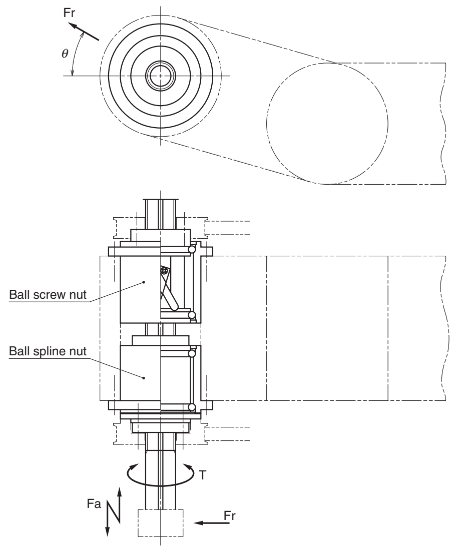


Fig. 5 Example structure of Z axis plus θ axis actuator

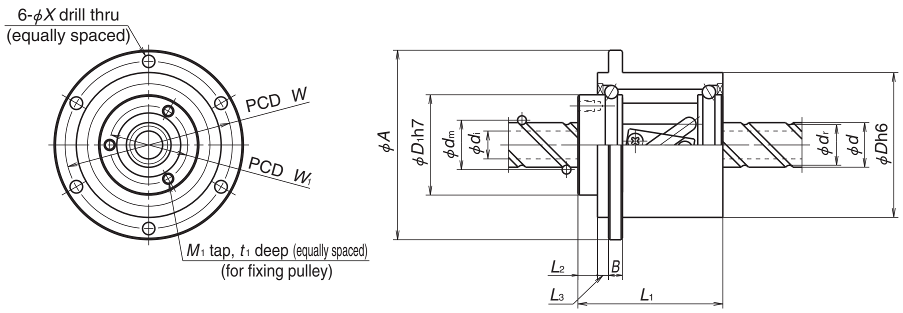
7. Structure of reference number

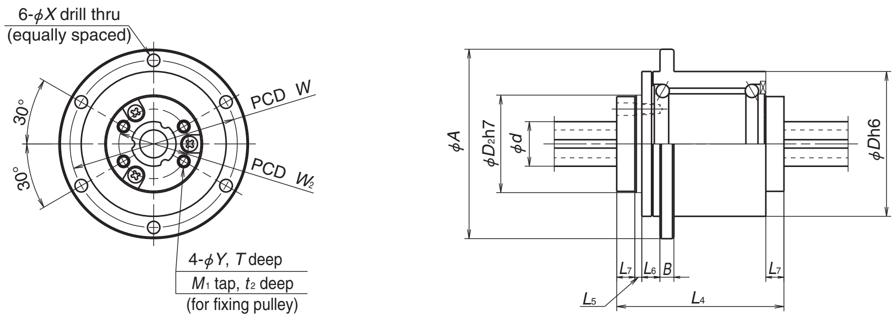
The following describes the structure of "Reference number for ball screw".

◇Reference number for ball screw

PW 25 02 - ＊＊ P T U - C5 Z 20

Product code
Screw shaft diameter (mm)
Effective threaded length (in the unit of 100 mm)
Design serial number
Preload code: No code, Non-preload; P, P-preload (page B5)
Hollow shaft ball screw specification
Use support unit
Accuracy grade: C3, C5, C7 (Ct7) (page B37 to B42)
Axial play code: Z, T, S (page B20)
Lead (mm)



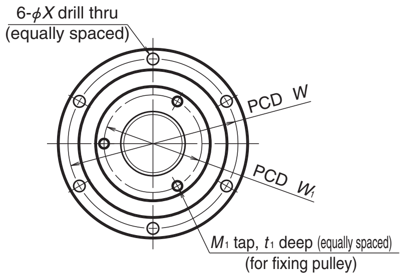


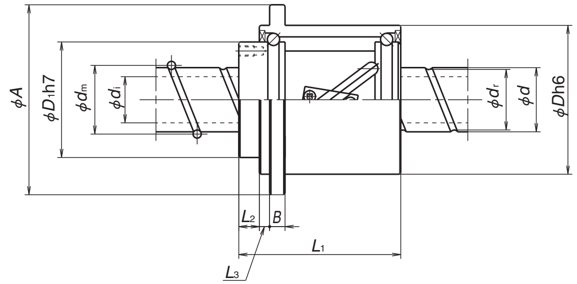
Unit: mm

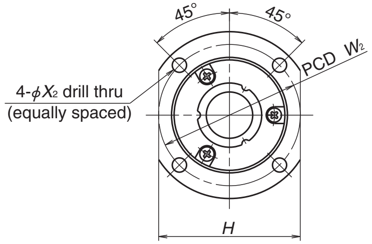
Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Screw shaft hollow	Ball screw nut																
							Basic load rating (N)		Dimensions													Moment of inertia	Mass
	d	l	D_w	d_m	d_r	d_i	Dynamic C_a	Static C_{0a}	D	A	B	L_1	L_2	L_3	M_1	t_1	W_1	D_1	W	X	(kg·cm²)	(kg)
Σ1610	16	10	3.175	16.75	13.4	(8)	4 710	8 110	48	64	5	47	7	4	3-M4	6	28	35	56	4.5	0.41	0.50
Σ1632		32					2 990	4 870				52									0.44	0.55
Σ2010	20	10	3.175	20.75	17.4	(14)	8 210	17 500	54	70	6	57	8	4	3-M4	6	32	40	62	4.5	0.64	0.74
Σ2020		20					5 290	10 300				63									0.65	0.81
Σ2040		40					3 360	6 170				57									0.64	0.74
Σ2510	25	10	3.175	25.75	22.4	(18)	9 110	21 900	58	74	6	57	8	4	3-M4	6	38	45	66	4.5	1.10	0.81
Σ2520		20					5 870	13 200				63									1.18	0.88
Σ2525		25					5 870	13 200				72									1.30	1.00
Σ3220	32	20	3.175	32.75	29.4	(25)	6 540	16 800	70	95	8	70	10	6	3-M5	10	44	53	82	6.6	2.60	1.46
Σ3232		32					6 540	16 800				91									3.15	1.83
Σ4020	40	20	3.969	41.0	36.9	(30)	9 770	26 300	85	110	8	73	10	6	4-M5	10	58	67	96	6.6	5.96	2.02
Σ4040		40					9 770	26 300				107									7.85	2.85
Σ4520	45	20	3.969	46.0	41.9	(35)	10 300	29 700	90	115	8	73	10	6	4-M5	10	63	72	101	6.6	7.73	2.17
Σ4540		40					10 300	29 700				107									10.3	3.06

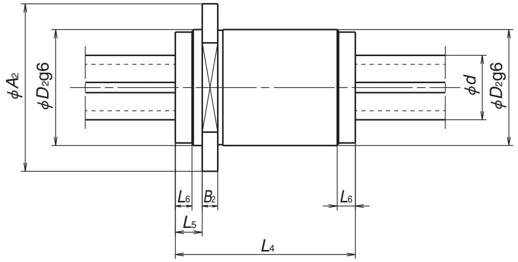
Model No.	Ball spline nut																					
	Basic load rating (N)		Basic torque (N·m)		Dimensions															Moment of inertia	Mass
	Dynamic C_r	Static C_{0r}	Dynamic C_t	Static C_{0t}	D	A	B	L_4	L_5	L_6	L_7	Y	T	M_2	t_2	W_2	D_2	W	X	(kg·cm²)	(kg)
Σ1610	5 530	7 270	61.5	91.3	48	64	5	60	2.5	6.5	6.5	4.5	6.5	M4	7	25	35	56	4.5	0.71	0.63
Σ1632	5 890	8 000	65.5	100																	
Σ2010	6 260	8 720	86.3	135	54	70	6	65	2.5	6.5	6.5	5.5	6.5	M5	8	30.5	40	62	4.5	1.15	0.87
Σ2020	6 610	9 450	91.1	145																	
Σ2040	6 610	9 450	91.1	145																	
Σ2510	6 630	9 450	115	185	58	74	6	70	2.5	6.5	6.5	5.5	6.5	M5	8	35.5	45	66	4.5	1.88	1.03
Σ2520	7 290	10 900	125	210																	
Σ2525	7 290	10 900	125	210																	
Σ3220	7 630	11 600	165	285	70	95	8	75	2.5	7.5	6.5	5.5	6.5	M5	8	42	50	82	6.6	3.80	1.62
Σ3232	7 950	12 400	175	305																	
Σ4020	10 600	14 800	290	455	85	110	8	80	4	7.5	8	5.5	8	M5	8	55	65	96	6.6	9.74	2.38
Σ4040	11 200	15 900	305	490																	
Σ4520	11 200	15 900	340	550	90	115	8	85	4	7.5	8	5.5	8	M5	8	60	70	101	6.6	12.5	2.56
Σ4540	11 700	17 000	360	590																	

Σ Z Type





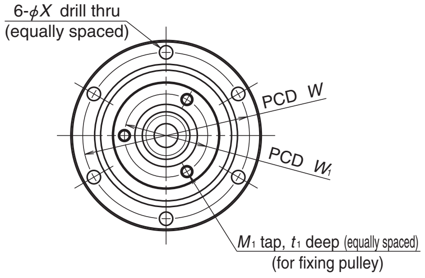


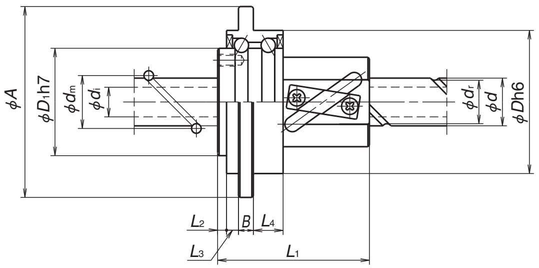


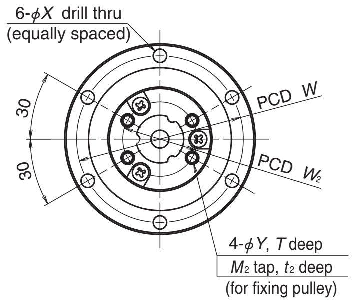
Unit: mm

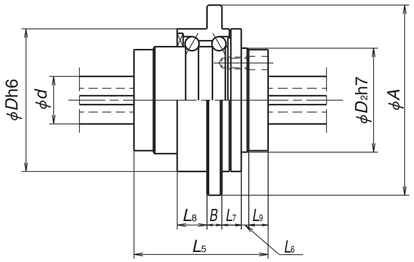
Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Screw shaft hollow	Ball screw nut															Moment of inertia (kg·cm²)	Mass (kg)	Ball spline nut															
							Basic load rating (N)		Dimensions															Basic load rating (N)		Basic torque (N·m)		Dimensions										Mass (kg)
							Dynamic	Static																Dynamic	Static	Dynamic	Static										
	d	l	D_w	d_m	d_r	d_i	C_a	C_{0a}	D	A	B	L_1	L_2	L_3	M_1	t_1	W_1	D_1	W	X				C_r	C_{0r}	C_t	C_{0t}	D_2	A_2	B_2	L_4	L_5	L_6	H	W_2	X	
ΣZ1610	16	10	3.175	16.75	13.4	(8)	4 710	8 110	48	64	5	47	7	4	3-M4	6	28	35	56	4.5		0.41	0.50	5 530	7 270	61.5	91.3	35	55	6	60	10.5	6.5	45	4.5	4.5	0.35
ΣZ1632		32					2 990	4 870				52										0.44	0.55	5 890	8 000	65.5	100										
ΣZ2010	20	10	3.175	20.75	17.4	(14)	8 210	17 500	54	70	6	57	8	4	3-M4	6	32	40	62	4.5		0.64	0.74	6 260	8 720	86.5	135	40	60	6	65	10.5	6.5	50	50	5.5	0.46
ΣZ2020		20					5 290	10 300				63										0.65	0.81	6 610	9 450	91.1	145										
ΣZ2040		40					3 360	6 170				57										0.64	0.74	6 610	9 450	91.1	145										
ΣZ2510	25	10	3.175	25.75	22.4	(18)	9 110	21 900	58	74	6	57	8	4	3-M4	6	38	45	66	4.5		1.10	0.81	6 630	9 450	115	185	45	65	6	70	10.5	6.5	55	55	5.5	0.57
ΣZ2520		20					5 870	13 200				63										1.18	0.88	7 290	10 900	125	210										
ΣZ2525		25					5 870	13 200				72										1.30	1.00	7 290	10 900	125	210										
ΣZ3220	32	20	3.175	32.75	29.4	(25)	6 540	16 800	70	95	8	70	10	6	3-M5	10	44	53	82	6.6		2.60	1.46	7 630	11 600	165	285	50	70	6	75	10.5	6.5	60	60	5.5	0.64
ΣZ3232		32					6 540	16 800				91										3.15	1.83	7 950	12 400	175	305										
ΣZ4020	40	20	3.969	41.0	36.9	(30)	9 770	26 300	85	110	8	73	10	6	4-M5	10	58	67	96	6.6		5.96	2.02	10 600	14 800	290	455	65	88	8	80	12	8	76	76	6.6	1.20
ΣZ4040		40					9 770	26 300				107										7.85	2.85	11 200	15 900	305	490										
ΣZ4520	45	20	3.969	46.0	41.9	(35)	10 300	29 700	90	115	8	73	10	6	4-M5	10	63	72	101	6.6		7.73	2.17	11 200	15 900	340	550	70	93	8	85	12	8	81	81	6.6	1.39
ΣZ4540		40					10 300	29 700				107										10.3	3.06	11 700	17 000	360	590										

∑ C Type





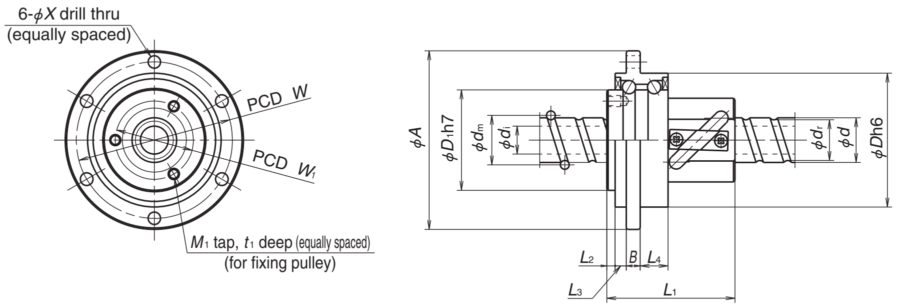


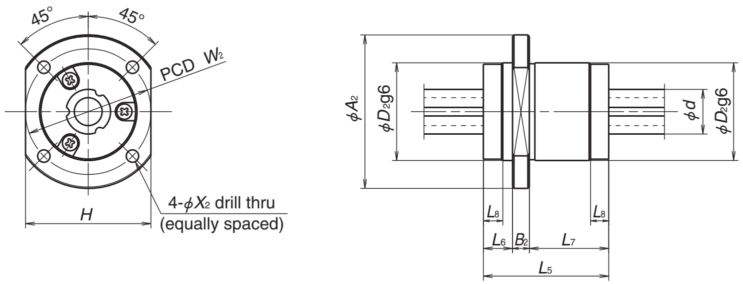


Unit: mm

Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Screw shaft hollow	Ball screw nut															
							Basic load rating(N)		Dimensions													Moment of inertia
	d	l	D_w	d_m	d_r	d_i	Dynamic C_a	Static C_{0a}	D	A	B	L_1	L_2	L_3	L_4	M_1	t_1	W_1	D_1	W	X	(kg·cm^2)
∑C1610	16	10	3.175	16.75	13.4	(8)	4 710	8 110	48	64	5	46	3	4	10	3-M4	6	28	35	56	4.5	0.40
∑C1632		32					2 990	4 870				51										0.43
∑C2010	20	10	3.175	20.75	17.4	(14)	8 210	17 500	54	70	6	56	4	4	10	3-M4	6	32	40	62	4.5	0.63
∑C2020		20					5 290	10 300				63										0.65
∑C2040		40					3 360	6 170				56										0.63
∑C2510	25	10	3.175	25.75	22.4	(18)	9 110	21 900	58	74	6	56	4	4	10	3-M4	6	38	45	66	4.5	1.04
∑C2520		20					5 870	13 200				63										1.13
∑C2525		25					5 870	13 200				71										1.24

Model No.	Mass	Ball spline nut																					
		Basic load rating(N)		Basic torque(N·m)		Dimensions																Moment of inertia	Mass
	(kg)	Dynamic C_r	Static C_{0r}	Dynamic C_t	Static C_{0t}	D	A	B	L_5	L_6	L_7	L_8	L_9	Y	T	M_2	t_3	W_2	D_2	W	X	(kg·cm^2)	(kg)
∑C1610	0.41	4 300	5 090	47.9	63.9	48	64	5	45	2.5	6.5	10	6.5	4.5	6.5	M4	7	25	35	56	4.5	0.52	0.42
∑C1632	0.43																						
∑C2010	0.53	4 730	5 820	65.1	90.5	54	70	6	50	2.5	6.5	10	6.5	5.5	6.5	M5	8	30.5	40	62	4.5	0.86	0.56
∑C2020	0.56	5 110	6 540	70.5	100																		
∑C2040	0.53	5 110	6 540	70.5	100																		
∑C2510	0.60	5 130	6 540	87.8	125	58	74	6	55	2.5	6.5	10	6.5	5.5	6.5	M5	8	35.5	45	66	4.5	1.44	0.67
∑C2520	0.64	5 870	8 000	100	155																		
∑C2525	0.69	5 870	8 000	100	155																		





Unit: mm

Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Screw shaft hollow	Ball screw nut														
							Basic load rating(N)		Dimensions												
							Dynamic	Static													
	d	l	D_w	d_m	d_r	d_i	C_a	C_{0a}	D	A	B	L_1	L_2	L_3	L_4	M_1	t_1	W_1	D_1	W	X
ΣCZ1610	16	10	3.175	16.75	13.4	(8)	4 710	8 110	48	64	5	46	3	4	10	3-M4	6	28	35	56	4.5
ΣCZ1632		32					2 990	4 870				51									
ΣCZ2010	20	10	3.175	20.75	17.4	(14)	8 210	17 500	54	70	6	56	4	4	10	3-M4	6	32	40	62	4.5
ΣCZ2020		20					5 290	10 300				63									
ΣCZ2040		40					3 360	6 170				56									
ΣCZ2510	25	10	3.175	25.75	22.4	(18)	9 110	21 900	58	74	6	56	4	4	10	3-M4	6	38	45	66	4.5
ΣCZ2520		20					5 870	13 200				63									
ΣCZ2525		25					5 870	13 200				71									

Model No.	Moment of inertia	Mass	Ball spline nut															
			Basic load rating(N)		Basic torque(N·m)		Dimensions										Mass
			Dynamic	Static	Dynamic	Static											
	(kg·cm²)	(kg)	C_r	C_{0r}	C_t	C_{0t}	D_2	A_2	B_2	L_5	L_6	L_7	L_8	H	W_2	X_2	(kg)
ΣCZ1610	0.40	0.41	4 300	5 090	47.9	63.9	35	55	6	45	10.5	28.5	6.5	45	45	4.5	0.26
ΣCZ1632	0.43	0.43															
ΣCZ2010	0.63	0.53	4 730	5 820	65.1	90.5	40	60	6	50	10.5	33.5	6.5	50	50	5.5	0.35
ΣCZ2020	0.65	0.56	5 110	6 540	70.5	100											
ΣCZ2040	0.63	0.53	5 110	6 540	70.5	100											
ΣCZ2510	1.04	0.60	5 130	6 540	87.8	125	45	65	6	55	10.5	38.5	6.5	55	55	5.5	0.44
ΣCZ2520	1.13	0.64	5 870	8 000	100	155											
ΣCZ2525	1.24	0.69	5 870	8 000	100	155											

B-3-3.10 Equipped with "NSK K1™" Lubrication Unit

This product is being applied for a patent.

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 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 equipment, 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 10 000 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^{-1} (80 m/min)
Stroke	600 mm

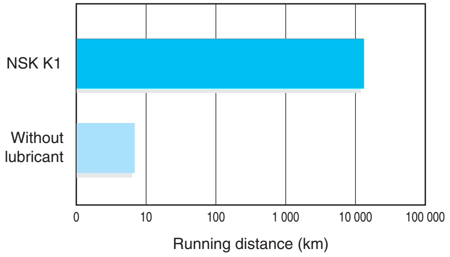


Fig. 1 Duration test results on ball screws without lubricant

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 that of the standard ball screw. Combination of NSK standard grease (factory-packed in the nut) and NSK K1 are standard specifications.

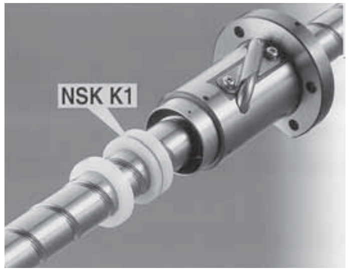


Fig. 2 NSK K1

(2) Accuracy grade and axial play

Accuracy grades, clearance and preload specifications remain unchanged from the existing products. 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 becomes longer than that of standard ball screws after equipped with NSK K1. The nut length after equipped with K1 is shown in pages B539 to B542 for each type of ball recirculation. NSK K1 can be installed on other types not listed in the dimension table. Please consult with NSK if you require the K1 for a special ball nut.

(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.

Semiconductor/liquid crystal display manufacturing equipment

Industrial robot

Wood working machines

Machine tools

Automobile manufacturing machines

3. Precautions for use

Temperature range for use: Maximum temperature: 50°C
Momentary maximum temperature: 80°C

Chemicals that should not come to contact with 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 K1 Seal.

Note: NSK K1 is not applicable to the Compact FA series.

4. Example of reference number

A structure of "Reference number for ball screw" is as follows.

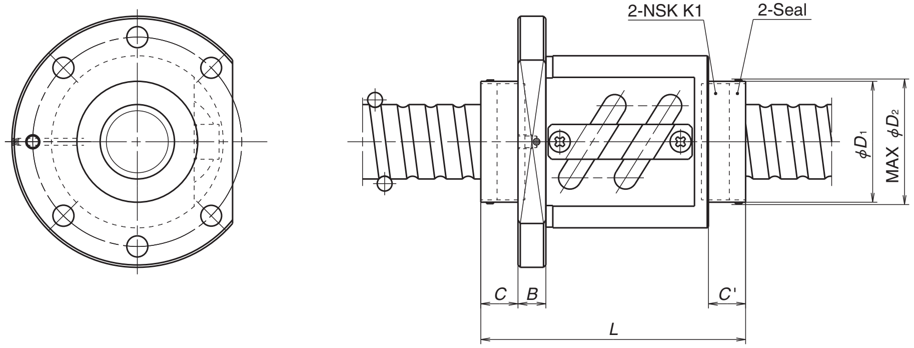
Note: "K1" is added at the end of "nut model code" and "Specifications number".

◇Reference number for ball screw equipped with NSK K1

W1401 -＊＊ P K1 - C3 Z10

NSK K1 equipped type ball screw code

(1) Tube type

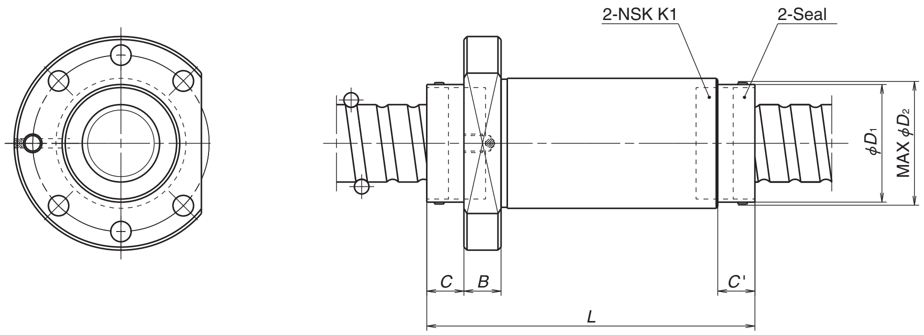


Tube type

Model No.	Screw shaft dia.	Lead	K1 installing dimension		Frange width	Overall length when equipped K1	K1 cap dimension	
	d	*l*	*C*	*C'*	*B*	*L*	Cap dia. ϕD_1	Protruding dimension ϕD_2
PFT1004-2.5	10	4	14	15	10	61.5	ϕ22	MAX ϕ24
PFT1205-2.5	12	5	14	15	10	66	ϕ26.5	MAX ϕ29
LPFT1210-2.5		10		17		79		
PFT1405-2.5	14	5	14	15	10	65	ϕ30	MAX ϕ32
LPFT1510-2.5	15	10	14	15	10	76	ϕ30	MAX ϕ32
PFT1605-2.5	16	5	14	15	10	67	ϕ32	MAX ϕ34
PFT2005-5	20	5	14	14	10	81	ϕ38	MAX ϕ40
LPFT2010-2.5		10				78		
LPFT2020-1.5		20				84		
ZFT2505-10	25	5	16	17	10	115	ϕ44	MAX ϕ46
PFT2506-5		6	16	17	12	93	ϕ44	MAX ϕ46
PFT2510-2.5		10	16	17	12	89	ϕ44	MAX ϕ46
ZFT2510-3						103		
LPFT2520-2.5		20	12	12	12	109	ϕ38	MAX ϕ40
LPFT2525-1.5		25	12	12	12	98	ϕ38	MAX ϕ40
DFT2805-5	28	5	16	17	12	137	ϕ48	MAX ϕ50
PFT2810-2.5		10				90		
DFT2810-3						174		
PFT3206-5	32	6	16	17	12	93	ϕ52	MAX ϕ54
ZFT3206-10						129		
PFT3210-5		10	16	17		122	ϕ52	MAX ϕ54
ZFT3210-5				17		122		
DFT3210-5				16		212		
PFT3212-3		12	16	17		114	ϕ52	MAX ϕ54
DFT3212-3				16		198		
LPFT3225-2.5		25	12	12		122	ϕ46	MAX ϕ48
LPFT3232-1.5		32	12	12		109	ϕ46	MAX ϕ48
PFT3610-5	36	10	19	20	15	131	ϕ56	MAX ϕ58
DFT3610-5				19		221		
HZF3616-5		16		19		163		
HZF3620-3.5		20		19		146		
PFT4008-5	40	8	19	20	16	117	ϕ62	MAX ϕ64
ZFT4008-10						165		
ZFT4010-7		10	19	20		152	ϕ62	MAX ϕ64
DFT4010-5				19		222	ϕ61	
PFT4012-5		12	19	20		144	ϕ62	MAX ϕ64
DFT4012-5				19		252	ϕ61	
HZF4016-5		16	19	19		164	ϕ61	MAX ϕ64
HZF4020-5		20	19	19		189	ϕ61	MAX ϕ64
LPFT4032-2.5		32	14	14		151	ϕ54	MAX ϕ56
LPFT4040-1.5		40	14	14		133	ϕ54	MAX ϕ56
DFT4510-5	45	10	19	19	16	222	ϕ72	MAX ϕ75
DFT4512-5		12			16	254		
HZF4520-5		20			18	190		
ZFT5010-10	50	10	19	20	18	194	ϕ73	MAX ϕ76
DFT5012-5		12		19		256		
ZFT5016-5		16		20		172		
DFT5016-5				19		300		
HZF5020-5		20		19		192		
HZF5025-5		25		19		221		
DFT5516-5	55	16	22	22	18	178	ϕ81	MAX ϕ87
HZF5520-5		20				198		MAX ϕ81
HZF5525-5		25				227		MAX ϕ81
DFT6316-5	63	16	22	22	18	322	ϕ89	MAX ϕ95
DFT6320-5		20				362		

Notes: 1. NSK K1 can be installed in 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.

(2) Deflector type

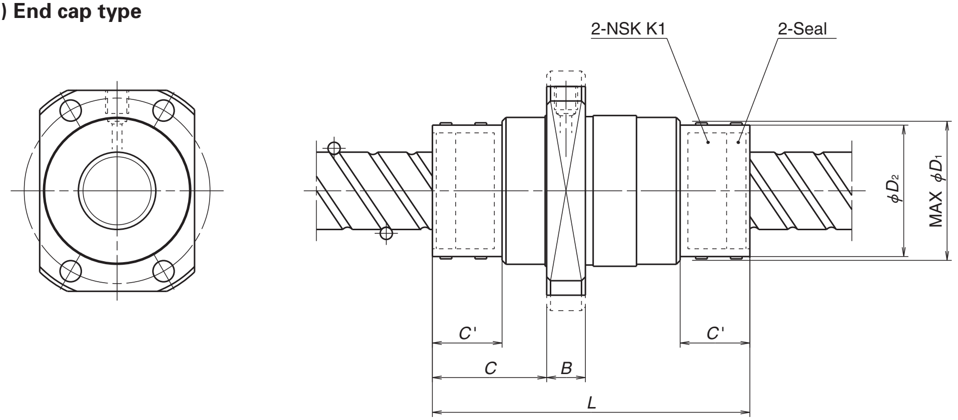


Deflector type

Model No.	Screw shaft dia.	Lead	K1 installing dimension		Frange width	Overall length when equipped K1	K1 cap dimension	
	d	*l*	*C*	*C'*	*B*	*L*	Cap dia. ϕ *D₁*	Protruding dimension ϕ *D₂*
ZFD2005-6	20	5	9	9	12	87	ϕ32	MAX ϕ34
ZFD2506-6	25	6	12	–	12	102	ϕ38	MAX ϕ40
ZFD2510-4		10		12		106		
ZFD3208-8	32	8	12	12	12	136	ϕ46	MAX ϕ48
ZFD3210-6		10				138		
ZFD3212-6		12				153		
ZFD4010-8	40	10	14	14	16	167	ϕ54	MAX ϕ57
ZFD4012-8		12				189		
ZFD5010-8	50	10	14	14	18	169	ϕ64	MAX ϕ67
ZFD5012-6		12				167		

Notes: 1. NSK K1 can be installed in other types not listed in the table. Please consult NSK.
2. C,C' and L are the dimensions when one NSK K1 is equipped to both ends of the nut.

(3) End cap type



End cap type

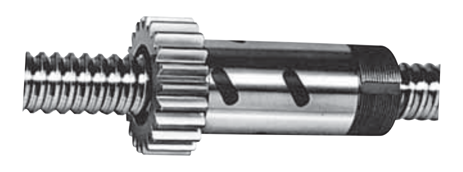
Model No.	Screw shaft dia.	Lead	K1 installing dimension		Frange width	Overall length when equipped K1	K1 cap dimension	
	d	*l*	*C*	*C'*	*B*	*L*	Cap dia. ϕ *D₁*	Protruding dimension ϕ *D₂*
UPFC1520-1.5	15	20	29	18	10	81	ϕ30	MAX ϕ32
LPFC1616-3	16	16	28	18	10	74	ϕ28	MAX ϕ30
LPFC2020-3	20	20	29.5	18	10	82	ϕ34	MAX ϕ36
UPFC2040-1		40	29			77	ϕ32	MAX ϕ34
LPFC2525-3	25	25	34	21	12	97	ϕ44	MAX ϕ46
UPFC2550-1		50				92		
LPFC3232-3	32	32	37	21	12	112	ϕ52	MAX ϕ54
UPFC3264-1		64	36.5			104		
LPFC4040-3	40	40	43.5	24	15	133	ϕ62	MAX ϕ65
LPFC5050-3	50	50	45.5	24	20	155	ϕ74	MAX ϕ77

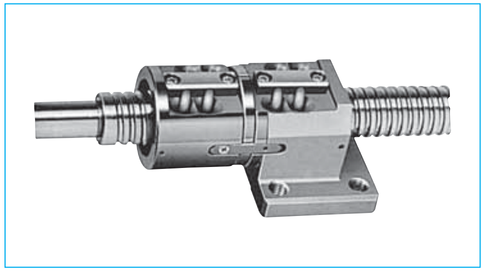
Notes: 1. NSK K1 can be installed in other types not listed in the table. Please consult NSK.
2. C,C' and L are the dimensions when one NSK K1 is equipped to both ends of the nut.

B-3-3.11 Special Ball Screws

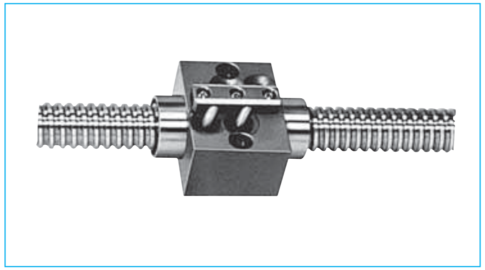
In addition to the standard ball screws, NSK manufactures various types of ball screws in special shapes as shown below.

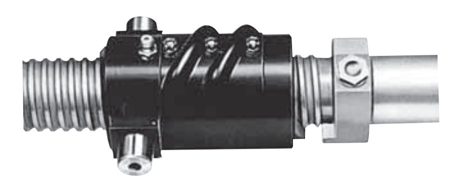
Thoroughly discuss with NSK the specifications before determining specifications and ordering ball screws in special shapes.

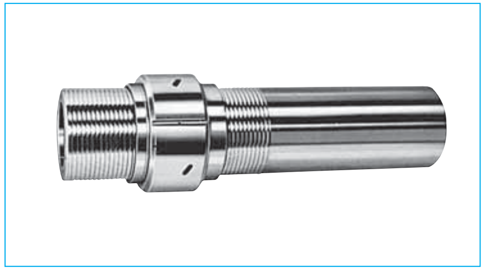

Nut with gear

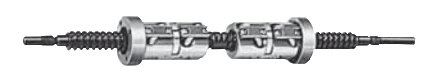

Double nut with flat mounting surface

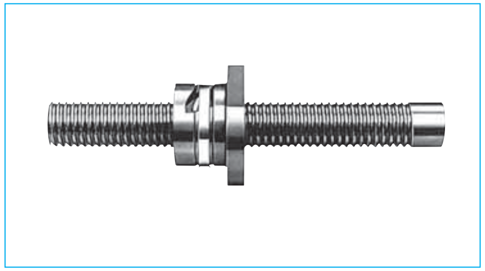

Lightly preloaded single nut with bearing seat

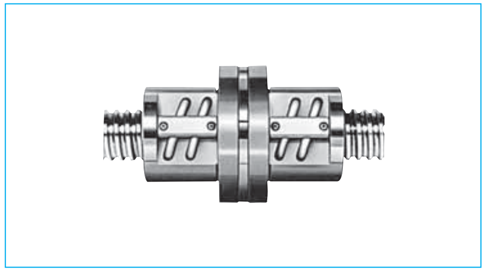

Lightly preloaded single nut with flat mounting surface

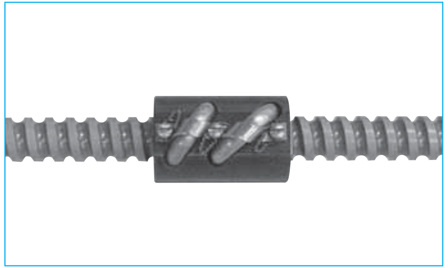

Nut with trunion

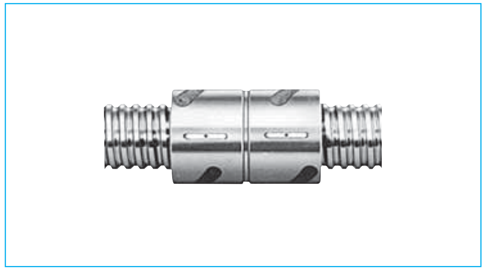

Hollow shaft, lightly preloaded single nut, with large shaft diameter and fine lead

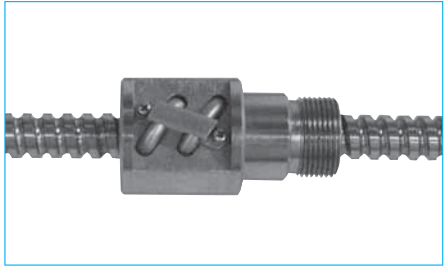

Double nut with right and left turn thread on each side of screw shaft

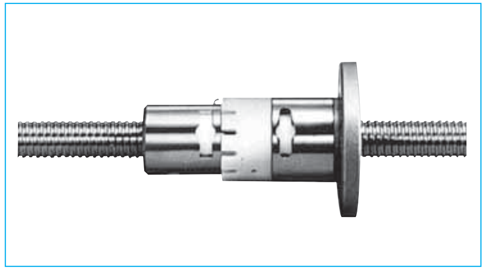

Ceramic ball screw

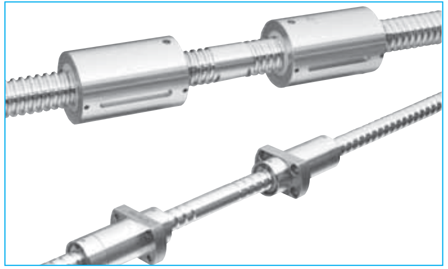

Flanged to flanged ball nut


Ball screw for aircraft


Cylindrical double nut


Ball screw for nuclear power plant


Spring preloaded ball screw


Right and left hand thread on each side of screw

C-1 Monocarrier™

C-2 MCM Series

C-3 MCH Series

Monocarrier™

C BLOCK

C1-C22
C23-C68
C69-C88

C-1 Monocarrier™

C-1-1 Features

NSK's Monocarrier is the culmination of technology and innovation in linear motion. This lightweight, compact single axis linear actuator integrates quality NSK ball screw, linear guide and support bearings into one unit.

1 Light weight, compact design

○Available in two different shapes of cross-section, depending on application.
Light weight type: MCM Series
Rigid type: MCH Series

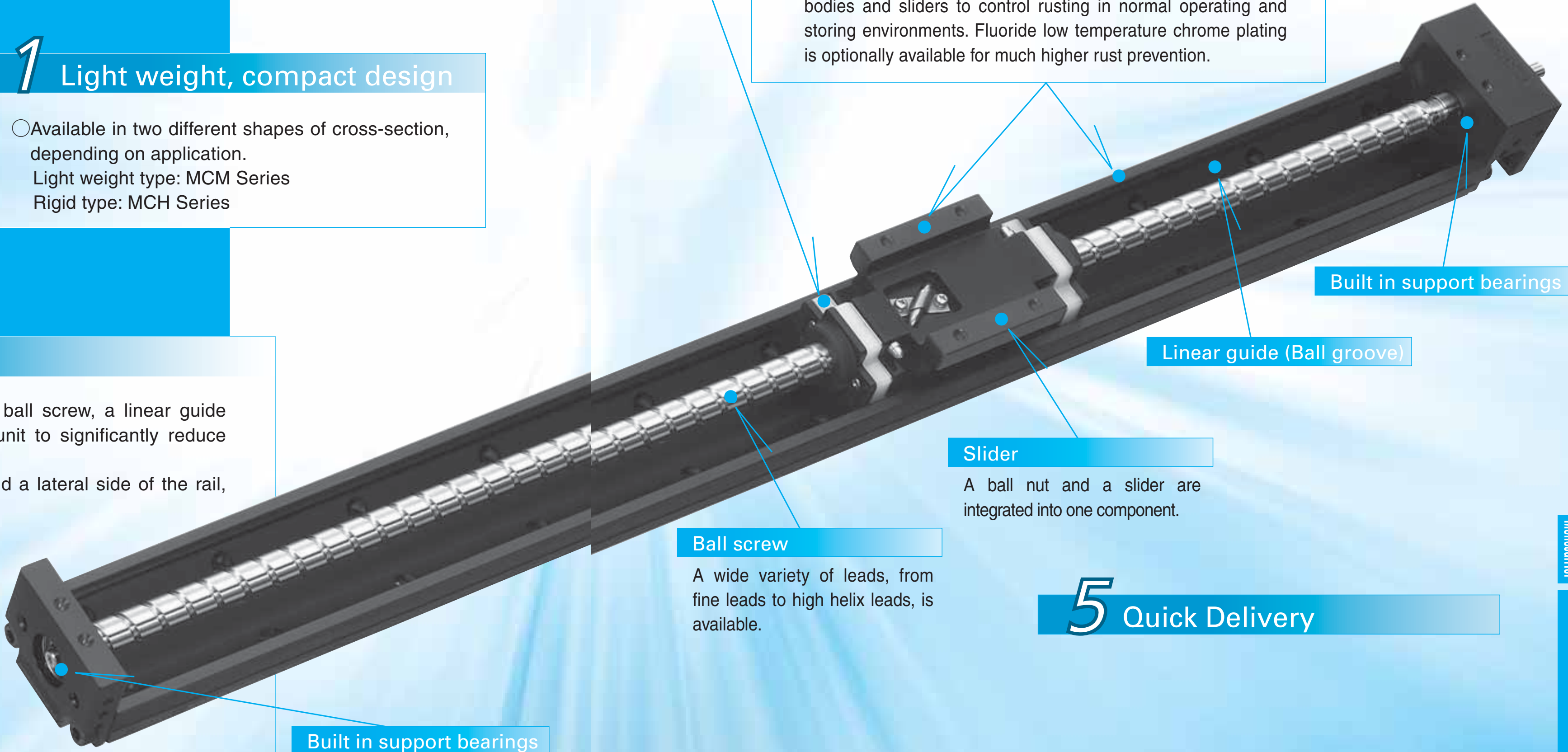
2 All -in-one structure

○The all-in-one structure integrates a ball screw, a linear guide and support bearings into a single unit to significantly reduce design and installation time.

○Multiple datum planes, the bottom and a lateral side of the rail, facilitate highly accurate installation.

○Immediate operation after installation and run-in is possible.

○A wide selection of fine to high helix leads are available.



Slider
A ball nut and a slider are integrated into one component.

Ball screw
A wide variety of leads, from fine leads to high helix leads, is available.

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.

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.

5 Quick Delivery

MONOCARRIER™

C-1-2 Classification and Series

Table 2.1

	Light Weight	Beam Rigidity	Moment Rigidity	Accuracy	Long Stroke	Size Variation
MCM Series	◎	○	○	◎	○	◎
MCH Series	○	◎	○	◎	◎	○

◎: Excellent ○: Suitable in use

【MCM Series Cross-sections】

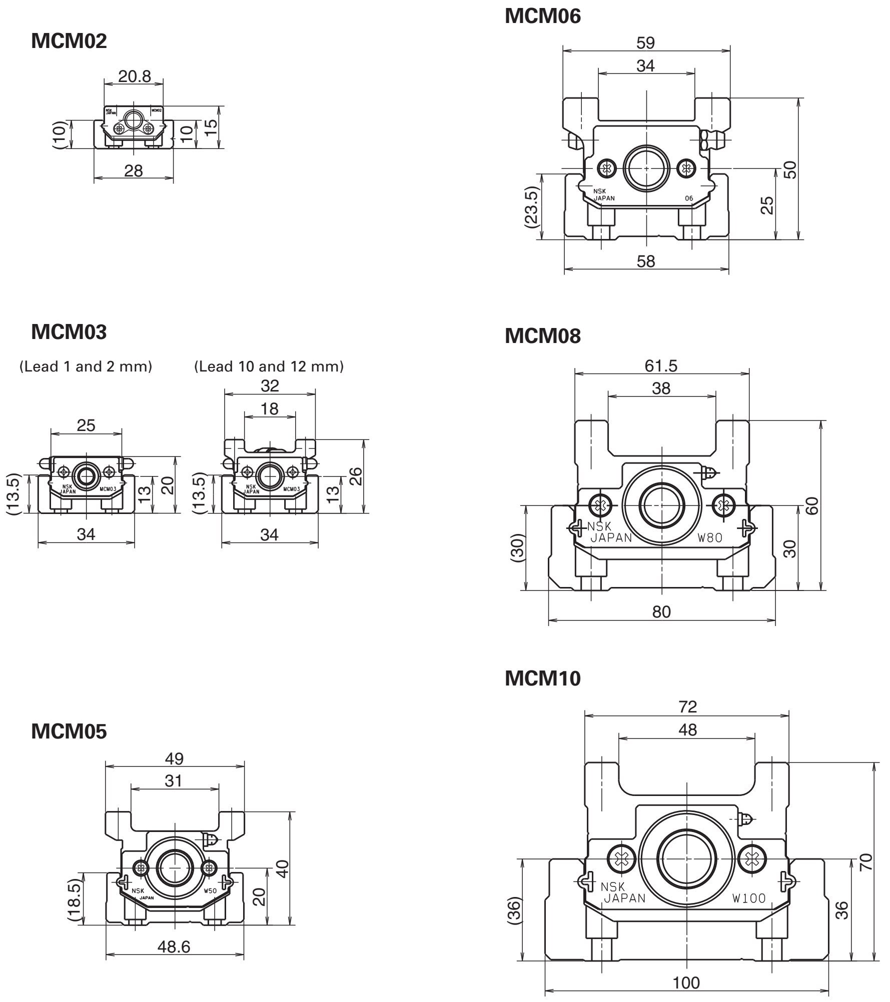


Fig. 2.1

【MCH Series Cross-sections】

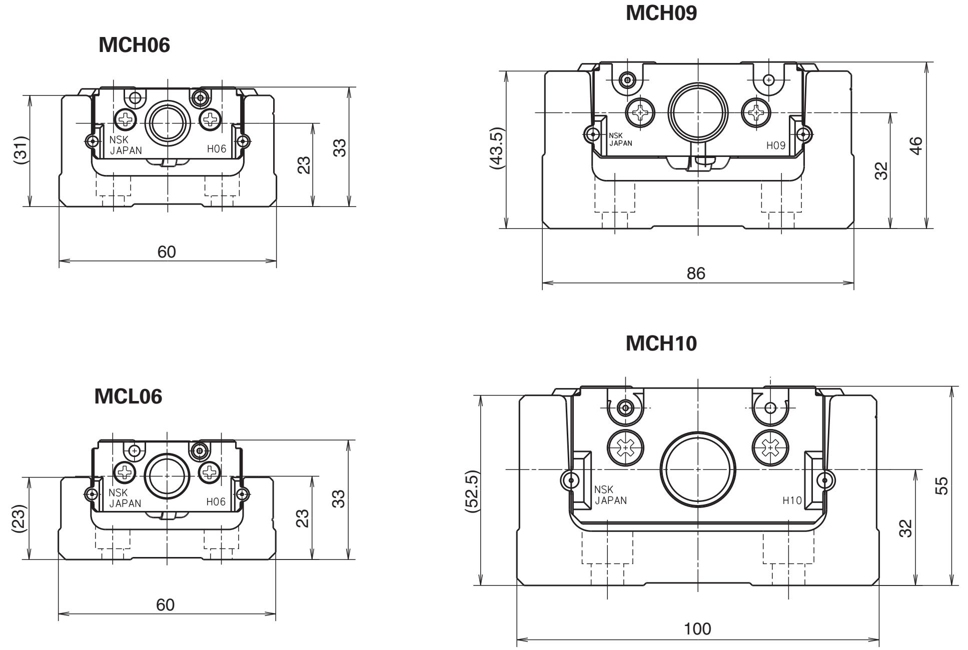


Fig. 2.2

C-1-3 Optional Components

MCM Series

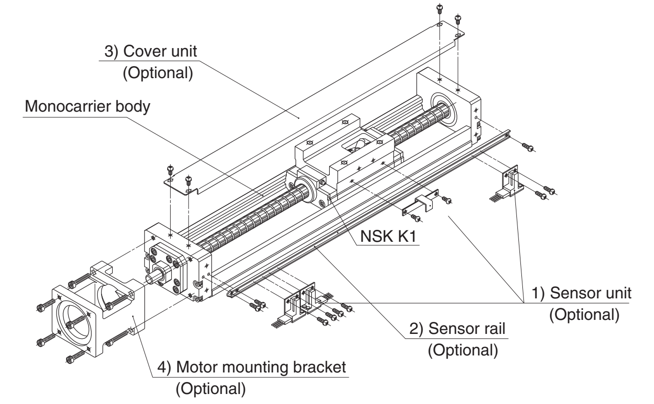


Fig. 3.1 Assembly: Optional components for MCM10 (example)

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

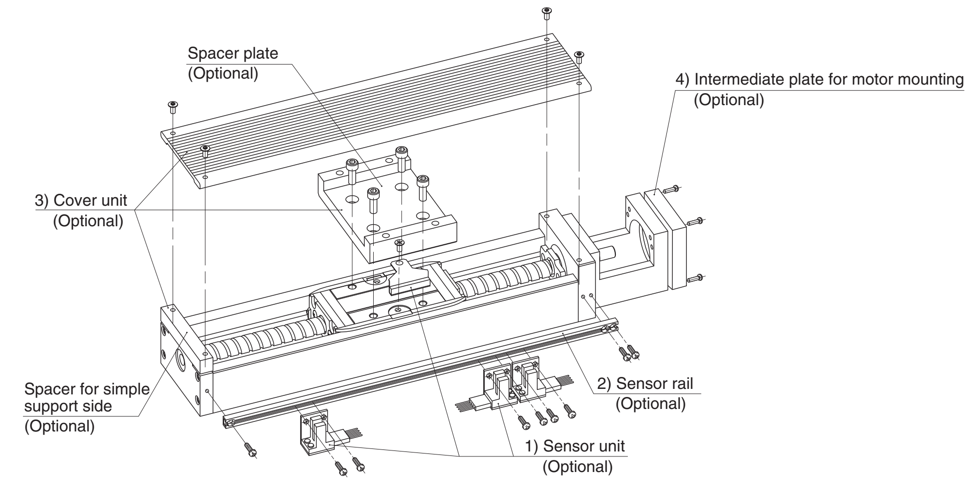


Fig. 3.2 Assembly: Optional components for MCH10 (example)

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 model number of Monocarrier based on stroke and rigidity (refer to **Figs. 4.2**, and **4.3**).

Select a ball screw lead referring to "**C-1-4.3 Maximum Speed**" so that the rotational speed does not exceed the limit.

Study the loads to be applied to the linear guide and obtain the equivalent load (*F*e) substituting them for equation 1) or 2) on page 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

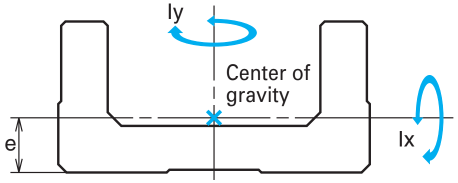


Fig. 4.1

Table 4.1 Rigidity of rail

Model No.	Geometrical moment of inertia ×10⁴ (mm⁴)		Center of gravity (mm)	Mass (kg/100 mm)
	Ix	Iy	e	w
MCM02	0.097	1.32	3.3	0.11
MCM03	0.30	3.3	4.5	0.18
MCM05	0.78	11.4	6.0	0.31
MCM06	2.14	26.1	7.0	0.57
MCM08	5.90	81.0	9.2	0.88
MCM10	15.6	219	12.2	1.52
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

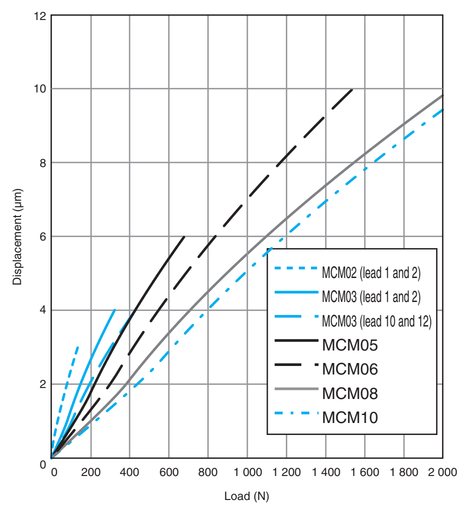


Fig. 4.2 MCM Series rigidity in radial direction

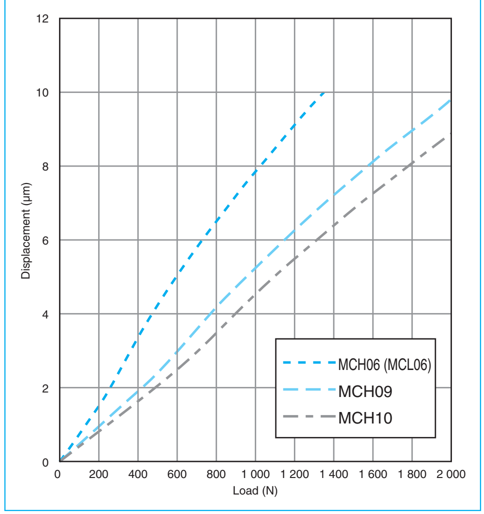


Fig. 4.3 MCH Series rigidity in radial direction

C-1-4. 3 Maximum Speed

(1) Maximum Speed of MCM Series

Maximum speed of Monocarrier is determined by critical speed of ball screw shaft and d • n value.

Do not exceed maximum speeds on the table below.

Table 4.2

	Ball screw lead	Stroke (mm)	Rail length L_2 (mm)	Maximum speed (mm/s)
MCM02 Single slider	1	50	100	50
		100	150	
		150	200	
	2	50	100	100
		100	150	
		150	200	
MCM03 Single slider	1	50	115	50
		100	190	
		150	240	
	2	50	115	100
		100	190	
		150	240	
	10	100 – 250	190 – 340	500
	12	100 – 250	190 – 340	600
MCM05 Single slider	5	50 – 200	180 – 330	250
	10	50 – 600	180 – 730	500
	20	300 – 600	430 – 730	1 000
	30	300 – 400	430 – 530	2 500
		500	630	2 200
		600	730	1 600
MCM05 Double slider	10	60 – 510	280 – 730	500
	20	210 – 510	430 – 730	1 000
MCM06 Single slider	5	50 – 500	190 – 640	250
	10	50 – 600	190 – 740	500
		700	840	490
		800	940	390
	20	300 – 600	440 – 740	1 000
		700	840	980
		800	940	770
MCM06 Double slider	5	110 – 410	340 – 640	250
	10	110 – 610	340 – 840	500
		710	940	490
	20	210 – 610	440 – 840	1 000
		710	940	980
MCM08 Single slider	5	50 – 200	220 – 370	250
	10	100 – 700	270 – 870	500
		800	970	390
	20	300 – 700	470 – 870	1 000
		800	970	780
	30	400 – 500	570 – 670	2 500
		600	770	1 860
		700	870	1 425
MCM08 Double slider	10	80 – 680	370 – 970	500
	20	180 – 680	470 – 970	1 000
MCM10 Single slider	10	200 – 800	380 – 980	500
		900	1 080	440
		1 000	1 180	360
	20	300 – 800	480 – 980	1 000
		900	1 080	880
		1 000	1 180	720
	30	500 – 600	680 – 780	2 500
		700	880	1 920
		800	980	1 510
MCM10 Double slider	10	70 – 670	380 – 980	500
		870	1 180	440
	20	170 – 670	480 – 980	1 000
		870	1 180	880

Note: When operating Monocarriers near critical speed or exceeding maximum speed in the table, please consult NSK.

Note: When operating Monocarriers near critical speed or exceeding maximum speed in the table, please consult NSK.

(2) Maximum Speed of MCH Series

Maximum speed of Monocarrier is determined by critical speed of ball screw shaft and d • n value.

Do not exceed maximum speeds on the table below.

Table 4.3

	Ball screw lead	Stroke (mm)	Rail length L_2 (mm)	Maximum speed (mm/s)
MCH06 MCL06 Single slider	5	50 – 500	150 – 600	250
	10	50 – 500	150 – 600	500
	20	50 – 500	150 – 600	1000
MCH06 Double slider	5	100 – 400	300 – 600	250
	10	100 – 400	300 – 600	500
	20	100 – 400	300 – 600	1000
MCH09 Single slider	5	200 – 600	340 – 740	250
		800	940	210
	10	200 – 600	340 – 740	500
		800	940	410
	20	200 – 600	340 – 740	1 000
		800	940	830
MCH09 Double slider	5	150 – 650	440 – 940	250
	10	150 – 650	440 – 940	500
	20	150 – 650	440 – 940	1 000
MCH10 Single slider	10	400 – 800	580 – 980	500
		900	1 080	440
		1 000	1 180	360
		1 100	1 280	300
		1 200	1 380	250
	20	400 – 800	580 – 980	1000
		900	1 080	870
		1 000	1 180	720
		1 100	1 280	600
		1 200	1 380	510
MCH10 Double slider	10	250 – 750	580 – 1 080	500
		850	1 180	480
		950	1 280	390
		1 050	1 380	320
	20	250 – 750	580 – 1 080	1 000
		850	1 180	950
		950	1 280	780
		1 050	1 380	650

Note: When operating Monocarriers near critical speed or exceeding maximum speed in the table, please consult NSK.

Note: When operating Monocarriers near critical speed or exceeding maximum speed in the table, please consult NSK.

C-1-4. 4 Accuracy Grade

The accuracy grade of Monocarrier standard series is high grade (H), except for lead 1 and 2 mm of MCM02, and MCM03.

When you require strokes longer than 1 200 mm, please consult NSK about the accuracy grade.

Table 4.4

Unit : μm

Accuracy	High grade (H)			Precision (P)			
Stroke (mm)	Repeatability	Running Parallelism (vertical)	Backlash	Repeatability	Positioning accuracy	Running Parallelism (vertical)	Backlash
– 200	±10	14	20 or less	±3	20	8	3 or less
– 400		16			25	10	
– 600		20			30	12	
– 700		23			30	15	
– 1 000		23			35	15	
– 1 200		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

Model No.	MCM02		MCM03				MCM05				MCM06			MCM08				MCM10		
Stroke \ Lead	1	2	1	2	10	12	5	10	20	30	5	10	20	5	10	20	30	10	20	30
50	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓					
100	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	
150	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	
200					✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	
250					✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	
300							✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	
400							✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
500							✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
600							✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
700											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
800											✓	✓	✓	✓	✓	✓		✓	✓	✓
900																		✓	✓	
1 000																		✓	✓	

Table 4.6 Double slider

Unit : mm

Model No.	MCM05		MCM06			MCM08		MCM10	
Stroke \ Lead	10	20	5	10	20	10	20	10	20
60	✓								
70								✓	
80						✓			
110	✓		✓	✓					
160	✓								
170								✓	✓
180						✓	✓		
210	✓	✓	✓	✓	✓				
270								✓	✓
280						✓	✓		
310	✓	✓	✓	✓	✓				
370								✓	✓
380						✓	✓		
410	✓	✓	✓	✓	✓				
470								✓	✓
480						✓	✓		
510	✓	✓		✓	✓				
570								✓	✓
580						✓	✓		
610				✓	✓				
670								✓	✓
680						✓	✓		
710				✓	✓				
870								✓	✓

Note: Please consult NSK about double slider of MCM02 and MCM03.

(2) MCH Series Standard Combinations of Stroke and Ball Screw Lead

Table 4.7 Single slider

Unit : mm

Model No.	MCH06			MCH09			MCH10	
Stroke \ Lead	5	10	20	5	10	20	10	20
50	✓	✓	✓					
100	✓	✓	✓	✓	✓	✓	✓	✓
200	✓	✓	✓	✓	✓	✓	✓	✓
300	✓	✓	✓	✓	✓	✓	✓	✓
400	✓	✓	✓	✓	✓	✓	✓	✓
500	✓	✓	✓	✓	✓	✓	✓	✓
600				✓	✓	✓	✓	✓
700				✓	✓	✓	✓	✓
800				✓	✓	✓	✓	✓
900							✓	✓
1 000							✓	✓
1 100							✓	✓
1 200							✓	✓

Table 4.8 Double slider

Unit : mm

Model No.	MCH06			MCH09			MCH10	
Stroke \ Lead	5	10	20	5	10	20	10	20
100	✓	✓						
150				✓	✓			
200	✓	✓						
250				✓	✓		✓	✓
300	✓	✓						
350				✓	✓		✓	✓
400		✓	✓					
450					✓	✓	✓	✓
550							✓	✓
650					✓	✓	✓	✓
750								✓
850								✓
950								✓
1 050								✓

Table 4.9 Limitations

	Model No.	Lead (mm)	Slider	Stroke (mm)
MCM series	MCM02	1,2	Single	150
	MCM03	1,2	Single	150
		10,12	Single	350
	MCM05	5,10,20,30*	Single	900
			Double	810
	MCM06	5,10,20	Single	1 000
			Double	910
	MCM08	5,10,20,30*	Single	1 000
			Double	880
	MCM10	10,20,30*	Single	1 800
			Double	1 670
MCH series	MCH06	5,10,20	Single	600
			Double	500
	MCH09	5,10,20	Single	1 000
			Double	850
	MCH10	10,20	Single	1 800
			Double	1 650
	MCL06	5,10,20	Single	500

*) Applicable only to single slider

C-1-4. 6 Basic Load Rating

(1) MCM Series Basic Load Rating

Table 4.10 Basic Load Rating

Model No.	Lead ℓ (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	ϕ 6	340 (High grade) 405 (Precision)	4 910	615	1	555 (High grade) 615 (Precision)	2 120	490
	2		340 (High grade) 405 (Precision)	3 900		2	555 (High grade) 615 (Precision)		
MCM03	1	ϕ 6	735	10 900	2 670	1	1 230	4 900	1 040
	2		735	8 650		2			
	10	ϕ 8	1 230	6 250		10	1 690	6 620	
	12		1 230	5 880		12			
MCM05	5	ϕ 12	3 760	15 600	4 400	5	6 310	10 900	1 450
	10		2 260	12 400		10	3 780		
	20		2 260	9 850		20	3 780		
	30		3 260	8 600	6 550	30	5 400		2 730
MCM06	5	ϕ 16	7 310	25 200	6 550	5	13 500	17 000	2 730
	10	ϕ 15	7 060	20 000		10	12 700		
	20		4 560	15 900		20	7 750		
MCM08	5	ϕ 16	7 310	30 800	7 100	5	13 500	22 800	3 040
	10	ϕ 15	7 060	24 400		10	12 700		
	20		4 560	19 400		20	7 750		
	30		5 070	16 930		30	8 730		
MCM10	10	ϕ 20	10 900	33 500	7 600	10	21 700	29 400	3 380
	20		7 060	26 600		20	12 700		
	30		11 700	23 200		30	22 700		

Notes: ●Basic dynamic and static load ratings indicate values for one slider. ●Basic dynamic load rating of linear guide is load of perpendicular direction to the axis that allows 90% of a group of the same Monocarriers to operate "Rated running distance" in table, that is equivalent to 1 million revolutions of ball screw and support unit under the same conditions without causing flaking by rolling contact fatigue. ●Basic dynamic load rating of ball screw is load in the axial direction that allows 90% of ball screws of a group of the same Monocarriers to rotate 1 million revolutions under the same conditions without causing flaking by rolling contact fatigue. ●Basic dynamic load rating of support unit is constant load in the axial direction that allows 90% of support units of the same group of Monocarriers to rotate 1 million revolutions under the same conditions without causing flaking by rolling contact fatigue. ●Basic static load rating is load that results in combined permanent deformations at contact points of balls and ball grooves of respective parts at a diameter of 0.01%.

Table 4.11 Basic static moment load of linear guide

Model No.	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	28	28
	10, 12		92	51	51
MCM05	5, 10, 20, 30*	Single	229	89	89
		Double	455	765	765
MCM06	5, 10, 20	Single	415	174	174
		Double	825	1 220	1 220
MCM08	5, 10, 20, 30*	Single	770	300	300
		Double	1 540	2 050	2 050
MCM10	10, 20, 30*	Single	1 170	425	425
		Double	2 340	2 940	2 940

Notes: ● Basic static moment of double slider is value when two sliders equipped with NSK K1 are butted against each other.
● Basic static moment is value when rolling contact pressure of balls exceeds 4 000 N/mm².
● If extremely heavy load is required, please consult NSK for estimation of fatigue life.
*) Applicable only to single slider

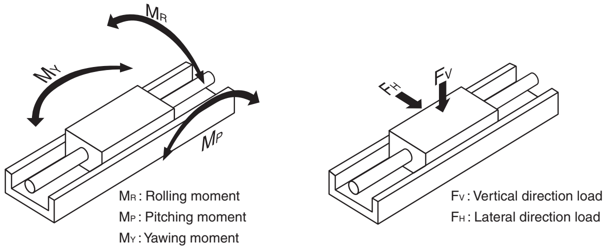


Fig. 4.4

(2) MCH Series Basic Load Rating

Table 4.12 Basic Load Rating

Model No.	Lead ℓ (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	ϕ 12	3 000 (High grade) 3 760 (Precision)	22 800	4 400	5	5 410 (High grade) 6 310 (Precision)	16 300	1 450
	10		1 930 (High grade) 2 260 (Precision)	18 100		10	3 160 (High grade) 3 780 (Precision)		
	20		1 930 (High grade) 2 260 (Precision)	14 400		20	3 160 (High grade) 3 780 (Precision)		
MCH09	5	ϕ 15	6 820 (High grade) 7 100 (Precision)	40 600	7 100	5	13 200 (High grade) 13 000 (Precision)	30 500	3 040
	10		5 110 (High grade) 7 060 (Precision)	32 200		10	9 290 (High grade) 12 700 (Precision)		
	20		3 290 (High grade) 4 560 (Precision)	25 500		20	5 620 (High grade) 7 750 (Precision)		
MCH10	10	ϕ 20	8 230 (High grade) 10 900 (Precision)	44 600	7 600	10	17 100 (High grade) 21 700 (Precision)	42 000	3 380
	20		5 300 (High grade) 7 060 (Precision)	35 400		20	10 300 (High grade) 12 700 (Precision)		

Notes: ●Basic dynamic and static load ratings indicate values for one slider. ●Basic dynamic load rating of linear guide is load of perpendicular direction to the axis that allows 90% of a group of the same Monocarriers to operate "Rated running distance" in table, that is equivalent to 1 million revolutions of ball screw and support unit under the same conditions without causing flaking by rolling contact fatigue. ●Basic dynamic load rating of ball screw is load in the axial direction that allows 90% of ball screws of a group of the same Monocarriers to rotate 1 million revolutions under the same conditions without causing flaking by rolling contact fatigue. ●Basic dynamic load rating of support unit is constant load in the axial direction that allows 90% of support units of the same group of Monocarriers to rotate 1 million revolutions under the same conditions without causing flaking by rolling contact fatigue. ●Basic static load rating is load that results in combined permanent deformations at contact points of balls and ball grooves of respective parts at a diameter of 0.01%.

Table 4.13 Basic static moment load of linear guide

Model No.	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	1 780	2 070	2 070
MCH10	Single	1 460	610	610
	Double	2 920	3 430	3 430

Notes: ● Basic static moment of double slider is value when two sliders equipped with NSK K1 are butted against each other.
● Basic static moment is value when rolling contact pressure of balls exceeds 4 000 N/mm².
● If extremely heavy load is required, please consult NSK for estimation of fatigue life.
*) Applicable only to single slider

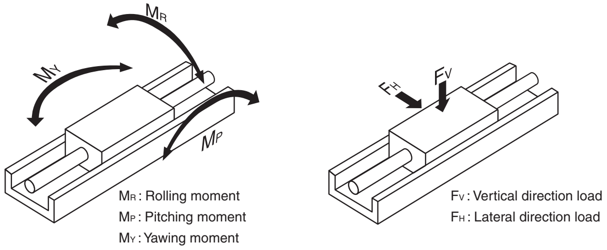


Fig. 4.5

C-1-4. 7 Estimation of Life Expectancy

(1) Life of Linear Guide

Study the load to be applied to the linear guide of Monocarrier (**Fig. 4.6**). 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

$$Fe = Y_H F_H + Y_V F_V + Y_R \varepsilon_R M_R + Y_P \varepsilon_P M_P + Y_Y \varepsilon_Y M_Y \cdots\cdots 1)$$

● In case of the double slider

$$Fe = \frac{Y_H F_H}{2} + \frac{Y_V F_V}{2} + Y_R \varepsilon_{Rd} M_R + Y_P \varepsilon_{Pd} M_P + Y_Y \varepsilon_{Yd} M_Y \cdots\cdots 2)$$

F_H : Lateral direction load acting on the slider (N)
F_V : Vertical direction load acting on the slider (N)
M_R : Rolling moment acting on the slider (N · m)
M_P : Pitching moment acting on the slider (N · m)
M_Y : Yawing moment acting on the slider (N · m)
ε_R, ε_{Rd}
: Dynamic equivalent coefficient to rolling moment
ε_P, ε_{Pd}
: Dynamic equivalent coefficient to pitching moment
ε_Y, ε_{Yd}
: Dynamic equivalent coefficient to yawing moment

Refer to **Table 4.14** about Dynamic equivalent coefficient.

Y_H, Y_V, Y_R, Y_P, Y_Y
: 1.0 or 0.5

At equations 1) and 2) for obtaining equivalent load *Fe*, among F_H, F_V, $\varepsilon_P M_P$, $\varepsilon_R M_R$, $\varepsilon_Y M_Y$, the maximum load is assumed to be 1.0, and others are to be 0.5.

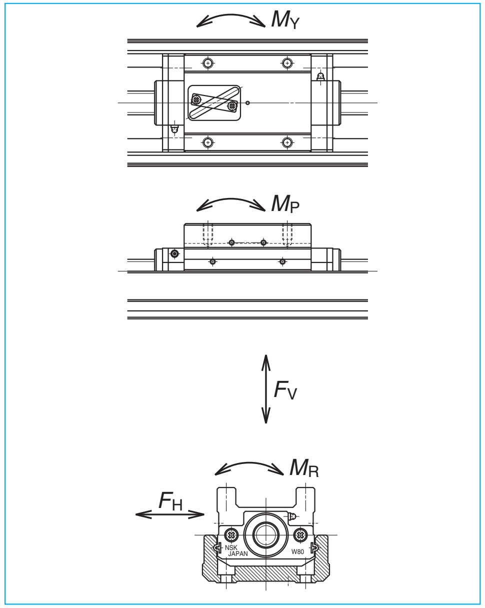


Fig. 4.6 Direction of load

Table 4.14 Dynamic equivalent coefficient

Model No.	MCM02	MCM03		MCM05	MCM06	MCM08	MCM10	MCH06 MCL06	MCH09	MCH10
		Lead 1, 2	Lead 10, 12							
ε_R	95.2	79.4	79.4	52.6	45.5	32.5	27.8	48.3	34.5	28.6
ε_P	174	113.9	84.2	81.3	65.1	48.8	45.2	75.1	47.9	41.0
ε_Y	174	113.9	84.2	81.3	65.1	48.8	45.2	75.1	47.9	41.0
ε_{Rd}	–	–	–	26.3	22.7	16.3	13.9	24.2	17.2	14.3
ε_{Pd}	–	–	–	10.4 (12.2)	9.7 (11.5)	7.6 (8.6)	7.1 (8.0)	11.4 (13.2)	8.11 (9.10)	6.98 (7.82)
ε_{Yd}	–	–	–	10.4 (12.2)	9.7 (11.5)	7.6 (8.6)	7.1 (8.0)	11.4 (13.2)	8.11 (9.10)	6.98 (7.82)

Note: Parenthesized figures are dynamic equivalent coefficient in case of the Monocarrier without NSK K1.

In case when the load acting on the slider may fluctuate (In general, M_P, M_Y may fluctuate with the acceleration/deceleration of slider), the mean effective load is determined by Eq. 3).

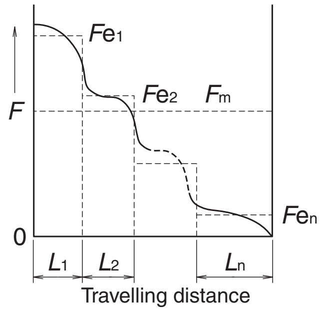


Fig. 4.7 Stepwise Fluctuating Load

Travelling distance under the equivalent load Fe_1 : L_1
Travelling distance under the equivalent load Fe_2 : L_2
. . . .
Travelling distance under the equivalent load Fe_n : L_n

$$Fm = \sqrt[3]{\frac{1}{L}\left(Fe_1{}^3L_1 + Fe_2{}^3L_2 + \cdots Fe_n{}^3L_n\right)} \cdots 3)$$

Fm : Mean effective load of fluctuating loads
L : Total travelling distance

The life of linear guide is calculated by Eq. 4).

$$L = L_a \times \left(\frac{C}{f_W \cdot Fm}\right)^3 \cdots\cdots 4)$$

L : Life of linear guide (km)
Fm : Mean effective load acting on the linear guide (N)
C : Basic dynamic load rating of the linear guide (N)
L_a : Travelling distance (km)
f_W : Load factor (refer to **Table 4.15**)

When the estimated life does not clear the required life, the life of the linear guide is to be calculated again after the following measures are taken:

1. Change from 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).

$$L = \ell \times \left(\frac{C_a}{f_W \cdot Fm}\right)^3 \times 10^6 \cdots\cdots 5)$$

ℓ : Lead of ball screw (mm)
L : Life of ball screw (km)
C_a : Basic dynamic load rating of the ball screw (N)
Fm : Mean effective load acting on the ball screw (N)
f_W : Load factor (refer to **Table 4.15**)

The life of a support unit is calculated by Eq. 5).

If the life of ball screw/support unit does not clear the required life, use a larger size Monocarrier.

After applying the calculations mentioned above, selection of the Monocarrier is completed.

Table 4.15 Values of load factor f_w

Operating conditions	Load factor f_W
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>>

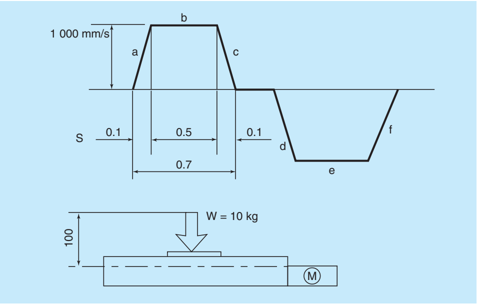


Fig. 4.8

1. Use condition

Stroke	: 600 mm
Maximum speed	: 1000 mm/s
Load mass	: W = 10 kg
Acceleration	: g = 9.8 m/s²
Setting position	: Horizontal
Operating profile	: See above figure

2. Selection of Model number (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 $Fe_1 = Y_V F_V = Y_V W_g = 1 \cdot 10 \cdot 9.8 = 98\ \text{N}$

ii) Accelerating $Fe_2 = Y_V F_V + Y_P \varepsilon_P M_P = 0.5 \cdot 10 \cdot 9.8 + 1 \cdot 65.1 \cdot 0.1 \cdot 100 = 700\ \text{N}$

iii) Decelerating $Fe_3 = Y_V F_V + Y_P \varepsilon_P M_P = 0.5 \cdot 10 \cdot 9.8 + 1 \cdot 65.1 \cdot 0.1 \cdot 100 = 700\ \text{N}$

Mean effective load *Fm*

$$Fm = \sqrt[3]{\frac{1}{L}\left(Fe_1^3 \cdot L_1 + Fe_2^3 \cdot L_2 + Fe_3^3 \cdot L_3\right)}$$

$$= \sqrt[3]{\frac{1}{600}\left(98^3 \cdot 500 + 700^3 \cdot 50 + 700^3 \cdot 50\right)}$$

$$= 387\ \text{N}$$

$$L = \left(\frac{C}{f_w \cdot F_m}\right)^3 \times L_a$$

$$= \left(\frac{15\ 900}{1.2 \cdot 387}\right)^3 \times 20$$

$$= 8.02 \times 10^5\ \text{km}$$

3-1-2. Static safety factor: Divide the basic static load rating by the maximum load.

$$F_S = \frac{C_0}{Fe} = \frac{C_0}{Fe_2} = \frac{17\ 000}{700} = 24.2$$

3-2. Ball screw

3-2-1. Fatigue life: Obtain the axial load of each stage of operation referring to the operation profile, then calculate the mean load.

By the process above,

i) Constant speed

$Fe_1 = \mu \cdot W \cdot g = 0.01 \cdot 10 \cdot 9.8 = 0.98$

ii) Accelerating

$Fe_2 = Fe_1 + W\alpha = 101\ \text{N}$

iii) Decelerating

$Fe_3 = Fe_1 - W\alpha = 99\ \text{N}$

Axial mean effective load *Fm*

$$Fm = \sqrt[3]{\frac{1}{L}\left(Fe_1^3 \cdot L_1 + Fe_2^3 \cdot L_2 + Fe_3^3 \cdot L_3\right)}$$

$$= \sqrt[3]{\frac{1}{600}\left(0.98^3 \cdot 500 + 101^3 \cdot 50 + 99^3 \cdot 50\right)}$$

$$= 55\ \text{N}$$

$$L = \left(\frac{C_a}{f_w \cdot F_m}\right)^3 \times \ell \times 10^6$$

$$= \left(\frac{4\ 560}{1.2 \cdot 55}\right)^3 \times 20 \times 10^6\ (\text{mm})$$

$$= 6.5 \times 10^6\ \text{km}$$

3-2-2. Static safety factor: Divide the basic static load rating by the maximum axial load.

$$F_S = \frac{C_{0a}}{Fe} = \frac{C_{0a}}{Fe_2} = \frac{7\ 750}{101} = 76.7$$

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 1 000 mm/s.

3-3. Support unit

3-3-1. Fatigue life: Use the axial load *Fm* = 55 N, that is the result of above calculation 3-2-1.

$$L = \left(\frac{C_a}{fw \cdot Fm}\right)^3 \times \ell \times 10^6 = \left(\frac{6\ 550}{1.2 \times 55}\right)^3 \times 20 \times 10^6\ (\text{mm})$$

$$= 1.95 \times 10^7\ \text{km}$$

3-3-2. Static safety factor: Divide the limit load by the maximum axial load.

$$F_S = \frac{C_{0a}}{Fe} = \frac{C_{0a}}{Fe_2} = \frac{2\ 730}{101} = 27.0$$

3-4. Result

MCM06060H20K00	Linear guide	Ball screw	Support unit
Fatigue life	8.02 × 10⁵ km	6.5 × 10⁶ km	1.95 × 10⁷ 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>>

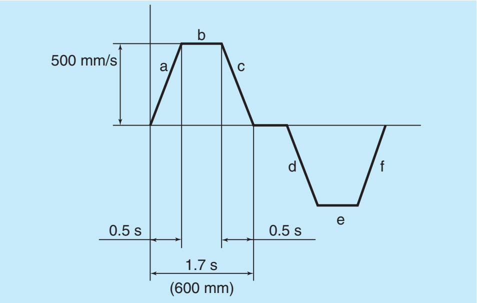


Fig. 4.9

1. Use condition

Stroke	: 600 mm
Maximum speed	: 500 mm/s
Load mass	: W = 20 kg
Acceleration	: 9.8 m/s²
Setting position	: Horizontal
Operating profile	: See above figure

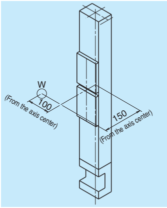


Fig. 4.10

2. Selection of Model number (Interim Selection)

Select a 10 mm lead ball screw as the maximum speed is 500 mm/s.

The interim selection is MCM08068H10D00 as a double slider specification of MCM08 has 680 mm stroke, and the setting position is vertical.

3. Calculation

3-1. Linear guide

3-1-1. Fatigue life: Multiply the result of the Eq. 2) by the dynamic equivalent coefficient (**Table 4.14.** double slider) to convert the load volume. From operation profile (**Fig. 4.9**), the acceleration is 1 m/s².

i) Constant speed $Fe_1 = Y_P \times \varepsilon_{Pd} \times M_P + Y_Y \times \varepsilon_{Yd} \times M_Y = 1 \cdot 7.6 \cdot 20 \cdot 9.8 \cdot 0.15 + 0.5 \cdot 7.6 \cdot 20 \cdot 9.8 \cdot 0.1 = 298\ \text{N}$

ii) Accelerating $Fe_2 = Y_P \times \varepsilon_{Pd} \times M_P + Y_Y \times \varepsilon_{Yd} \times M_Y = 1 \cdot 7.6 \cdot 20 \cdot (9.8 + 0.15) \cdot 0.15 + 0.5 \cdot 7.6 \cdot 20 \cdot (9.8 + 1.0) \cdot 0.1 = 329\ \text{N}$

iii) Decelerating $Fe_3 = Y_P \times \varepsilon_{Pd} \times M_P + Y_Y \times \varepsilon_{Yd} \times M_Y = 1 \cdot 7.6 \cdot 20 \cdot (9.8 - 1.0) \cdot 0.15 + 0.5 \cdot 7.6 \cdot 20 \cdot (9.8 - 1.0) \cdot 0.1 = 268\ \text{N}$

Mean effective load *Fm*

$$Fm = \sqrt[3]{\frac{1}{L}\left(Fe_1^3 \cdot L_1 + Fe_2^3 \cdot L_2 + Fe_3^3 \cdot L_3\right)}$$

$$= \sqrt[3]{\frac{1}{600}\left(298^3 \cdot 350 + 329^3 \cdot 125 + 268^3 \cdot 125\right)}$$

$$= 300\ \text{N}$$

$$L = L_a \times \left(\frac{C}{f_w \cdot F_m}\right)^3$$

$$= 10 \times \left(\frac{24\ 400}{1.2 \cdot 300}\right)^3$$

$$= 3.11 \times 10^6\ \text{km}$$

3-1-2. Static safety factor: Divide the basic static load rating by the maximum load.

$$F_S = \frac{C_0}{Fe} = \frac{C_0}{Fe_2} = \frac{22\ 800}{329} = 69.3$$

3-2. Ball screw

3-2-1. Fatigue life: Obtain the axial load of each stage of operation referring to the operation profile, then calculate the mean load.

i) Constant speed

$Fe_1 = W \cdot g = 20 \cdot 9.8 = 196\ \text{N}$

ii) Accelerating

$Fe_2 = Fe_1 + W \cdot \alpha = 196 + 20 \cdot 1 = 216\ \text{N}$

iii) Decelerating

$Fe_3 = Fe_1 - W \cdot \alpha = 196 - 20 \cdot 1 = 176\ \text{N}$

Axial mean effective load *Fm*

$$Fm = \sqrt[3]{\frac{1}{L}\left(Fe_1^3 \cdot L_1 + Fe_2^3 \cdot L_2 + Fe_3^3 \cdot L_3\right)}$$

$$= \sqrt[3]{\frac{1}{600}\left(196^3 \cdot 350 + 216^3 \cdot 125 + 176^3 \cdot 125\right)}$$

$$= 197 \text{ N}$$

$$L = \ell \times \left(\frac{C_a}{f_w \cdot F_m}\right)^3 \times 10^6$$

$$= 10 \times \left(\frac{7\,060}{1.2 \cdot 197}\right)^3 \times 10^6 \text{ (mm)}$$

$$= 2.66 \times 10^5 \text{ km}$$

3-2-2. Static safety factor: Divide the basic static load rating by the maximum axial load.

$$F_S = \frac{C_{0a}}{Fe} = \frac{C_{0a}}{Fe_2} = \frac{12\,700}{216} = 58.7$$

C-1-5 Maintenance

C-1-5.1 Maintenance Method

1. For standard Monocarrier, we pack grease in the slider, linear guides and ball screw.
2. 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.
3. The NSK K1 Lubrication Unit is ideal in environments where oily dust exists. However, the life may be shorter than described in Clause 2 above. In such a case, it requires increasing the frequency of replenishment.

3-3. Support unit

3-3-1. Fatigue life: Use the axial load Fm = 197 N, that is the result of above calculation 3-2-1.

$$L = \ell \times \left(\frac{C_a}{fw \cdot Fm}\right)^3 \times 10^6 = 10 \times \left(\frac{7\,100}{1.2 \times 197}\right)^3 \times 10^6 \text{ (mm)}$$

$$= 2.70 \times 10^5 \text{ km}$$

3-3-2. Static safety factor: Divide the limit load by the maximum axial load.

$$F_S = \frac{C_{0a}}{Fe} = \frac{C_{0a}}{Fe_2} = \frac{3\,040}{216} = 14.0$$

3-4. Result

MCM08068H10D00	Linear guide	Ball screw	Support unit
Fatigue life	3.11 × 10⁶ km	2.66 × 10⁵ km	2.70 × 10⁵ km
Static safety factor	69.3	58.7	14.0

4. A Nozzle for the NSK grease pump for MCH Monocarriers is available as an option.
NSK reference number: NSK HGP NZ8

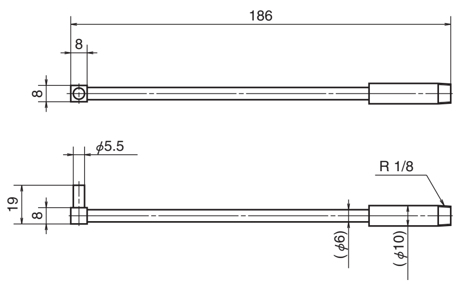


Fig. 5.1 NSK HGP NZ8

Precautions for handling

1. Please consult with NSK when the motor is coupled to the ball screw using a pulley because there is a restriction on allowable load to the end of ball screw shaft.
2. To extend high performance of NSK K1 lubrication unit, please observe the following.

1. Temperature range	Ambient temperature: 50˚C Max. instantaneous temperature: 80˚C
2. Use of chemicals	Never leave a Monocarrier 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: 1 800 mm
No lubricant	All grease removed
NSK K1	All grease removed + NSK K1

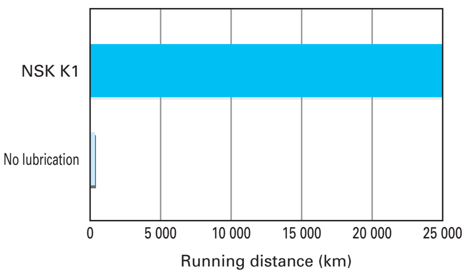


Fig. 5.2 Results of high-speed durability test of linear guides without lubricant

(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⁻¹)
	Stroke: 600 mm
No lubricant	All grease removed
NSK K1	All grease removed + NSK K1

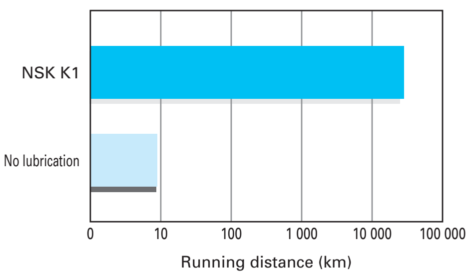


Fig. 5.3 Results of high-speed durability test of ball screws without lubricant

●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^2/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.

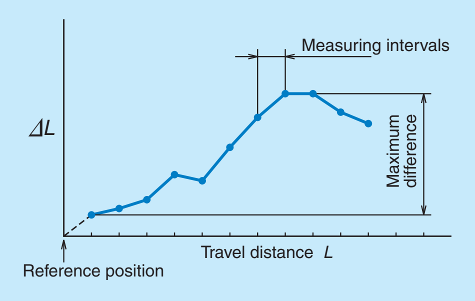


Fig. 7.1

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 (±) sign.

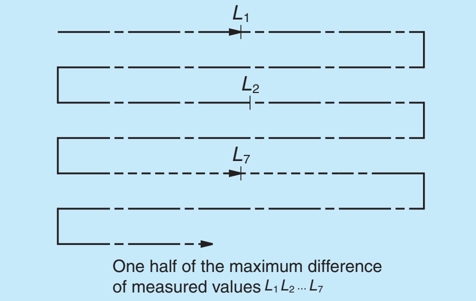


Fig. 7.2

C-1-7. 3 Running Parallelism (Vertical direction)

We specify the parallelism of slider to the datum bottom surface of rail. An indicator is moved in the axial slider making its stylus slightly 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.

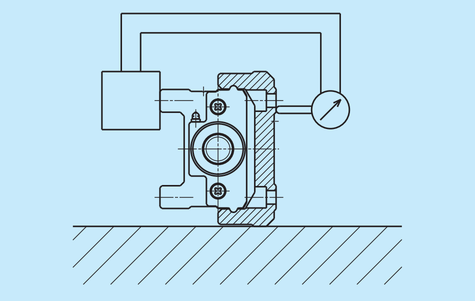


Fig. 7.3 Setting of indicator

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)

i) Shaft end processing
- Key way processing
- One flat or two flats processing

ii) Pin hole processing
- Slider
- Rail

Note: Due to interference with the internal construction, the position of pin hole is limited. Please consult with NSK about 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 do not check motor running condition.
2) Please refer to the bottom of page C85 to C87 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 with NSK for available leads.

(6) Ball-Screw-Less Specification (Only Linear Guide Part)

A ball-screw-less rail part with the same cross section of standard Monocarriers is available for a driven linear guide. It will lessen a height adjustment work compared with a construction with two standard Monocarriers.

Note: Height grinding adjustment of the two axes assembly is not available.

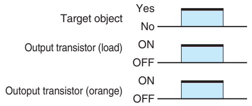
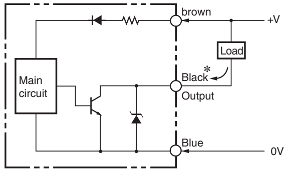
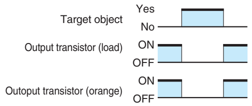
C-1-9 Sensor Specification

C-1-9. 1 Proximity Switch

Use of OMRON E2S-W13 and E2S-W14

Item	E2S–W13 type	E2S–W14 type
Setting surface	Front face	
Sensing distance	1.6 mm ±15%	
Setting distance	0 to 1.2 mm	
Differential travel	10% max. of sensing distance	
Detectable 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 (Normally open contact)	NC (Normally close contact)
Wire lead length	1 000 mm	

Notes: 1) Do not make a wrong connection.
2) Please contact NSK for PNP output type.

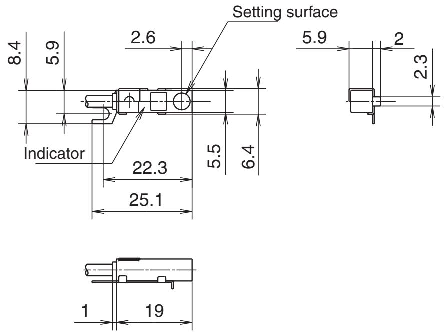
Movement mode	Output type	Type	Time chart	Output circuit
NO	NPN	E2S-W13 type		
NC		E2S-W14 type		

*(Maximum load current: 50 mA)

E2S-W13 (Normally open contact)

E2S-W14 (Normally close contact)

The external appearances are the same.

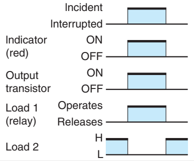
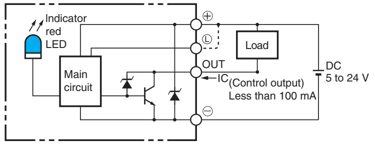
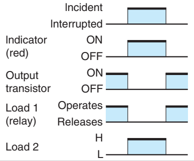


C-1-9. 2 Photo Sensor

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 peak wavelength of 940 nm
Indicator (without detecting object)	ON GaP red LED (peak emission wavelength, 690 nm)
Supply voltage	5 to 24 VDC ±10%; ripple (p--p), 10% max.
Current consumption	35 mA max.
Control output	NPN open collector output models, 5 to 24 VDC, 100 mA load current
Response frequency	1 kHz max. (3 kHz typ.)
Ambient illumination	Fluorescent light, 1 000 lx max.
Ambient temperature	-25°C to 55°C (-13°F to 131°F) (for operating); -30°C to 80°C (-22°F to 176°F) (for storing)
Ambient humidity	5 to 85% RH (for operating); 5 to 95% RH (for storing)
Connecting method	EE-1001/1006 Connectors, soldering terminals

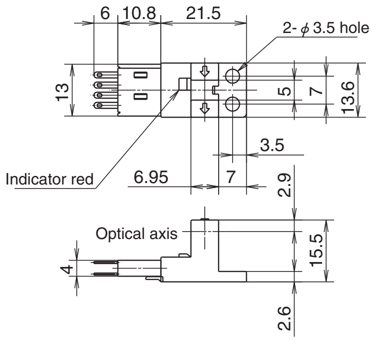
Notes: 1) Do not make a wrong connection.
2) Please contact NSK for PNP output type.

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.



MCM Series

C-2 MCM Series

C-2-1 MCM Series Reference Number Coding

[Body]

Example: 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

Standard grease specification: 0 (AS2)
Clean grease specification: B (LG2)

Slider specification K: Single slider
D: Double slider (See page C9.)

Ball screw lead (mm)

[With Option part]

Example: 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: Option parts are available separately.

Table 1 Sensor unit (See page C45.)

Reference No. code	Specification	Reference No.
0	N/A	—
1	Proximity switch (normally close contact 3 pieces)	MC – SRxx – 10
2	Proximity switch (normally open contact 3 pieces)	MC – SRxx – 11
3	Proximity switch (normally open contact 1 piece, normally close contact 2 pieces)	MC – SRxx – 12
4	Photo sensor 3 pieces	MC – SRxx – 13

Note 1) xx: Reference number
2) Sensor rail is not included in sensor unit. If you require the rail, please request separately. (See page C46 to C48.)

Table 2 Cover unit (See pages C49 to C50.)

Reference No. code	Specification	Reference No.
0	N/A	—
1	With top cover	MC – CVxxxxx – 01 (02) ＊
2	Full cover	MC – CVxxxxx – 00

Note 1) xxxxx: Reference number and stroke number
2)*: "-02" is only used for Monocarrier MCM03.
3) When a sensor unit is used, full cover unit cannot be used.

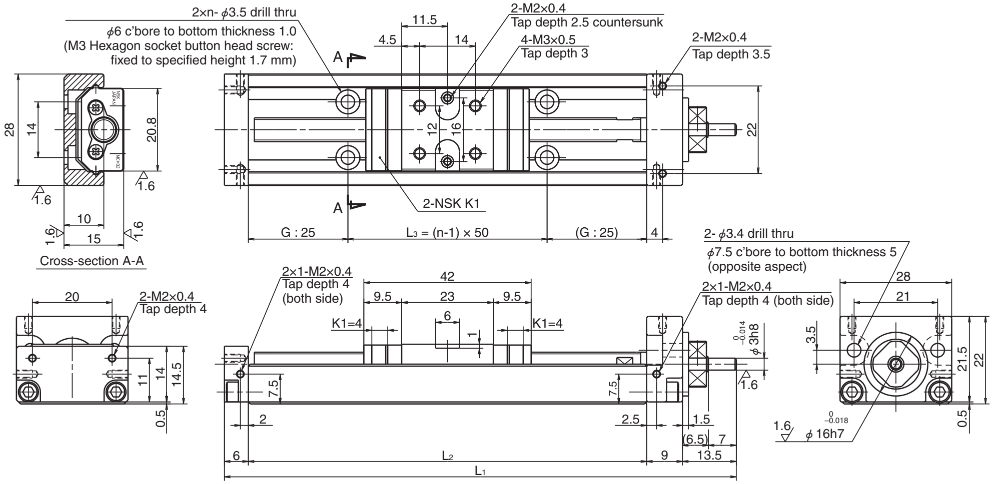
Table 3 Motor bracket (See pages C51 to C67.)

Reference No. code	Reference No.				
	MCM03	MCM05	MCM06	MCM08	MCM10
0	N/A	N/A	N/A	N/A	N/A
1	**MC-BK03-146-00**	**MC-BK05-145-00**	**MC-BK06-145-00**	**MC-BK08-145-00**	**MC-BK10-170-00**
2	**MC-BK03-148-01**	**MC-BK05-146-00**	**MC-BK06-146-00**	**MC-BK08-146-00**	**MC-BK10-170-01**
3	**MC-BK03-231-00**	**MC-BK05-148-00**	**MC-BK06-148-00**	**MC-BK08-160-00**	**MC-BK10-190-00**
4	—	**MC-BK05-160-00**	**MC-BK06-160-00**	**MC-BK08-170-00**	**MC-BK10-270-00**
5	—	**MC-BK05-250-00**	**MC-BK06-170-00**	**MC-BK08-170-01**	—
6	—	—	**MC-BK06-170-01**	**MC-BK08-190-00**	—
7	—	—	**MC-BK06-250-00**	**MC-BK08-250-00**	—
8	—	—	—	**MC-BK08-270-00**	—

N/A: Not applicable

C-2-2 MCM Series Dimension Table of Standard Products

MCM02



Dimension of MCM02 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm)	Ball screw lead (mm)	Body length (mm)			No. of mounting hole	Inertia	Mass (kg)
				L_1	L_2	L_3	n	$\times 10^{-7}$ (kg · m^2)	
MCM02005H01K	50	58	1	128.5	100	50	2	0.93	0.26
MCM02005P01K									
MCM02005H02K			2						
MCM02005P02K									
MCM02010H01K	100	108	1	178.5	150	100	3	1.36	0.32
MCM02010P01K									
MCM02010H02K			2						
MCM02010P02K									
MCM02015H01K	150	158	1	228.5	200	150	4	1.81	0.39
MCM02015P01K									
MCM02015H02K			2						
MCM02015P02K									

Monocarrier dynamic torque specification (N · cm)

		High grade	Precision
Ball screw lead (mm)	1	0.1 – 1.3	0.2 – 1.6
	2		

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.

Basic load rating

Lead	Shaft dia	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
ℓ (mm)	d (mm)	Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
1	ϕ6	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)		

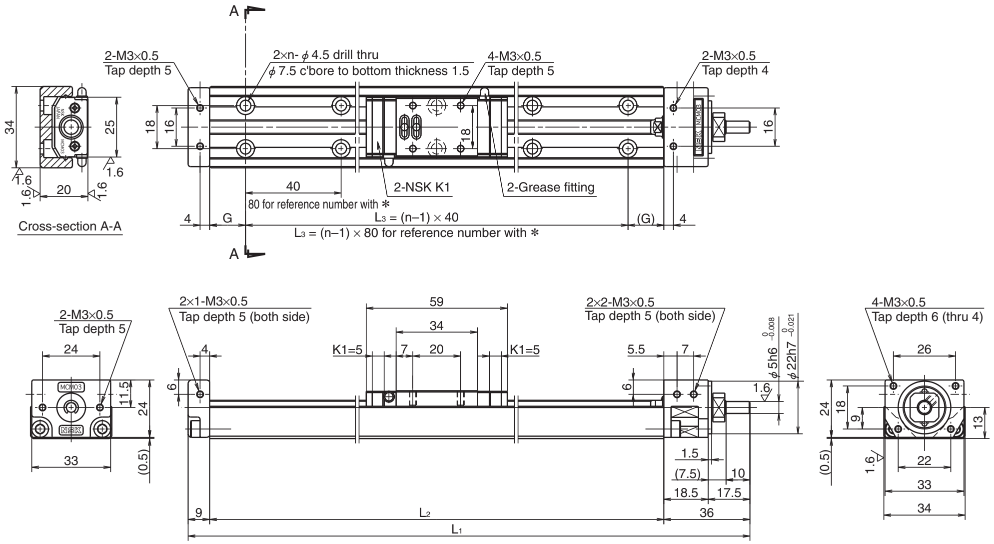
Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	24	8	8

MCM03

Accuracy grade: Precision (P)

Ball screw lead 1 and 2



Dimension of MCM03 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)				No. of mounting hole	Inertia × 10^{-5} (kg · m^2)	Mass (kg)
				L_1	L_2	G	L_3	n		
∗MCM03005P01K00	50	56	1	160	115	17.5	80	2	0.015	0.6
∗MCM03005P02K00		(66)	2						0.016	
MCM03010P01K00	100	131	1	235	190	15	160	5	0.021	0.7
MCM03010P02K00		(141)	2						0.022	
MCM03015P01K00	150	181	1	285	240	20	200	6	0.025	0.8
MCM03015P02K00		(191)	2						0.026	

Note: Bolt hole pitch L_3 on items marked with ∗ is 80 mm.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)		
	1	0.2 – 1.7
	2	

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.
4. A spacer plate is required when using a cover unit or sensor unit for MCM03 with the lead of 1 or 2 mm. (See page C49.)

Basic load rating

Lead	Shaft dia	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
ℓ (mm)	d (mm)	Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
1	ϕ6	735	10 900	2 670	1	1 230	4 900	1 040
2		735	8 650		2			

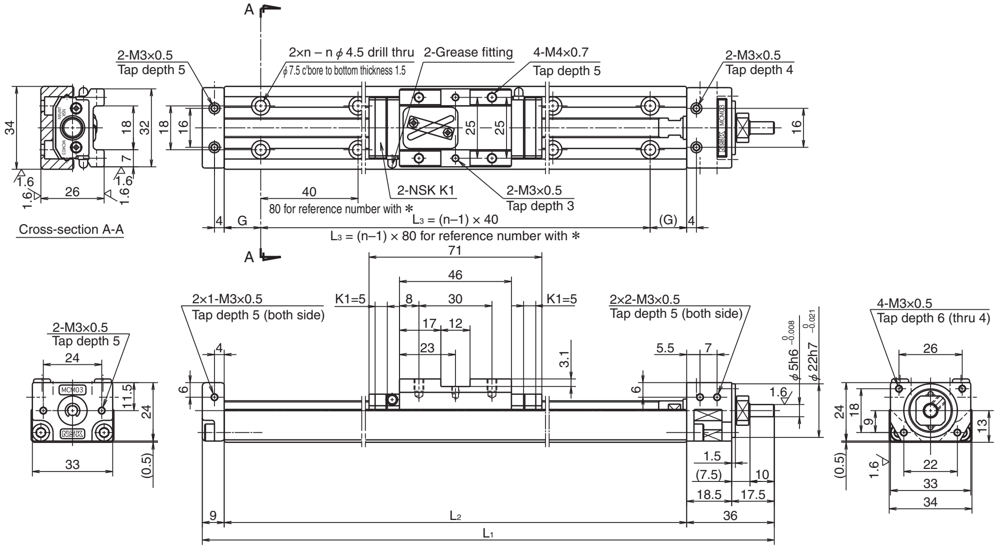
Basic static moment load of linear guide

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)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)				No. of mounting hole	Inertia × 10^{-5} (kg · m^2)	Mass (kg)
				L_1	L_2	G	L_3	n		
∗MCM03005H10K00	50	69	10	185	140	30	80	2	0.080	0.6
∗MCM03005H12K00		(79)	12						0.097	
MCM03010H10K00	100	119	10	235	190	15	160	5	0.092	0.7
MCM03010H12K00		(129)	12						0.109	
MCM03015H10K00	150	169	10	285	240	20	200	6	0.105	0.8
MCM03015H12K00		(179)	12						0.122	
MCM03020H10K00	200	219	10	335	290	25	240	7	0.118	0.9
MCM03020H12K00		(229)	12						0.135	
MCM03025H10K00	250	269	10	385	340	30	280	8	0.131	1.0
MCM03025H12K00		(279)	12						0.147	

Note: Bolt hole pitch L_3 on items marked with ∗ is 80 mm.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)		
	10	0.3 – 3.0
	12	

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in 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	Shaft dia	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
ℓ (mm)	d (mm)	Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
10	ϕ8	1 230	6 250	2 670	10	1 690	6 620	1 040
12		1 230	5 880		12			

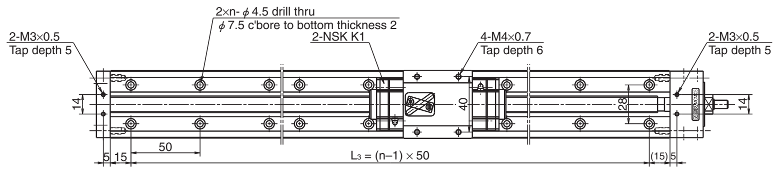
Basic static moment load of linear guide

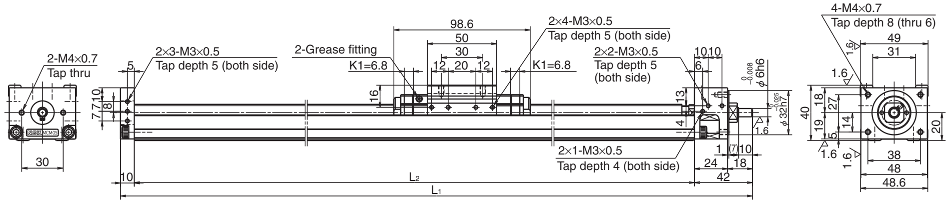
Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	92	51	51

MCM05

Accuracy grade: High grade (H)

Ball screw lead 5, 10 and 20





Dimension of MCM05 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting hole n	Inertia $\times 10^{-4}$ (kg · m^2)	Mass (kg)
MCM05005H05K00	50	80 (95)	5	232	180	150	4	0.025	1.4
MCM05005H10K00			10					0.035	
MCM05005H20K00			20					0.073	
MCM05010H05K00	100	130 (145)	5	282	230	200	5	0.031	1.6
MCM05010H10K00			10					0.040	
MCM05010H20K00			20					0.078	
MCM05015H05K00	150	180 (195)	5	332	280	250	6	0.036	1.8
MCM05015H10K00			10					0.046	
MCM05015H20K00			20					0.084	
MCM05020H05K00	200	230 (245)	5	382	330	300	7	0.042	2.0
MCM05020H10K00			10					0.051	
MCM05020H20K00			20					0.089	
MCM05025H05K00	250	280 (295)	5	432	380	350	8	0.047	2.2
MCM05025H10K00			10					0.057	
MCM05025H20K00			20					0.095	

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	5	1.0 – 4.8
	10	1.1 – 5.8
	20	1.6 – 7.9
	30	1.8 – 11.1

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in 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) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Linear guides C_0	Support unit load limit (N)
5	ϕ12	3 760	15 600	4 400	5	6 310	10 900	1 450
10		2 260	12 400		10	3 780		
20		2 260	9 850		20	3 780		
30		3 260	8 600	6 550	30	5 400		2 730

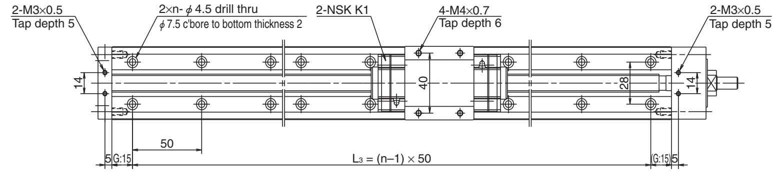
Basic static moment load of linear guide

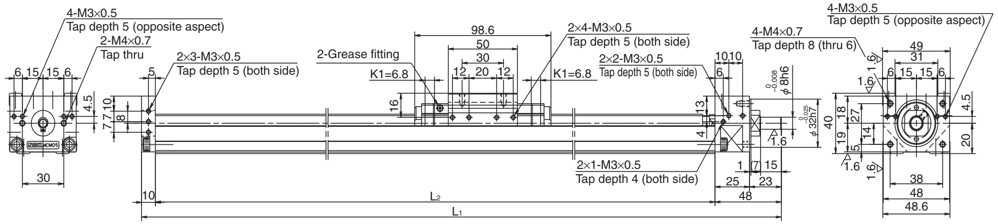
Slider	Basic static moment load (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	229	89	89

MCM05

Accuracy grade: High grade (H)

Ball screw lead 30





Dimension of MCM05 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting hole n	Inertia $\times 10^{-4}$ (kg · m^2)	Mass (kg)
MCM05030H05K00	300	330 (345)	5	482	430	400	9	0.053	2.3
MCM05030H10K00			10					0.063	
MCM05030H20K00			20					0.101	
MCM05030H30K00			30	487				0.164	
MCM05040H05K00	400	430 (445)	5	582	530	500	11	0.064	2.7
MCM05040H10K00			10					0.074	
MCM05040H20K00			20					0.112	
MCM05040H30K00			30	587				0.175	2.8
MCM05050H05K00	500	530 (545)	5	682	630	600	13	0.076	3.1
MCM05050H10K00			10					0.085	
MCM05050H20K00			20					0.123	
MCM05050H30K00			30	687				0.186	3.2
MCM05060H05K00	600	630 (645)	5	782	730	700	15	0.087	3.5
MCM05060H10K00			10					0.096	
MCM05060H20K00			20					0.134	
MCM05060H30K00			30	787				0.198	3.6

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
	30	1.8 – 11.1

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in 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

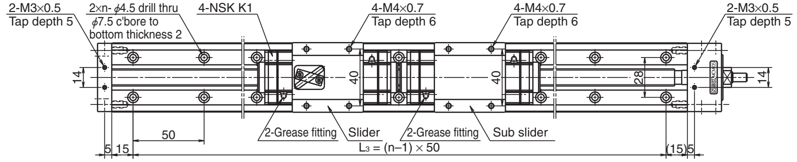
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Linear guides C_0	Support unit load limit (N)
5	ϕ12	3 760	15 600	4 400	5	6 310	10 900	1 450
10		2 260	12 400		10	3 780		
20		2 260	9 850		20	3 780		
30		3 260	8 600	6 550	30	5 400		2 730

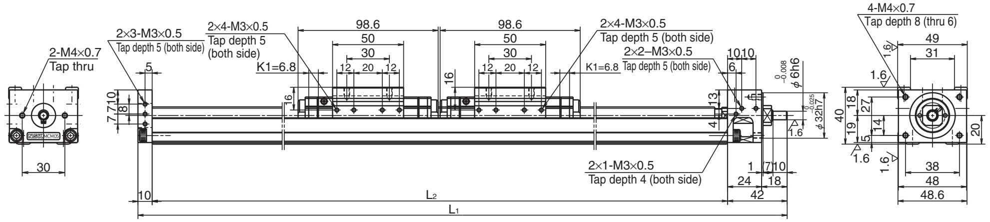
Basic static moment load of linear guide

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)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting hole	Inertia	Mass
				L_1	L_2	L_3	n	$\times 10^{-4}$ (kg · m^2)	(kg)
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 (260)	10	482	430	400	9	0.075	2.8
MCM05021H20D00			20					0.151	

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	10	1.5 – 7.6
	20	2.3 – 11.8

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in 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

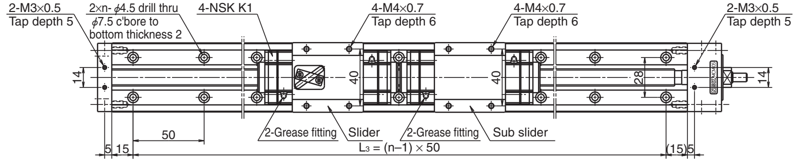
Lead	Shaft dia	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
ℓ	d	Ball screw	Linear guides	Support unit	Rated running distance	Ball screw	Linear guides	
(mm)	(mm)	C_a	C	C_a	L_a (km)	C_{0a}	C_0	
5	ϕ 12	3 760	15 600	4 400	5	6 310	10 900	1 450
10		2 260	12 400		10	3 780		
20		2 260	9 850		20	3 780		

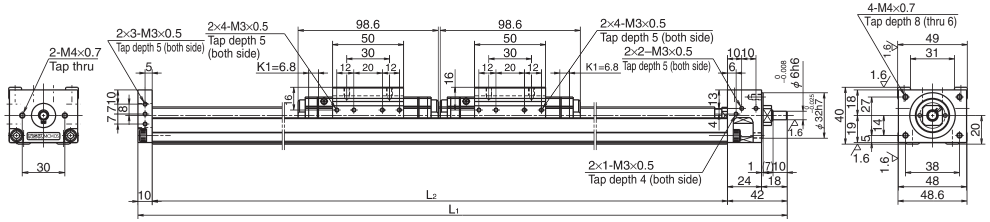
Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	455	765	765

MCM05 (Double slider)

Accuracy grade: High grade (H)





Dimension of MCM05 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting hole	Inertia	Mass
				L_1	L_2	L_3	n	$\times 10^{-4}$ (kg · m^2)	(kg)
MCM05031H10D00	310	333 (360)	10	582	530	500	11	0.086	3.2
MCM05031H20D00			20					0.162	
MCM05041H10D00	410	433 (460)	10	682	630	600	13	0.098	3.6
MCM05041H20D00			20					0.174	
MCM05051H10D00	510	533 (560)	10	782	730	700	15	0.109	4.2
MCM05051H20D00			20					0.185	

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	10	1.5 – 7.6
	20	2.3 – 11.8

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in 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

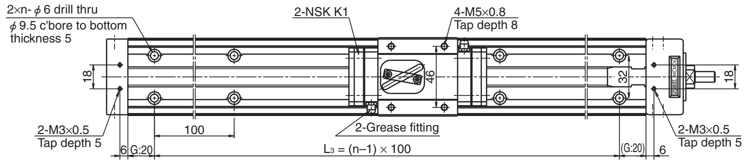
Lead	Shaft dia	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
ℓ	d	Ball screw	Linear guides	Support unit	Rated running distance	Ball screw	Linear guides	
(mm)	(mm)	C_a	C	C_a	L_a (km)	C_{0a}	C_0	
5	ϕ 12	3 760	15 600	4 400	5	6 310	10 900	1 450
10		2 260	12 400		10	3 780		
20		2 260	9 850		20	3 780		

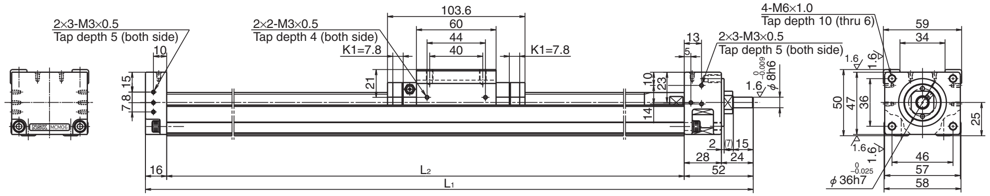
Basic static moment load of linear guide

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)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm) L1	L2	L3	No. of mounting hole n	Inertia ×10^{-4} (kg · m^2)	Mass (kg)
◇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	

Note: Dimension G is 45 for items 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:

1. Frictional resistance of NSK K1 is included in dynamic torque in 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

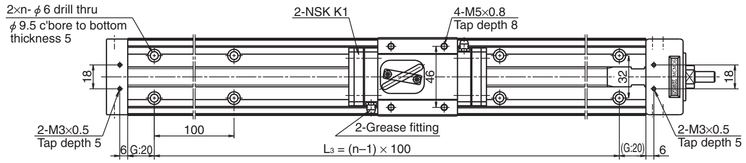
Lead	Shaft dia	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
ℓ (mm)	d (mm)	Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
5	ϕ 16	7 310	25 200	6 550	5	13 500	17 000	2 730
10	ϕ 15	7 060	20 000		10	12 700		
20		4 560	15 900		20	7 750		

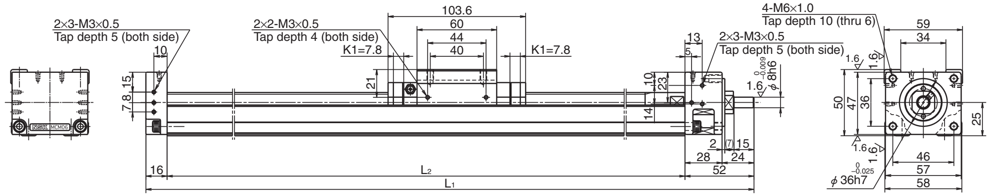
Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	415	174	174

MCM06

Accuracy grade: High grade (H)





Dimension of MCM06 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm) L1	L2	L3	No. of mounting hole n	Inertia ×10^{-4} (kg · m^2)	Mass (kg)
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	1 008	940	900	10	0.374	8.1
MCM06080H10K00			10					0.298	
MCM06080H20K00			20					0.343	

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:

1. Frictional resistance of NSK K1 is included in dynamic torque in 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

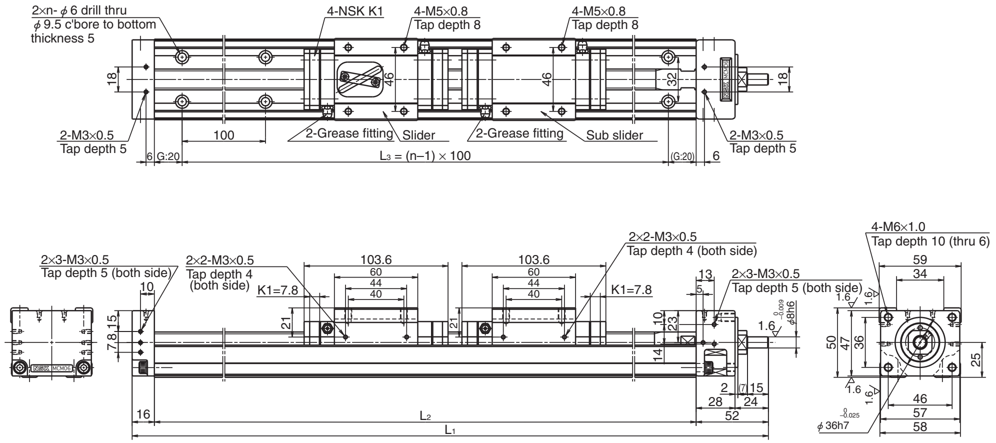
Lead	Shaft dia	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
ℓ (mm)	d (mm)	Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
5	ϕ 16	7 310	25 200	6 550	5	13 500	17 000	2 730
10	ϕ 15	7 060	20 000		10	12 700		
20		4 560	15 900		20	7 750		

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)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting hole	Inertia	Mass
				L_1	L_2	L_3	n	$\times 10^{-4}$ (kg · m^2)	(kg)
MCM06011H05D00	110	133 (164)	5	408	340	300	4	0.145	4.4
MCM06011H10D00			10					0.136	
MCM06021H05D00	210	233 (264)	5	508	440	400	5	0.184	5.1
MCM06021H10D00			10					0.166	
MCM06021H20D00			20					0.257	
MCM06031H05D00	310	333 (364)	5	608	540	500	6	0.223	5.8
MCM06031H10D00			10					0.195	
MCM06031H20D00			20					0.286	

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:
1. Frictional resistance of NSK K1 is included in dynamic torque in 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

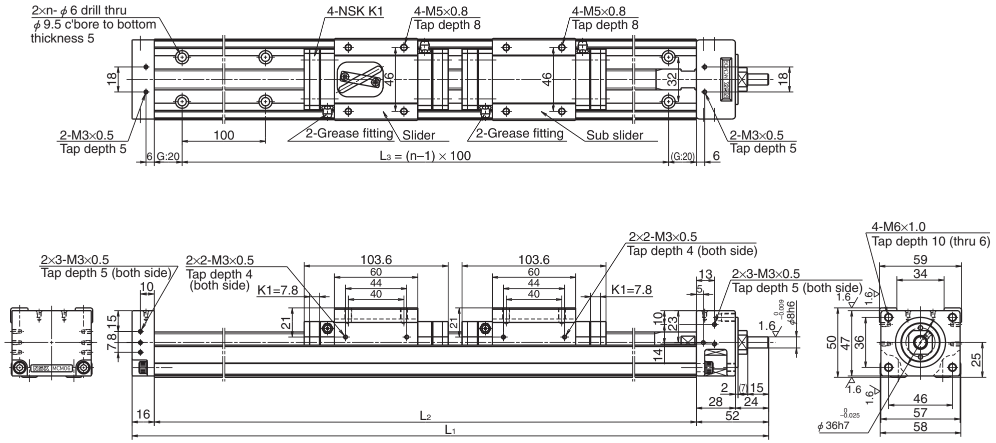
Lead	Shaft dia	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
ℓ	d	Ball screw	Linear guides	Support unit	Rated running distance	Ball screw	Linear guides	
(mm)	(mm)	C_a	C	C_a	L_a (km)	C_{0a}	C_0	
5	ϕ 16	7 310	25 200	6 550	5	13 500	17 000	2 730
10	ϕ 15	7 060	20 000		10	12 700		
20		4 560	15 900		20	7 750		

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	1 220	1 220

MCM06 (Double slider)

Accuracy grade: High grade (H)



Dimension of MCM06 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting hole	Inertia	Mass
				L_1	L_2	L_3	n	$\times 10^{-4}$ (kg · m^2)	(kg)
MCM06041H05D00	410	433 (464)	5	708	640	600	7	0.262	6.6
MCM06041H10D00			10					0.224	
MCM06041H20D00			20					0.316	
MCM06051H10D00	510	533 (564)	10	808	740	700	8	0.254	7.3
MCM06051H20D00			20					0.345	
MCM06061H10D00	610	633 (664)	10	908	840	800	9	0.283	8.0
MCM06061H20D00			20					0.375	
MCM06071H10D00	710	733 (764)	10	1 008	940	900	10	0.313	8.7
MCM06071H20D00			20					0.404	

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:
1. Frictional resistance of NSK K1 is included in dynamic torque in 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	Shaft dia	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
ℓ	d	Ball screw	Linear guides	Support unit	Rated running distance	Ball screw	Linear guides	
(mm)	(mm)	C_a	C	C_a	L_a (km)	C_{0a}	C_0	
5	ϕ 16	7 310	25 200	6 550	5	13 500	17 000	2 730
10	ϕ 15	7 060	20 000		10	12 700		
20		4 560	15 900		20	7 750		

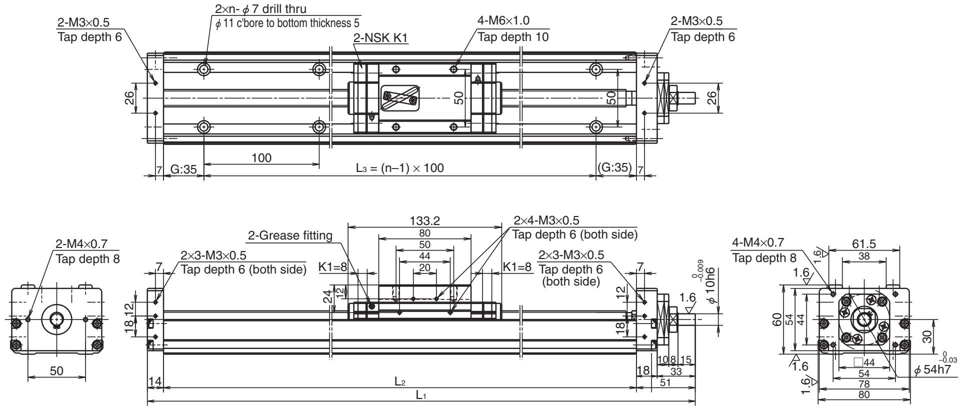
Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	825	1 220	1 220

MCM08

Accuracy grade: High grade (H)

Ball screw lead 5, 10 and 20



Dimension of MCM08 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting hole	Inertia	Mass
				L_1	L_2	L_3	n	$\times 10^{-4}$ (kg · m^2)	(kg)
◇MCM08005H05K00	50	85 (101)	5	285	220	100	2	0.101	4.1
◇MCM08005H10K00			10					0.100	
MCM08010H05K00	100	135 (151)	5	335	270	200	3	0.120	4.6
MCM08010H10K00			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	200	235 (251)	5	435	370	300	4	0.159	5.5
MCM08020H10K00			10					0.144	
MCM08020H20K00			20					0.220	
◇MCM08025H05K00	250	285 (301)	5	485	420	300	4	0.178	6.0
◇MCM08025H10K00			10					0.159	
◇MCM08025H20K00			20					0.235	
MCM08030H05K00	300	335 (351)	5	535	470	400	5	0.198	6.5
MCM08030H10K00			10					0.173	
MCM08030H20K00			20					0.249	

Note: Dimension G is 60 for items marked with ◇.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	5	1.0 – 5.9
	10	2.0 – 7.8
	20	2.5 – 10.8
	30	2.8 – 12.0

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.

Basic load rating

Lead	Shaft dia	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
ℓ	d	Ball screw	Linear guides	Support unit	Rated running distance	Ball screw	Linear guides	
(mm)	(mm)	C_a	C	C_a	L_a (km)	C_{0a}	C_0	
5	ϕ 16	7 310	30 800	7 100	5	13 500	22 800	3 040
10	ϕ 15	7 060	24 400		10	12 700		
20		4 560	19 400		20	7 750		
30		5 070	169 300		30	8 730		

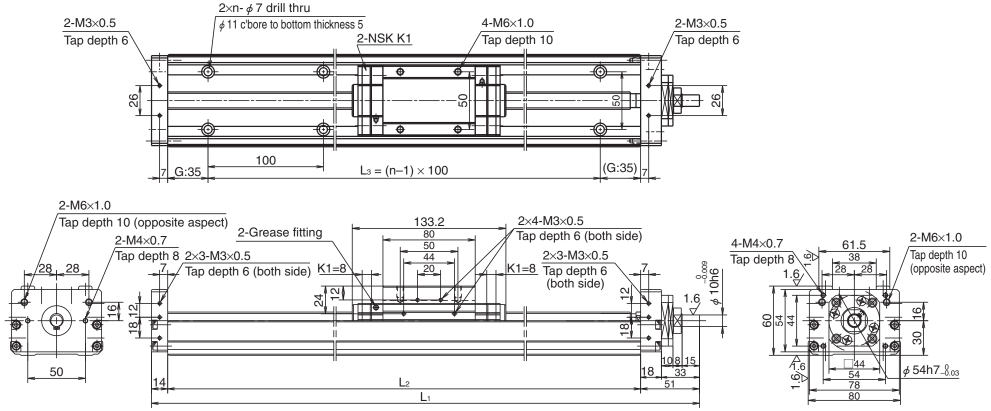
Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	770	300	300

MCM08

Accuracy grade: High grade (H)

Ball screw lead 30



Dimension of MCM08 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting hole	Inertia	Mass
				L_1	L_2	L_3	n	$\times 10^{-4}$ (kg · m^2)	(kg)
MCM08040H05K00	400	435 (451)	5	635	570	500	6	0.236	7.4
MCM08040H10K00			10					0.203	
MCM08040H20K00			20					0.279	
MCM08040H30K00			30					0.405	
MCM08050H05K00	500	535 (551)	5	735	670	600	7	0.275	8.4
MCM08050H10K00			10					0.232	
MCM08050H20K00			20					0.308	
MCM08050H30K00			30					0.435	
MCM08060H05K00	600	635 (651)	5	835	770	700	8	0.314	9.3
MCM08060H10K00			10					0.262	
MCM08060H20K00			20					0.338	
MCM08060H30K00			30					0.464	
MCM08070H05K00	700	735 (751)	5	935	870	800	9	0.353	10.5
MCM08070H10K00			10					0.291	
MCM08070H20K00			20					0.367	
MCM08070H30K00			30					0.494	
MCM08080H05K00	800	835 (851)	5	1 035	970	900	10	0.391	11.2
MCM08080H10K00			10					0.320	
MCM08080H20K00			20					0.396	
MCM08080H30K00			30					0.396	

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	5	1.0 – 5.9
	10	2.0 – 7.8
	20	2.5 – 10.8
	30	2.8 – 12.0

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.

Basic load rating

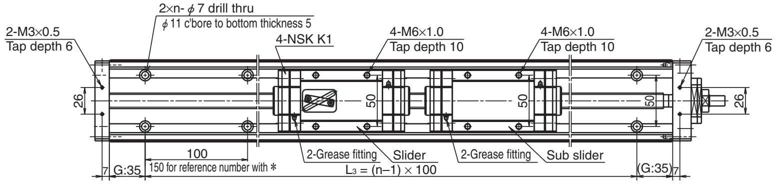
Lead	Shaft dia	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
ℓ	d	Ball screw	Linear guides	Support unit	Rated running distance	Ball screw	Linear guides	
(mm)	(mm)	C_a	C	C_a	L_a (km)	C_{0a}	C_0	
5	ϕ 16	7 310	30 800	7 100	5	13 500	22 800	3 040
10	ϕ 15	7 060	24 400		10	12 700		
20		4 560	19 400		20	7 750		
30		5 070	169 300		30	8 730		

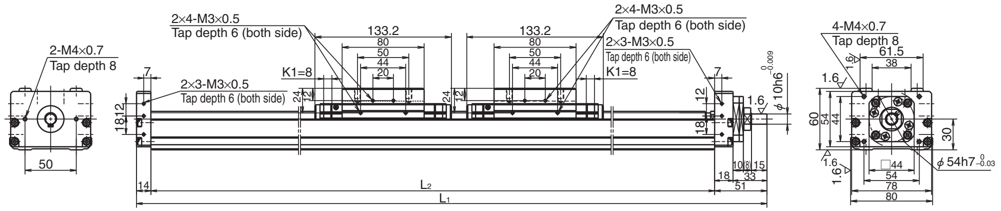
Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	770	300	300

MCM08 (Double slider)

Accuracy grade: High grade (H)





Dimension of MCM08 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting hole	Inertia	Mass
				L_1	L_2	L_3	n	$\times 10^{-4}$ (kg · m^2)	(kg)
∗MCM08008H10D00	80	104 (136)	10	435	370	300	3	0.169	6.5
MCM08018H10D00	180	204	10	535	470	400	5	0.199	7.5
MCM08018H20D00		(236)	20					0.351	
MCM08028H10D00	280	304	10	635	570	500	6	0.228	8.4
MCM08028H20D00		(336)	20					0.380	
MCM08038H10D00	380	404	10	735	670	600	7	0.257	9.4
MCM08038H20D00		(436)	20					0.409	

Note: Bolt hole pitch L_3 on item marked with ∗ is 150 mm.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	10	2.5 – 10.8
	20	4.0 – 17.2

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in 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

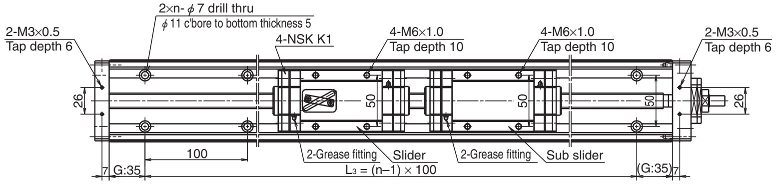
Lead	Shaft dia	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
ℓ	d	Ball screw	Linear guides	Support unit	Rated running distance	Ball screw	Linear guides	
(mm)	(mm)	C_a	C	C_a	L_a (km)	C_{0a}	C_0	
5	φ 16	7 310	30 800	7 100	5	13 500	22 800	3 040
10	φ 15	7 060	24 400		10	12 700		
20		4 560	19 400		20	7 750		

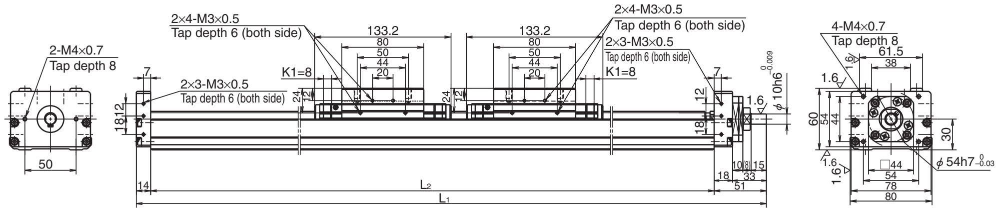
Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	1 540	2 050	2 050

MCM08 (Double slider)

Accuracy grade: High grade (H)





Dimension of MCM08 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)			No. of mounting hole	Inertia	Mass
				L_1	L_2	L_3	n	$\times 10^{-4}$ (kg · m^2)	(kg)
MCM08048H10D00	480	504	10	835	770	700	8	0.287	10.3
MCM08048H20D00		(536)	20					0.439	
MCM08058H10D00	580	604	10	935	870	800	9	0.316	11.5
MCM08058H20D00		(636)	20					0.468	
MCM08068H10D00	680	704	10	1035	970	900	10	0.346	12.2
MCM08068H20D00		(736)	20					0.498	

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	10	2.5 – 10.8
	20	4.0 – 17.2

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in 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	Shaft dia	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
ℓ	d	Ball screw	Linear guides	Support unit	Rated running distance	Ball screw	Linear guides	
(mm)	(mm)	C_a	C	C_a	L_a (km)	C_{0a}	C_0	
5	φ 16	7 310	30 800	7 100	5	13 500	22 800	3 040
10	φ 15	7 060	24 400		10	12 700		
20		4 560	19 400		20	7 750		

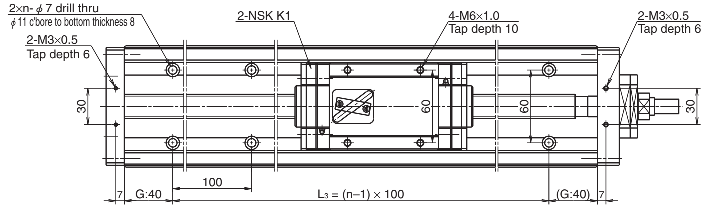
Basic static moment load of linear guide

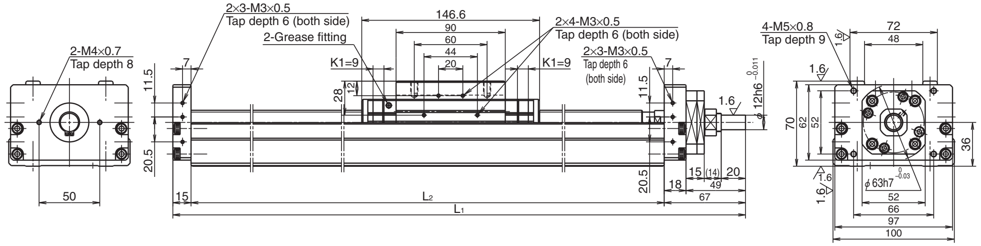
Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	1 540	2 050	2 050

MCM10

Accuracy grade: High grade (H)

Ball screw lead 10 and 20





Dimension of MCM10 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm) L₁	L₂	L₃	No. of mounting hole n	Inertia ×10⁻⁴ (kg · m²)	Mass (kg)
MCM10010H10K00	100	130 (151)	10	362	280	200	2✻	0.332	7.8
MCM10010H20K00			20					0.446	
◇MCM10015H10K00	150	180 (201)	10	412	330	300	4	0.378	8.7
◇MCM10015H20K00			20					0.492	
MCM10020H10K00	200	230 (251)	10	462	380	300	4	0.425	9.5
MCM10020H20K00			20					0.539	
◇MCM10025H10K00	250	280 (301)	10	512	430	400	5	0.472	10.4
◇MCM10025H20K00			20					0.586	
MCM10030H10K00	300	330 (351)	10	562	480	400	5	0.519	11.2
MCM10030H20K00			20					0.633	
MCM10040H10K00	400	430 (451)	10	662	580	500	6	0.612	13.0
MCM10040H20K00			20					0.726	
MCM10050H10K00	500	530 (551)	10	762	680	600	7	0.706	14.6
MCM10050H20K00			20					0.820	
MCM10050H30K00			30					1.010	

Note: 1) Dimension G is 15 for items marked with ◇.

2) ✻: Use mounting holes on each end of the rail.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	10	2.7 – 10.8
	20	3.1 – 12.7
	30	5.1 – 18.0

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball 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) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Linear guides C_0	Support unit load limit (N)
10	ϕ 20	10 900	33 500	7 600	10	21 700	29 400	3 380
20		7 060	26 600		20	12 700		
30		11 700	23 200		30	22 700		

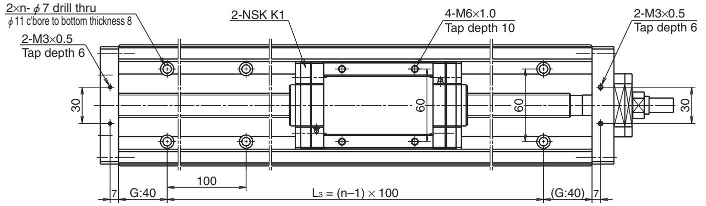
Basic static moment load of linear guide

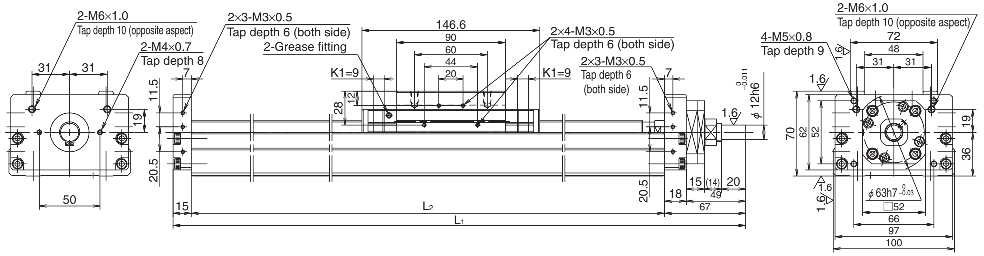
Slider	Basic static moment load (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	1 170	425	425

MCM10

Accuracy grade: High grade (H)

Ball screw lead 30





Dimension of MCM10 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm) L₁	L₂	L₃	No. of mounting hole n	Inertia ×10⁻⁴ (kg · m²)	Mass (kg)
MCM10060H10K00	600	630 (651)	10	862	780	700	8	0.800	16.3
MCM10060H20K00			20					0.914	
MCM10060H30K00			30					1.104	
MCM10070H10K00	700	730 (751)	10	962	880	800	9	0.893	18.0
MCM10070H20K00			20					1.007	
MCM10070H30K00			30					1.197	
MCM10080H10K00	800	830 (851)	10	1 062	980	900	10	0.987	19.7
MCM10080H20K00			20					1.101	
MCM10080H30K00			30					1.291	
MCM10090H10K00	900	930 (951)	10	1 162	1 080	1 000	11	1.081	21.4
MCM10090H20K00			20					1.195	
◇MCM10100H10K00	1 000	1 030 (1 051)	10	1 262	1 180	1 000	11	1.174	23.1
◇MCM10100H20K00			20					1.288	

Note: Dimension G is 90 for items marked with ◇.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	10	2.7 – 10.8
	20	3.1 – 12.7
	30	5.1 – 18.0

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.

Basic load rating

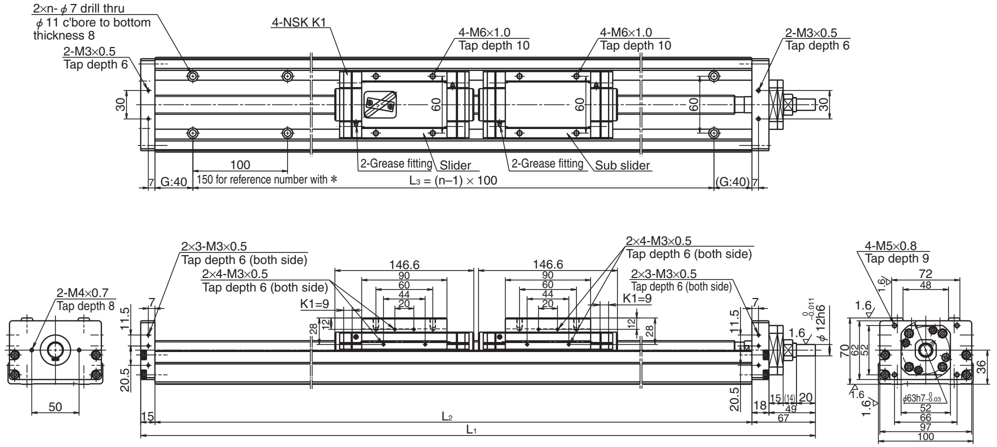
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Linear guides C_0	Support unit load limit (N)
10	ϕ 20	10 900	33 500	7 600	10	21 700	29 400	3 380
20		7 060	26 600		20	12 700		
30		11 700	23 200		30	22 700		

Basic static moment load of linear guide

Slider	Basic static moment load (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	1 170	425	425

MCM10 (Double slider)

Accuracy grade: High grade (H)



Dimension of MCM10 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting hole n	Inertia $\times 10^{-4}$ (kg · m^2)	Mass (kg)
∗MCM10007H10D00	70	86 (122)	10	462	380	300	3	0.463	11.0
MCM10017H10D00	170	186 (222)	10	562	480	400	5	0.557	12.7
MCM10017H20D00			20					0.785	
MCM10027H10D00	270	286 (322)	10	662	580	500	6	0.650	13.4
MCM10027H20D00			20					0.878	
MCM10037H10D00	370	386 (422)	10	762	680	600	7	0.744	15.1
MCM10037H20D00			20					0.972	
MCM10047H10D00	470	486 (522)	10	862	780	700	8	0.838	17.8
MCM10047H20D00			20					1.066	

Note: Bolt hole pitch L_3 on item marked with ∗ is 150 mm.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	10	4.2 – 15.6
	20	5.0 – 19.6

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in 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

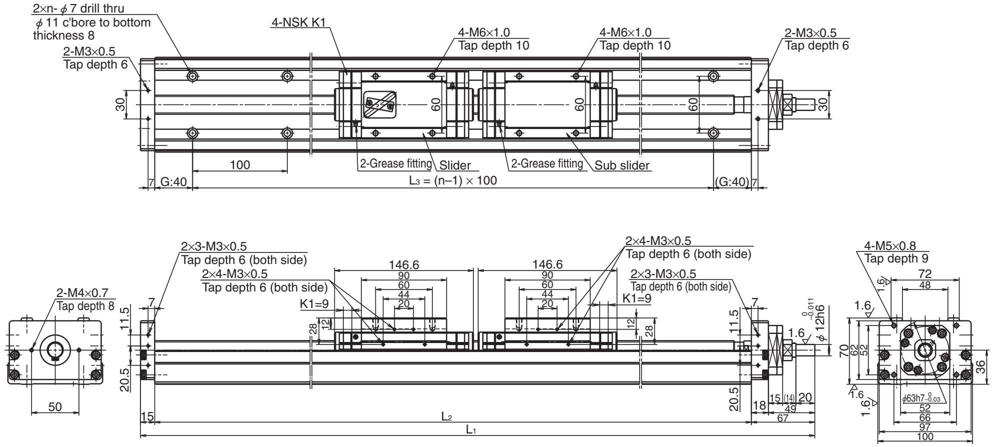
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Linear guides C_0	Support unit load limit (N)
10	ϕ20	10 900	33 500	7 600	10	21 700	29 400	3 380
20		7 060	26 600		20	12 700		

Basic static moment load of linear guide

Slider	Basic static moment load (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	2 340	2 940	2 940

MCM10 (Double slider)

Accuracy grade: High grade (H)



Dimension of MCM10 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting hole n	Inertia $\times 10^{-4}$ (kg · m^2)	Mass (kg)
MCM10057H10D00	570	586 (622)	10	962	880	800	9	0.931	19.5
MCM10057H20D00			20					1.159	
MCM10067H10D00	670	686 (722)	10	1 062	980	900	10	1.025	21.2
MCM10067H20D00			20					1.253	
◇MCM10087H10D00	870	886 (922)	10	1 262	1 180	1 000	11	1.212	23.6
◇MCM10087H20D00			20					1.440	

Note: Dimension G is 90 for items marked with ◇.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	10	4.2 – 15.6
	20	5.0 – 19.6

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in 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) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Linear guides C_0	Support unit load limit (N)
10	ϕ20	10 900	33 500	7 600	10	21 700	29 400	3 380
20		7 060	26 600		20	12 700		

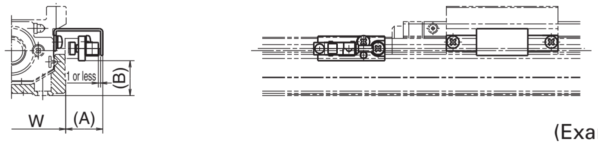
Basic static moment load of linear guide

Slider	Basic static moment load (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	2 340	2 940	2 940

C-2-3 MCM Series Option Part

C-2-3. 1 Sensor Unit

●Proximity switch

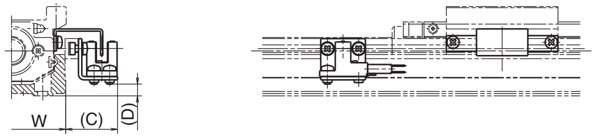


(Example of assembly)

Model No.		Reference No.			A (mm)	B (mm)	Body width W (mm)
MCM02		MC-SR02-00	MC-SR02-01	MC-SR02-02	17	2	28
MCM03		MC-SR03-10	MC-SR03-11	MC-SR03-12	17	3	34
MCM05		MC-SR05-10	MC-SR05-11	MC-SR05-12	17	15	48.6
MCM06		MC-SR06-10	MC-SR06-11	MC-SR06-12	17	19	58
MCM08		MC-SR08-10	MC-SR08-11	MC-SR08-12	16	27	80
MCM10		MC-SR10-10	MC-SR10-11	MC-SR10-12	16	35	100
Quantity	Proximity switch (normally open contact)	—	3	1	E2S-W13 (OMRON Corp.)		
	Proximity switch (normally close contact)	3	—	2	E2S-W14 (OMRON Corp.)		

Notes: 1. See page C21 for proximity switch specification.
2. A sensor unit consists of sensors, a sensor dog and sensor mounting parts.
3. Sensor unit for MCM02 contains two sensor dogs.
4. A spacer plate is required when using a cover unit or sensor unit for MCM03 with the lead of 1 or 2 mm. (Refer to page C49.)

●Photo sensor



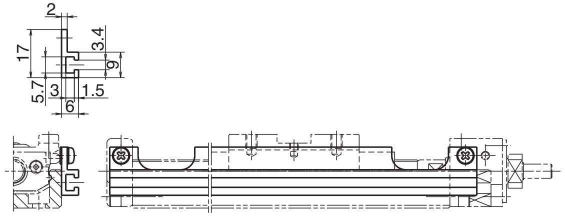
(Example of assembly)

Model No.	Reference No.	C (mm)	D (mm)	Body width W (mm)	Remarks
MCM03	MC-SR03-13	24	0.5	34	EE-SX674 (OMRON Corp.) 3 sets (EE-1001 connector attachment)
MCM05	MC-SR05-13	24	5	48.6	
MCM06	MC-SR06-13	24	9	58	
MCM08	MC-SR08-13	23	17	80	
MCM10	MC-SR10-13	22	24	100	

Notes: 1. See page C22 for photo sensor specification.
2. A sensor unit consists of sensors, a sensor dog and sensor mounting parts.
3. A spacer plate is required when using a cover unit or sensor unit for MCM03 with the lead of 1 or 2 mm. (Refer to page C49.)

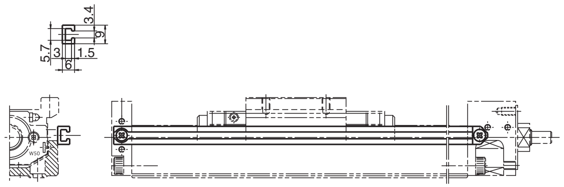
(1) Sensor Rail

Sensor rail for MCM03: MC-SRL3-＊＊＊＊



(Example of assembly)

Sensor rail for MCM05: MC-SRL5-＊＊＊＊



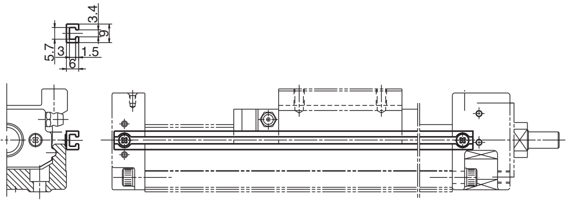
(Example of assembly)

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)

Notes: 1. ＊＊＊＊ is the same as rail dimension L_2.
2. Please assemble the attached seat between the sensor rail and the support unit for MCM03, MCM05, MCM06 and MCM08.
3. For combinations of sensors and rails, see pages C47 to C48.

MCM Series and Sensor Rail Combination Table

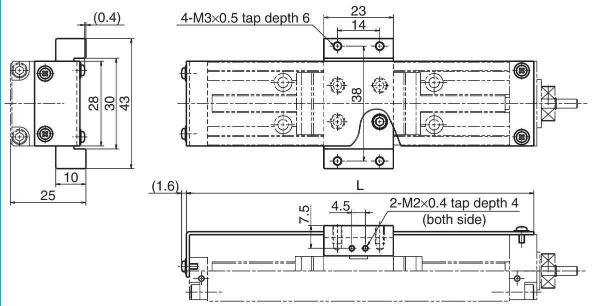
Table 4

Model No.	Body length L_2 (mm)	Reference No.	Sensor rail reference No.
MCM02	100	MCM02005H01K MCM02005P01K MCM02005H02K MCM02005P02K	MC-SRL2-0100*
	150	MCM02010H01K MCM02010P01K MCM02010H02K MCM02010P02K	MC-SRL2-0150
	200	MCM02015H01K MCM02015P01K MCM02015H02K MCM02015P02K	MC-SRL2-0200
MCM03	115	MCM03005P01K00 MCM03005P02K00	MC-SRL3-0115
	140	MCM03005H10K00 MCM03005H12K00	MC-SRL3-0140
	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	MC-SRL5-0180
	230	MCM05010H05K00 MCM05010H10K00 MCM05010H20K00	MC-SRL5-0230
	280	MCM05015H05K00 MCM05015H10K00 MCM05015H20K00 MCM05006H10D00	MC-SRL5-0280
	330	MCM05020H05K00 MCM05020H10K00 MCM05020H20K00 MCM05011H10D00	MC-SRL5-0330
	380	MCM05025H05K00 MCM05025H10K00 MCM05025H20K00 MCM05016H10D00	MC-SRL5-0380
	430	MCM05030H05K00 MCM05030H10K00 MCM05030H20K00 MCM05030H30K00 MCM05021H10D00 MCM05021H20D00	MC-SRL5-0430
	530	MCM05040H05K00 MCM05040H10K00 MCM05040H20K00 MCM05040H30K00 MCM05031H10D00 MCM05031H20D00	MC-SRL5-0530
	630	MCM05050H05K00 MCM05050H10K00 MCM05050H20K00 MCM05050H30K00 MCM05041H10D00 MCM05041H20D00	MC-SRL5-0630
MCM05	730	MCM05060H05K00 MCM05060H10K00 MCM05060H20K00 MCM05060H30K00 MCM05051H10D00 MCM05051H20D00	MC-SRL5-0730
MCM06	190	MCM06005H05K00 MCM06005H10K00 MCM06005H20K00	MC-SRL6-0190
	240	MCM06010H05K00 MCM06010H10K00 MCM06010H20K00	MC-SRL6-0240
	290	MCM06015H05K00 MCM06015H10K00 MCM06015H20K00	MC-SRL6-0290
	340	MCM06020H05K00 MCM06020H10K00 MCM06020H20D00 MCM06011H05D00 MCM06011H10D00	MC-SRL6-0340
	390	MCM06025H05K00 MCM06025H10K00 MCM06025H20K00	MC-SRL6-0390
	440	MCM06030H05K00 MCM06030H10K00 MCM06030H20K00 MCM06021H05D00 MCM06021H10D00 MCM06021H20D00	MC-SRL6-0440
	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
MCM08	220	MCM08005H05K00 MCM08005H10K00	MC-SRL8-0220
	270	MCM08010H05K00 MCM08010H10K00 MCM08010H20K00	MC-SRL8-0270
	320	MCM08015H05K00 MCM08015H10K00 MCM08015H20K00	MC-SRL8-0320
	370	MCM08020H05K00 MCM08020H10K00 MCM08020H20K00 MCM08008H10D00	MC-SRL8-0370
	420	MCM08025H05K00 MCM08025H10K00 MCM08025H20K00	MC-SRL8-0420
	470	MCM08030H05K00 MCM08030H10K00 MCM08030H20K00 MCM08018H10D00 MCM08018H20D00	MC-SRL8-0470
	570	MCM08040H05K00 MCM08040H10K00 MCM08040H20K00 MCM08040H30K00 MCM08028H10D00 MCM08028H20D00	MC-SRL8-0570
	670	MCM08050H05K00 MCM08050H10K00 MCM08050H20K00 MCM08050H30K00 MCM08038H10D00 MCM08038H20D00	MC-SRL8-0670
	770	MCM08060H05K00 MCM08060H10K00 MCM08060H20K00 MCM08060H30K00 MCM08048H10D00 MCM08048H20D00	MC-SRL8-0770
	870	MCM08070H05K00 MCM08070H10K00 MCM08070H20K00 MCM08070H30K00 MCM08058H10D00 MCM08058H20D00	MC-SRL8-0870
	970	MCM08080H05K00 MCM08080H10K00 MCM08080H20K00 MCM08080H30K00 MCM08068H10D00 MCM08068H20D00	MC-SRL8-0970
MCM10	280	MCM10010H10K00 MCM10010H20K00	MC-SRL1-0280
	330	MCM10015H10K00 MCM10015H20K00	MC-SRL1-0330
	380	MCM10020H10K00 MCM10020H20K00 MCM10007H10D00	MC-SRL1-0380
	430	MCM10025H10K00 MCM10025H20K00	MC-SRL1-0430
	480	MCM10030H10K00 MCM10030H20K00 MCM10017H10D00 MCM10017H20D00	MC-SRL1-0480
	580	MCM10040H10K00 MCM10040H20K00 MCM10027H10D00 MCM10027H20D00	MC-SRL1-0580
	680	MCM10050H10K00 MCM10050H20K00 MCM10050H30K00 MCM10037H10D00 MCM10037H20D00	MC-SRL1-0680
	780	MCM10060H10K00 MCM10060H20K00 MCM10060H30K00 MCM10047H10D00 MCM10047H20D00	MC-SRL1-0780
	880	MCM10070H10K00 MCM10070H20K00 MCM10070H30K00 MCM10057H10D00 MCM10057H20D00	MC-SRL1-0880
	980	MCM10080H10K00 MCM10080H20K00 MCM10080H30K00 MCM10067H10D00 MCM10067H20D00	MC-SRL1-0980
	1 080	MCM10090H10K00 MCM10090H20K00	MC-SRL1-1080
	1 180	MCM10100H10K00 MCM10100H20K00 MCM10087H10D00 MCM10087H20D00	MC-SRL1-1180

*) When using NSK standard sensors, prepare two sensor rails. Two sensor rails will also be required for another Monocarriers depending on signal points of sensors. Contact NSK for details.

C-2-3. 2 Cover Unit

Cover Unit for MCM02



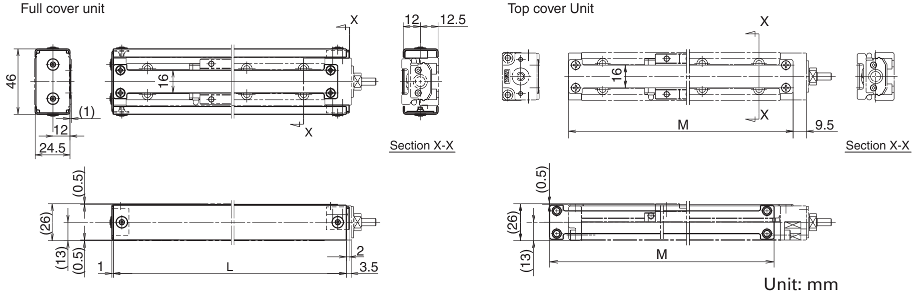
Unit: mm

Stroke	Reference No.	Length(*L*)
50	**MC-CV02005-00**	115
100	**MC-CV02010-00**	165
150	**MC-CV02015-00**	215

Height of screw head is not included.

Cover Unit for MCM03

Note: Optional spacer (MC-SP03-00) is required for a main unit with ball screw lead of 1 and 2 mm.



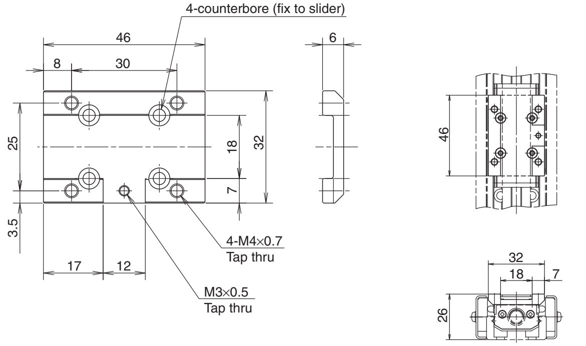
Unit: mm

Stroke	Reference No.		Cover length	
	Top cover unit	Full cover unit	Length (*L*)	Length (*M*)
50 (lead 1, 2)	**MC-CV03005-02**	***MC-CV03005-01**	139	133
50 (lead 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

*) The full-cover unit cannot be used when the sensor unit is used.

Height of screw head is not included.

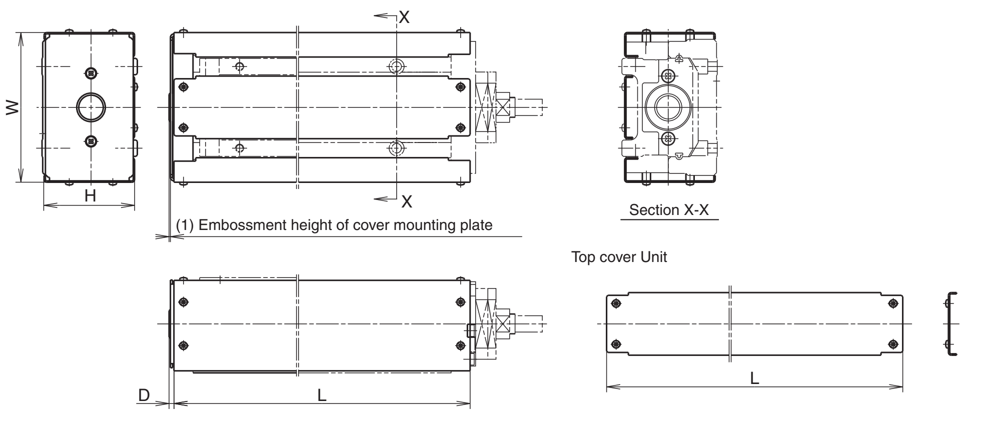
Spacer for MCM03 (Optional) MC-SP03-00 (for ball screw lead 1 and 2 mm)



<<Example of assembly>>

Note: Spacer is required when using sensor unit and cover unit.

Cover unit for MCM05, 06, 08, and 10



Unit: mm

Model No.	Stroke		Cover unit reference No.		Cover length			
	Single slider	Double slider	Top cover Unit	Full cover Unit[*1]	Length (L)	Height (H)	Width (W)	End part (D)
MCM05	50	—	MC-CV05005-01	MC-CV05005-00	200	38.5	65	2.6
	100	—	MC-CV05010-01	MC-CV05010-00	250			
	150	60	MC-CV05015-01	MC-CV05015-00	300			
	200	110	MC-CV05020-01	MC-CV05020-00	350			
	250	160	MC-CV05025-01	MC-CV05025-00	400			
	300	210	MC-CV05030-01	MC-CV05030-00	450			
	400	310	MC-CV05040-01	MC-CV05040-00	550			
	500	410	MC-CV05050-01	MC-CV05050-00	650			
	600	510	MC-CV05060-01	MC-CV05060-00	750			
MCM06	50	—	MC-CV06005-01	MC-CV06005-00	225	48.5	75	—[*2]
	100	—	MC-CV06010-01	MC-CV06010-00	275			
	150	—	MC-CV06015-01	MC-CV06015-00	325			
	200	110	MC-CV06020-01	MC-CV06020-00	375			
	250	—	MC-CV06025-01	MC-CV06025-00	425			
	300	210	MC-CV06030-01	MC-CV06030-00	475			
	400	310	MC-CV06040-01	MC-CV06040-00	575			
	500	410	MC-CV06050-01	MC-CV06050-00	675			
	600	510	MC-CV06060-01	MC-CV06060-00	775			
	700	610	MC-CV06070-01	MC-CV06070-00	875			
	800	710	MC-CV06080-01	MC-CV06080-00	975			
MCM08	50	—	MC-CV08005-01	MC-CV08005-00	248	56.5	90	2.6
	100	—	MC-CV08010-01	MC-CV08010-00	298			
	150	—	MC-CV08015-01	MC-CV08015-00	348			
	200	80	MC-CV08020-01	MC-CV08020-00	398			
	250	—	MC-CV08025-01	MC-CV08025-00	448			
	300	180	MC-CV08030-01	MC-CV08030-00	498			
	400	280	MC-CV08040-01	MC-CV08040-00	598			
	500	380	MC-CV08050-01	MC-CV08050-00	698			
	600	480	MC-CV08060-01	MC-CV08060-00	798			
	700	580	MC-CV08070-01	MC-CV08070-00	898			
	800	680	MC-CV08080-01	MC-CV08080-00	998			
MCM10	100	—	MC-CV10010-01	MC-CV10010-00	308	66.5	110	3.6
	150	—	MC-CV10015-01	MC-CV10015-00	358			
	200	70	MC-CV10020-01	MC-CV10020-00	408			
	250	—	MC-CV10025-01	MC-CV10025-00	458			
	300	170	MC-CV10030-01	MC-CV10030-00	508			
	400	270	MC-CV10040-01	MC-CV10040-00	608			
	500	370	MC-CV10050-01	MC-CV10050-00	708			
	600	470	MC-CV10060-01	MC-CV10060-00	808			
	700	570	MC-CV10070-01	MC-CV10070-00	908			
	800	670	MC-CV10080-01	MC-CV10080-00	1008			
	900	—	MC-CV10090-01	MC-CV10090-00	1108			
	1000	870	MC-CV10100-01	MC-CV10100-00	1208			

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.

*1) When using sensor unit, full-cover unit cannot be used.

*2) A cover mounting plate is not used to MCM06.

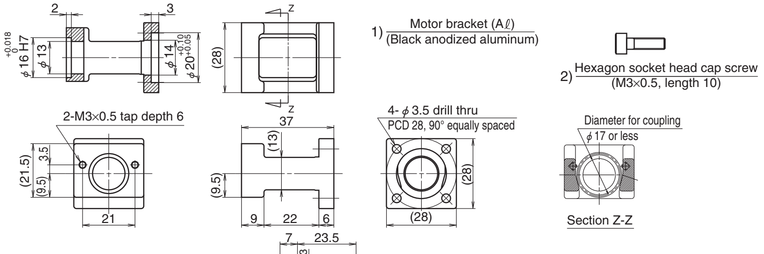
C-2-3. 3 Motor Bracket

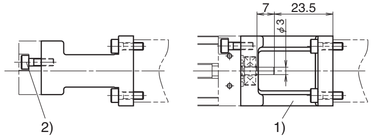
Motor models are subject to change at the motor manufacturers. For details, please contact the manufacturer.

Motor bracket for MCM02

■Reference number

MC-BK02-128-00



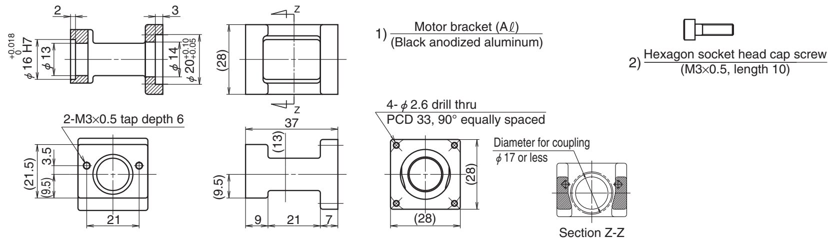


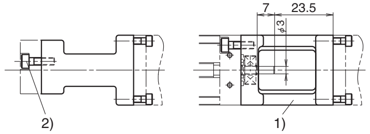
Note: Be sure to align centerlines when installing motor.

Compatible motor	
Maker	Motor models
Yaskawa Electric Corp. (Σ- mini Series)	SGMM-A1 (10W) SGMM-A2 (20W)

■Reference number

MC-BK02-133-00



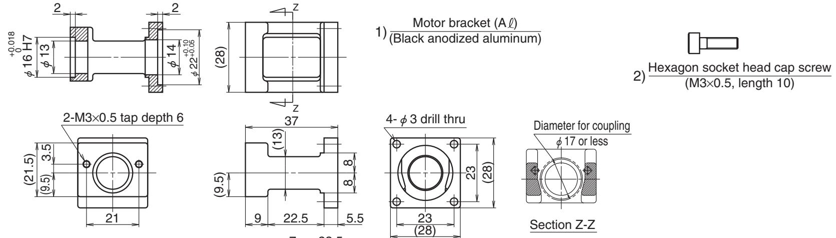


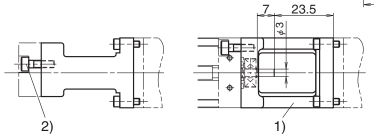
Note: Be sure to align centerlines when installing motor.

Compatible motor	
Maker	Motor models
Mitsubishi Electric Corp. (Melservo series)	HC-AQ013 (10W) HC-AQ023 (20W)

■Reference number

MC-BK02-223-00





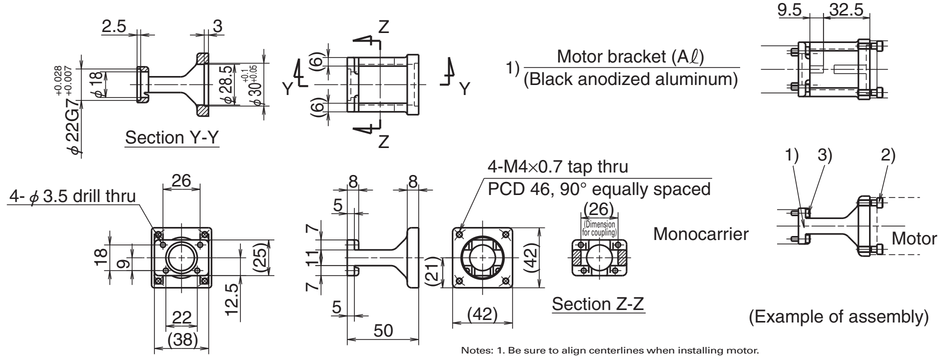
Note: Be sure to align centerlines when installing motor.

Compatible motor	
Maker	Motor models
Oriental Motor Co., Ltd.	PMU33/35 (5-phase stepping motor) PMC33/35 (5-phase stepping motor)

Motor bracket for MCM03

■Reference number

MC-BK03-146-00



2) Hexagon socket head cap screw (M4, length 12)

3) Hexagon socket head cap screw (M3, length 10)

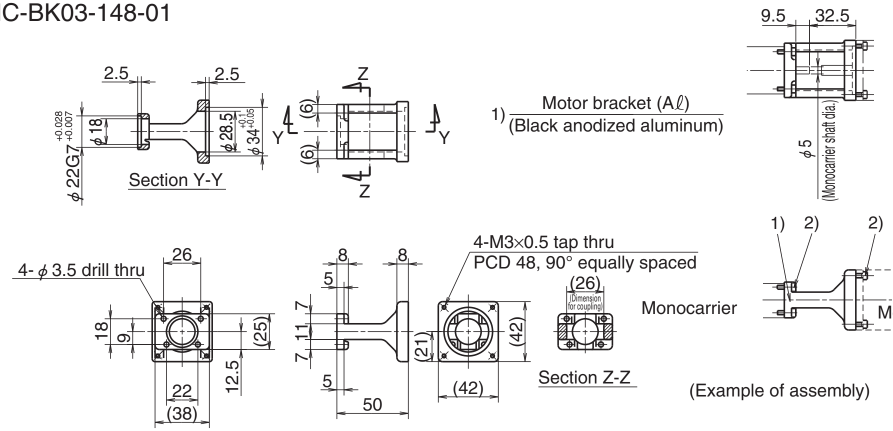
Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

Compatible motor	
Maker	Motor models
Yaskawa Electric Corp.	SGMAH-A3(30W), SGMJV-A5A(50W), SGMAV-A5A(50W) SGMJV-01A(100W), SGMAV-01A(100W), SGMAV-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.	P30B04003(30W), P30B04005(50W), P30B04010(100W)

Motor bracket for MCM03

■Reference number

MC-BK03-148-01



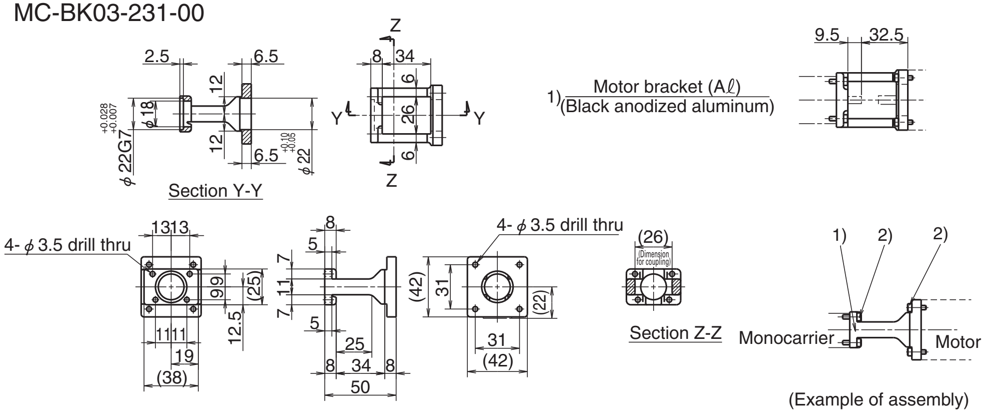
2) Hexagon socket head cap screw (M3, length 10)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	P50B04006 (60W), P50B04010 (100W)

Motor bracket for MCM03

■Reference number
MC-BK03-231-00



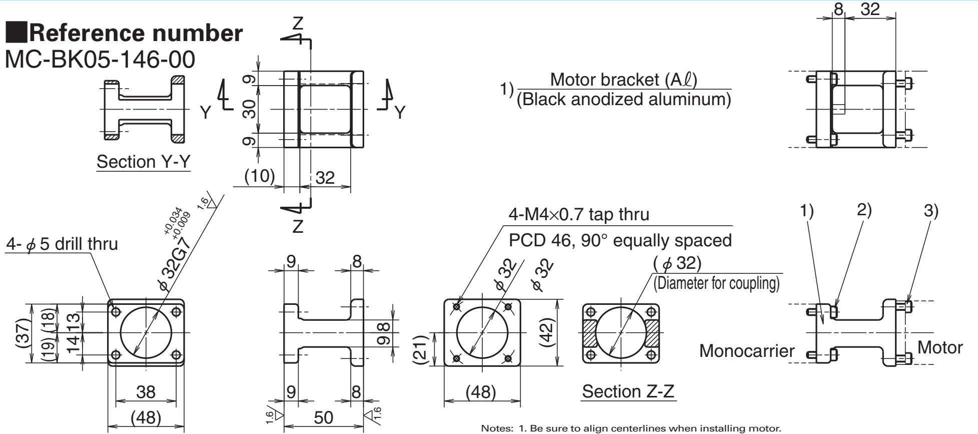
2) Hexagon socket head cap screw (M3, length 10)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

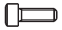
Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	PBM423xxx, 103F55xx
Oriental Motor Co., Ltd.	AS46, ASC46, UPK54x, PK54x, CSK54x, CFK54x UMK24x, CSK24x, PK24x

Motor bracket for MCM05

■Reference number
MC-BK05-146-00



2) Hexagon socket head cap screw (M4, length 15)



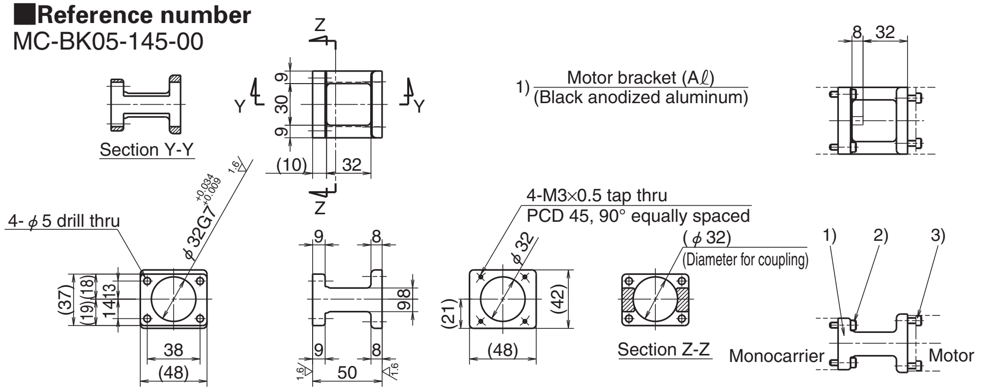
3) Hexagon socket head cap screw (M4, length 12)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

Compatible motor	
Maker	Motor models
Yaskawa Electric Corp.	SGMAH-A3(30W), SGMJV-A5A(50W), SGMAV-A5A(50W) SGMJV-01A(100W), SGMAV-01A(100W), SGMAV-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.	P30B04003(30W), P30B04005(50W), P30B04010(100W)

Motor bracket for MCM05

■Reference number
MC-BK05-145-00



2) Hexagon socket head cap screw (M4, length 15)

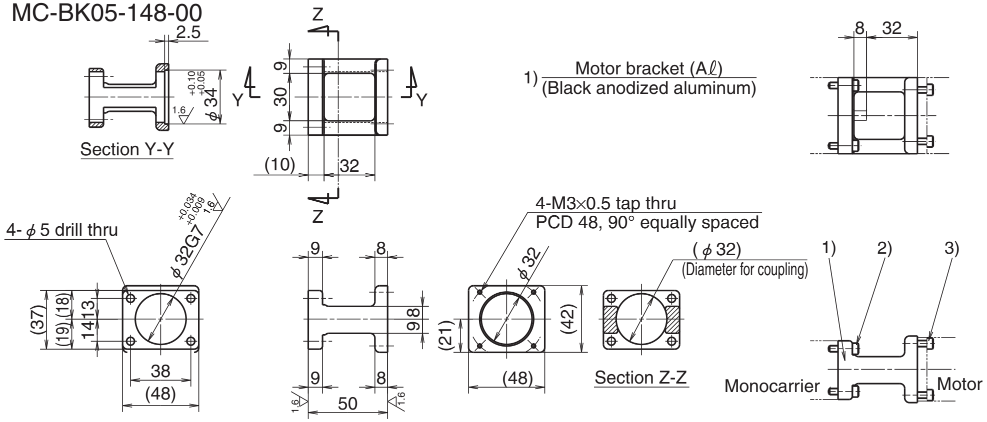
3) Hexagon socket head cap screw (M3, length 12)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

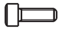
Compatible motor	
Maker	Motor models
Panasonic Co., Ltd.	MSMD5A(50W), MSMD01(100W)

Motor bracket for MCM05

■Reference number
MC-BK05-148-00



2) Hexagon socket head cap screw (M4, length 15)



3) Hexagon socket head cap screw (M3, length 12)

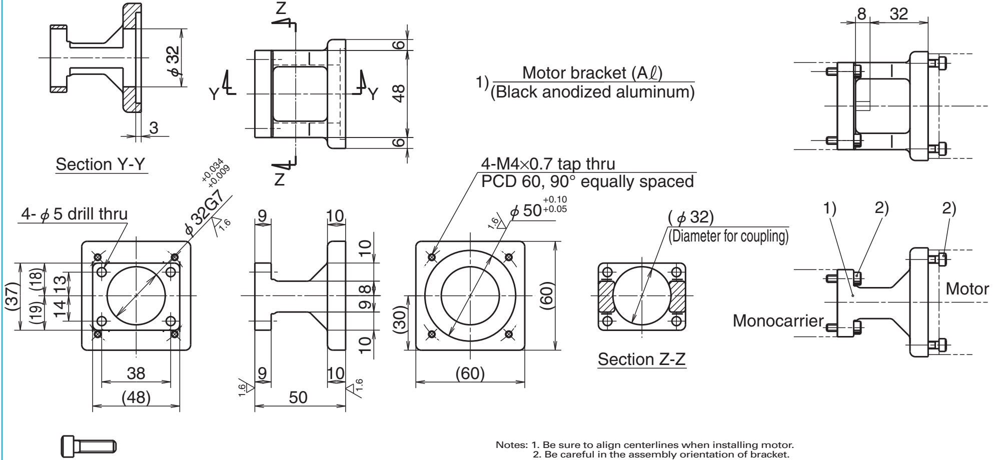
Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

Compatible motor	
Maker	Motor models
Panasonic Co., Ltd.	MAMA01(100W)

Motor bracket for MCM05

■Reference number

MC-BK05-160-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw
(M4, length 15)

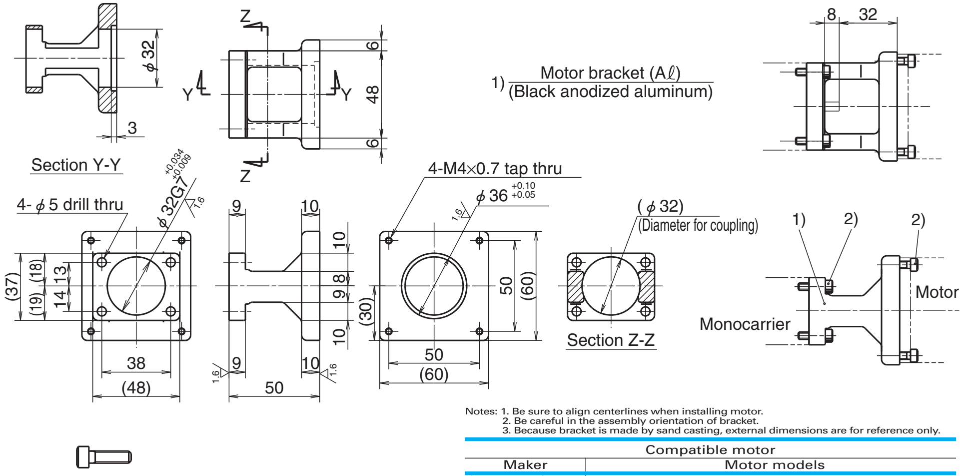
Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	P50B05005(50W), P50B05010(100W), P50B05020(200W)

Motor bracket for MCM05

■Reference number

MC-BK05-250-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw
(M4, length 15)

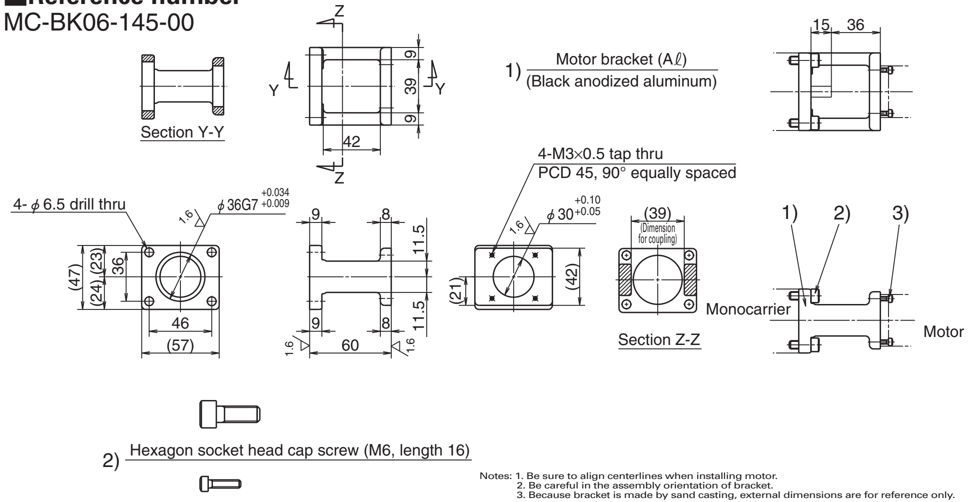
Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	PBM603xxx, PBM604xxx, 103F78xx
Oriental Motor Co., Ltd.	AS66, ASC66, UPK56x, UFK56x PK56x, CSK56x, CFK56x

Motor bracket for MCM06

■Reference number

MC-BK06-145-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M6, length 16)

3) Hexagon socket head cap screw (M3, length 12)

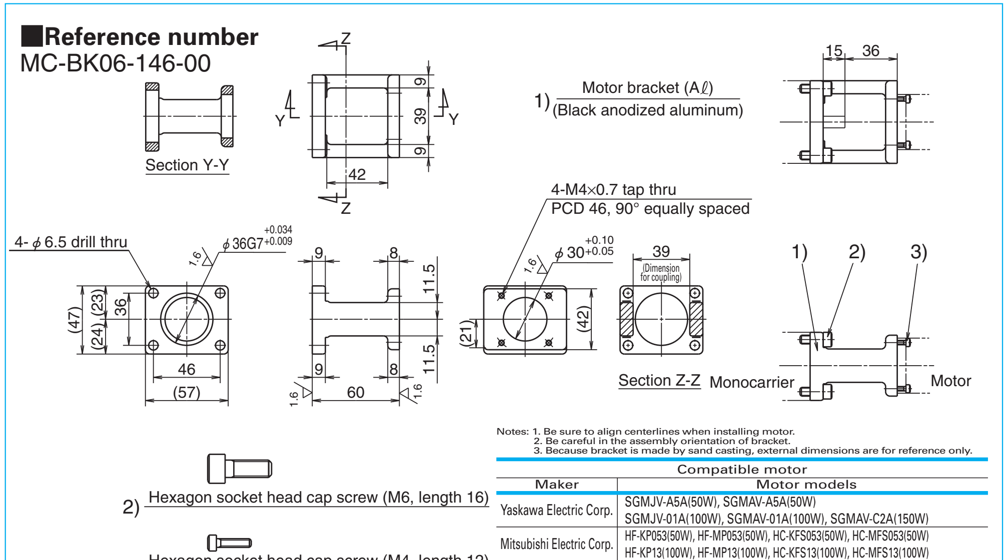
Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

Compatible motor	
Maker	Motor models
Panasonic Co., Ltd.	MSMD5A(50W), MSMD01(100W)

Motor bracket for MCM06

■Reference number

MC-BK06-146-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M6, length 16)

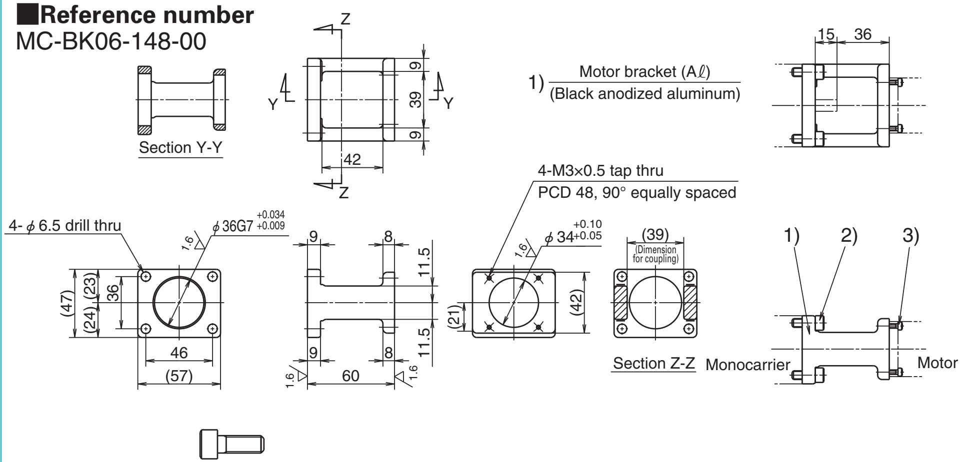
3) Hexagon socket head cap screw (M4, length 12)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

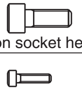
Compatible motor	
Maker	Motor models
Yaskawa Electric Corp.	SGMJV-A5A(50W), SGMAV-A5A(50W) SGMJV-01A(100W), SGMAV-01A(100W), SGMAV-C2A(150W)
Mitsubishi Electric Corp.	HF-KP053(50W), HF-MP053(50W), HC-KFS053(50W), HC-MFS053(50W) HF-KP13(100W), HF-MP13(100W), HC-KFS13(100W), HC-MFS13(100W)
OMRON Corp.	R88M-W03(30W), R88M-W05(50W), R88M-W10(100W)
Sanyo Denki Co., Ltd.	P30B04003(30W), P30B04005(50W), P30B04010(100W)

Motor bracket for MCM06

■Reference number
MC-BK06-148-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)



2) Hexagon socket head cap screw (M6, length 16)

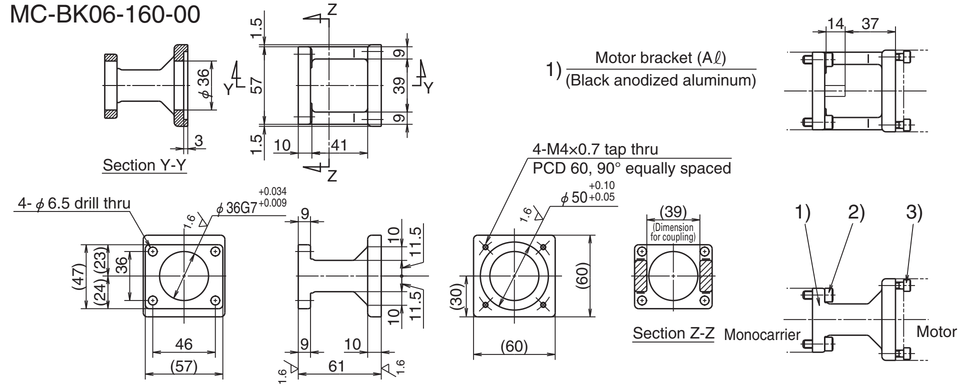
3) Hexagon socket head cap screw (M3, length 12)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

Compatible motor	
Maker	Motor models
Panasonic Co., Ltd.	MAMA01(100W)
Sanyo Denki Co., Ltd.	P50B04006(60W), P50B04010(100W)

Motor bracket for MCM06

■Reference number
MC-BK06-160-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M6, length 16)

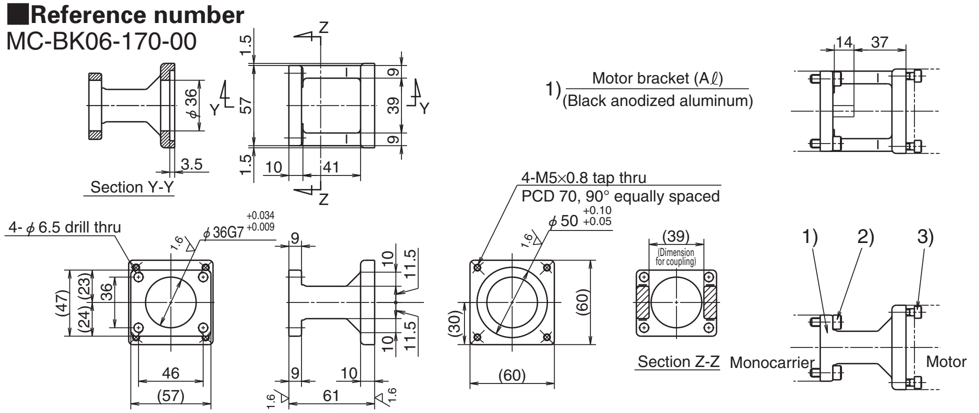
3) Hexagon socket head cap screw (M4, length 14)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for 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 (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M6, length 16)

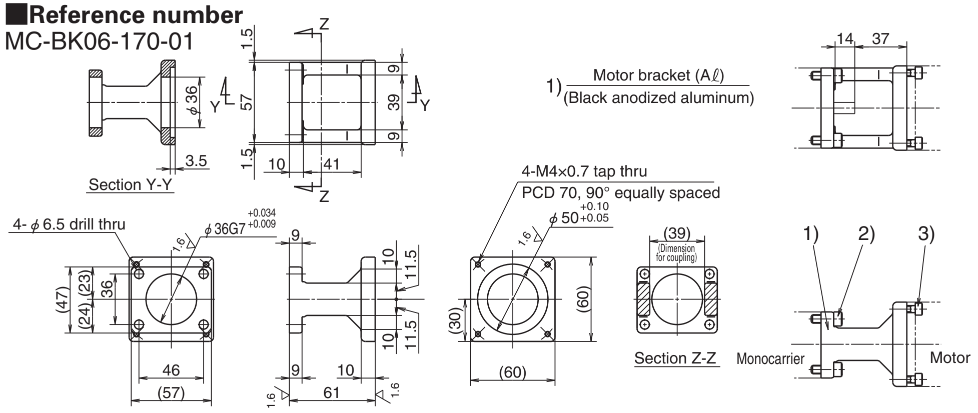
3) Hexagon socket head cap screw (M5, length 14)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

Compatible motor	
Maker	Motor models
Yaskawa Electric Corp.	SGMJV-02A(200W), SGMAV-02A(200W), SGMJV-04A(400W), SGMAV-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 MCM06

■Reference number
MC-BK06-170-01



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M6, length 16)

3) Hexagon socket head cap screw (M4, length 14)

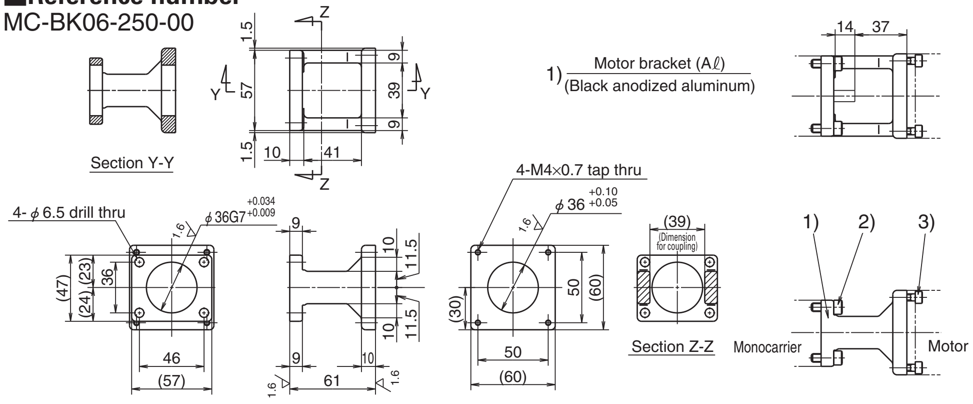
Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

Compatible motor	
Maker	Motor models
Panasonic Co., Ltd.	MSMD02(200W), MAMA02(200W), MSMD04(400W), MAMA04(400W)

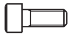
Motor bracket for MCM06

■Reference number

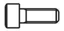
MC-BK06-250-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)



2) Hexagon socket head cap screw (M6, length 16)



3) Hexagon socket head cap screw (M4, length 14)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

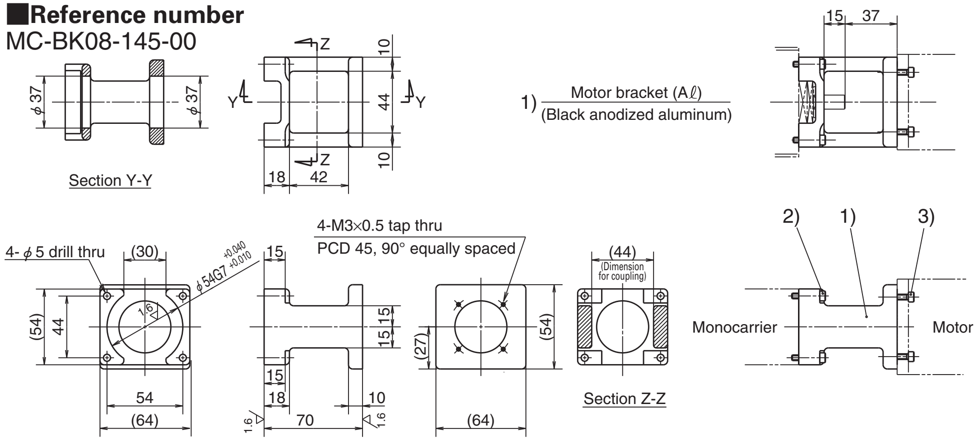
Compatible motor

Maker	Motor models
Sanyo Denki Co., Ltd.	PBM603xxx, PBM604xxx, 103F78xx
Oriental Motor Co., Ltd.	AS66, ASC66, UPK56x, PK56x, CSK56x CFK56x, UFK56x

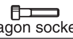
Motor bracket for MCM08

■Reference number

MC-BK08-145-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)



2) Hexagon socket head cap screw (M4, length 20)

3) Hexagon socket head cap screw (M3, length 12)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

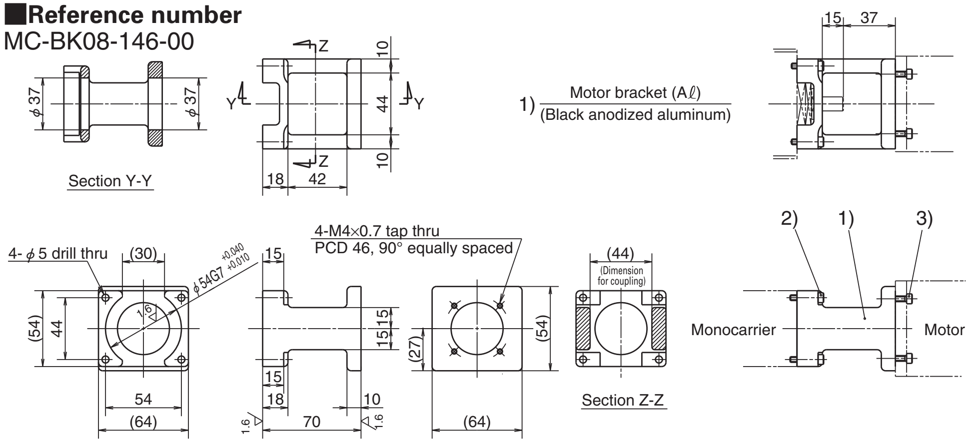
Compatible motor

Maker	Motor models
Panasonic Co., Ltd.	MSMD01(100W)

Motor bracket for MCM08

■Reference number

MC-BK08-146-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M4, length 20)

3) Hexagon socket head cap screw (M4, length 14)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

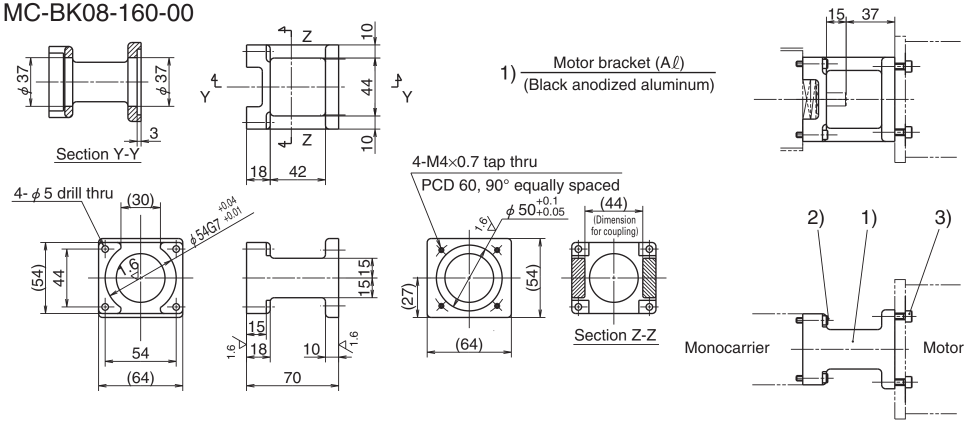
Compatible motor

Maker	Motor models
Yaskawa Electric Corp.	SGMJV-01A(100W), SGMAV-01A(100W), SGMAV-C2A(150W)
Mitsubishi Electric Corp.	HF-KP13(100W), HF-MP13(100W), HC-KFS13(100W), HC-MFS13(100W)
Sanyo Denki Co., Ltd.	P30B04003(30W), P30B04005(50W), P30B04010(100W)

Motor bracket for MCM08

■Reference number

MC-BK08-160-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M4, length 20)

3) Hexagon socket head cap screw (M4, length 14)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

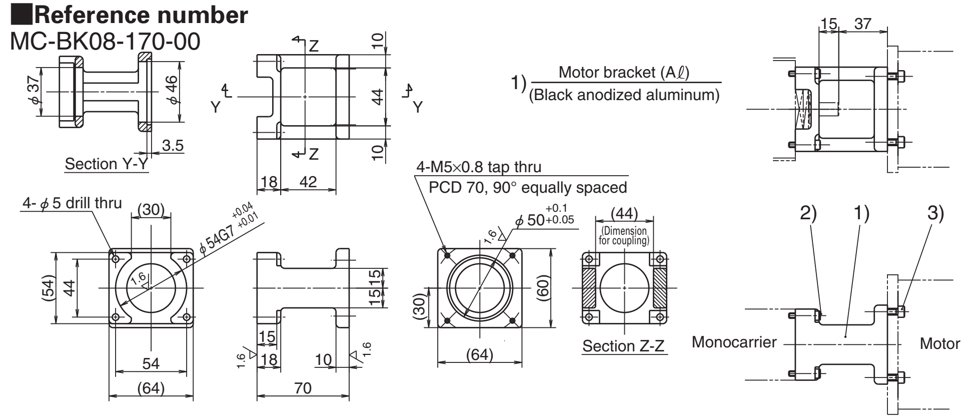
Compatible motor

Maker	Motor models
Sanyo Denki Co., Ltd.	P50B05005(50W), P50B05010(100W), P50B05020(200W)

Motor bracket for MCM08

■Reference number

MC-BK08-170-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M4, length 20)

3) Hexagon socket head cap screw (M5, length 14)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

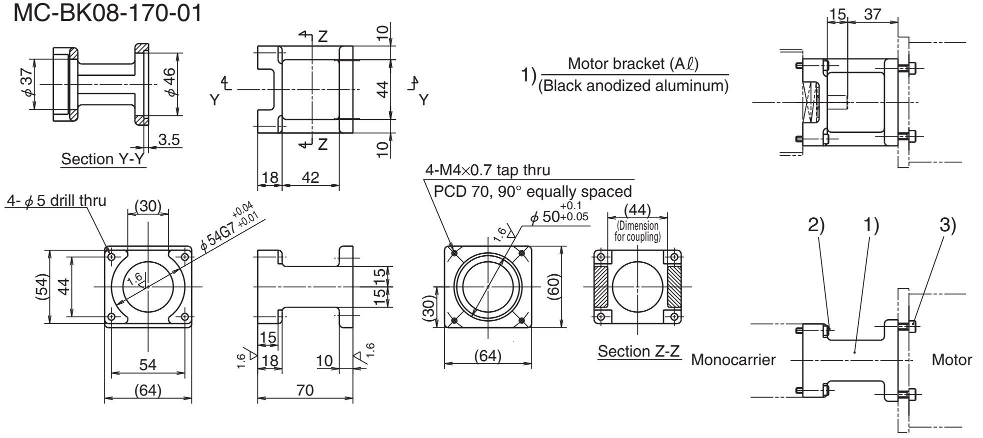
Compatible motor

Maker	Motor models
Yaskawa Electric Corp.	SGMJV-02A(200W), SGMAV-02A(200W), SGMJV-04A(400W), SGMAV-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 MCM08

■Reference number

MC-BK08-170-01



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M4, length 20)

3) Hexagon socket head cap screw (M4, length 14)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

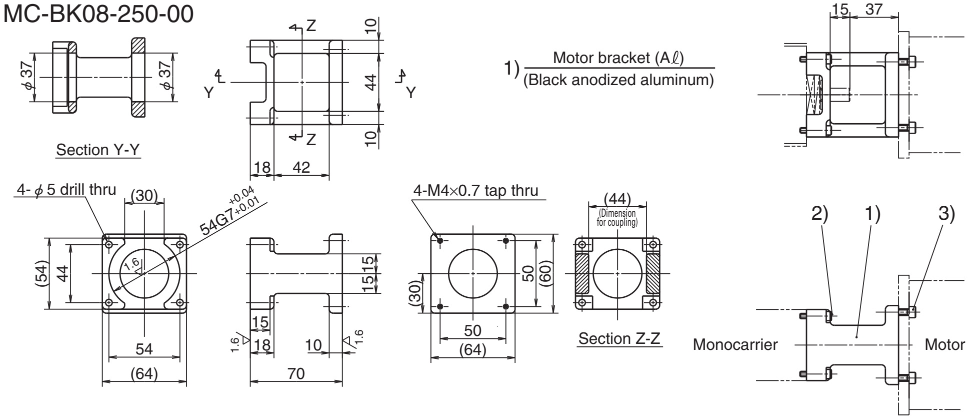
Compatible motor

Maker	Motor models
Panasonic Co., Ltd.	MSMD02(200W), MAMA02(200W), MSMD04(400W), MAMA04(400WW)

Motor bracket for MCM08

■Reference number

MC-BK08-250-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M4, length 20)

3) Hexagon socket head cap screw (M4, length 14)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

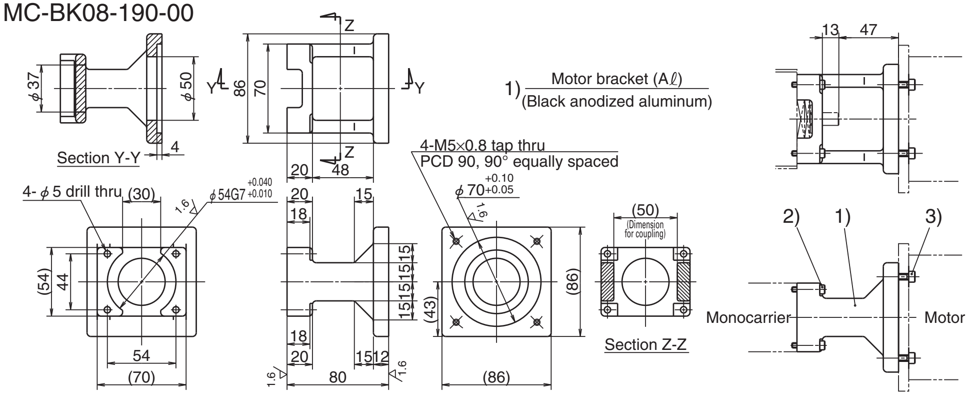
Compatible motor

Maker	Motor models
Sanyo Denki Co., Ltd.	PBM603xxx, PBM604xxx, 103F78xx
Oriental Motor Co., Ltd.	AS66, ASC66, UPK56xx, PK56xx, CSK56x CFK56x, UFK56x

Motor bracket for MCM08

■Reference number

MC-BK08-190-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M4, length 22)

3) Hexagon socket head cap screw (M5, length 16)

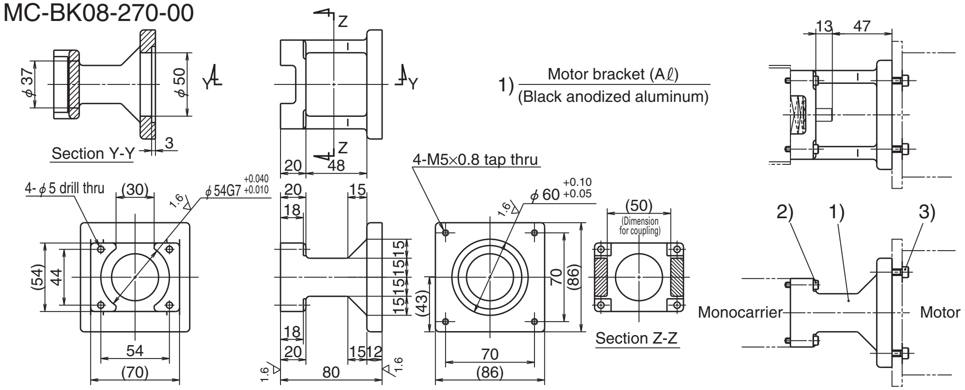
Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

Compatible motor

Maker	Motor models
Sanyo Denki Co., Ltd.	P50B07020(200W), P50B07030(300W), P50B07040(400W)

Motor bracket for MCM08

■Reference number
MC-BK08-270-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

2) Hexagon socket head cap screw (M4, length 22)

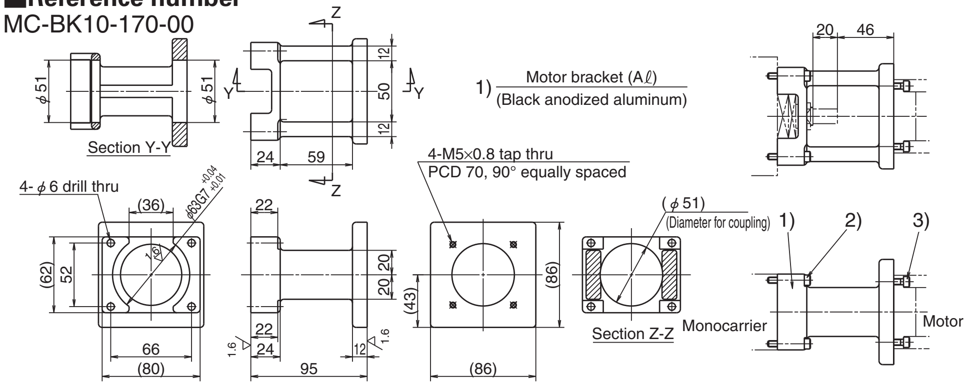
3) Hexagon socket head cap screw (M5, length 16)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

Compatible motor	
Maker	Motor models
Oriental Motor Co., Ltd.	AS98, UPK59x, PK59x CSK59x, CFK59x, UFK59x
Sanyo Denki Co., Ltd.	103F85xx

Motor bracket for MCM10

■Reference number
MC-BK10-170-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

4-M5×0.8 tap thru
PCD 70, 90° equally spaced

2) Hexagon socket head cap screw (M5, length 30)

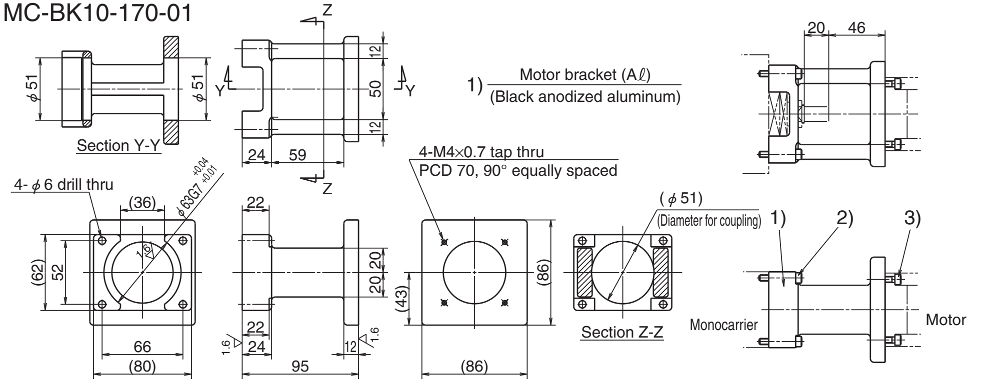
3) Hexagon socket head cap screw (M5, length 16)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

Compatible motor	
Maker	Motor models
Yaskawa Electric Corp.	SGMJV-02A(200W), SGMAV-02A(200W), SGMJV-04A(400W), SGMAV-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-BK10-170-01



1) Motor bracket (Aℓ)
(Black anodized aluminum)

4-M4×0.7 tap thru
PCD 70, 90° equally spaced

2) Hexagon socket head cap screw (M5, length 30)

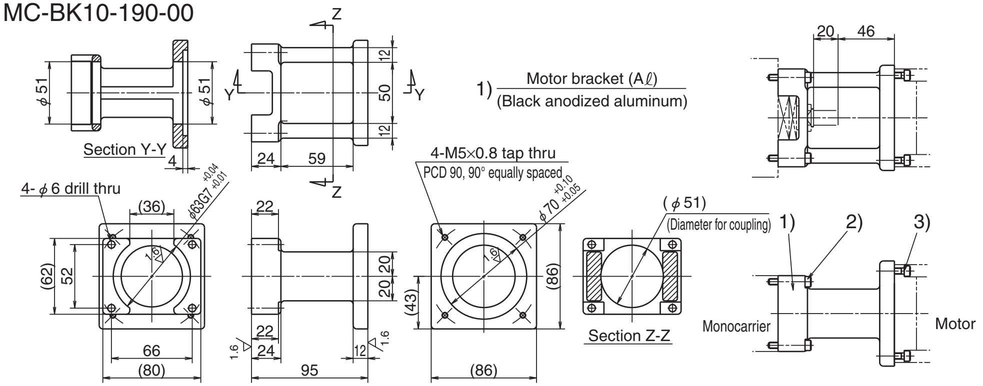
3) Hexagon socket head cap screw (M4, length 16)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

Compatible motor	
Maker	Motor models
Panasonic Co., Ltd.	MSMD02(200W), MAMA02(200W), MSMD04(400W), MAMA04(400W)

Motor bracket for MCM10

■Reference number
MC-BK10-190-00



1) Motor bracket (Aℓ)
(Black anodized aluminum)

4-M5×0.8 tap thru
PCD 90, 90° equally spaced

2) Hexagon socket head cap screw (M5, length 30)

3) Hexagon socket head cap screw (M5, length 16)

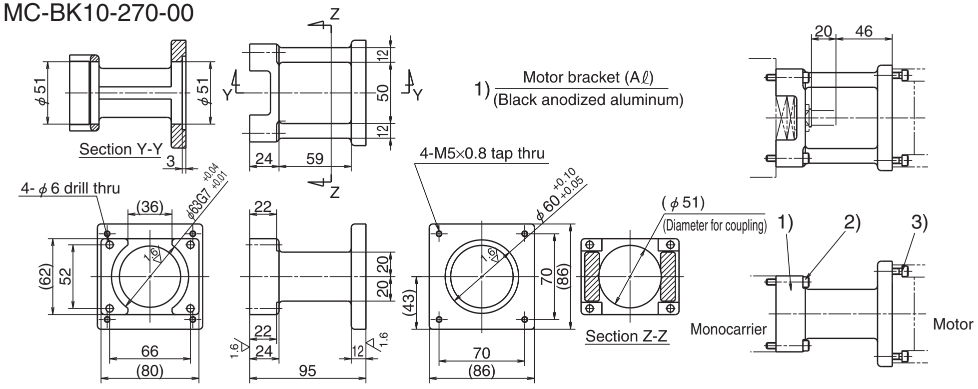
Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

Compatible motor	
Maker	Motor models
Panasonic Co., Ltd.	MSMD08(750W), MAMA08(750W)
Sanyo Denki Co., Ltd.	P50B07020(200W), P50B07030(300W), P50B07040(400W)

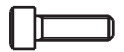
Motor bracket for MCM10

■Reference number

MC-BK10-270-00



2) Hexagon socket head cap screw (M5, length 30)



3) Hexagon socket head cap screw (M5, length 18)

Notes: 1. Be sure to align centerlines when installing motor.
2. Be careful in the assembly orientation of bracket.
3. Because bracket is made by sand casting, external dimensions are for reference only.

Compatible motor

Maker	Motor models
Sanyo Denki Co., Ltd.	103F85xx
Oriental Motor Co., Ltd.	AS98, UPK59x, PK59x, CSK59x CFK59x, UFK59x

Motor Availability Table of Motor Bracket for MCM Series

Table 5

Model No.	Reference No. code	Motor bracket reference No.	Motor manufacturer	Stepping motor model No.	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.	PMU33/35 (5-phase) PMC33/35 (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		R88M-W10					
			Sanyo Denki Co., Ltd.				P30B04003	P30B04005		P30B04010					
	2	MC-BK03-148-01	Sanyo Denki Co., Ltd.						P50B04006	P50B04010					
	3	MC-BK03-231-00	Sanyo Denki Co., Ltd.	PBM423xxx											
			Sanyo Denki Co., Ltd.	103F55xx											
			Oriental Motor Co., Ltd.	AS46, ASC46 UPK54x, PK54x CSK54x, CFK54x UMK24x, CSK24x PK24x											
MCM05	1	MC-BK05-145-00	Panasonic Co., Ltd.					MSMD5A		MSMD01					
	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		R88M-W10					
			Sanyo Denki Co., Ltd.				P30B04003	P30B04005		P30B04010					
	3	MC-BK05-148-00	Panasonic Co., Ltd.							MAMA01					
	4	MC-BK05-160-00	Sanyo Denki Co., Ltd.					P50B05005		P50B05010		P50B05020			
	5	MC-BK05-250-00	Sanyo Denki Co., Ltd.	PBM603xx, PBM604xx											
			Sanyo Denki Co., Ltd.	103F78xx											
			Oriental Motor Co., Ltd.	AS66, ASC66 UPK56x, UFK56x PK56x, CSK56x, CFK56x											
MCM06	1	MC-BK06-145-00	Panasonic Co., Ltd.					MSMD5A		MSMD01					
	2	MC-BK06-146-00	Yaskawa Electric Corp.					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		R88M-W10					
			Sanyo Denki Co., Ltd.				P30B04003	P30B04005		P30B04010					
	3	MC-BK06-148-00	Sanyo Denki Co., Ltd.						P50B04006	P50B04010					
			Panasonic Co., Ltd.							MAMA01					
	4	MC-BK06-160-00	Sanyo Denki Co., Ltd.					P50B05005		P50B05010		P50B05020			
	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	
			Sanyo Denki Co., Ltd.									P30B06020		P30B06040	
	6	MC-BK06-170-01	Panasonic Co., Ltd.									MSMD02 MAMA02		MSMD04 MAMA04	
	7	MC-BK06-250-00	Sanyo Denki Co., Ltd.	PBM603xxx, PBM604xxx											
			Sanyo Denki Co., Ltd.	103F78xx											
			Oriental Motor Co., Ltd.	AS66, ASC66 UPK56x, PK56x CSK56x, CFK56x UFK56x											

Model No.	Reference No. code	Motor bracket reference No.	Motor manufacturer	Stepping motor model No.	Wattage of AC servo motor										
					10	20	30	50	60	100	150	200	300	400	750
MCM08	1	MC-BK08-145-00	Panasonic Co., Ltd.							MSMD01					
	2	MC-BK08-146-00	Yaskawa Electric Corp.							SGMJV-01A SGMAV-01A	SGMAV-C2A				
			Mitsubishi Electric Corp.							HF-KP13 HF-MP13 HC-KFS13 HC-MFS13					
			Sanyo Denki Co., Ltd.				P30B04003	P30B04005		P30B04010					
	3	MC-BK08-160-00	Sanyo Denki Co., Ltd.					P50B05005		P50B05010		P50B05020			
	4	MC-BK08-170-00	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	
			Sanyo Denki Co., Ltd.									P30B06020		P30B06040	
	5	MC-BK08-170-01	Panasonic Co., Ltd.									MSMD02 MAMA02		MSMD04 MAMA04	
	6	MC-BK08-190-00	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 UFK56x											
	8	MC-BK08-270-00	Sanyo Denki Co., Ltd.	103F85xx											
			Oriental Motor Co., Ltd.	AS98 UPK59x, PK59x CSK59x, CFK59x UFK59x											
MCM10	1	MC-BK10-170-00	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	
			Sanyo Denki Co., Ltd.									P30B06020		P30B06040	
	2	MC-BK10-170-01	Panasonic Co., Ltd.									MSMD02 MAMA02		MSMD04 MAMA04	
	3	MC-BK10-190-00	Panasonic Co., Ltd.												MSMD08 MAMA08
			Sanyo Denki Co., Ltd.									P50B07020	P50B07030	P50B07040	
	4	MC-BK10-270-00	Sanyo Denki Co., Ltd.	103F85xx											
			Oriental Motor Co., Ltd.	AS98 UPK59x, PK59x CSK59x, CFK59x UFK59x											

MCH Series

C-3 MCH Series

C-3-1 MCH Series Reference Number Coding

[Body]

Example: MC H 06 040 H 10 K (B 0) *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)

NSK management number

Grease specification: B (LG2) (See page C19.)

Slider specification K: Single slider

D: Double slider (See page C10.)

Ball screw lead (mm)

*1 : These two code fields are added when non-standard grease is used. Coding of MCH Monocarrier with standard grease has 12 characters, as shown above.

[With option part]

Example: MC S 06 040 H 10 K 0 0 K 0 0 0

S: With MCH option part

R: With MCL option part

NSK management number

Sensor unit

Cover unit

Intermediate plate for motor

Note: Option parts are available separately.

Table 1 Sensor unit (See page C79.)

Reference No. code	Specification	Reference No.
0	N/A	—
1	Proximity switch (Normally close contact 3 pieces)	MC—SRHxx—10
2	Proximity switch (Normally open contact 3 pieces)	MC—SRHxx—11
3	Proximity switch (Normally open contact 1 piece, Normally close contact 2 pieces)	MC—SRHxx—12
4	Photo sensor 3 pieces	MC—SRHxx—13

Notes: 1) xx: Nominal size
2) Sensor rail is not included in a sensor unit. If you require the rail, please specify upon ordering. (See page C79 to C80.)

Table 2 Cover unit (See page C81 to C83.)

Reference No. code	Specification	Reference No.
0	N/A	—
1	For single slider	MC—HVxxxxx—00
	For double slider	MC—HVxxxxxD00

Note: xxxxx; Nominal size and stroke number

Table 3 Intermediate plate for motor (See page C85 to C88.)

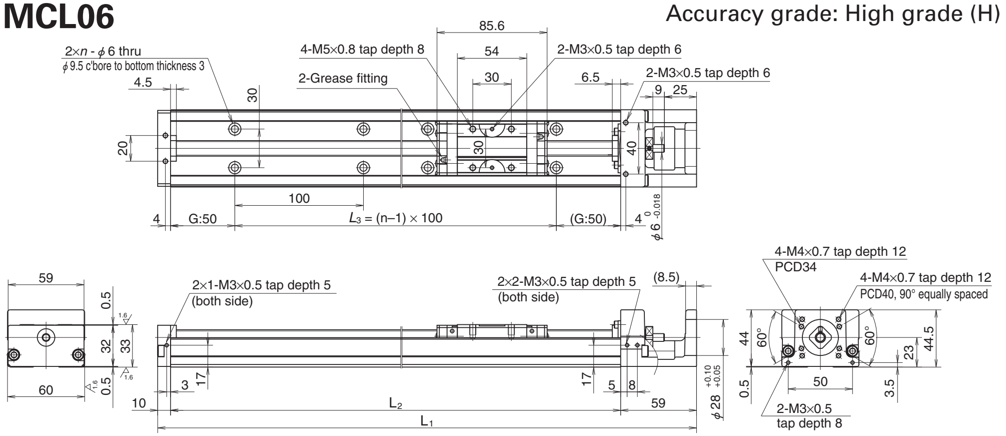
Reference No. code	Model No.		
	MCH06 (MCL06)	MCH09	MCH10
0	N/A	N/A	N/A
1	**MC-BKH06-145-00**	**MC-BKH09-145-00**	**MC-BKH10-170-00**
2	**MC-BKH06-146-00**	**MC-BKH09-146-00**	**MC-BKH10-170-01**
3	**MC-BKH06-231-00**	**MC-BKH09-170-00**	**MC-BKH10-190-00**
4	**MC-BKH06-250-00**	**MC-BKH09-170-01**	**MC-BKH10-190-01**
5	—	**MC-BKH09-231-00**	**MC-BKH10-250-00**
6	—	**MC-BKH09-250-00**	**MC-BKH10-270-00**

N/A: Not applicable

C-3-2 MCH Series Dimension Table of Standard Products

MCL06

Accuracy grade: High grade (H)



- ●Rail of MCL 06 is made lighter than that of MCH 06 by lowering rail height. Weight ratio between MCH 06 and MCL 06 is 5 to 4.
- ●Double slider specification is also available for MCL 06.
- ●Combinations of stroke and ball screw lead of MCL 06 are the same as those of MCH 06.

Dimension of MCL06 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)				Inertia x 10^{-6}(kg · m^2)	Mass (kg)
				L_1	L_2	L_3	n		
◇**MCL06005H05K**	50	53	5	219	150	100	2	2.38	1.0
◇**MCL06005H10K**		(65)	10					3.45	
MCL06010H05K	100	103	5	269	200	100	2	3.17	1.3
MCL06010H10K		(115)	10					4.12	
MCL06020H05K	200	203	5	369	300	200	3	4.51	1.9
MCL06020H10K		(215)	10					5.46	
MCL06030H10K	300	303	10	469	400	300	4	6.80	2.6
MCL06030H20K		(315)	20					10.6	
MCL06040H10K	400	403	10	569	500	400	5	8.13	3.2
MCL06040H20K		(415)	20					11.9	
MCL06050H10K	500	503	10	669	600	500	6	9.47	3.9
MCL06050H20K		(515)	20					13.3	

Note: Dimension G is 25 for items 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 dynamic torque in 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

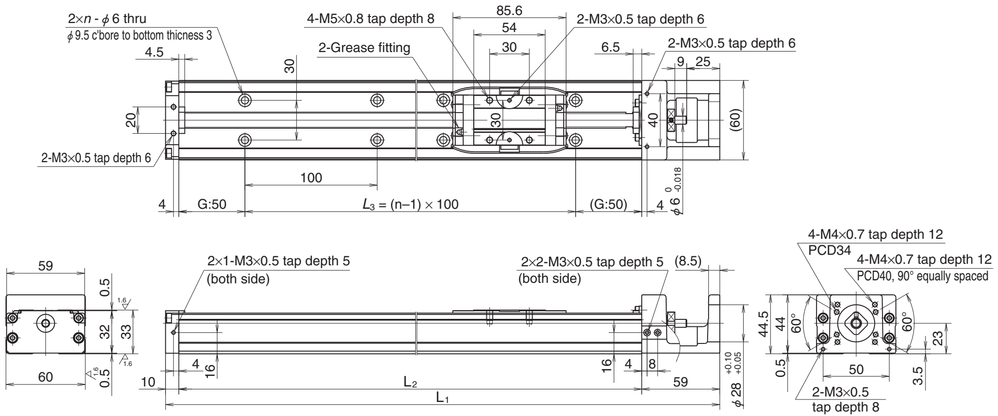
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
		Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
5	ϕ12	3 000 (High grade) 3 760 (Precision)	22 800	4 400	5	5 410 (High grade) 6 310 (Precision)	10 900	1 450
10		1 930 (High grade) 2 260 (Precision)	18 100		10	3 160 (High grade) 3 780 (Precision)		
20		1 930 (High grade) 2 260 (Precision)	14 400		20	3 160 (High grade) 3 780 (Precision)		

Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	335	133	133

MCH06

Accuracy grade: High grade (H)



Dimension of MCH06 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)				Inertia × 10^{-6}(kg · m^2)	Mass (kg)
				L_1	L_2	L_3	n		
◇**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	

Note: Dimension G is 25 for items 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 dynamic torque in 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

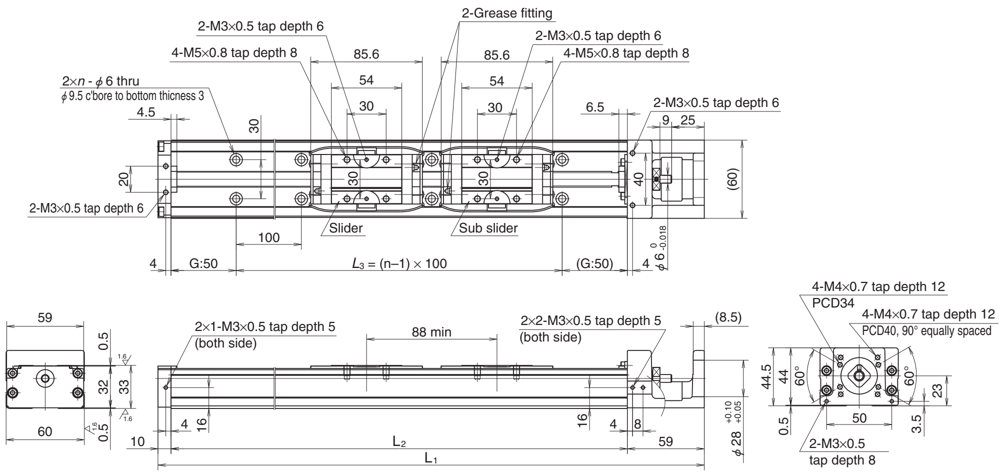
Lead	Shaft dia	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
ℓ (mm)	*d* (mm)	Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
5	ϕ12	3 000 (High grade) 3 760 (Precision)	22 800	4 400	5	5 410 (High grade) 6 310 (Precision)	16 300	1 450
10		1 930 (High grade) 2 260 (Precision)	18 100		10	3 160 (High grade) 3 780 (Precision)		
20		1 930 (High grade) 2 260 (Precision)	14 400		20	3 160 (High grade) 3 780 (Precision)		

Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	335	133	133

MCH06 (Double slider)

Accuracy grade: High grade (H)



Dimension of MCH06 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)				Inertia × 10^{-6}(kg · m^2)	Mass (kg)
				L_1	L_2	L_3	n		
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	

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	5	1.2 – 5.2
	10	1.5 – 9.6
	20	2.3 – 11.8

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in 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

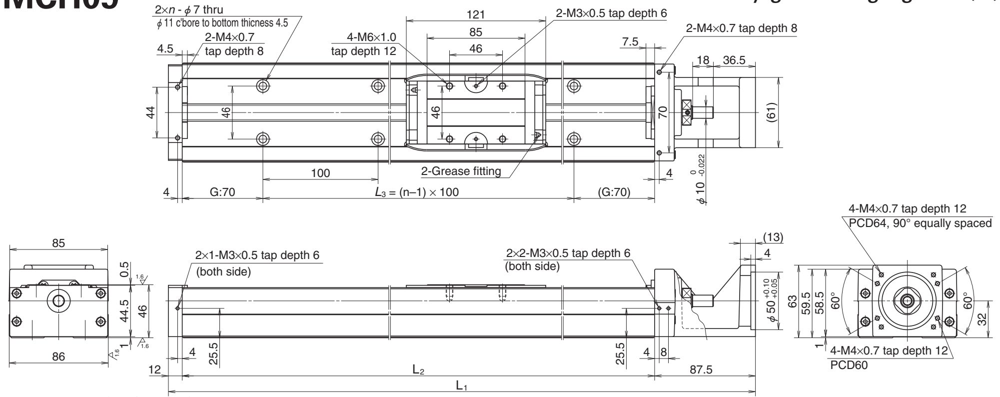
Lead	Shaft dia	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
ℓ (mm)	*d* (mm)	Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
5	ϕ12	3 000 (High grade) 3 760 (Precision)	22 800	4 400	5	5 410 (High grade) 6 310 (Precision)	16 300	1 450
10		1 930 (High grade) 2 260 (Precision)	18 100		10	3 160 (High grade) 3 780 (Precision)		
20		1 930 (High grade) 2 260 (Precision)	14 400		20	3 160 (High grade) 3 780 (Precision)		

Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	770	730	730

MCH09

Accuracy grade: High grade (H)



Dimension of MCH09 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)				Inertia $\times 10^{-6}$(kg · m^2)	Mass (kg)
				L_1	L_2	L_3	n		
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	

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 dynamic torque in 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

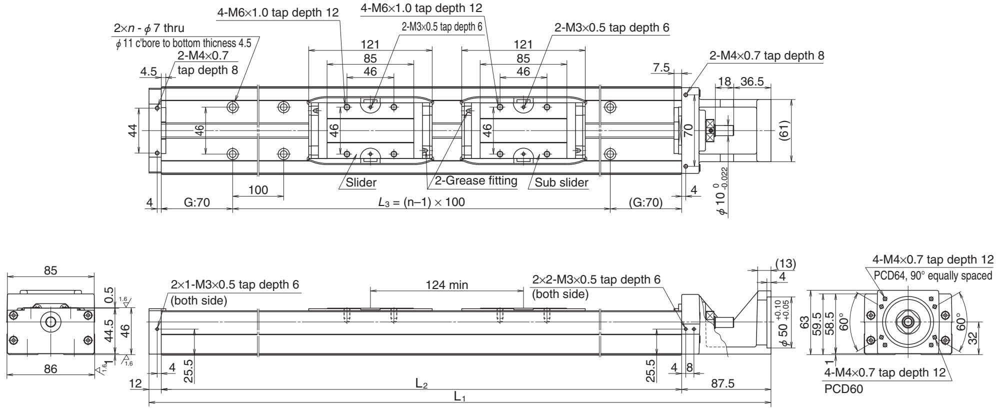
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
		Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
5	ϕ 15	6 820 (High grade) 7 100 (Precision)	40 600	7 100	5	13 200 (High grade) 13 000 (Precision)	30 500	3 040
10		5 110 (High grade) 7 060 (Precision)	32 200		10	9 290 (High grade) 12 700 (Precision)		
20		3 290 (High grade) 4 560 (Precision)	25 500		20	5 620 (High grade) 7 750 (Precision)		

Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	890	385	385

MCH09 (Double slider)

Accuracy grade: High grade (H)



Dimension of MCH09 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)				Inertia $\times 10^{-6}$(kg · m^2)	Mass (kg)
				L_1	L_2	L_3	n		
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	

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 dynamic torque in 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

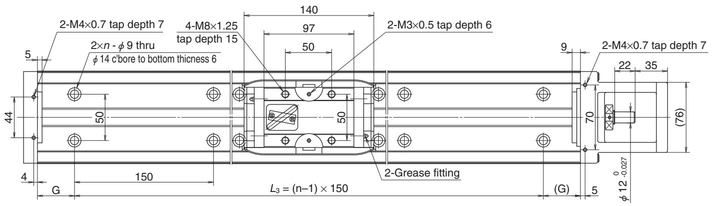
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
		Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
5	ϕ 15	6 820 (High grade) 7 100 (Precision)	40 600	7 100	5	13 200 (High grade) 13 000 (Precision)	30 500	3 040
10		5 110 (High grade) 7 060 (Precision)	32 200		10	9 290 (High grade) 12 700 (Precision)		
20		3 290 (High grade) 4 560 (Precision)	25 500		20	5 620 (High grade) 7 750 (Precision)		

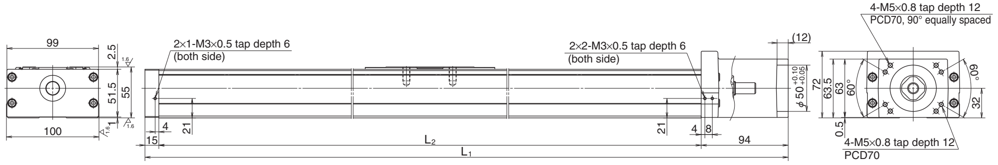
Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	1 780	2 070	2 070

MCH10

Accuracy grade: High grade (H)





Dimension of MCH10 (Single slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)					Inertia × 10^{-6}(kg · m^2)	Mass (kg)
				*L*1	*L*2	*G*	*L*3	*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	

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	10	2.7 – 10.8
	20	3.1 – 12.7

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in 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

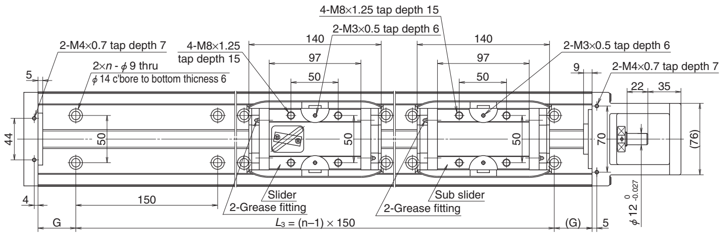
Lead	Shaft dia	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
ℓ (mm)	*d* (mm)	Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
10	ϕ 20	8 230 (High grade) 10 900 (Precision)	44 600	7 600	10	17 100 (High grade) 21 700 (Precision)	42 000	3 380
20		5 300 (High grade) 7 060 (Precision)	35 400		20	10 300 (High grade) 12 700 (Precision)		

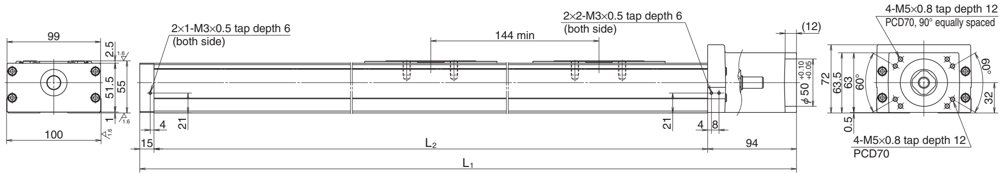
Basic static moment load of linear guide

Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	1 460	610	610

MCH10 (Double slider)

Accuracy grade: High grade (H)





Dimension of MCH10 (Double slider)

Reference No.	Nominal stroke (mm)	Stroke limit (mm) (without K1)	Ball screw lead (mm)	Body length (mm)					Inertia × 10^{-6}(kg · m^2)	Mass (kg)
				*L*1	*L*2	*G*	*L*3	*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

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	10	4.2 – 15.6
	20	5.0 – 19.6

Notes:
1. Frictional resistance of NSK K1 is included in dynamic torque in 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	Shaft dia	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
ℓ (mm)	*d* (mm)	Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
10	ϕ 20	8 230 (High grade) 10 900 (Precision)	44 600	7 600	10	17 100 (High grade) 21 700 (Precision)	42 000	3 380
20		5 300 (High grade) 7 060 (Precision)	35 400		20	10 300 (High grade) 12 700 (Precision)		

Basic static moment load of linear guide

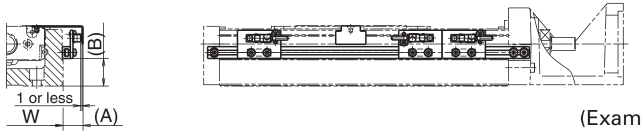
Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	2 920	3 430	3 430

C-3-3 MCH Series Option Part

C-3-3. 1 Sensor Unit

●Proximity switch

Sensor rail is not included in a sensor unit.



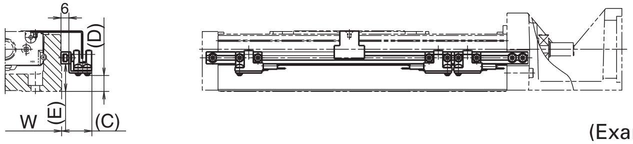
(Example of assembly)

Model No.		Reference No.			A (mm)	B (mm)	Body width W (mm)
MCH06		MC-SRH06-10	MC-SRH06-11	MC-SRH06-12	17	10	60
MCH09		MC-SRH09-10	MC-SRH09-11	MC-SRH09-12	16	21	86
MCH10		MC-SRH10-10	MC-SRH10-11	MC-SRH10-12	16	16	100
Quantity	Proximity switch (normally open contact)	—	3	1	E2S-W13 (OMRON Corp.)		
	Proximity switch (normally close contact)	3	—	2	E2S-W14 (OMRON Corp.)		

Notes: 1. See page C21 for proximity switch specifications. 2. A sensor unit consists of sensors, a sensor dog and sensor mounting parts.

●Photo sensor

Sensor rail is not included in a sensor unit.



(Example of assembly)

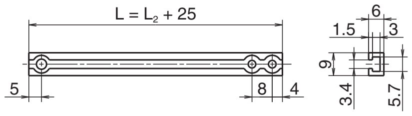
Model No.	Reference No.	C (mm)	D (mm)	E (mm)	Body width W (mm)	Remarks
MCH06	MC-SRH06-13	24	2	11	60	EE-SX674 (OMRON Corp.) 3 sets (EE-1001 connector attachment)
MCH09	MC-SRH09-13	23	12	21	86	
MCH10	MC-SRH10-13	23	29	16	100	

Notes: 1. See page C22 for proximity switch specifications. 2. A sensor unit consists of sensors, a sensor dog and sensor mounting parts.

(1) Sensor rail

Reference number: MC-SRL- * * * *

● * * * * is the same as rail dimension L_2.



Note: For combinations of sensors and rails, see page C80.

Body of MCH Series and Sensor Rail Combination Table

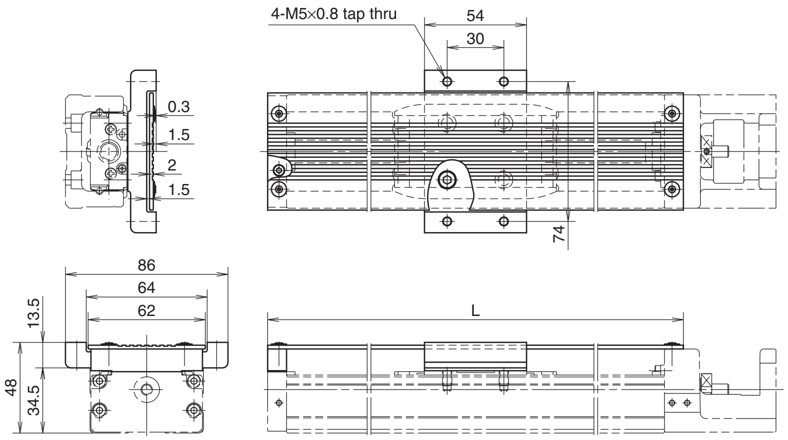
Table 4

Model No.	Body length L_2 (mm)	Reference No.	Sensor rail reference No.
MCH06	150	MCH06005H05K MCH06005H10K MCH06005H20K	MC-SRL-0150
	200	MCH06010H05K MCH06010H10K MCH06010H20K	MC-SRL-0200
	300	MCH06020H05K MCH06020H10K MCH06020H20K MCH06010H05D MCH06010H10D	MC-SRL-0300
	400	MCH06030H05K MCH06030H10K MCH06030H20K MCH06020H05D MCH06020H10D	MC-SRL-0400
	500	MCH06040H05K MCH06040H10K MCH06040H20K MCH06030H05D MCH06030H10D	MC-SRL-0500
	600	MCH06050H05K MCH06050H10K MCH06050H20K MCH06040H10D MCH06040H20D	MC-SRL-0600
MCL06	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

Model No.	Body length L_2 (mm)	Reference No.	Sensor rail reference No.
MCH09	840	MCH09070H05K MCH09070H10K MCH09070H20K	MC-SRL-0840
	940	MCH09080H05K MCH09080H10K MCH09080H20K MCH09065H10D MCH09065H20D	MC-SRL-0940
MCH10	280	MCH10010H10K MCH10010H20K	MC-SRL-0280
	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
	1 080	MCH10090H10K MCH10090H20K MCH10075H20D	MC-SRL-1080
	1 180	MCH10100H10K MCH10100H20K MCH10085H20D	MC-SRL-1180
	1 280	MCH10110H10K MCH10110H20K MCH10095H20D	MC-SRL-1280
	1 380	MCH10120H10K MCH10120H20K MCH10105H20D	MC-SRL-1380

C-3-3. 2 Cover Unit

Cover unit for MCH06 and MCL06

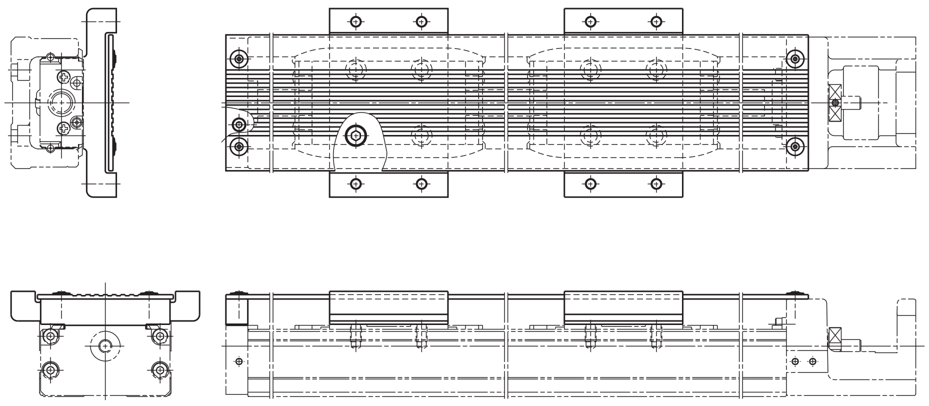


Unit: mm

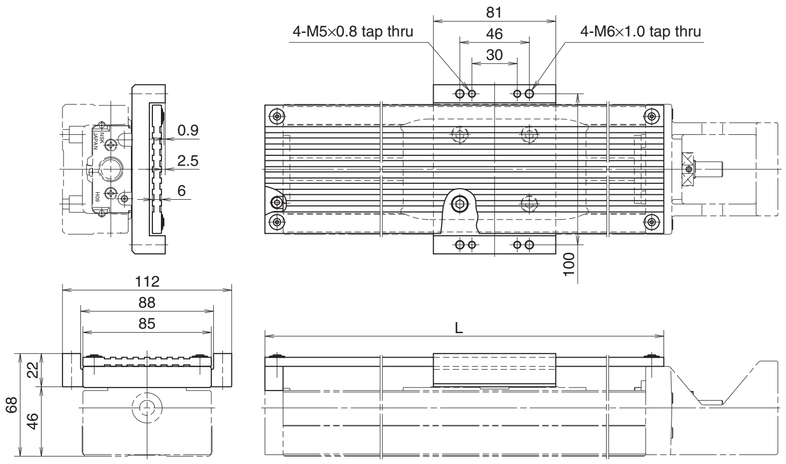
Single slider		Double slider		Top cover length
Stroke	Reference No.	Stroke	Reference No.	*L*
50	MC-HV06005-00	–	–	170
100	MC-HV06010-00	–	–	220
200	MC-HV06020-00	100	MC-HV06010D00	320
300	MC-HV06030-00	200	MC-HV06020D00	420
400	MC-HV06040-00	300	MC-HV06030D00	520
500	MC-HV06050-00	400	MC-HV06040D00	620

●Cover unit for double sliders

Two spacers are provided for double slider.



Cover unit for MCH09

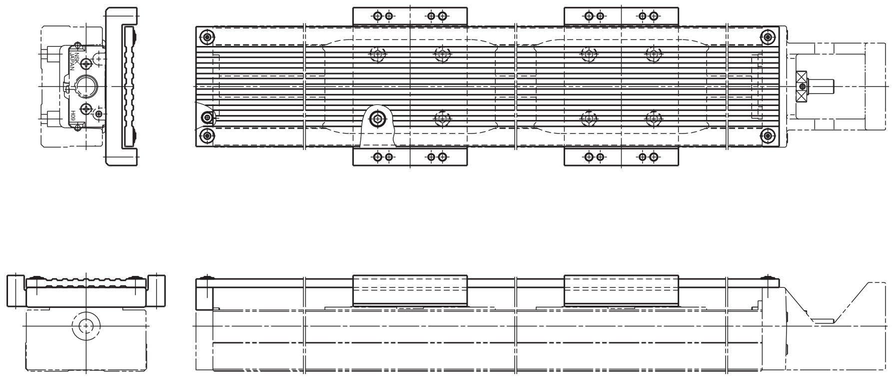


Unit: mm

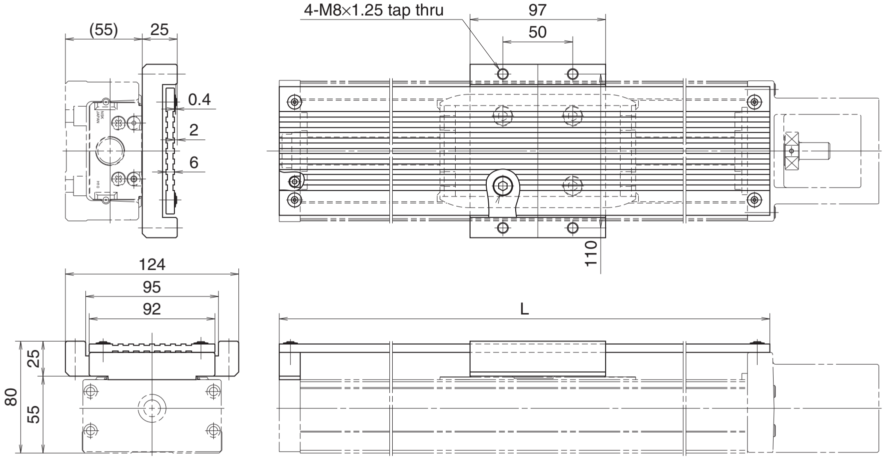
Single slider		Double slider		Top cover length
Stroke	Reference No.	Stroke	Reference No.	*L*
100	MC-HV09010-00	–	–	264
200	MC-HV09020-00	–	–	364
300	MC-HV09030-00	150	MC-HV09015D00	464
400	MC-HV09040-00	250	MC-HV09025D00	564
500	MC-HV09050-00	350	MC-HV09035D00	664
600	MC-HV09060-00	450	MC-HV09045D00	764
700	MC-HV09070-00	–	–	864
800	MC-HV09080-00	650	MC-HV09065D00	964

●Cover unit for double sliders

Two spacers are provided for double slider.



Cover unit for MCH10

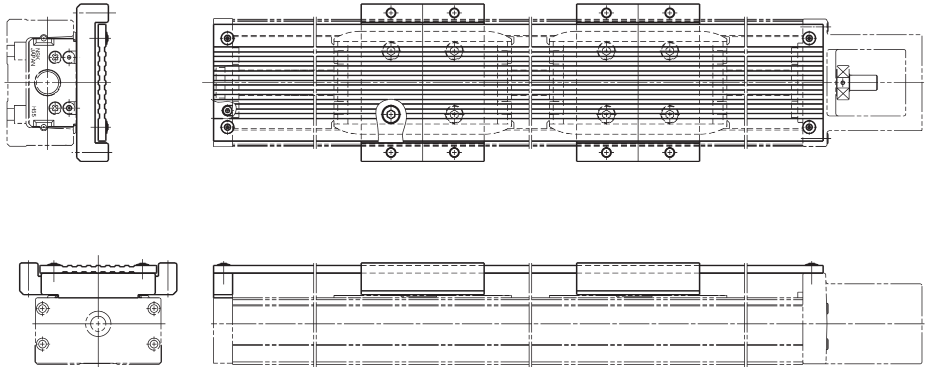


Unit: mm

Single slider		Double slider		Top cover length
Stroke	Reference No.	Stroke	Reference No.	*L*
100	MC-HV10010-00	–	–	310
200	MC-HV10020-00	–	–	410
300	MC-HV10030-00	–	–	510
400	MC-HV10040-00	250	MC-HV10025D00	610
500	MC-HV10050-00	350	MC-HV10035D00	710
600	MC-HV10060-00	450	MC-HV10045D00	810
700	MC-HV10070-00	550	MC-HV10055D00	910
800	MC-HV10080-00	650	MC-HV10065D00	1 010
900	MC-HV10090-00	750	MC-HV10075D00	1 110
1000	MC-HV10100-00	850	MC-HV10085D00	1 210
1100	MC-HV10110-00	950	MC-HV10095D00	1 310
1200	MC-HV10120-00	1050	MC-HV10105D00	1 410

●Cover unit for double sliders

Two spacers are provided for double slider.

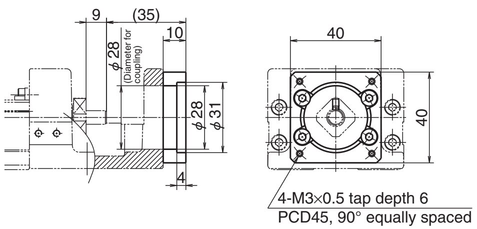


C-3-3. 3 Intermediate Plate for Motor

- ●Please ask NSK about motors not listed in compatible motor list.
- ●In case of parallel motor mount, please consult with NSK. ●Be sure to align centerlines when installing motor.
- ●Motor models are subject to change at the motor manufacturers. For details, please contact the manufacturer.

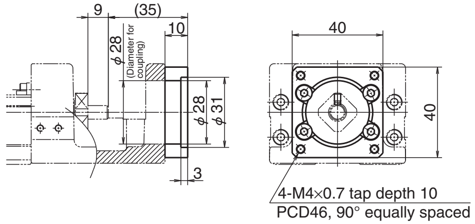
Motor Bracket for MCH06 and MCL06

Reference number: MC-BKH06-145-00



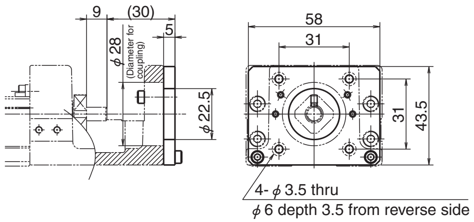
Compatible motor	
Maker	Motor models
Panasonic Co., Ltd.	MSMD5A(50W), MSMD01(100W)

Reference number: MC-BKH06-146-00



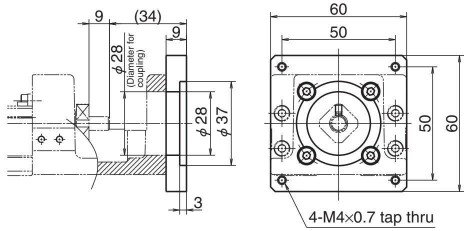
Compatible motor	
Maker	Motor models
Yaskawa Electric Corp.	SGMAH-A3(30W), SGMJV-A5A(50W), SGMAV-A5A(50W) SGMJV-01A(100W), SGMAV-01A(100W)
Mitsubishi Electric Corp.	HF-KP053(50W), HF-MP053(50W), HC-KFS053(50W) HC-MFS053(50W), HF-KP13(100W), HF-MP13(100W) HC-KFS13(100W), HC-MFS13(100W)
OMRON Corp.	R88M-W03(30W), R88M-W05(50W), R88M-W10(100W)
Sanyo Denki Co., Ltd.	P30B04xxx P Series

Reference number: MC-BKH06-231-00



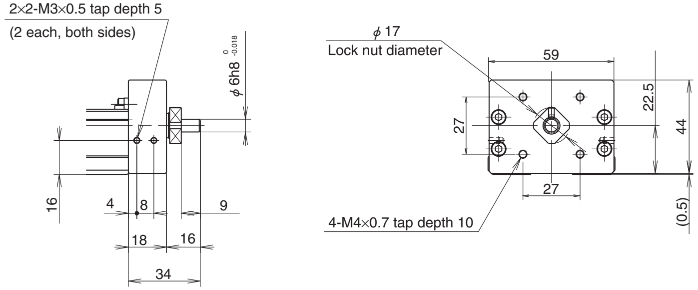
Compatible motor	
Maker	Motor models
Oriental Motor Co., Ltd.	AS46, ASC46, UPK54x, PK54x, CSK54x, CFK54x, UMK24x, CSK24x, PK24x
Sanyo Denki Co., Ltd.	PBM423xxx, 103F55xx

Reference number: MC-BKH06-250-00



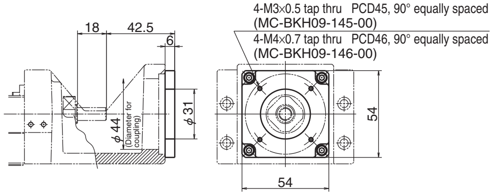
Compatible motor	
Maker	Motor models
Oriental Motor Co., Ltd.	AS66, ASC66, UPK56x, UFK56x, PK56x, CSK56x, CFK56x
OMRON Corp.	MUMS02(200W), MUMS04(400W)
Sanyo Denki Co., Ltd.	PBM603xx, PBM604xx, 103F78xx

Diameter of ball screw shaft end to install a pulley for parallel motor mount of MCH06



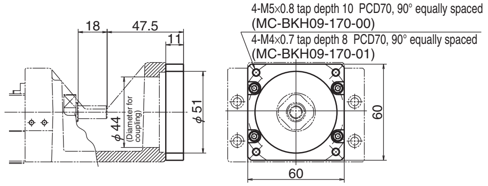
Motor Bracket for MCH09

Reference number: MC-BKH09-145-00
MC-BKH09-146-00



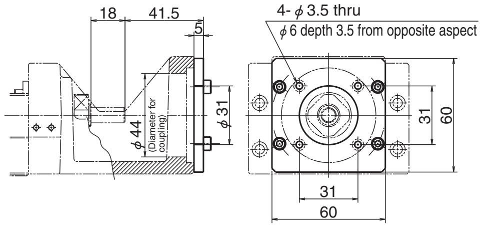
Reference No.	Compatible motor	
	Maker	Motor models
MC-BKH09-145-00	Panasonic Co., Ltd.	MSMD5A(50W), MSMD01(100W)
MC-BKH09-146-00	Yaskawa Electric Corp.	SGMJV-A5A(50W), SGMAV-A5A(50W) SGMJV-01A(100W), SGMAV-01A(100W)
	Mitsubishi Electric Corp.	HF-KP053(50W), HF-MP05(50W), HC-KFS053(50W) HC-MFS053(50W), HF-KP13(100W), HF-MP13(100W) HC-KFS13(100W), HC-MFS13(100W)
	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



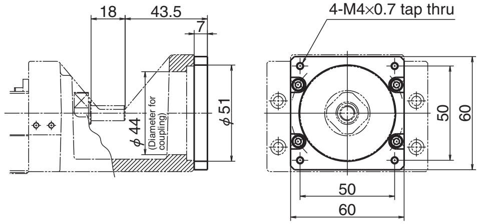
Reference No.	Compatible motor	
	Maker	Motor models
MC-BKH09-170-00	Yaskawa Electric Corp.	SGMJV-02A(200W), SGMAV-02A(200W) SGMJV-04A(400W), SGMAV-04A(400W)
	Mitsubishi Electric Corp.	HF-KP23(200W), HF-MP23(200W), HF-KP43(400W) HF-MP43(400W), HC-KFS23(200W), HC-MFS23(200W) HC-KFS43(400W), HC-MFS43(400W)
	OMRON Corp.	R88M-W20(200W), R88M-W40(400W)
	Sanyo Denki Co., Ltd.	P30B06xxx P Series
MC-BKH09-170-01	Panasonic Co., Ltd.	MSMD02(200W), MSMA02(200W) MSMA04(400W), MSMD04(400W)

Reference number: MC-BKH09-231-00



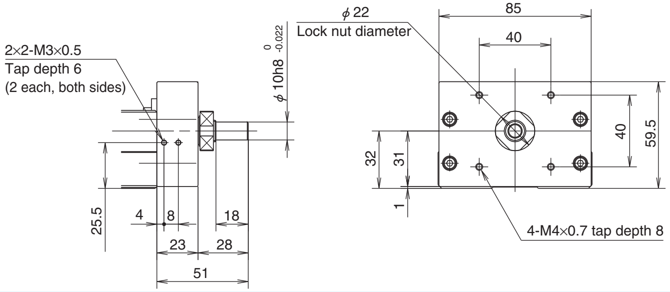
Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	PBM423xxx, 103F55xx
Oriental Motor Co., Ltd.	AS46, ASC46, UPK54x, PK54x, CSK54x, CFK54x UMK24x, CSK24x, PK24x

Reference number: MC-BKH09-250-00



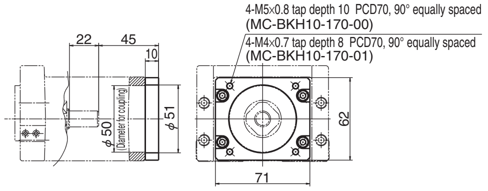
Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	PBM603xx, PBM604xx, 103F78xx
Oriental Motor Co., Ltd.	AS66, ASC66, UPK56x, UFK56x, PK56x CSK56x, CFK56x

Diameter of ball screw shaft end to install a pulley for parallel motor mount of MCH09



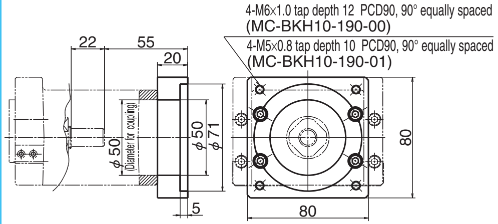
Motor Bracket for MCH10

Reference number: MC-BKH10-170-00
MC-BKH10-170-01



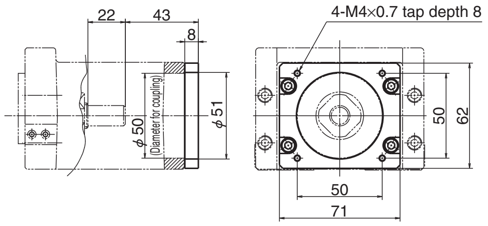
Reference No.	Compatible motor	
	Maker	Motor models
MC-BKH10-170-00	Yaskawa Electric Corp.	SGMJV-02A(200W), SGMAV-02A(200W) SGMJV-04A(400W), SGMAV-04A(400W)
	Mitsubishi Electric Corp.	HF-KP23(200W), HF-MP23(200W), HF-KP43(400W) HF-MP43(400W), HC-KFS23(200W), HC-MFS23(200W) HC-KFS43(400W), HC-MFS43(400W)
	OMRON Corp.	R88M-W20(200W), R88M-W40(400W)
	Sanyo Denki Co., Ltd.	P30B06xxx P Series
MC-BKH10-170-01	Panasonic Co., Ltd.	MSMD02(200W), MSMA02(200W) MSMD04(400W), MSMA04(400W)

Reference number: MC-BKH10-190-00
MC-BKH10-190-01



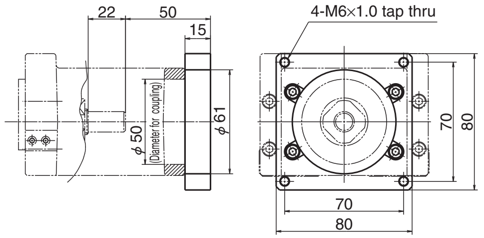
Reference No.	Compatible motor	
	Maker	Motor models
MC-BKH10-190-00	Mitsubishi Electric Corp.	HC-KFS73(750W), HC-MFS73(750W) HF-KP73(750W), HF-MP73(750W)
MC-BKH10-190-01	Sanyo Denki Co., Ltd.	P50B07xxx P Series

Reference number: MC-BKH10-250-00



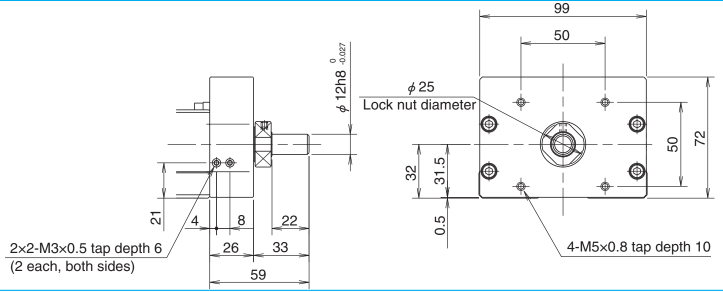
Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	PBM603xx, PBM604xx, 103F78xx
Oriental Motor Co., Ltd.	AS66, ASC66, UPK56x, PK56x, CSK56x, CFK56x UMK56x, UFK56X

Reference number: MC-BKH10-270-00



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 parallel motor mount of MCH10



Motor Availability Table of Intermediate Plate for MCH Series
Table 5

Model No.	Reference No. code	Motor bracket reference No.	Motor manufacturer	Stepping motor model No.	Wattage of AC servo motor					
					30	50	100	200	400	750
MCH06 MCL06	1	MC-BKH06-145-00	Panasonic Co., Ltd.			MSMD5A	MSMD01			
	2	MC-BKH06-146-00	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.		R88M-W03	R88M-W05	R88M-W10			
			Sanyo Denki Co., Ltd.	P30B04xxx (P Series)						
	3	MC-BKH06-231-00	Sanyo Denki Co., Ltd.	PBM423xxx 103F55xx						
			Oriental Motor Co., Ltd.	AS46 , ASC46 UPK54x , PK54x CSK54x , CFK54x UMK24x , CSK24x PK24x						
	4	MC-BKH06-250-00	Sanyo Denki Co., Ltd.	PBM603xx PBM604xx 103F78xx						
			Oriental Motor Co., Ltd.	AS66 , ASC66 UPK56x , UFK56x PK56x , CSK56x CFK56x						
			OMRON Corp.					MUMS02	MUMS04	
MCH09	1	MC-BKH09-145-00	Panasonic Co., Ltd.			MSMD5A	MSMD01			
	2	MC-BKH09-146-00	Yaskawa Electric Corp.			SGMJV-A5A SGMAV-A5A	SGMJV-01A SGMAV-01A			
			Mitsubishi Electric Corp.			HF-KP053 HF-MP05 HC-KFS053 HC-MFS053	HF-KP13 HF-MP13 HC-KFS13 HC-MFS13			
			OMRON Corp.			R88M-W05	R88M-W10			
			Sanyo Denki Co., Ltd.	P30B04xxx (P Series)						
	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.					R88M-W20	R88M-W40	
			Sanyo Denki Co., Ltd.	P30B06xxx (P Series)						
	4	MC-BKH09-170-01	Panasonic Co., Ltd.					MSMD02 MSMA02	MSMD04 MSMA04	
	5	MC-BKH09-231-00	Sanyo Denki Co., Ltd.	PBM423xxx 103F55xx						
			Oriental Motor Co., Ltd.	AS46 , ASC46 UPK54x , PK54x CSK54x , CFK54x UMK24x , CSK24x PK24x						
	6	MC-BKH09-250-00	Sanyo Denki Co., Ltd.	PBM603xx PBM604xx 103F78xx						
			Oriental Motor Co., Ltd.	AS66 , ASC66 UPK56x , UFK56x PK56x , CSK56x CFK56x						
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.					R88M-W20	R88M-W40	
			Sanyo Denki Co., Ltd.	P30B06xxx (P Series)						
	2	MC-BKH10-170-01	Panasonic Co., Ltd.					MSMD02 MSMA02	MSMD04 MSMA04	
	3	MC-BKH10-190-00	Mitsubishi Electric Corp.							HC-KFS73 HC-MFS73 HF-KP73 HF-MP73
	4	MC-BKH10-190-01	Sanyo Denki Co., Ltd.	P50B07xxx (P Series)						
	5	MC-BKH10-250-00	Sanyo Denki Co., Ltd.	PBM603xx PBM604xx 103F78xx						
			Oriental Motor Co., Ltd.	AS66 , ASC66 UPK56x , PK56x CSK56x , CFK56x UMK56x , UFK56x						
	6	MC-BKH10-270-00	Oriental Motor Co., Ltd.	AS98 , ASC98 UPK59x , PK59x CSK59x , CFK59x UMK59x , UFK59x						

MEMO

Other

Other

1 Special Environments

1.1 Specifications for Special Environments

1. Linear guide

Table 1.1 Linear guide specifications

Environment	Condition	NSK linear guide specifications				Technical Explanation Page No.
		Rail, slide	Steel balls/rollers	Ball recirculation component	Lubrication/surface treatment	
Clean	Atmosphere, normal temperature	Standard material	Standard material	Standard material	LG2, LGU Grease	D8
					NSK K1 lubrication unit	D10
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	LG2, LGU Grease	D8
					NSK K1 lubrication unit	D10
					Fluoride low temperature chrome plating	D5
	Atmosphere-Vacuum, normal temperature				Fluoride grease	
	Atmosphere-Vacuum up to 200°C					
Vacuum	Atmosphere-Vacuum, normal temperature	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Fluoride grease	
	Atmosphere-Vacuum up to 200°C					
	Atmosphere-Vacuum up to 300°C				Molybdenum disulfide	
	High vacuum up to 500°C				Special silver film	D7
Corrosion resistance	Vapor, steam	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		
		Standard material	Standard material	Standard material	Fluoride low temperature chrome plating	D5
	Acid, alkali			Austenitic stainless steel		D5
		Martensitic stainless steel	Martensitic stainless steel			D5
	Acid, alkali, clean				Fluoride low temperature chrome plating	D5
					LG2, LGU Grease	D8
	Strong acid, strong alkali				Fluoride low temperature chrome plating	D5
					Fluoride grease	
	Organic solvent				Fluoride grease	
High temperature	Atmosphere up to 150°C	Standard material	Standard material	Austenitic stainless steel	ET150 Grease	
		Martensitic stainless steel	Martensitic stainless steel			
	Atmosphere up to 200°C				Fluoride grease	
	Atmosphere up to 200°C, Corrosion resistant				Fluoride grease	
Low temperature	-273°C and higher	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Solid lubricant	
Radiation resistance	Atmosphere	Standard material	Standard material	Standard material	Radiation resistant grease	
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		
Foreign matters	Fine particles, wooden chips	Standard material	Standard material	Standard material	NSK K1 lubrication unit	D10
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel		D10
	Water, under water		Standard material	Standard material		D10
			Martensitic stainless steel	Austenitic stainless steel		D10

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, LGU Grease	D8
					NSK K1 lubrication unit	D10
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	LG2, LGU Grease	D8
					NSK K1 lubrication unit	D10
					Fluoride low temperature chrome plating	D5
	Atmosphere-Vacuum, normal temperature				Fluoride grease	
	Atmosphere-Vacuum up to 200°C					
	Atmosphere-Vacuum up to 200°C, Corrosion resistant	Ceramic	Ceramic	Ceramic	Fluoride grease	
Vacuum	Atmosphere-Vacuum, normal temperature	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Fluoride grease	
	Atmosphere-Vacuum up to 200°C					
	Atmosphere-Vacuum up to 300°C				Molybdenum disulfide	
	High vacuum up to 500°C				Special silver film	D7
Corrosion resistance	Acid, alkali, clean	Standard material	Standard material	Austenitic stainless steel	Fluoride low temperature chrome plating	D5
		Martensitic stainless steel	Martensitic stainless steel			D5
		Precipitation hardening stainless steel	Precipitation hardening stainless steel		Fluoride grease	
	Strong acid, strong alkali, clean, nonmagnetic	Ceramic	Ceramic			
Nonmagnetic	Atmosphere-Vacuum, clean	Special austenitic stainless steel	Ceramic	Austenitic stainless steel	Fluoride grease	
	Atmosphere-Vacuum, up to 200°C, clean	Ceramic			Fluoroplastic	
High temperature	Atmosphere up to 200°C	Standard material	Standard material	Austenitic stainless steel	Fluoride grease	
	Atmosphere up to 200°C	Martensitic stainless steel	Martensitic stainless steel		Fluoride low temperature chrome plating	D5
	Atmosphere up to 500°C, corrosion resistance	Ceramic	Ceramic		Fluoride grease	
Low temperature	-273°C and higher	Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	Solid lubricant	
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.

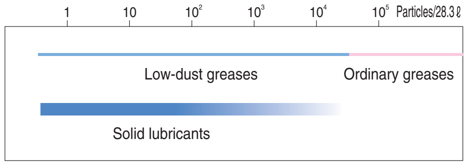


Fig. 2.1 Lubrication in clean environment

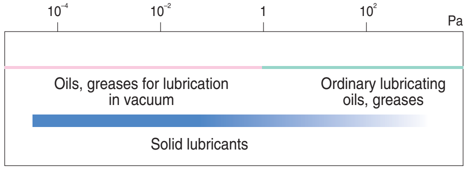


Fig. 2.2 Lubrication in vacuum

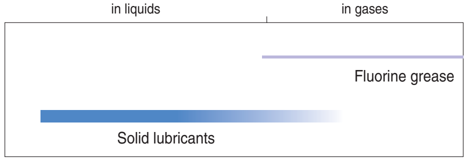


Fig. 2.3 Lubrication in corrosive environment

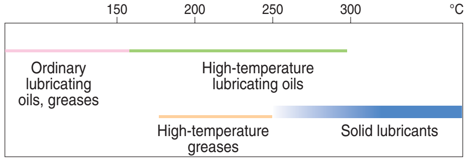


Fig. 2.4 Lubrication in high temperature

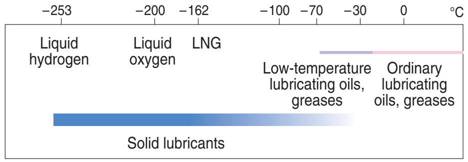


Fig. 2.5 Lubrication in low temperature

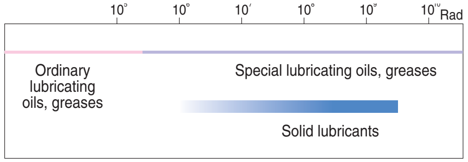


Fig. 2.6 Lubrication in radioactive environment

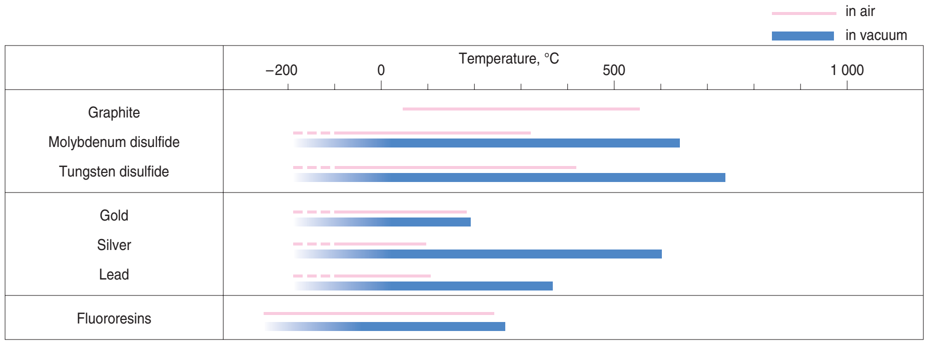


Fig. 2.7 Temperature range for using solid lubricants

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 ×10⁻⁶/°C	Young's modulus GPa	Hardness* HB
For clean environment, vacuum environment, corrosion resistance, low temperature, high temperature, radioactive resistance	Martensitic stainless steel SUS440C	10.1	200	580
	Austenitic stainless steel SUS304	16.3	193	150
	Precipitation hardening stainless steel SUS630	10.8	200	277 – 363
Nonmagnetic	Nonmagnetic stainless steel	17.0	195	420

*) Hardness of steel is usually indicated by Rockwell C Scale. For comparison, these figures are expressed by Brinell number.

1.3 Rust Prevention and Surface Treatment

1. Fluoride low temperature chrome plating

The use environment of NSK linear guides ball screws, and monocarriers is expanding from general industrial machines, semiconductor and liquid crystal manufacturing systems to aerospace equipment.

Among all measures to cope with environment, rust prevention is the most challenging. Such environment includes:

- Moisture for washing machines and other equipment
- Chemicals used in the wet processing of semiconductor and liquid crystal display manufacturing equipment.

NSK has developed electrolytic rust prevention black film treatment (black chrome plating) which is added by 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 the above equipment.

● What is "Fluoride low temperature chrome plating?"

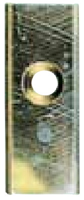
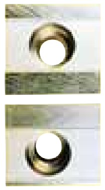
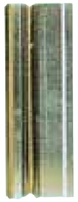
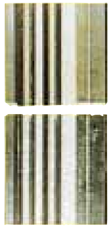
This is a type of black chrome plating which forms a black film (1 to 2 μm in thickness) on the metal surface. Fluoroplastic coating is added to the film to increase corrosion resistance.

- Accuracy control is easily manageable due to low temperature treatment and to the absence of hydrogen embrittlement.
- Product accuracy is less affected due to the thin film which has high corrosion resistance.
- This method is superior to other surface treatments in durability on the rolling surface.
- Inexpensive compared with products with other surface treatment and stainless steel products.

Do not use organic solvent because it adversely affects antirust property of the plating.

● Humidity chamber test

Table 3.1 Results of the humidity test

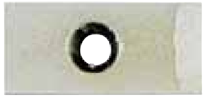
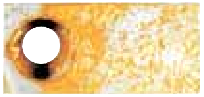
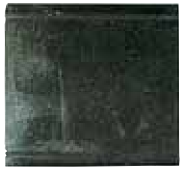
Test sample Characteristic			Fluoride low temperature chrome plating (recommended)	Hard chrome plating (reference)	Electroless nickel plating (reference)	Equivalent to SUS440C material	Standard steel
Corrosion-resistant property	Rusting	Top	(Ground) B	(Ground) B	(Ground) A	(Ground) C	(Ground) D
		Side	(Ground) A	(Ground) A	(Ground) A	(Ground) C	(Ground) E
		Bottom	(Ground) A	(Ground) A	(Ground) A	(Ground) C	(Ground) E
		End	(Machined) A	(Machined) C	(Machined) A	(Machined) C	(Machined) E
		Chamfer/grinding recess	(Drawn) A	(Drawn) D	(Drawn) A	(Drawn) C	(Drawn) E
	<Test conditions> ● Testing chamber: High temperature, highly moist chamber (made by DABAI ESPEC) ● Temperature: 70°C ● Relative humidity: 95% ● Testing time: 96 h Time to "ramp-up" and "ramp-down" condition of the temperature and the humidity conditions Ramp-up: 5 h Ramp-down: 2 h						
							
	Film thickness		5 μm	0.5 – 7 μm	10 μm	—	—

Rusting A: No rust B: Not rusted, but slightly discolored
C: Spotty rust D: slightly rusted E: Completely rusted

● Chemical corrosion resistance test

Table 3.2 Results of the corrosion resistance test

Test conditions Rail base material: Equivalent to SUS440C
Chemical density: 1 mol/ℓ

Fluoride low temperature chrome plating		Hard chrome plating	None surface treatment
	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_2O_2 : H_2O =1 : 1 : 8		
○	Hydrochloric acid (immersed)	○	▲
○	Sulfuric acid (immersed)	○	X
○	Ammonia or sodium hydroxide	○	△

○: Normal △: Partial surface damage ▲: Overall surface damage X: Corroded

● Surface treatment durability test

Peeling resistamce of surface treatment

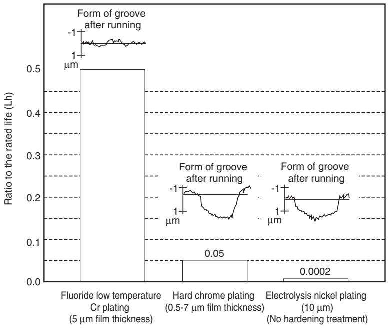


Fig. 3.1 Results of durability test

● Total evaluation

Table 3.3 Evaluation

	Available length	Rust prevention ability	Quality stability	Durability	Cost
Fluoride low temperature chrome plating	◎ (4 m)	◎	○	◎	◎
Hard chrome plating	△ (2 m)	○	X	△	△
Electroless nickel plating	◎ (4 m)	◎	△	X	△
Material equivalent to SUS440C	○ (3.5 m)	○	◎	◎	△

◎: Excellent ○: Suitable in use
△: Not so good for use X: Problem in use

1.4 Measures Against Special Environments

1. In vacuum

● Silver-film plated ball screw

Ball screws that are plated by soft metal (special silver film) as a solid lubricant are developed the application for vacuum environment such as semiconductor manufacturing equipment and surface modification systems.

● Durability test in high vacuum

Test equipment and conditions

Table 4.1 shows ball screw specifications. **Fig. 4.1** is a schematic of the testing system in vacuum chamber. **Table 4.2** shows testing conditions.

Table 4.1 Ball screw specifications

Shaft diameter		12 mm
Lead		4 mm
Steel ball diameter		2.381 mm
Numbers of circuit of balls		2.5 turns, 1 circuit
Axis load (preload)		29.4 N
Maximum surface pressure (preload volume)		about 690 MPa
Material	Shaft	SUS630
	Nut	SUS440C
	Ball return tube	SUS304
	Steel balls	SUS440C
Solid lubricant		Special silver film

Table 4.2 Testing conditions

Rotational speed	300 min^{-1}
Vacuum chamber pressure	1.3×10^{-5} – 1.3×10^{-6} Pa
Stroke	160 mm

Evaluation method

It is understood that the rolling bearing with solid lubrication reaches end of life when the lubrication film deteriorates, resulting in sudden rise of friction torque. In this test, ball screw rotation torque was constantly measured to study durability and operation. Results were then evaluated.

Test results

Fig. 4.2 shows two distinctive examples obtained in the torque characteristic test.

Photo 4.1 Vacuum testing system

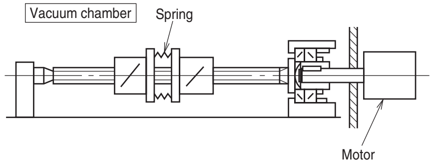


Fig. 4.1 Schematic of the testing system

Test results of the ball screw (a)

The torque tendency was stable until about 1×10^{7} rev. Then the torque characteristics slightly deteriorated. At about 1.35×10^{7} rev, the torque suddenly rose. At this point, it was determined that the ball screw reached the end of its life.

Test results of the ball screw (b)

Torque value is a little higher in the test (a). The value is also little unstable. The torque momentarily soared several times during the test (some 10 N·cm). It is thought this is attributable to the repeated peeling/sticking of the surface film made of soft metal (silver, etc.).

When the torque finally soared at 1.13×10^{7} rev., it was determined that the ball screw reached the end of its life.

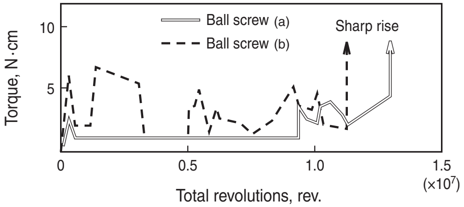


Fig. 4.2 Torque variation

Table 4.3 Ball screw durability

Classification		Ball screw (a)	Ball screw (b)
Life	Total revolutions (rev.)	1.35×10^{7}	1.13×10^{7}
	Total traveling distance (km)	54.0	45.2
	Total traveling hours* (h)	750	628

*) Total traveling hours when operated constantly at 300 min^{-1}

Conclusion

Table 4.3 explains results of the two ball screw durability tests.

From these results and other findings, it is estimated that a life of more than 1×10^{7} rev. is possible with a load of about 29.4 N.

Torque may soar momentarily before the ball screw reaches its final life due to peeling/sticking of the surface film made of soft metal like silver. For this reason, it is recommendable to select a drive motor with extra torque capacity.

2. Clean environment

● NSK Clean Grease LG2 and LGU

NSK Clean Grease LG2 is used in clean room for NSK linear guides, ball screws, Monocarriers, XY Modules, Megatorque 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 and LGU

Name	Thickener	Base oil	Base oil kinematic viscosity mm²/s (40°C)	Consistency	Dropping point °C
Clean Grease LG2	Lithium soap	Synthetic hydrocarbon oil + mineral oil	30	207	200
Clean Grease LGU	Diurea	Synthetic hydrocarbon oil	100	209	260

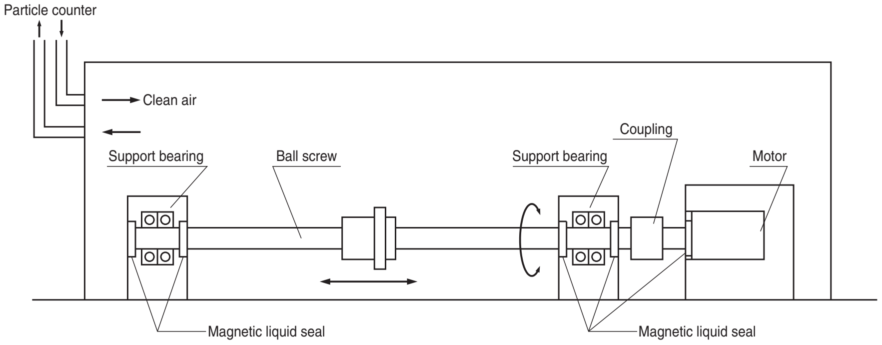


Fig. 4.3 Setting to measure dust generated by ball screw

● Feature 1: Remarkably low dust emission

Compared with fluoride greases, dust emission by LG2 is low and stable for long period of time.

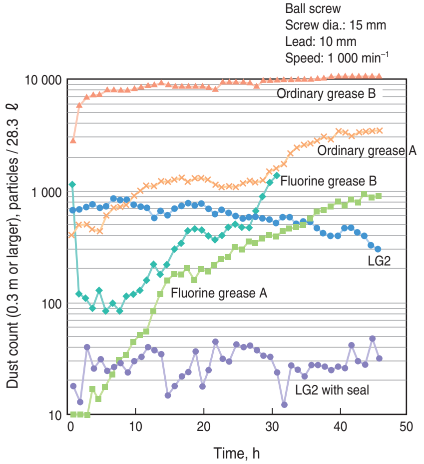


Fig. 4.4 Comparison in dust emission characteristics

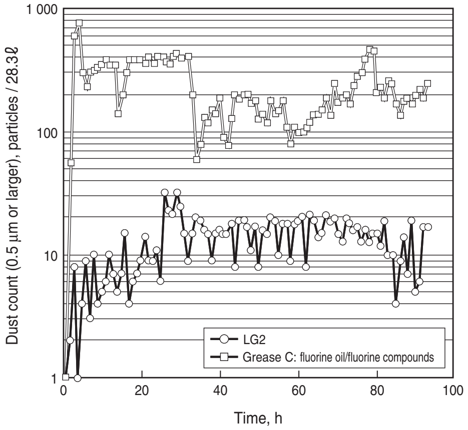


Fig. 4.5 Dust emission from linear guide (Linear guide: LU09)

● Feature 2: Long life

Life is ten times or longer than fluorine greases, and equivalent to ordinary greases. This stretches maintenance intervals.

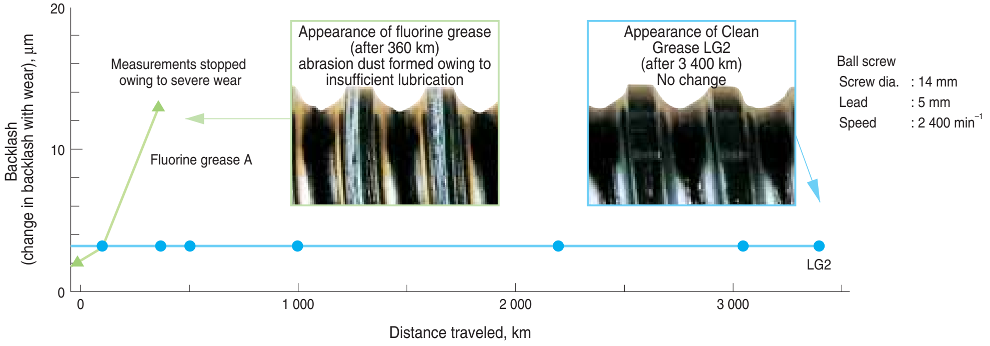


Fig. 4.6 Results of ball screw durability test

●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.

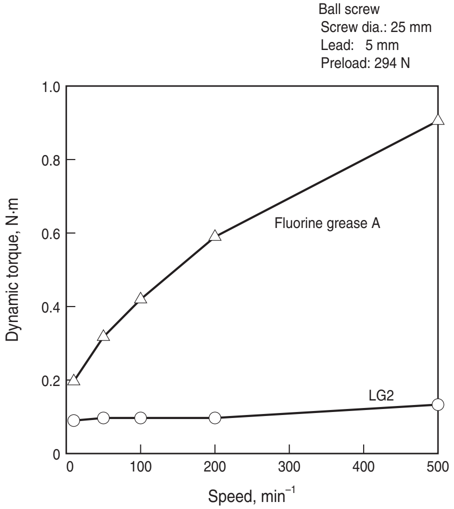


Fig. 4.7 Comparison of torque characteristics

● 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 for ball screws is also available.

For monocarriers, NSK K1 is equipped as a standard feature.

Features

- **Extend maintenance-free intervals**
- **No contamination of surrounding environment**
- **Prolong life of the products exposed to water**

Refer to pages A38, B533 and C18 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
LH	LH08	○		○			
	LH10	○		○			
	LH12	○		○		○	
	LH15	○		○		○	
	LH20	○	○	○	○	○	
	LH25	○	○	○	○	○	
	LH30	○	○	○	○	○	
	LH35	○		○	○	○	
	LH45	○		○	○		
	LH55	○		○			
	LH65	○		○			
SH	SH15	○		○			
	SH20	○		○			
	SH25	○		○			
	SH30	○		○			
	SH35	○		○			
	SH45	○		○			
	SH55	○		○			
VH	VH15	○		○			○
	VH20	○		○			○
	VH25	○		○			○
	VH30	○		○			○
	VH35	○		○			○
	VH45	○		○			○
	VH55	○		○			○
TS	TS15	○		○			
	TS20	○		○			
	TS25	○		○			
	TS30	○		○			
	TS35	○		○			
LS	LS15	○	○	○	○	○	
	LS20	○	○	○	○	○	
	LS25	○	○	○	○	○	
	LS30	○	○	○	○*	○	
	LS35	○		○		○	
SS	SS15	○		○			
	SS20	○		○			
	SS25	○		○			
	SS30	○		○			
	SS35	○		○			
LW	LW17	○		○	○*	○	
	LW21	○		○	○*	○	
	LW27	○		○	○	○	
	LW35	○		○		○	
	LW50	○		○			
PU	PU05	○		○			
	PU07	○		○			
PU	PU09	○		○		○	
	PU12	○		○		○	
	PU15	○		○		○	
LU	LU05	○		○			
	LU07	○		○			
	LU09_L	○	○	○	○	○	
	LU09_R	○		○		○	
	LU12_L	○	○	○	○	○	
	LU12_R	○		○		○	
	LU15	○	○	○	○*	○	
PE	PE05	○		○			
	PE07	○		○			
	PE09	○		○		○	
	PE12	○		○		○	
	PE15	○		○		○	
LE	LE05	○		○			
	LE07	○	○	○	○*		
	LE09_L	○	○	○	○*	○	
	LE09_R	○		○		○	
	LE12_L	○	○	○	○	○	
	LE12_R	○		○		○	
	LE15_L	○	○	○	○	○	
	LE15AR	○		○		○	
RA	RA15	○		○			
	RA20	○		○			
	RA25	○		○			
	RA30	○		○			
	RA35	○		○			
	RA45	○		○			
	RA55	○		○			
	RA65	○		○			
LA	LA25	○		○			
	LA30	○		○			
	LA35	○		○			
	LA45	○		○			
	LA55	○		○			
	LA65	○		○			
HA	HA25	○		○			
	HA30	○		○			
	HA35	○		○			
	HA45	○		○			
	HA55	○		○			
HS	HS15	○		○			
	HS20	○		○			
	HS25	○		○			
	HS30	○		○			
	HS35	○		○			

*) Dust-proof parts are not applicable to high-temperature environmental use.

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.

3. Monocarriers

Please consult with NSK for special environmental use.

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 (random-matching type linear guide) and ball nut (R series 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, linear guides and monocarriers.
Use a lubricant agent and method most suitable to condition requirements and purpose to optimize functions of ball screws, linear guides and monocarriers.
In general, lubricants with low base oil kinematic viscosity are used for high-speed operation, in which thermal expansion has a large impact, and in low temperatures.
Lubrication with high base oil kinematic viscosity is used for oscillating operations, low speeds and high temperatures.
The following are lubrication methods using grease and oil.

2.1 Grease Lubrication

Grease lubrication is widely used because it does not require a special oil supply system or piping. Grease lubricants made by NSK are:

- Various types of grease in bellows tubes that can be instantly attached to a grease pump;
- NSK Grease Unit that consists of a hand grease pump and various nozzles. They are compact and easy to use.

1. NSK grease lubricants

Table 1.1 shows the marketed general grease widely used for linear guides, ball screws, and monocarrier for specific uses, conditions and purposes.

Table 1.1 Grease lubricant for linear guides, ball screws and monocarriers

Type	Thickener	Base oil	Base oil kinematic viscosity mm^2/s (40°C)	Range of use temperature (°C)	Purpose
AS2	Lithium type	Mineral oil	130	–10 – 110	For general use at high load
PS2	Lithium type	Synthetic oil + mineral oil	15	–50 – 110	For low temperature and high frequency operation
LR3	Lithium type	Synthetic oil	30	–30 – 130	For high speed, medium load
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 hydrocarbon oil	27	–40 – 100	For fretting resistance

(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, ball screws and monocarriers. It is prevalently used in many applications because of its high base oil viscosity, high load resistance, and stability in oxidization.

● Nature

Thickener	Lithium soap base
Base oil	Mineral oil
Consistency	275
Dropping point	181°C
Volume of evaporation	0.24% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	2.8% (100°C, 24 hr)
Base oil kinematic viscosity	130 mm^2/s (40°C)

(2) NSK Grease LR3

● Features

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 2 000 hours in the endurance test at 150°C. Its rust prevention capacity in severe conditions such as water and moist environments is further strengthened.

● Application

It is a standard grease for ball screws PSS type (shaft dia. 15 mm or over), FSS type, FA type (except shaft dia. 10 mm with lead of 4mm and shaft dia. 12 mm with lead of 5 mm) and VFA type. It is ideal for operation with medium load, at high speed such as positioning in high tact material handling equipment.

● Nature

Thickener	Lithium soap base
Base oil	Synthetic 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^2/s (40°C)

(3) 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.

● 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^2/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^2/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^2/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 100°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^2/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.

Note) Refer to NSK Grease Unit Catalog (CAT. No.3317) for details of NSK Grease.

2. Before use of NSK Precision Products

Wipe off the rust preventive oil before use for the products that the oil is applied.

If grease is not applied, apply grease, and move a ball slide or ball nut a few strokes so the grease permeates into the ball slide and inside the nut. (Move the ball slide or the ball nut 5 to 10 times with full stroke.)

Then wipe off the excess grease.

3. How to replenish grease and volume of grease to be replenished

Use grease fitting if exclusive grease supply component is not used. Supply required amount through grease fitting by a grease pump.

Wipe off old grease and accumulated dust before supplying new grease. If grease fitting is not used, apply grease directly to the rail or to the ball groove of the screw shaft. Move a ball slide or ball nut a few strokes so the grease permeates into the ball slide and inside the nut.

Once grease is replenished, another supply is not required for a long time. But under some operational conditions, it is necessary to periodically replenish grease. The following are replenishing methods.

* When replenishing using a grease pump:

Use a grease pump and fill the inside of ball slide, ball nut and monocarrier slider with grease. Supply grease until it comes out from the ball slide, ball nut or monocarrier slider area. Move ball slide, ball nut or monocarrier slider by hand while filling them with grease, so the grease permeates all areas. Do not operate the machine immediately after replenishing. Always try the system a few times to spread the grease throughout the system and to remove excess grease. Trial operations are necessary because the resistance to sliding force and screw torque greatly increases immediately after replenishment (full-pack state) and may cause problems. The agitating resistance of grease is accountable for this phenomenon. Wipe off excess grease that accumulates at end of rail and screw shaft after trial runs so the grease does not move to other areas.

* When there is an exclusive grease supply system and the volume from the spout can be controlled, the criterion is:

- All at once, replenish the amount that fills about 50% of the internal space of the ball slide or the internal space of the ball nut. This method eliminates waste of grease and is efficient.

Tables 1.2, **1.3** and **1.4** show internal spaces of ball slide, ball nut and monocarrier slider for reference.

Table 1.2 Inside space of the ball slide of linear guide

LH, SH Series

Unit: cm^3

Series	LH		SH	
Model No.	High-load type	Super-high-load type	High-load type	Super-high-load type
08	0.2	–	–	–
10	0.4	–	–	–
12	1.2	–	–	–
15	3	4	2	3
20	6	8	5	7
25	9	13	9	12
30	13	20	11	17
35	22	30	20	27
45	47	59	42	53
55	80	100	73	93
65	139	186	–	–

LW Series

Unit: cm^3

Series	LW
Model No.	
17	3
21	3
27	7
35	24
50	52

VH Series

Unit: cm^3

Series	VH	
Model No.	High-load type	Super-high-load type
15	3	4
20	6	8
25	9	13
30	13	20
35	22	30
45	47	59
55	80	100

PU, LU Series

Unit: cm^3

Series	PU		LU	
Model No.	Standard type	High-load type	Standard type	High-load type
05	0.1	–	0.1	–
07	0.1	–	0.1	–
09	0.2	0.3	0.2	0.3
12	0.3	0.4	0.3	0.4
15	0.8	1.1	0.8	1.1

TS Series

Unit: cm^3

Series	TS
Model No.	
15	2
20	3
25	6
30	9
35	15

PE, LE Series

Unit: cm^3

Series	PE		LE		
Model No.	Standard type	High-load type	Medium-load type	Standard type	High-load type
05	0.1	–	0.1	0.1	–
07	0.2	–	0.1	0.2	0.3
09	0.4	0.5	0.2	0.4	0.5
12	0.5	0.7	0.3	0.5	0.7
15	1.2	1.6	0.8	1.2	1.6

LS, SS Series

Unit: cm^3

Series	LS		SS	
Model No.	Medium-load type	High-load type	Medium-load type	High-load type
15	2	3	1.5	2
20	3	4	3	4
25	5	8	5	7
30	8	12	7	11
35	12	19	11	17

RA Series

Unit: cm^3

Series	RA	
Model No.	High-load type	Super-high-load type
15	1	1.5
20	2	2.5
25	3	3.5
30	5	6
35	6	8
45	10	13
55	15	20
65	33	42

LA Series

Unit: cm^3

Series	LA	
Model No.	High-load type	Super-high-load type
25	8	12
30	14	18
35	21	29
45	38	48
55	68	86
65	130	177

HA, HS Series

Unit: cm^3

Series	HA	HS
Model No.		
15	–	5
20	–	9
25	16	16
30	27	25
35	42	40
45	67	–
55	122	–

Table 1.3 Inside space of ball nut

Return tube type (single nut)

Unit: cm^3

Nut model	Inside space
1004 – 2.5	0.8
1205 – 2.5	1.2
1210 – 2.5	1.4
1405 – 2.5	2.2
1510 – 2.5	2.3
1605 – 2.5	2.6
1616 – 1.5	2.1
2004 – 5	2.7
2005 – 5	4.3
2010 – 2.5	4.7
2020 – 1.5	4.2
2504 – 5	3.2
2505 – 5	5
2506 – 5	7
2510 – 3	9.5
2520 – 2.5	12
2525 – 1.5	7.5
2805 – 5	6
3205 – 5	7
3206 – 5	9.5
3210 – 5	22
3225 – 2.5	17
3232 – 1.5	15
3610 – 5	32
4005 – 10	14
4010 – 5	30
4012 – 5	34
4510 – 5	34
5010 – 5	37
5010 – 10	59

Deflector type (single nut)

Unit: cm^3

Nut model	Inside space
2505 – 6	6.5
2510 – 4	10
3205 – 8	9.5
3210 – 6	28
4010 – 8	42
5010 – 8	52

End cap type

Unit: cm^3

Nut model	Inside space
1520 – 1.5	1.9
2040 – 1	2.8
2550 – 1	4.2

Note:

Nut model: shaft diameter, lead, total number of turns of balls

Please consult NSK for other specifications.

Refer to B110 to B142 for Compact FA Series.

Table 1.4 Inside space of the monocarrier

MCM Series

Model No.	Lead (mm)	Inside space
MCM03	1	1
	2	0.9
	10	1.8
	12	1.7
MCM05	5	4.2
	10	4
	20	2.1
	30	2.0
MCM06	5	8.3
	10	6.5
	20	5.5
MCM08	5	11.6
	10	9.8
	20	8.7
	30	4.3
MCM10	10	19.4
	20	17.4
	30	8.8

MCH Series

Model No.	Lead (mm)	Inside space
MCH06	5	2.8
	10	2.7
	20	2.7
MCH09	5	5.8
	10	5.8
	20	5.6
MCH10	10	10.9
	20	10.1

4. Intervals of checks and replenishments

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. Grease should be replenished depending on frequency of use. The following is a guide of grease replenishment intervals for linear guides and ball screws.

Table 1.5 Intervals of checks and replenishments for grease lubrication

Intervals of checks	Items to check	Intervals of replenishments
3-6 months	Dirt, foreign matters such as cutting chips	Usually once per year. Every 3 000 km for material handling system that travels more than 3 000 km per year. Replenish if checking results warrant it necessary.

Notes: 1) As a general rule, do not mix greases of different brands.
2) Grease viscosity varies by temperature. Viscosity is particular high in winter due to low temperatures. Pay attention to increases in linear guide and monocarrier sliding resistance and ball screw and monocarrier torque in such conditions.
3) When the ambient temperature is low, or in Winter, if it is difficult to pump out the grease from the container, wait until the grease is softened.
4) In locations where coolant is dispersed or scattered, emulsification of lubricants and rinsing with water may significantly deteriorate the integrity of the lubricant and efficiency of the grease. Protect the grease unit from coolant by shielding it with a cover, etc.

5. NSK Grease Unit

Supply grease to NSK linear guides and ball screws by manual type hand grease pump. Install grease in bellows tube to the pump. Several types of grease (80 g) are available.

Grease in bellows tube

(1) Composition of NSK Grease Unit

Components and grease types are shown below.

NSK Grease Unit	Name	(Tube color)	Reference number
NSK Grease (80 g in a bellows tube)	NSK Grease AS2	(Brown)	NSK GRS AS2
	NSK Grease PS2	(Orange)	NSK GRS PS2
	NSK Grease LR3	(Green)	NSK GRS LR3
	NSK Grease LG2	(Blue)	NSK GRS LG2
	NSK Grease LGU	(Yellow)	NSK GRS LGU
	NSK Grease NF2	(Gray)	NSK GRS NF2
NSK Hand Grease Pump Unit			
	NSK Hand Grease Pump (Straight nozzle NSK HGP NZ1 -- One nozzle is provided with hand pump.)		NSK HGP
	Grease nozzle (used with hand grease pump)		
	NSK straight nozzle		NSK HGP NZ1
	NSK chuck nozzle		NSK HGP NZ2
	NSK drive fitting nozzle		NSK HGP NZ3
	NSK point nozzle		NSK HGP NZ4
	NSK flexible nozzle		NSK HGP NZ5
	NSK flexible extension pipe		NSK HGP NZ6
	NSK straight extension pipe		NSK HGP NZ7
	NSK nozzle for MCH		NSK HGP NZ8

(2) NSK Greases (80 g in bellows tube)

Refer to pages D14 and D15 for their natures and details.

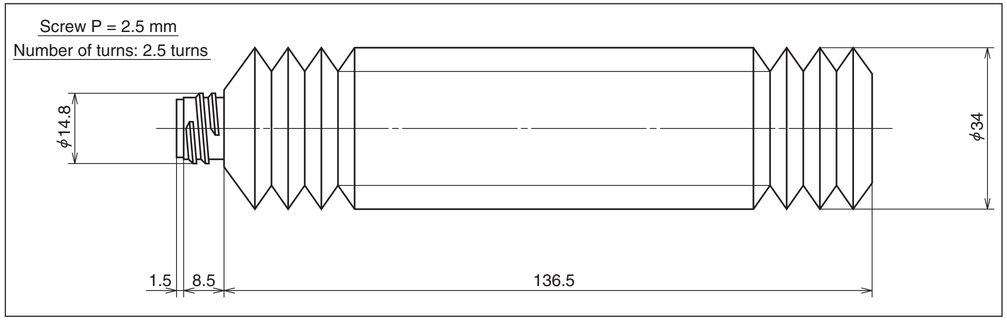


Fig. 1.1 Bellows tube

(3) NSK Manual Grease Pump Unit

a) NSK Hand Grease Pump (Reference number: NSK HGP)

● Features

- Light-weight ·········· Can be operated by one hand, yet there is no worry to make a mistake.
- Inserting by high pressure···· Insert at 15 Mpa.
- No leaking ············ Does not leak when held upside down.
- Easy to change grease···· Simply attach grease in bellows tube.
- Remaining grease ····· Can be confirmed through slit on tube.
- Several nozzles ······ Six types of nozzles to choose from.

● Specifications

- Discharge pressure ·· 15 Mpa
- Spout volume ········ 0.35 cc/shot
- Mass of main body ··· Without nozzle 240 g
  Provided nozzle 90 g
- Grease tube outer diameter ϕ 38.1
- Accessory·············· Several nozzles for a unique application can be attached

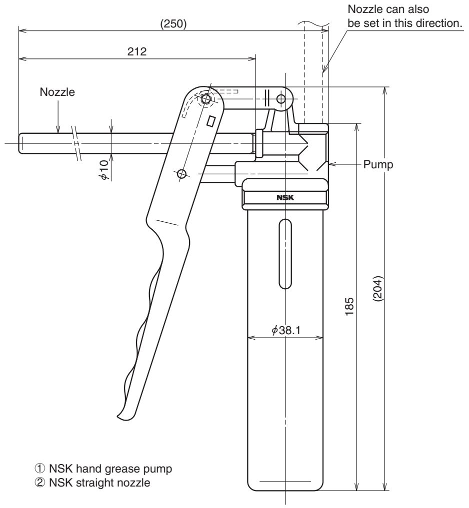


Fig. 1.2 NSK Hand Grease Pump with NSK straight nozzle

b) Nozzles

Table 1.5 Nozzles that can be attached to NSK Hand Grease Pump

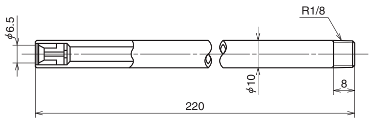
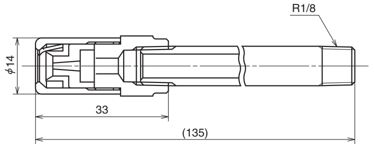
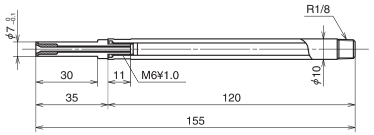
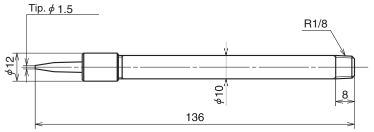
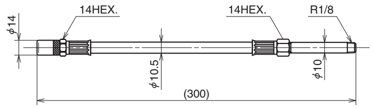
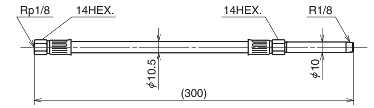
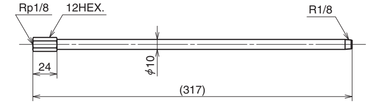
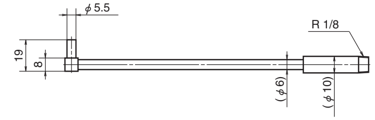
Name	Designation code	Use	Dimensions
NSK straight nozzle	NSK HGP NZ1	Can be used with grease fitting A, B, and C under JIS B1575 standard.	
NSK chuck nozzle	NSK HGP NZ2	Same as above. However, there is no need to press the hand pump because the grease fitting and the nozzle come to contact due to the 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 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.	
NSK nozzle for MCH	NSK HGP NZ8	For MCH Series grease replenishment	

Table 1.6 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
LH	LH08, 10	—	—				○	
	LH12, 15	φ3	Drive-in type			○		
	LH20, 25, 30, 35*	M6×0.75	B type	○	○			○
	LH45, 55, 65, 85	Rc1/8	B type	○	○			○
SH	SH15	φ3	Drive-in type			○		
	SH20, 25, 30, 35*	M6×0.75	B type	○	○			○
	SH45, 55	Rc1/8	B type	○	○			○
VH	VH15	φ3	Drive-in type			○		
	LH20, 25, 30, 35*	M6×0.75	B type	○	○			○
	VH45, 55	Rc1/8	B type	○	○			○
TS	TS15	φ3	Drive-in type			○		
	TS20, 25, 30, 35*	M6×0.75	B type	○	○			○
LS	LS15	φ3	Drive-in type			○		
	LS20, 25, 30, 35*	M6×0.75	B type	○	○			○
SS	SS15	φ3	Drive-in type			○		
	SS20, 25, 30, 35*	M6×0.75	B type	○	○			○
LW	LW17	φ3	Drive-in type			○		
	LW21, 27, 35*	M6×0.75	B type	○	○			○
	LW50	Rc1/8	B type	○	○			○
PU	PU05, 07, 09, 12	–	–				○	
	PU15	φ3	Drive-in type			○		
LU	LU05, 07, 09, 12, 15	–	–				○	
PE	PE05, 07, 09, 12	–	–				○	
	PE15	φ3	Drive-in type			○		
LE	LE05, 07, 09, 12, 15	–	–				○	
RA	RA15, 20	φ3	Drive-in type			○		
	RA25, 30, 35*	M6×0.75	B type	○	○			○
	RA45, 55, 65	Rc1/8	B type	○	○			○
LA	LA25, 30, 35*	M6×0.75	B type	○	○			○
	LA45, 55, 65	Rc1/8	B type	○	○			○
HA	HA25, 30, 35*	M6×0.75	B type	○	○			○
	HA45, 55	Rc1/8	B type	○	○			○
HS	HS15	φ3	Drive-in type			○		
	HS20, 25, 30, 35*	M6×0.75	B type	○	○			○

*) If using a chuck nozzle, avoid interference with table and rail.

Note: 1) For PU, PE, LU, and LE Series, apply grease directly to ball groove, etc. using point nozzle.

2) 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.

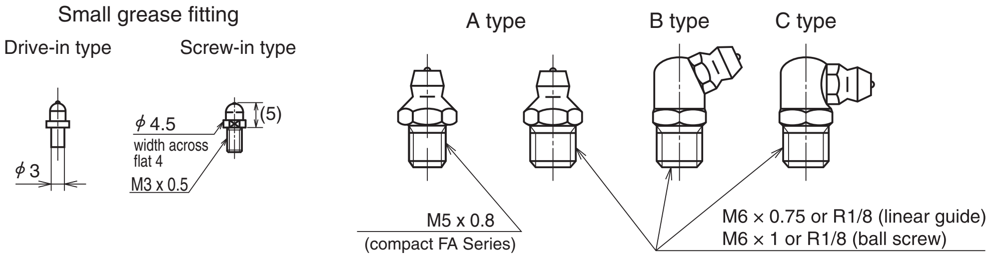


Fig. 1.3 Grease fittings

Table 1.7 Applicable grease nozzle for ball screws

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
Finished shaft end	Compact FA	High-accuracy, clean	USS		M5×0.8	A type	○	○			○
		General	PSS			A type	○	○			○
		Transfer equipment	FSS			A type	○	○			○
	Miniature, fine lead		MA	Shaft dia. 12 or less	–	–				○	
				Shaft dia. 16 or over	M6×1	–	○	○			○
	Small equipment		FA		M6×1	–	○	○			○
	Machine tools		SA	Shaft dia. 36 or less	M6×1	–	○	○			○
				Shaft dia. 40 or over	Rc1/8	–	○	○			○
	Stainless steel		KA	Shaft dia. 12 or less and lead 2 or less	M3×0.5	–			○		
				except above	M6×1	–	○	○			○
	Transfer equipment		VFA	Shaft dia. 12 or less	ϕ 2.7	–				○	
				Shaft dia. 15 or over	ϕ 3.5	–				○	
			RMA		–	–				○	
Blank shaft end	Miniature, fine lead		MS	Shaft dia. 12 or less	–	–				○	
				Shaft dia. 16 or over	M6×1	–	○	○			○
	Small equipment		FS		M6×1	–	○	○			○
	Machine tools		SS	Shaft dia. 36 or less	M6×1	–	○	○			○
				Shaft dia. 40 or over	Rc1/8	–	○	○			○
	Transfer equipment		RMS		–	–				○	
			RNFTL	Shaft dia. 12 or less	M3×0.5	–			○		
				Shaft dia. 14 or over	M6×1	–	○	○			○
			RNFBL	Shaft dia. 12 or less	M3×0.5	–			○		
				Shaft dia. 14 or over	M6×1	–	○	○			○
			RNCT		–	–				○	
			RNFCL	Shaft dia. 12 or less	M3×0.5	–			○		
				Shaft dia. 15 or over	M6×1	–	○	○			○
			RNSTL		M6×1	–	○	○			○

Notes: 1) Normally, grease fitting is not provided to NSK ball screw except Compact FA Series. Ball nut has a tap hole to install a grease fitting. The user should install a grease fitting if necessary.

2) For M3 × 0.5 tap hole, small fitting (screw-in type) is available. Please contact NSK.

3) VFA type cannot install grease fitting. Apply grease directly to inside the nut through oil hole using point nozzle.

4) MA, RMA, MS, RMS, and RNCT types have no tap hole, apply grease directly to the screw shaft and ball grooves using point nozzle.

Table 1.7 Applicable grease nozzles for Monocarriers

Series	Model no.	Tap hole for grease fitting	Standard grease fitting	Straight nozzle NZ1	Chuck nozzles NZ2	Drive-in fitting nozzle NZ3	Flexible nozzle NZ5	MCH exclusive fitting nozzle NZ8
MCM	MCM02	–	–					
	MCM03,05,08,10	ϕ 3	Drive-in type			○		○*
	MCM06	M6×0.75	A type	○	○		○	
MCH	MCH06,09,10	ϕ 3	Drive-in type					○

*) Use of NZ3 is recommended.

2.2 Oil Lubrication

Required amount of new oil is regularly supplied by:
- Manual or automatic intermittent supply system;
- Oil mist lubricating system via piping.

Equipment for oil lubrication is more costly than grease lubrication. However, oil mist lubricating system supplies air as well as oil, raising the inner pressure of the ball slide. This prevents foreign matters from entering, and the air cools the system. Use an oil of high atomizing rate such as ISO VG 32 to 68 for the oil mist lubrication system.

ISO VG 68 to 220 are recommended for common intermittent replenishment system. Approximate volume of oil Q for a ball slide of linear guide per hour can be obtained by the following formula.

In case of ball type linear guides except the LA Series

$Q = n/150$ (cm³/hr)

In case of LA Series, RA Series

$Q \geq n/100$ (cm³/hr)

n: Linear guide code

e.g. When LH45 is used,

$n = 45$

Therefore,

$Q = 45/150 = 0.3$ cm³/hr

Similarly, approximate oil supply volume Q to ball screw can be obtained by the following formula.

$Q = d/15$ (cm³/hr)

d: Nominal shaft diameter of the ball screw

e.g. When the shaft diameter is 50,

$d = 50$

Therefore,

$Q = 50/15 = 3.3$ cm³/hr

For oil lubrication by gravity drip, the oil supply position and installation position of the ball slide or ball nut are crucial. In case of linear guide, unless it is installed to a horizontal position, the oil flows only on the down side, and does not spread to all raceway surface. This may cause insufficient lubrication. For ball screw lubrication as well, oil does not spread if the oil orifice is installed at the bottom, causing insufficient lubrication. Please consult NSK to correct such situations prior to use. NSK has internal design which allows oil lubricant to flow throughout the system. **Table 2.1** shows the criterion of intervals of oil checks and replenishments.

Table 2.1 Intervals of checks and replenishments

Method	Intervals of checks	Items to check	Replenishment or intervals of changes
Automatic intermittent supply	Weekly	Volume of oil, dirt, etc.	Replenish at each check. Suitable volume for tank capacity.
Oil bath	Daily before operation	Oil surface	Make a suitable criterion based on consumption

Notes: 1) As with grease lubrication, do not mix oil lubricant with different types.

2) Some components of the linear guide and ball screw are made of plastic. Avoid using an oil that adversely affects synthetic resin.

3) When using oil mist lubricating 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

E

BLOCK

Appendices: Tables

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^2	N	Pa	Pa	J	W
CGS system	cm	g	s	°C	Gal	dyn	dyn/cm^2	dyn/cm^2	erg	erg/s
Engineering system	m	kgf • s^2/m	s	°C	m/s^2	kgf	kgf/m^2	kgf/m^2	kgf • m	kgf • m/s

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^{6}
			Angstrom	Å	10^{10}
Area	Square meter	m^2	Are	a	10^{-2}
			Hectare	ha	10^{-4}
Volume	Cubic meter	m^3	Liter	l, L	10^{3}
			Deciliter	dl, dL	10^{4}
Time	Second	s	Minute	min	1/60
			Hour	h	1/3 600
			Day	d	1/86 400
Numbers of vibration numbers of frequency	Hertz	Hz	Cycle	s^{-1}	1
Rotational speed	Times per second	s^{-1}	Times per minute	rpm	60
Velocity	Meter per second	m/s	Kilometer per hour	km/h	3 600/1 000
			Knot	kn	3 600/1 852
Acceleration	Meter per square second	m/s^2	Gal	Gal	10^{2}
			G	G	1/9.806 65
Mass	Kilogram	kg	Ton	t	10^{-3}
Force	Newton	N	Weight kilogram	kgf	1/9.806 65
			Weight ton	tf	1/(9.806 65×10^{3})
			Dyne	dyn	10^{5}
Torque and moment of force	Newton meter	N • m	Weight kilogram meter	kgf • m	1/9.806 65
Stress	Pascal	Pa	Weight kilogram per square centimeter	kgf/cm^2	1/(9.806 65×10^{4})
	(Newtons per square meter)	(N/m^2)	Weight kilogram per square millimeter	kgf/mm^2	1/(9.806 65×10^{6})

Prefixes for SI units

Powers of 10	Prefix		Powers of 10	Prefix	
	Name	Code		Name	Code
10^{18}	exa	E	10^{-1}	deci	d
10^{15}	peta	P	10^{-2}	centi	c
10^{12}	tera	T	10^{-3}	milli	m
10^{9}	giga	G	10^{-6}	micro	μ
10^{6}	mega	M	10^{-9}	nano	n
10^{3}	kilo	k	10^{-12}	pico	p
10^{2}	hecto	h	10^{-15}	femto	f
10^{1}	deca	da	10^{-18}	atto	a

Conversion 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	Pa	Weight kilogram per square meter	kgf/m^2	1/9.806 65
	(newton per square meter)	(N/m^2)	Water column meter	mH$_2$O	1/(9.806 65×10^{3})
			Mercurial column millimeter	mmHg	760/(1.013 25×10^{5})
			Torr	Torr	760/(1.013 25×10^{5})
			Bar	bar	10^{-5}
			Atmosphere	atm	1/(1.013 25×10^{5})
Energy	Joule	J	Erg	erg	10^{7}
	(newton meter)	(N • m)	Calorie (international)	cal$_{IT}$	1/4.186 8
			Weight kilogram meter	kgf • m	1/9.806 65
			Kilowatt hour	kW • h	1/(3.6×10^{6})
			Metric horsepower/hour	PS • h	≈3.776 72×10^{-7}
Electric power, power	Watt	W	Weight kilogram meter per second	kgf • m/s	1/9.806 65
	(joules per second)	(J/s)	Kilo calorie per hour	kcal/h	1/1.163
			Metric horsepower	PS	≈1/735.498 8
Viscosity, Viscosity index	Pascal second	Pa • s	Poise	P	10
Kinematic viscosity, Kinematic viscosity index	Square meter per second	m^2/s	Stokes	St	10^{4}
			Centistokes	cSt	10^{6}
Temperature, Difference in temperature	Kelvin, Celsius degrees	K, °C	Degree	°C	[See Note (1)]
Electrical current, magnetomotive force	Ampere	A	Ampere	A	1
Electrical power, electromotive force	Volt	V	(Watt per ampere)	(W/A)	1
Magnetic field intensity	Ampere per meter	A/m	Oersted	Oe	4π/10^{3}
Magnetic flux density	Tesla	T	Gauss	Gs	10^{4}
			Gamma	γ	10^{9}
Electrical resistance	Ohm	Ω	(Volt per ampere)	(V/A)	1

Note (1) Conversion from *TK* to θ °C is : $\theta = T - 273.15$. To indicate temperature difference: $\varDelta T = \varDelta\theta$. $\varDelta T$ and $\varDelta\theta$ 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 N = 0.1019716 kgf
1 kgf = 9.80665 N

N		kgf	N		kgf	N		kgf
9.8066	1	0.1020	333.43	34	3.4670	657.05	67	6.8321
19.613	2	0.2039	343.23	35	3.5690	666.85	68	6.9341
29.420	3	0.3059	353.04	36	3.6710	676.66	69	7.0360
39.227	4	0.4079	362.85	37	3.7729	686.47	70	7.1380
49.033	5	0.5099	372.65	38	3.8749	696.27	71	7.2400
58.840	6	0.6118	382.46	39	3.9769	706.08	72	7.3420
68.647	7	0.7138	392.27	40	4.0789	715.89	73	7.4439
78.453	8	0.8158	402.07	41	4.1808	725.69	74	7.5459
88.260	9	0.9177	411.88	42	4.2828	735.50	75	7.6479
98.066	10	1.0197	421.69	43	4.3848	745.31	76	7.7498
107.87	11	1.1217	431.49	44	4.4868	755.11	77	7.8518
117.68	12	1.2237	441.30	45	4.5887	764.92	78	7.9538
127.49	13	1.3256	451.11	46	4.6907	774.73	79	8.0558
137.29	14	1.4279	460.91	47	4.7927	784.53	80	8.1577
147.10	15	1.5296	470.72	48	4.8946	794.34	81	8.2597
156.91	16	1.6315	480.53	49	4.9966	804.15	82	8.3617
166.71	17	1.7335	490.33	50	5.0986	813.95	83	8.4636
176.52	18	1.8355	500.14	51	5.2006	823.76	84	8.5656
186.33	19	1.9375	509.95	52	5.3025	833.57	85	8.6676
196.13	20	2.0394	519.75	53	5.4045	843.37	86	8.7696
205.94	21	2.1414	529.56	54	5.5065	853.18	87	8.8715
215.75	22	2.2434	539.37	55	5.6084	862.99	88	8.9735
225.55	23	2.3453	549.17	56	5.7104	872.79	89	9.0755
235.36	24	2.4473	558.98	57	5.8124	882.60	90	9.1774
245.17	25	2.5493	568.79	58	5.9144	892.41	91	9.2794
254.97	26	2.6513	578.59	59	6.0163	902.21	92	9.3814
264.78	27	2.7532	588.40	60	6.1183	912.02	93	9.4834
274.59	28	2.8552	598.21	61	6.2203	921.83	94	9.5853
284.39	29	2.9572	608.01	62	6.3222	931.63	95	9.6873
294.20	30	3.0591	617.82	63	6.4242	941.44	96	9.7893
304.01	31	3.1611	627.63	64	6.5262	951.25	97	9.8912
313.81	32	3.2631	637.43	65	6.6282	961.05	98	9.9932
323.62	33	3.3651	647.24	66	6.7301	970.86	99	10.095

3. 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 kg = 2.2046226 lb
1 lb = 0.45359237 kg

kg		lb	kg		lb	kg		lb
0.454	1	2.205	15.422	34	74.957	30.391	67	147.71
0.907	2	4.409	15.876	35	77.162	30.844	68	149.91
1.361	3	6.614	16.329	36	79.366	31.298	69	152.12
1.814	4	8.818	16.783	37	81.571	31.751	70	154.32
2.268	5	11.023	17.237	38	83.776	32.205	71	156.53
2.722	6	13.228	17.690	39	85.980	32.659	72	158.73
3.175	7	15.432	18.144	40	88.185	33.112	73	160.94
3.629	8	17.637	18.597	41	90.390	33.566	74	163.14
4.082	9	19.842	19.051	42	92.594	34.019	75	165.35
4.536	10	22.046	19.504	43	94.799	34.473	76	167.55
4.990	11	24.251	19.958	44	97.003	34.927	77	169.76
5.443	12	26.455	20.412	45	99.208	35.380	78	171.96
5.897	13	28.660	20.865	46	101.41	35.834	79	174.17
6.350	14	30.865	21.319	47	103.62	36.287	80	176.37
6.804	15	33.069	21.772	48	105.82	36.741	81	178.57
7.257	16	35.274	22.226	49	108.03	37.195	82	180.78
7.711	17	37.479	22.680	50	110.23	37.648	83	182.98
8.165	18	39.683	23.133	51	112.44	38.102	84	185.19
8.618	19	41.888	23.587	52	114.64	38.555	85	187.39
9.072	20	44.092	24.040	53	116.84	39.009	86	189.60
9.525	21	46.297	24.494	54	119.05	39.463	87	191.80
9.979	22	48.502	24.948	55	121.25	39.916	88	194.01
10.433	23	50.706	25.401	56	123.46	40.370	89	196.21
10.886	24	52.911	25.855	57	125.66	40.823	90	198.42
11.340	25	55.116	26.308	58	127.87	41.277	91	200.62
11.793	26	57.320	26.762	59	130.07	41.730	92	202.83
12.247	27	59.525	27.216	60	132.28	42.184	93	205.03
12.701	28	61.729	27.669	61	134.48	42.638	94	207.23
13.154	29	63.934	28.123	62	136.69	43.091	95	209.44
13.608	30	66.139	28.576	63	138.89	43.545	96	211.64
14.061	31	68.343	29.030	64	141.10	43.998	97	213.85
14.515	32	70.548	29.484	65	143.30	44.452	98	216.05
14.969	33	72.753	29.937	66	145.51	44.906	99	218.26

4. Conversion table of hardness

Rockwell C Scale hardness (1 471 N)	Vickers hardness	Brinell hardness		Rockwell hardness A Scale	Rockwell hardness B Scale	Shore hardness
		Standard ball	Tungsten carbide ball	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
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	1 000	−320 −376	−170 −226	−86 −142	—	−26 −82	—	0 −56	0 −90	0 −140	0 −230	0 −360	—	±28
1 000	1 250	−350 −416	−195 −261	−98 −164	—	−28 −94	—	0 −66	0 −105	0 −165	0 −260	0 −420	—	±33
1 250	1 600	−390 −468	−220 −298	−110 −188	—	−30 −108	—	0 −78	0 −125	0 −195	0 −310	0 −500	—	±39
1 600	2 000	−430 −522	−240 −332	−120 −212	—	−32 −124	—	0 −92	0 −150	0 −230	0 −370	0 −600	—	±46

j5	j6	j7	k5	k6	k7	m5	m6	n6	p6	r6	r7	Classification of diameter (mm)	
												Over	or less
±2	+4 −2	+6 −4	+4 0	+6 0	+10 0	+6 +2	+8 +2	+10 +4	+12 +6	+16 +10	+20 +10	—	3
+3 −2	+6 −2	+8 −4	+6 +1	+9 +1	+13 +1	+9 +4	+12 +4	+16 +8	+20 +12	+23 +15	+27 +15	3	6
+4 −2	+7 −2	+10 −5	+7 +1	+10 +1	+16 +1	+12 +6	+15 +6	+19 +10	+24 +15	+28 +19	+34 +19	6	10
+5 −3	+8 −3	+12 −6	+9 +1	+12 +1	+19 +1	+15 +7	+18 +7	+23 +12	+29 +18	+34 +23	+41 +23	10	18
+5 −4	+9 −4	+13 −8	+11 +2	+15 +2	+23 +2	+17 +8	+21 +8	+28 +15	+35 +22	+41 +28	+49 +28	18	30
+6 −5	+11 −5	+15 −10	+13 +2	+18 +2	+27 +2	+20 +9	+25 +9	+33 +17	+42 +26	+50 +34	+59 +34	30	50
+6 −7	+12 −7	+18 −12	+15 +2	+21 +2	+32 +2	+24 +11	+30 +11	+39 +20	+51 +32	+60 +41	+71 +41	50	65
										+62 +43	+73 +43	65	80
+6 −9	+13 −9	+20 −15	+18 +3	+25 +3	+38 +3	+28 +13	+35 +13	+45 +23	+59 +37	+73 +51	+86 +51	80	100
										+76 +54	+89 +54	100	120
+7 −11	+14 −11	+22 −18	+21 +3	+28 +3	+43 +3	+33 +15	+40 +15	+52 +27	+68 +43	+88 +63	+103 +63	120	140
										+90 +65	+105 +65	140	160
										+93 +68	+108 +68	160	180
+7 −13	+16 −13	+25 −21	+24 +4	+33 +4	+50 +4	+37 +17	+46 +17	+60 +31	+79 +50	+106 +77	+123 +77	180	200
										+109 +80	+126 +80	200	225
										+113 +84	+130 +84	225	250
+7 −16	±16	±26	+27 +4	+36 +4	+56 +4	+43 +20	+52 +20	+66 +34	+88 +56	+126 +94	+146 +94	250	280
										+130 +98	+150 +98	280	315
+7 −18	±18	+29 −28	+29 +4	+40 +4	+61 +4	+46 +21	+57 +21	+73 +37	+98 +62	+144 +108	+165 +108	315	355
										+150 +114	+171 +114	355	400
+7 −20	±20	+31 −32	+32 +5	+45 +5	+68 +5	+50 +23	+63 +23	+80 +40	+108 +68	+166 +126	+189 +126	400	450
										+172 +132	+195 +132	450	500
—	—	—	—	+44 0	+70 0	—	+70 +26	+88 +44	+122 +78	+194 +150	+220 +150	500	560
										+199 +155	+225 +155	560	630
—	—	—	—	+50 0	+80 0	—	+80 +30	+100 +50	+138 +88	+225 +175	+255 +175	630	710
										+235 +185	+265 +185	710	800
—	—	—	—	+56 0	+90 0	—	+90 +34	+112 +56	+156 +100	+266 +210	+300 +210	800	900
										+276 +220	+310 +220	900	1 000
—	—	—	—	+66 0	+105 0	—	+106 +40	+132 +66	+186 +120	+316 +250	+355 +250	1 000	1 120
										+326 +260	+365 +260	1 120	1 250
—	—	—	—	+78 0	+125 0	—	+126 +48	+156 +78	+218 +140	+378 +300	+425 +300	1 250	1 400
										+408 +330	+455 +330	1 400	1 600
—	—	—	—	+92 0	+150 0	—	+150 +58	+184 +92	+262 +170	+462 +370	+520 +370	1 600	1 800
										+492 +400	+550 +400	1 800	2 000

6. 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	K5	K6	K7	M5	M6	M7	N5	N6	N7	P6	P7
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	0 −4	0 −6	0 −10	−2 −6	−2 −8	−2 −12	−4 −8	−4 −10	−4 −14	−6 −12	−6 −16
3	6	+28 +20	+18 +10	+22 +10	+12 +4	+16 +4	+8 0	+12 0	+18 0	+5 −3	±6	±4	±6	0 −5	+2 −6	+3 −9	−3 −8	−1 −9	0 −12	−7 −12	−5 −13	−4 −16	−9 −17	−8 −20
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	+1 −5	+2 −7	+5 −10	−4 −10	−3 −12	0 −15	−8 −14	−7 −16	−4 −19	−12 −21	−9 −24
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	+2 −6	+2 −9	+6 −12	−4 −12	−4 −15	0 −18	−9 −17	−9 −20	−5 −23	−15 −26	−11 −29
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	+1 −8	+2 −11	+6 −15	−5 −14	−4 −17	0 −21	−12 −21	−11 −24	−7 −28	−18 −31	−14 −35
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	+2 −9	+3 −13	+7 −18	−5 −16	−4 −20	0 −25	−13 −24	−12 −28	−8 −33	−21 −37	−17 −42
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	+3 −10	+4 −15	+9 −21	−6 −19	−5 −24	0 −30	−15 −28	−14 −33	−9 −39	−26 −45	−21 −51
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	+2 −13	+4 −18	+10 −25	−8 −23	−6 −28	0 −35	−18 −33	−16 −38	−10 −45	−30 −52	−24 −59
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	+3 −15	+4 −21	+12 −28	−9 −27	−8 −33	0 −40	−21 −39	−20 −45	−12 −52	−36 −61	−28 −68
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	+2 −18	+5 −24	+13 −33	−11 −31	−8 −37	0 −46	−25 −45	−22 −51	−14 −60	−41 −70	−33 −79
250	315	+142 +110	+88 +56	+108 +56	+49 +17	+69 +17	+32 0	+52 0	+81 0	+25 −7	+36 −16	±16	±26	+3 −20	+5 −27	+16 −36	−13 −36	−9 −41	0 −52	−27 −50	−25 −57	−14 −66	−47 −79	−36 −88
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	+3 −22	+7 −29	+17 −40	−14 −39	−10 −46	0 −57	−30 −55	−26 −62	−16 −73	−51 −87	−41 −98
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	+2 −25	+8 −32	+18 −45	−16 −43	−10 −50	0 −63	−33 −60	−27 −67	−17 −80	−55 −95	−45 −108
500	630	+189 +145	+120 +76	+146 +76	+66 +22	+92 +22	+44 0	+70 0	+110 0	—	—	±22	±35	—	0 −44	0 −70	—	−26 −70	−26 −96	—	−44 −88	−44 −114	−78 −122	−78 −148
630	800	+210 +160	+130 +80	+160 +80	+74 +24	+104 +24	+50 0	+80 0	+125 0	—	—	±25	±40	—	0 −50	0 −80	—	−30 −80	−30 −110	—	−50 −100	−50 −130	−88 −138	−88 −168
800	1 000	+226 +170	+142 +86	+176 +86	+82 +26	+116 +26	+56 0	+90 0	+140 0	—	—	±28	±45	—	0 −56	0 −90	—	−34 −90	−34 −124	—	−56 −112	−56 −146	−100 −156	−100 −190
1 000	1 250	+261 +195	+164 +98	+203 +98	+94 +28	+133 +28	+66 0	+105 0	+165 0	—	—	±33	±52.5	—	0 −66	0 −105	—	−40 −106	−40 −145	—	−66 −132	−66 −171	−120 −186	−120 −225
1 250	1 600	+298 +220	+188 +110	+235 +110	+108 +30	+155 +30	+78 0	+125 0	+195 0	—	—	±39	±62.5	—	0 −78	0 −125	—	−48 −126	−48 −173	—	−78 −156	−78 −203	−140 −218	−140 −265
1 600	2 000	+332 +240	+212 +120	+270 +120	+124 +32	+182 +32	+92 0	+150 0	+230 0	—	—	±46	±75	—	0 −92	0 −150	—	−58 −150	−58 −208	—	−92 −184	−92 −242	−170 −262	−170 −320

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