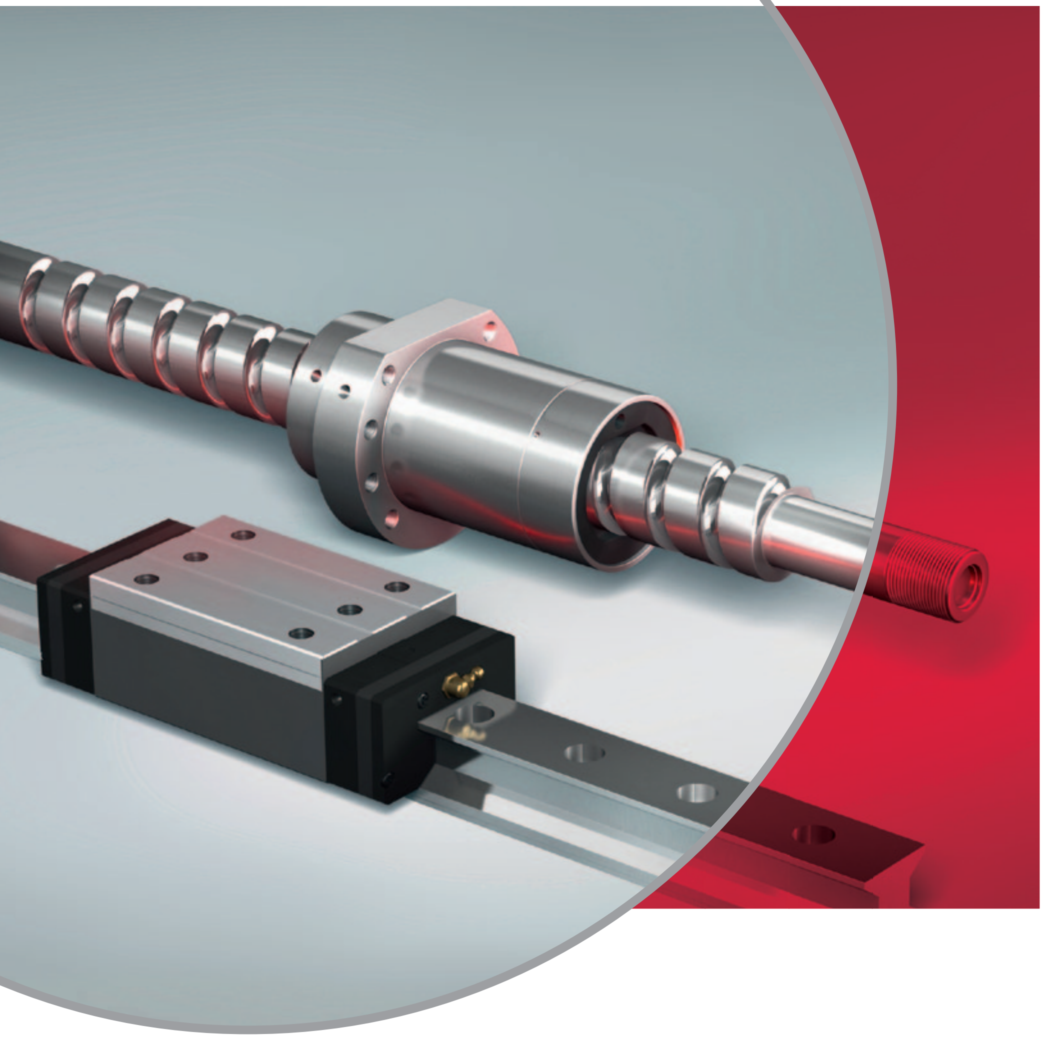
PRECISION MACHINE COMPONENTS



GLOBAL BRAND

NSK products are known and used all over the world

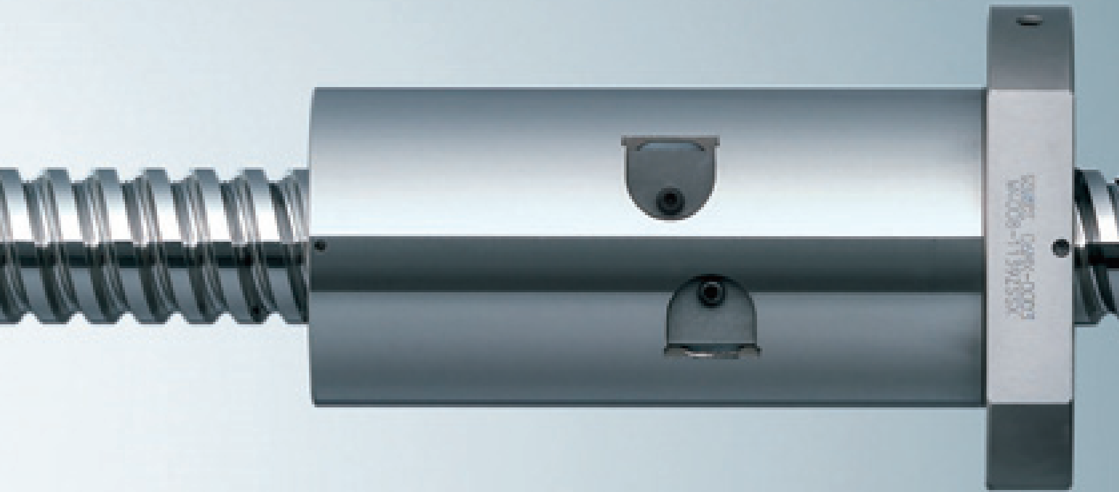
Since 1916, when it was the first company in Japan to produce ball bearings, NSK has contributed to industrial growth both domestically and overseas for 90 years. Now, the company’s accumulated technology in bearings has been applied to precision products in order to support core components used in a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


NSK

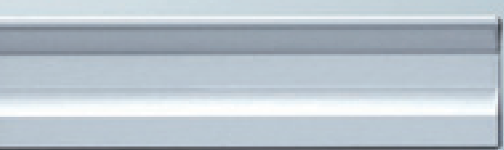
TOTAL QUALITY

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."



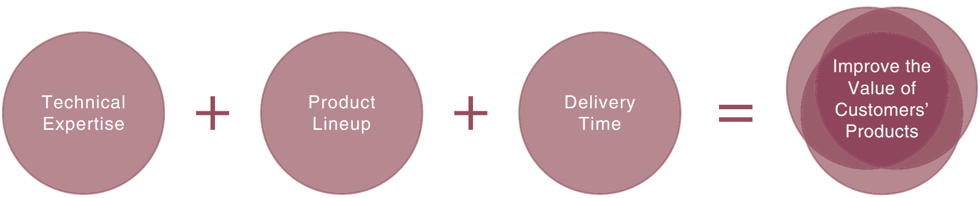

SOLUTION
TOTAL QUALITY
APS
TECHNOLOGY



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.

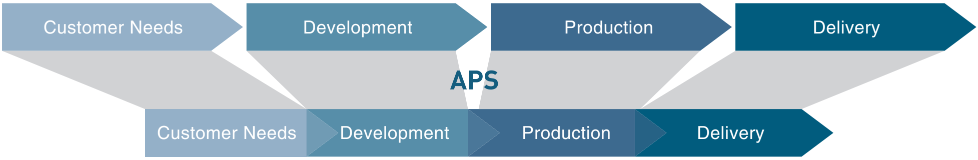


With its Technology Center as the cornerstone, NSK is able to provide technical support worldwide and quickly offer innovative solutions. We are able to more rapidly deliver the required products by combining a global production system with a broad lineup that includes precision products and bearings.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

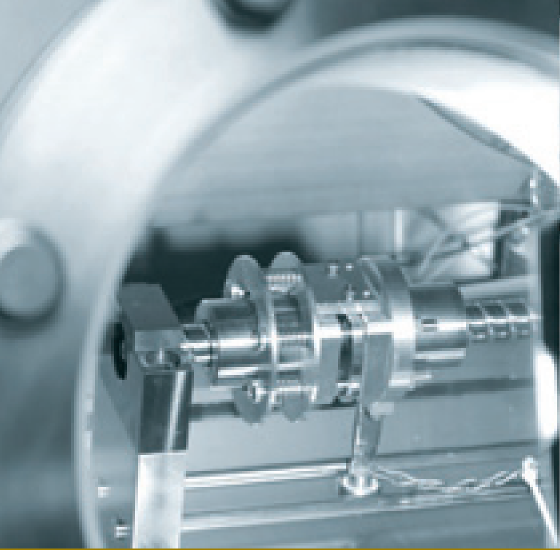
APS

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

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



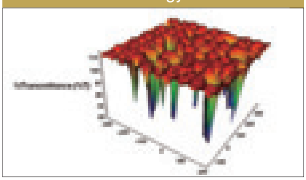
To more effectively respond to customer needs, NSK implemented APS (Advanced Production System) encompassing sales, development, design, manufacturing and distribution. Under our APS, we established a project for streamlining operations to shorten lead times. As a result, the system has boosted supply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



TECHNOLOGY

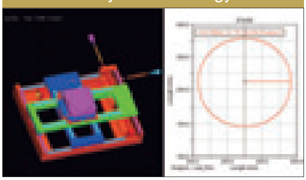
Developing innovative technologies and
products by our four core technologies

Tribology



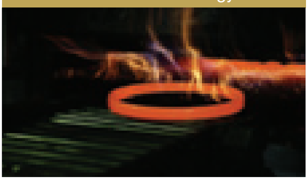
Precision products with rotational and linear movement require lubrication that supports high speed, low noise operation, load capacity, durability, and other desirable functionality. NSK has applied, and provided to customers, advanced tribology (friction control technology) to such areas as grease,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

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:

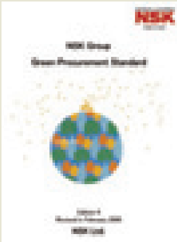
1. Each product should contribute toward the energy and resource conservation by the machine in which it is installed.
2. The amount of energy and resources required during product manufacturing should be minimal.
3. Environmentally harmful substances should not be used in products or manufacturing processes.
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.

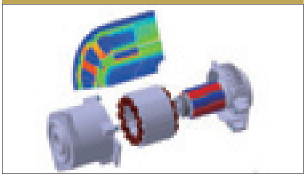
Green Procurement Standards

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



Green Procurement Standards

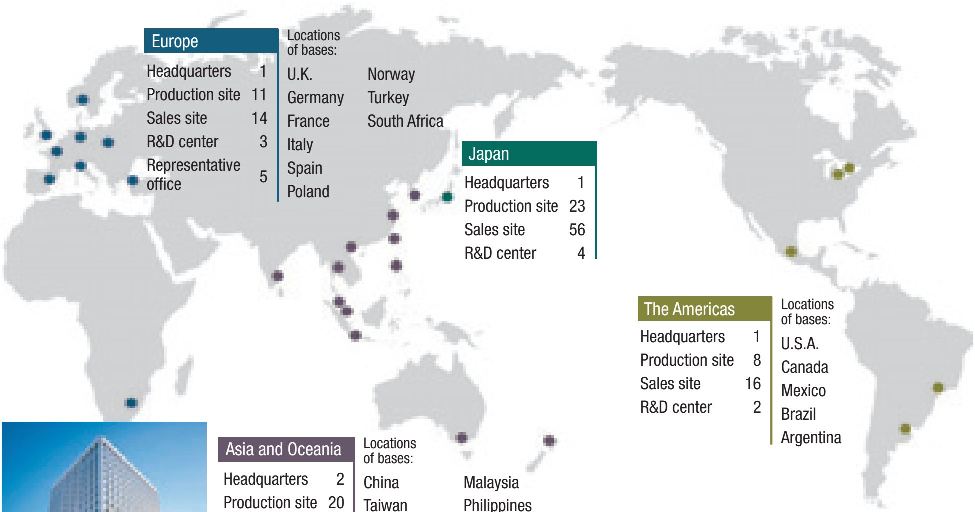
Mechatronics



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

NSK Global Network

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



Europe

Headquarters	1
Production site	11
Sales site	14
R&D center	3
Representative office	5

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

Japan

Headquarters	1
Production site	23
Sales site	56
R&D center	4

The Americas

Headquarters	1
Production site	8
Sales site	16
R&D center	2

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

Asia and Oceania

Headquarters	2
Production site	20
Sales site	43
R&D center	3
Representative office	4

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

NSK Ltd. Headquarters (Shinagawa, Tokyo)

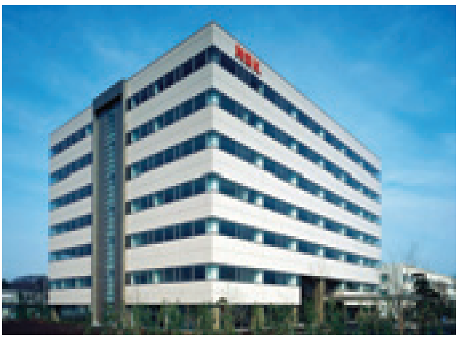
Research & Development

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

Precision Machinery and Parts Technology Center

Maebashi, Gunma

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



Fujisawa Research and Development Center

Fujisawa, Kanagawa

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

Manufacturing Bases

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

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

Maebashi, Gunma

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

Products: Ball Screws, Monocarriers, XY Tables, Support Units

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

Hanyu, Saitama

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

Products: Linear Guides

NSK Kyushu Co., Ltd.

Ukiha, Fukuoka

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

Products: Ball Screws

NSK Precision America, Inc. Franklin Plant

Indiana, U.S.A.

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

Products: Ball Screws, XY Tables

NSK Precision UK, Ltd. Newark Plant

Nottinghamshire, U.K.

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

Products: Linear Guides

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

http://www.nsk.com

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

Preface

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

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

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

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

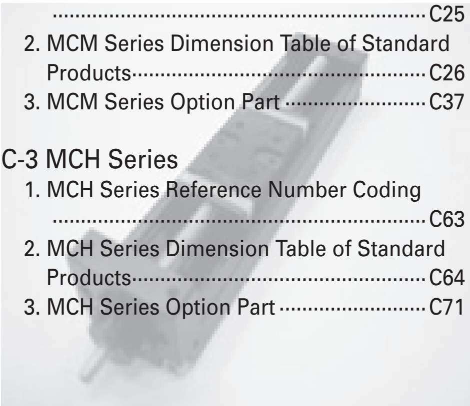
We hope abundant NSK products in the new catalog will be your aide in selecting the most suitable products for your purpose.
We solicit your continued patronage.

Contents

A. NSK Linear Rolling Guide

B. Ball Screws

C. Monocarrier™



D. Other

E Appendices: Tables

A BLOCK

NSK Linear Rolling Guide Product

Precision Machine Components <Linear Rolling Guide Product> Contents

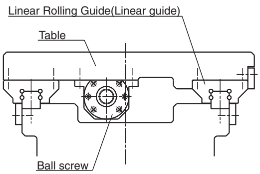
A-1 Characteristics of NSK Linear Rolling Guides

Characteristics of the NSK linear rolling guides are:

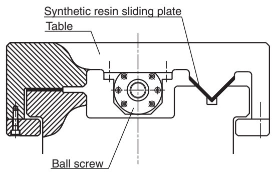
- Designs are simple and economic. This contributes to highly accurate and low cost machines.
- Low friction coefficient facilitates a compact and low cost driving mechanism.
- Ultra-high purity of materials and superb processing technology provide long-term highly reliable operation.
- Prompt delivery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

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

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



Example of rolling guide



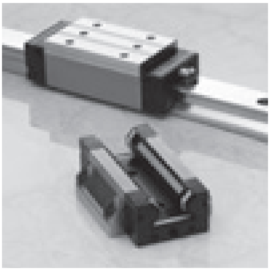
Example of sliding guide

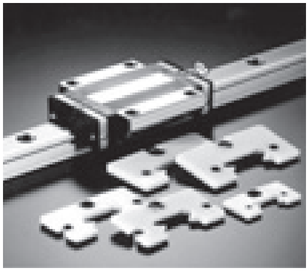
Comparative characteristics of rolling and sliding guide way

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

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

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





(1) Structure of NSK Linear Guides

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

(2) Characteristics of NSK Linear Guides

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

1 High precision and quality

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

2 High reliability and durability

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

3 Abundant in type for any purpose

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

4 Development of random-matching parts for short delivery time

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

5 Patented static load carrying capacity (impact-resistance)

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

6 Lineup of extremely high-load capacity series

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

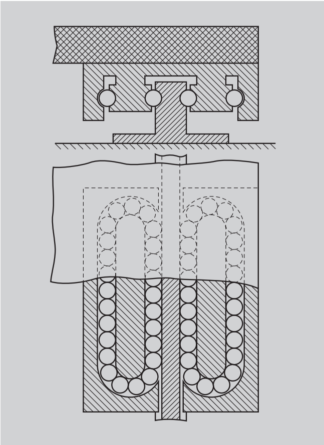


Fig. 1 • **French Patent in 1932.**
• **Inventor : Gretsh (German)**

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

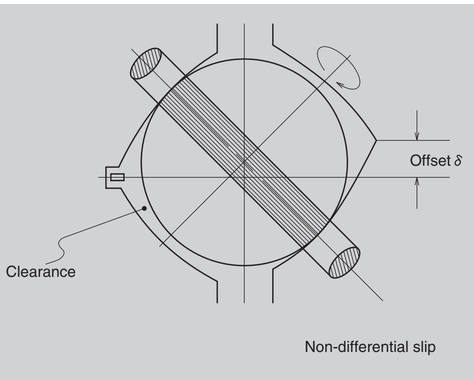


Fig. 3 Two contact point at offset Gothic arch groove

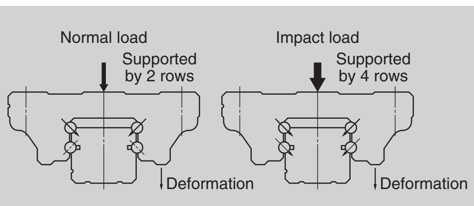


Fig. 5 Shock-resistance

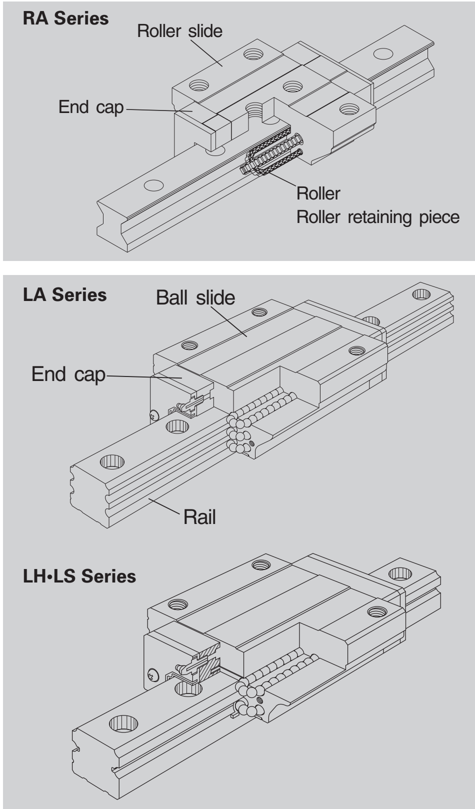


Fig. 2 Structure of NSK linear guides

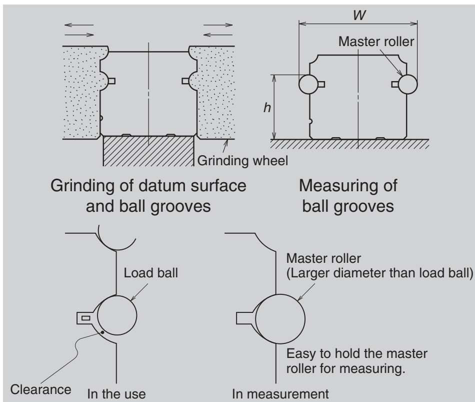
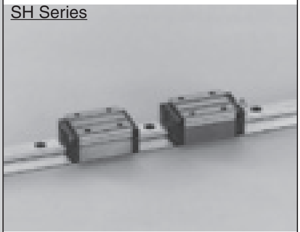
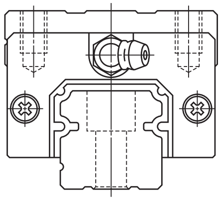
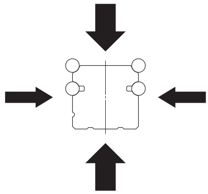
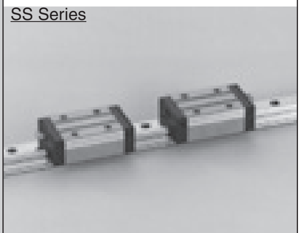
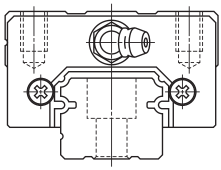
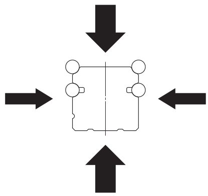
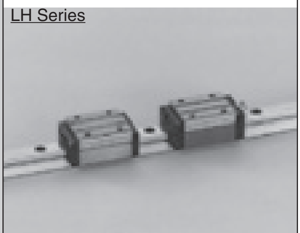
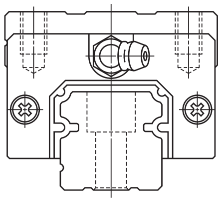
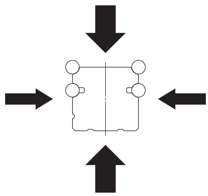
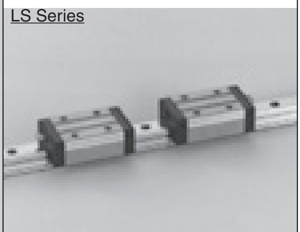
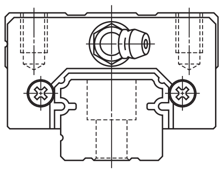
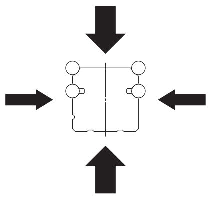


Fig. 4 Processing and measuring grooves

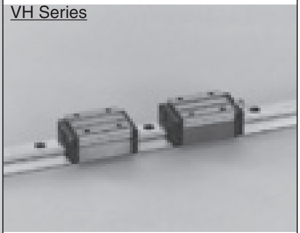
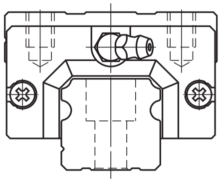
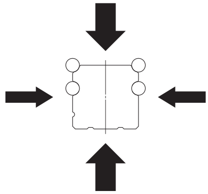
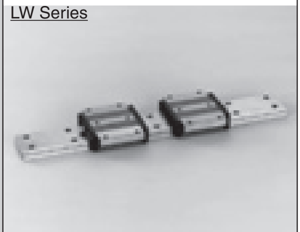
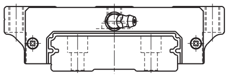
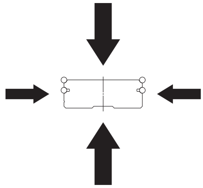
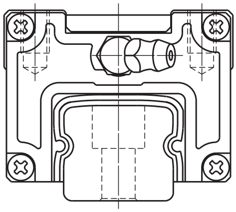
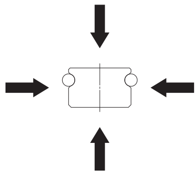
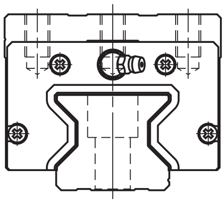
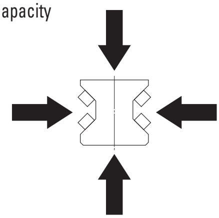
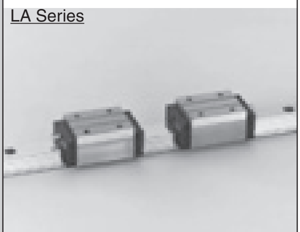
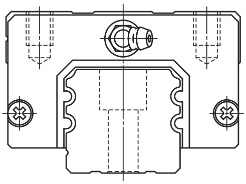
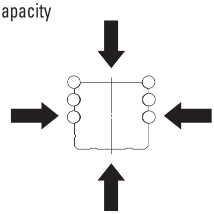
Measuring grooves is easy. You can obtain highly accurate results for all types of NSK series. This is why you can purchase rails and slides separately for random matching.

A-2 Types of NSK Linear Rolling Guides

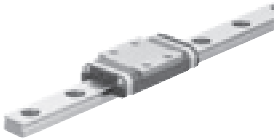
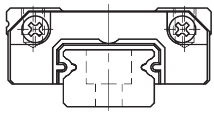
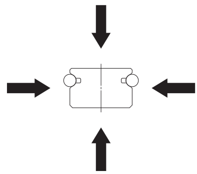
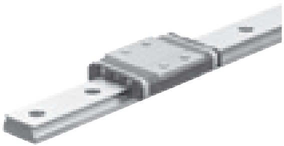
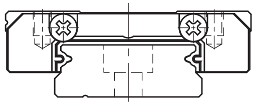
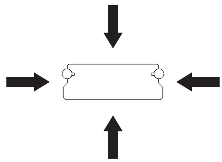
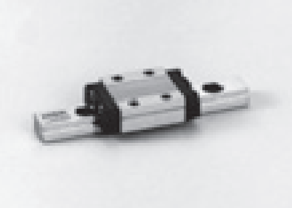
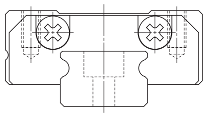
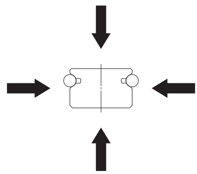
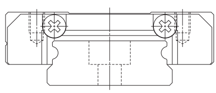
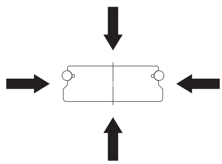
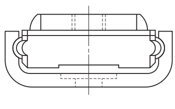
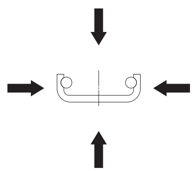
Product	Appearance	Shape	Rolling element	Load capability
NSK Linear Guides	SH Series 		Ball	High vertical load carrying capacity 
	SS Series 		Ball	High vertical load carrying capacity 
	LH Series 		Ball	High vertical load carrying capacity 
	LS Series 		Ball	High vertical load carrying capacity 

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

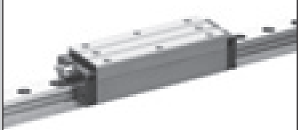
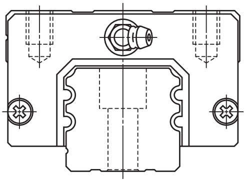
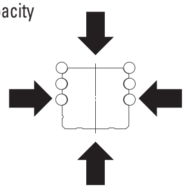
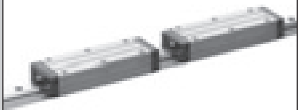
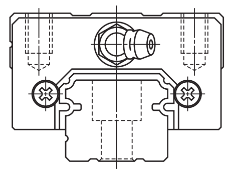
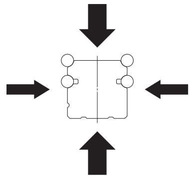
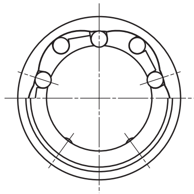
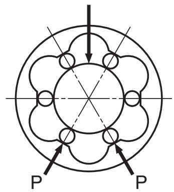
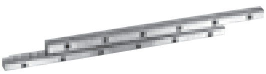
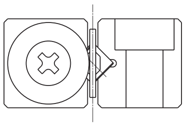
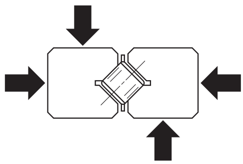
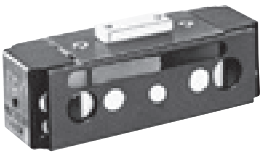
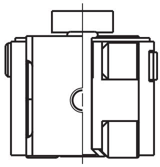
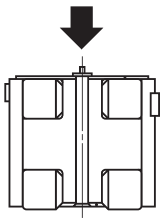
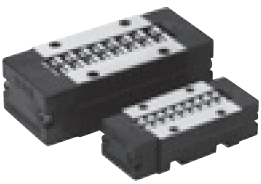
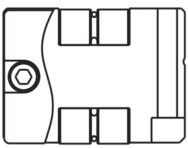
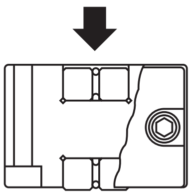
Rigidity	Friction characteristic	Mounting	Major applications	Page
◎	◎	◎	• Industrial robots • Materials handling • Semiconductor manufacturing equipment • Laser processing machines • Electric discharge machines • Packaging/packing machines	A115
◎	◎	◎	• Industrial robots • Materials handling • Electric discharge machines • Semiconductor manufacturing equipment • Packaging/packing machines • Pneumatic components	A139
◎	◎	◎	• Industrial robots • Materials handling • Semiconductor manufacturing equipment • Woodworking machines • Laser processing machines • Electric discharge machines • Packaging/packing machines	A161
◎	◎	◎	• Industrial robots • Materials handling • Electric discharge machines • Woodworking machines • Semiconductor manufacturing equipment • Packaging/packing machines • Pneumatic components	A185

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

Rigidity	Friction characteristic	Mounting	Major applications	Page
◎	◎	◎	• Industrial robots • Materials handling • Woodworking machines • Laser processing machines • Electric discharge machines • Packaging/packing machines	A207
◎	◎	◎	• Industrial robots • Materials handling • Electric discharge machines • Woodworking machines • Semiconductor manufacturing equipment • Packaging/packing machines • Pneumatic components	A229
◎	◎	◎	• Industrial robots • Materials handling • Woodworking machines • Laser processing machines • Electric discharge machines • Packaging/packing machines	A243
☆	◎	◎	• Machining centers • NC lathes • Heavy cutting machine tools • Grinders • Gear cutting machines • Press • Electric discharge machines	A251
⊚	○	◎	• Machining centers • NC lathes • Heavy cutting machine tools • Grinders • Gear cutting machines • Press • Electric discharge machines	A269

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

Rigidity	Friction characteristic	Mounting	Major applications	Page
○	◎	◎	• Semiconductor manufacturing equipment • Liquid crystal display manufacturing equipment • Medical equipment • Optical stage • Microscope XY stage • Small robots • Pneumatic equipment • Computer peripheral equipment	A289
○	◎	◎	• Semiconductor manufacturing equipment • Liquid crystal display manufacturing equipment • Medical equipment • Optical stage • Microscope XY stage • Small robots • Pneumatic equipment • Computer peripheral equipment	A299
○	◎	◎	• Semiconductor manufacturing equipment • Liquid crystal display manufacturing equipment • Medical equipment • Optical stage • Microscope XY stage • Small robots • Pneumatic equipment • Computer peripheral equipment	A309
○	◎	◎	• Semiconductor manufacturing equipment • Liquid crystal display manufacturing equipment • Medical equipment • Optical stage • Microscope XY stage • Small robots • Pneumatic equipment • Computer peripheral equipment	A321
○	◎	◎	• Knitting machines • Computer peripheral equipment • Pneumatic equipment • Office equipment	A335

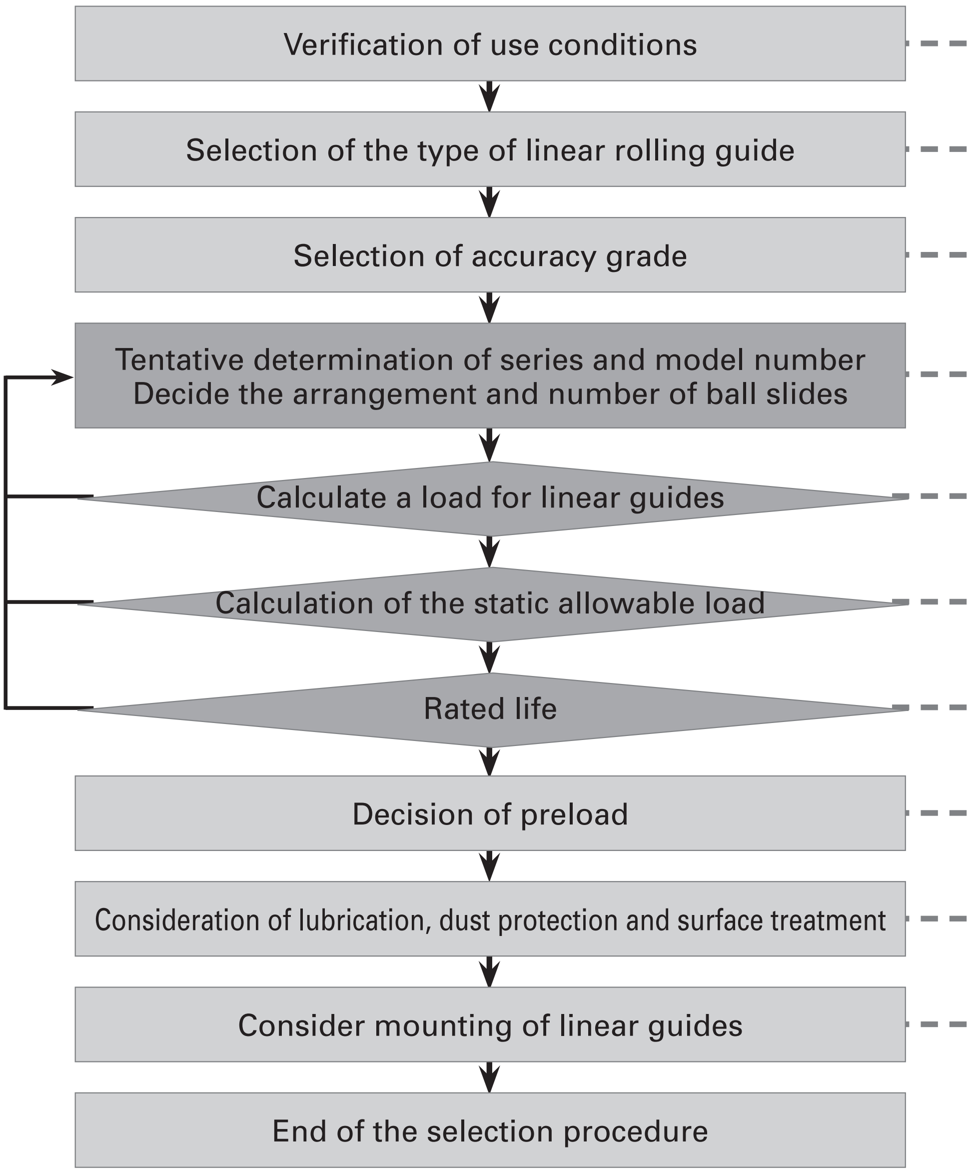
Product	Appearance	Shape	Rolling element	Load capability
NSK Linear Guides	HA Series 		Ball	Four-directional iso-load carrying capacity 
NSK Linear Guides	HS Series 		Ball	High vertical load carrying capacity 
Linear rolling bushing			Ball	
Crossed roller guide			Roller	
Roller pack			Roller	
Linear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

Rigidity	Friction characteristic	Mounting	Major applications	Page
⊚	○	◎	• Machining centers • Precision lathes • Grinders • Electric discharge machines • Optical stage • Liquid crystal display manufacturing equipment • Die and mold tooling machine • Precision measuring equipment	A341
⊚	◎	◎	• Machining centers • Precision lathes • Grinders • Electric discharge machines • Optical stage • Liquid crystal display manufacturing equipment • Precision measuring equipment	A355
○	◎	○	• Materials handling • Packaging/packing machines • Medical equipment • Pneumatic components • Office equipment • Assembling machines	A369
◎	◎	○	• Precision stage • Measuring equipment • Test equipment • Printed circuit board assembly	A380
⊚	◎	○	• Large machine tools • Conveyor system for heavy objects (guide for heavy load)	A386
⊚	◎	○	• Large machine tools • Conveyor system for heavy objects (guide for heavy load)	A393

A-3 Selection of NSK Linear Rolling Guides

A-3-1 Selection Flow Chart

Selection flow chart of NSK linear rolling guides



	Page
• Machine structure, guide installation space, installation position • Required functional conditions (required life, rigidity and accuracy) and use environment • Consider the load, rigidity, friction and installation position, and select the type of linear rolling guide most suitable to the condition requirements.	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 Description of the series of NSK Linear Guides
• Decide by the required running accuracy of the machine.	A32 Description of the accuracy
• Select 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 Description of the series of NSK Linear Guides
• Calculate up/down, right/left direction loads 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 condition 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 use environment.	A38 Description of lubrication A52 Description of dust protection
• Select 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 "life of accuracy deterioration" which is caused by wear.

(2) Rating fatigue life

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

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

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

(3) Basic load ratings in compliance with ISO standard

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

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

ISO : International Organization for Standardization

[Basic dynamic load rating]

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

Part 1: Dynamic load ratings and rating life

[Basic static load rating]

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

Part 2: Static load ratings

(4) Basic dynamic load rating

- Basic dynamic load rating, which indicates load carrying capacity of the linear guide, is a load whose direction and volume do not change, and which furnishes 50 km of rating fatigue life.
- In case of linear guide, it is a constant load applied to downward direction to the center of the slide.
- Value of basic dynamic load rating C is shown in "**A-5 Linear Guide Dimension Table.**"
- NSK defines the basic dynamic load rating as the load that furnishes 50 km of rated fatigue life. However some linear guide manufacturers in Europe and the United States define the load for the basic fatigue life of 100 km as the basic dynamic load ratings.
- The following formula may be used to convert the basic dynamic load rating C_{50} into the dynamic load rating for 100 km rated fatigue life.

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

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

(5) Calculation of rating fatigue life

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

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

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

L : Rating fatigue life (km)

C : Basic dynamic load rating (N) (50 km)

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

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

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

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

L : Rating fatigue life (km)

C_{100} : Dynamic load rating for 100 km (N)

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

(6) Dynamic equivalent load

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

(7) Basic static load rating

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

(8) Basic static moment load rating

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

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

(9) Basic load rating by load direction

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

Table 2.1 Basic load ratings by load direction

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

A-3-2.2 How to Calculate Life

(1) Setting operating condition of linear guide

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

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

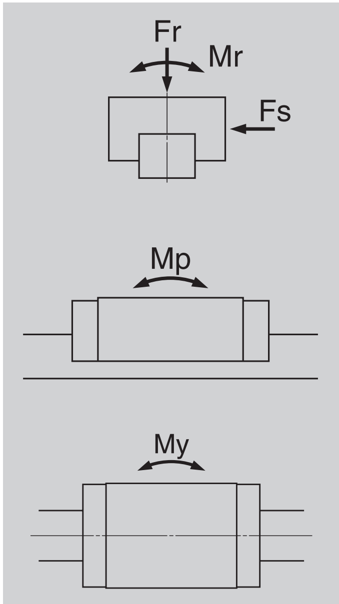


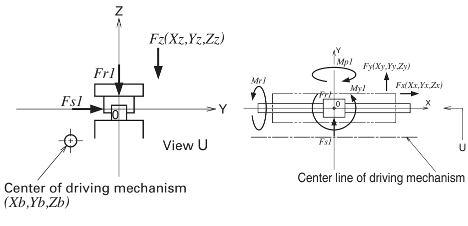
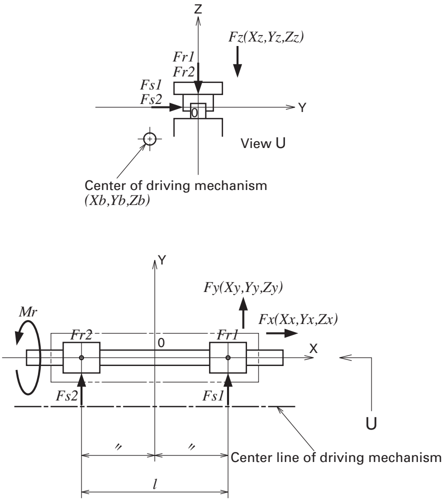
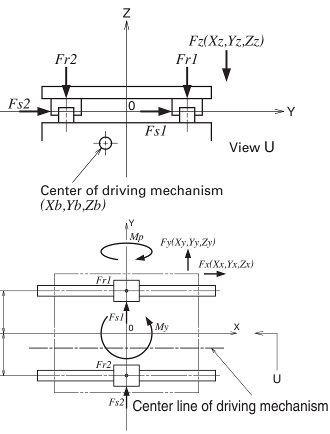
Fig. 2.1

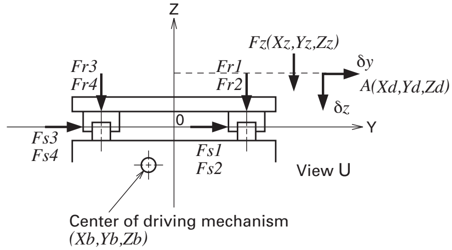
(2) Calculating load to a slide

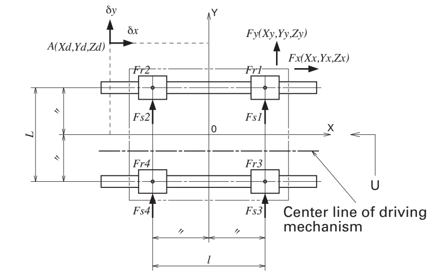
- Table 2.2 shows a formula to calculate loads that are going to be applied to each assembled slide into a machine.
  The Table shows six typical patterns of linear guide installing structure.
- In the Tables, directions indicated by arrows denote "plus" for the applied loads (F_x, F_y, F_z) and the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

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

Table 2.2 Loads applied to the slides

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

<table>
<tr><th>Pattern</th><th>Arrangement of slides</th><th>Load to slide and deformation at Point A</th></tr>
<tr><td>4</td><td>




</td><td>

$$Fr_1=\frac{\sum_{k=1}^{n}Fz_k}{4}+\frac{M1}{2L}+\frac{M2}{2l}\quad,\quad Fr_2=\frac{\sum_{k=1}^{n}Fz_k}{4}+\frac{M1}{2L}-\frac{M2}{2l}$$

$$Fr_3=\frac{\sum_{k=1}^{n}Fz_k}{4}-\frac{M1}{2L}+\frac{M2}{2l}\quad,\quad Fr_4=\frac{\sum_{k=1}^{n}Fz_k}{4}-\frac{M1}{2L}-\frac{M2}{2l}$$

$$Fs_1=Fs_3=\frac{\sum_{j=1}^{n}Fy_j}{4}+\frac{M3}{2l}\quad,\quad Fs_2=Fs_4=\frac{\sum_{j=1}^{n}Fy_j}{4}-\frac{M3}{2l}$$

$$M1=\sum_{j=1}^{n}\left(Fy_j\cdot Zy_j\right)+\sum_{k=1}^{n}\left(Fz_k\cdot Yz_k\right)$$

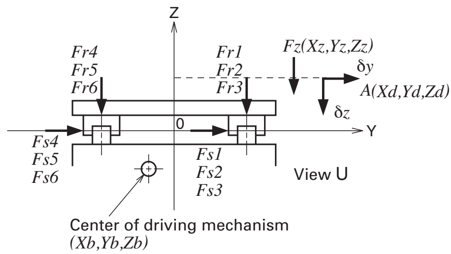
$$M2=\sum_{i=1}^{n}\left\{Fx_i\left(Zx_i-Zb\right)\right\}+\sum_{k=1}^{n}\left(Fz_k\cdot Xz_k\right)$$

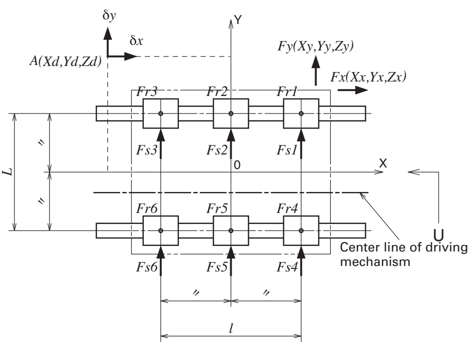
$$M3=-\sum_{i=1}^{n}\left\{Fx_i\left(Yx_i-Yb\right)\right\}+\sum_{j=1}^{n}\left(Fy_j\cdot Xy_j\right)$$

$$\delta x=Y_d\cdot\frac{Fs_2-Fs_1}{l\cdot Ks}+Z_d\cdot\frac{Fr_1-Fr_2}{l\cdot Kr}$$

$$\delta y=\frac{\sum_{j=1}^{n}Fy_j}{4\cdot Ks}+X_d\cdot\frac{Fs_1-Fs_2}{l\cdot Ks}+Z_d\cdot\frac{Fr_1-Fr_3}{L\cdot Kr}$$

$$\delta z=\frac{\sum_{k=1}^{n}Fz_k}{4\cdot Kr}+X_d\cdot\frac{Fr_1-Fr_2}{l\cdot Kr}+Y_d\cdot\frac{Fr_1-Fr_3}{L\cdot Kr}$$

</td></tr>
<tr><td>5</td><td>




</td><td>

$$Fr_1=\frac{\sum_{k=1}^{n}Fz_k}{6}+\frac{M1}{3L}+\frac{M2}{2l}\quad,\quad Fr_2=\frac{\sum_{k=1}^{n}Fz_k}{6}+\frac{M1}{3L}$$

$$Fr_3=\frac{\sum_{k=1}^{n}Fz_k}{6}+\frac{M1}{3L}-\frac{M2}{2l}\quad,\quad Fr_4=\frac{\sum_{k=1}^{n}Fz_k}{6}-\frac{M1}{3L}+\frac{M2}{2l}$$

$$Fr_5=\frac{\sum_{k=1}^{n}Fz_k}{6}-\frac{M1}{3L}\quad,\quad Fr_6=\frac{\sum_{k=1}^{n}Fz_k}{6}-\frac{M1}{3L}-\frac{M2}{2l}$$

$$Fs_1=Fs_4=\frac{\sum_{j=1}^{n}Fy_j}{6}+\frac{M3}{2l}\quad,\quad Fs_2=Fs_5=\frac{\sum_{j=1}^{n}Fy_j}{6}$$

$$Fs_3=Fs_6=\frac{\sum_{j=1}^{n}Fy_j}{6}-\frac{M3}{2l}$$

$$M1=\sum_{j=1}^{n}\left(Fy_j\cdot Zy_j\right)+\sum_{k=1}^{n}\left(Fz_k\cdot Yz_k\right)$$

$$M2=\sum_{i=1}^{n}\left\{Fx_i\cdot\left(Zx_i-Zb\right)\right\}+\sum_{k=1}^{n}\left(Fz_k\cdot Xz_k\right)$$

$$M3=-\sum_{i=1}^{n}\left\{Fx_i\cdot\left(Yx_i-Yb\right)\right\}+\sum_{j=1}^{n}\left(Fy_j\cdot Xy_j\right)$$

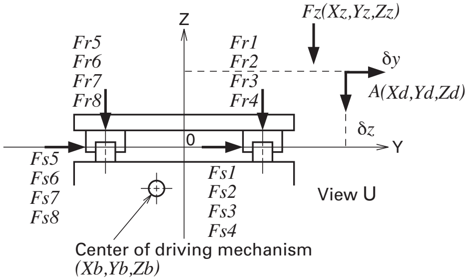
$$\delta x=Y_d\cdot\frac{Fs_3-Fs_1}{l\cdot Ks}+Z_d\cdot\frac{Fr_1-Fr_3}{l\cdot Kr}$$

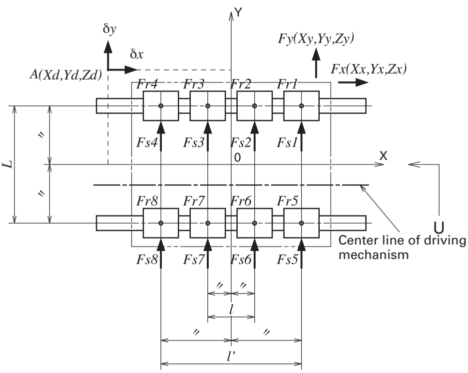
$$\delta y=\frac{\sum_{j=1}^{n}Fy_j}{6\cdot Ks}+X_d\cdot\frac{Fs_1-Fs_3}{l\cdot Ks}+Z_d\cdot\frac{Fr_1-Fr_4}{L\cdot Kr}$$

$$\delta z=\frac{\sum_{k=1}^{n}Fz_k}{6\cdot Kr}+X_d\cdot\frac{Fr_1-Fr_3}{l\cdot Kr}+Y_d\cdot\frac{Fr_1-Fr_4}{L\cdot Kr}$$

</td></tr>
</table>

Pattern	Arrangement of slides	Load to slide and deformation at Point A
6	see figures below	see equations below





$$Fr_1 = \frac{\sum_{k=1}^{n} Fz_k}{8} + \frac{M1}{4L} + \frac{M2 \cdot l'}{2 \cdot (l^2 + l'^2)}$$

$$Fr_2 = \frac{\sum_{k=1}^{n} Fz_k}{8} + \frac{M1}{4L} + \frac{M2 \cdot l}{2 \cdot (l^2 + l'^2)}$$

$$Fr_3 = \frac{\sum_{k=1}^{n} Fz_k}{8} + \frac{M1}{4L} - \frac{M2 \cdot l}{2 \cdot (l^2 + l'^2)}$$

$$Fr_4 = \frac{\sum_{k=1}^{n} Fz_k}{8} + \frac{M1}{4L} - \frac{M2 \cdot l'}{2 \cdot (l^2 + l'^2)}$$

$$Fr_5 = \frac{\sum_{k=1}^{n} Fz_k}{8} - \frac{M1}{4L} + \frac{M2 \cdot l'}{2 \cdot (l^2 + l'^2)}$$

$$Fr_6 = \frac{\sum_{k=1}^{n} Fz_k}{8} - \frac{M1}{4L} + \frac{M2 \cdot l}{2 \cdot (l^2 + l'^2)}$$

$$Fr_7 = \frac{\sum_{k=1}^{n} Fz_k}{8} - \frac{M1}{4L} - \frac{M2 \cdot l}{2 \cdot (l^2 + l'^2)}$$

$$Fr_8 = \frac{\sum_{k=1}^{n} Fz_k}{8} - \frac{M1}{4L} - \frac{M2 \cdot l'}{2 \cdot (l^2 + l'^2)}$$

$$Fs_1 = Fs_5 = \frac{\sum_{j=1}^{n} Fyj}{8} + \frac{M3 \cdot l'}{2 \cdot (l^2 + l'^2)}$$

$$Fs_2 = Fs_6 = \frac{\sum_{j=1}^{n} Fy_j}{8} + \frac{M3 \cdot l}{2 \cdot (l^2 + l'^2)}$$

$$Fs_3 = Fs_7 = \frac{\sum_{j=1}^{n} Fy_j}{8} - \frac{M3 \cdot l}{2 \cdot (l^2 + l'^2)}$$

$$Fs_4 = Fs_8 = \frac{\sum_{j=1}^{n} Fy_j}{8} - \frac{M3 \cdot l'}{2 \cdot (l^2 + l'^2)}$$

$$M1 = \sum_{j=1}^{n} (Fy_j \cdot Zy_j) + \sum_{k=1}^{n} (Fz_k \cdot Yz_k)$$

$$M2 = \sum_{i=1}^{n} \{Fx_i \cdot (Zx_i - Zb)\} + \sum_{k=1}^{n} (Fz_k \cdot Xz_k)$$

$$M3 = -\sum_{i=1}^{n} \{Fx_i \cdot (Yx_i - Yb)\} + \sum_{j=1}^{n} (Fy_j \cdot Xy_j)$$

$$\delta x = Y_d \cdot \frac{Fs_4 - Fs_1}{l_2 \cdot Ks} + Z_d \cdot \frac{Fr_1 - Fr_4}{l_2 \cdot Kr}$$

$$\delta y = \frac{\sum_{j=1}^{n} Fy_j}{8 \cdot Ks} + X_d \cdot \frac{Fs_1 - Fs_4}{l_2 \cdot Ks} + Z_d \cdot \frac{Fr_1 - Fr_5}{L \cdot Kr}$$

$$\delta z = \frac{\sum_{k=1}^{n} Fz_k}{8 \cdot Kr} + X_d \cdot \frac{Fr_1 - Fr_4}{l_2 \cdot Kr} + Y_d \cdot \frac{Fr_1 - Fr_5}{L \cdot Kr}$$

(3) Calculation of dynamic equivalent load

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

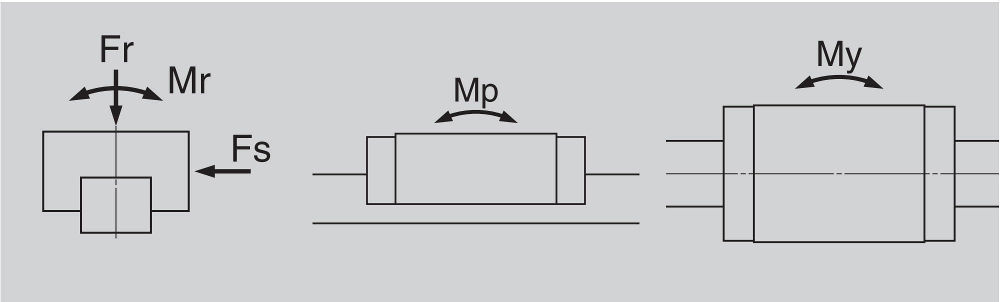
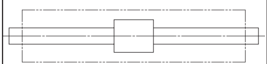
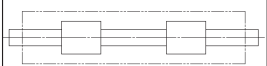
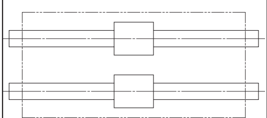
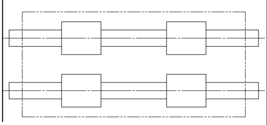


Fig. 2.3

Table 2.3 Loads in the arrangement of linear guides

Pattern	Arrangement of linear guide	Loads necessary to calculate dynamic equivalent load					Dynamic equivalent load
		Load		Moment load			
		Up/down (vertical)	Right/left (lateral)	Rolling	Pitching	Yawing	
1		F_r	F_s	M_r	M_p	M_y	$F_r = F_r$ $F_{se} = F_s \cdot \tan\alpha$ $F_{re} = \varepsilon_r \cdot M_r$ $F_{pe} = \varepsilon_p \cdot M_p$ $F_{ye} = \varepsilon_y \cdot M_y$ α : Contact angle SH, SS, LH, LS, VH, LW, HS Series $\alpha = 50°$ TS, RA, LA, PU, PE, LU, LE, 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 dynamic equivalent coefficient ε in the table below for easy conversion of moment load to dynamic equivalent load.
- 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
SH15	188	112	133	LS35S	76	87	104	PU12	163	204	204
SH15L	188	68	81					PU12L	163	125	125
SH20	142	82	98	VH15	188	111	132	PU15	133	174	174
SH20L	142	56	67	VH15L	188	72	86	PU15L	133	102	102
SH25	123	66	78	VH20	142	81	97				
SH25L	123	47	56	VH20L	142	57	68	PE05	194	277	277
SH30A	98	74	89	VH25	123	68	81	PE07	141	203	203
SH30EF	98	60	71	VH25L	123	51	61	PE09	123	161	161
SH30L	98	42	50	VH30A	98	70	83	PE09L	123	108	108
SH35	78	54	64	VH30EF	98	58	69	PE12	90	136	136
SH35L	78	36	43	VH30L	98	44	52	PE12L	90	90	90
SH45	60	39	46	VH35	78	51	61	PE15	50	111	111
SH45L	60	29	35	VH35L	78	36	43	PE15L	50	72	72
SH55	51	33	39	VH45	60	38	45				
SH55L	51	24	29	VH45L	60	30	36	LU05	385	359	359
				VH55	51	31	37	LU07	286	305	305
SS15	177	97	115	VH55L	51	25	30	LU09	217	242	242
SS15S	177	176	210					LU09L	217	138	138
SS20	127	87	104	LW17	66	125	149	LU09R	217	203	203
SS20S	127	138	164	LW21	59	108	129	LU12	167	204	204
SS25	111	70	83	LW27	53	76	91	LU12L	167	116	116
SS25S	111	115	137	LW35	32	51	61	LU15	133	174	174
SS30	94	57	68	LW50	25	38	46	LU15L	133	94	94
SS30S	94	106	126								
SS35	76	42	50	RA15	105	95	95	LE05	196	248	248
SS35S	76	94	112	RA15L	105	70	70	LE05S	196	323	323
				RA20	79	74	74	LE07	141	188	188
LH08	316	269	321	RA20L	79	55	55	LE07S	141	349	349
LH10	253	203	242	RA25	71	64	64	LE07L	141	122	122
LH12	223	136	162	RA25L	71	50	50	LE09	123	149	149
LH15	188	111	132	RA30	56	58	58	LE09S	123	277	277
LH15L	188	72	86	RA30L	56	44	44	LE09L	123	102	102
LH20	142	81	97	RA35	46	52	52	LE12	90	125	125
LH20L	142	57	68	RA35L	46	39	39	LE12S	90	233	233
LH25	123	68	81	RA45	37	40	40	LE12L	90	86	86
LH25L	123	51	61	RA45L	37	30	30	LE15	50	102	102
LH30A	98	70	83	RA55	32	33	33	LE15S	50	174	174
LH30EF	98	58	69	RA55L	32	24	24	LE15L	50	68	68
LH30L	98	44	52	RA65	26	28	28				
LH35	78	51	61	RA65L	26	19	19	HA25	122	33	33
LH35L	78	36	43					HA30	105	27	27
LH45	60	38	45	LA25	122	76	76	HA35	84	23	23
LH45L	60	30	36	LA25L	122	47	47	HA45	60	20	20
LH55	51	31	37	LA30	105	63	63	HA55	51	16	16
LH55L	51	25	30	LA30L	105	43	43				
LH65	43	27	32	LA35	84	54	54	HS15	177	45	54
LH65L	43	20	24	LA35L	84	37	37	HS20	127	39	47
LH85L	33	17	20	LA45	60	41	41	HS25	111	33	39
				LA45L	60	31	31	HS30	94	27	32
LS15	177	116	138	LA55	51	33	33	HS35	76	23	28
LS15S	177	174	208	LA55L	51	26	26				
LS20	127	94	112	LA65	43	29	29	TS15	128	122	122
LS20S	127	136	162	LA65L	43	20	20	TS20	97	90	90
LS25	111	70	83					TS25	81	77	77
LS25S	111	108	129	PU05	377	431	431	TS30	67	61	61
LS30	94	63	75	PU07	267	349	349	TS35	55	54	54
LS30S	94	102	121	PU09	215	222	222				
LS35	76	54	64	PU09L	215	136	136				

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

L	: Super-high-load type	; LH45L
S	: Medium load type	; LS25S
No code	: High-load type	; LY45__
A	: Ball slide shape is square	; LH30A (only LH30 and SH30)
EF	: Ball slide shape is flanged type (EL, FL type)	; LH30EF (only LH30 and SH30)
R	: Miniature Series with ball retainer	; LU09R

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

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

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

(4) Calculation of mean effective load

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

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

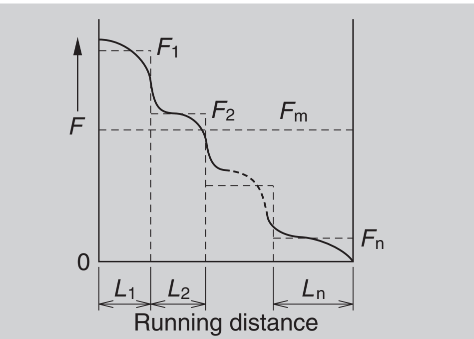


Fig. 2.3 Stepwise load change

Running distance while dynamic equivalent load F_1 is applied: L_1

Running distance while dynamic equivalent load F_2 is applied: L_2

Running distance while dynamic equivalent load F_3 is applied: L_3

• • • • • • • • • • • • • • • • • •

Running distance while dynamic equivalent load F_n is applied: L_n

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

In case of ball

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

In case of roller

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

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

L : Running distance (ΣLn)

② **When load changes almost lineally (Fig. 2.4)**

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

$$F\mathrm{m} \doteqdot \frac{1}{3}(F\mathrm{min} + 2F\mathrm{max})$$

Fmin : Minimum value of dynamic equivalent load (N)

Fmax : Maximum value of dynamic equivalent load (N)

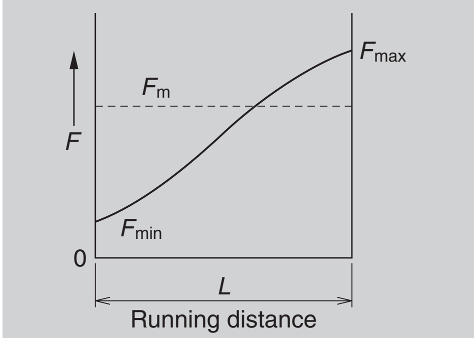


Fig. 2.4 Linear load change

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

At time of (a): Fm = 0.65 Fmax

At time of (b): Fm = 0.75 Fmax

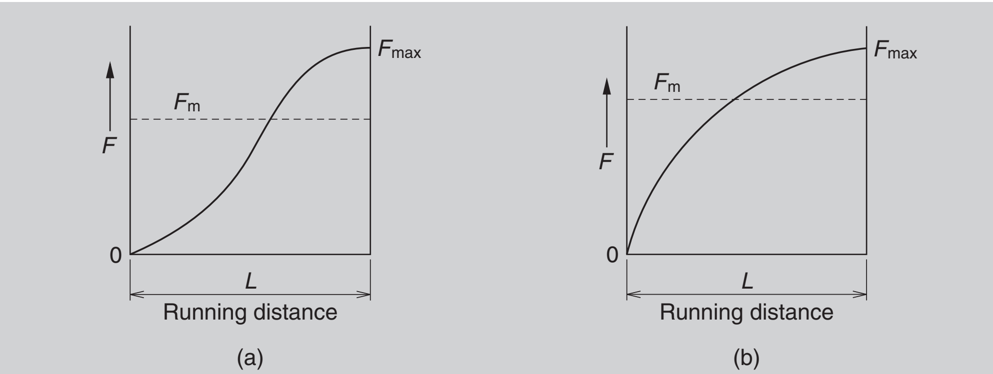


Fig. 2.5 Load that changes in sinusoidal pattern

(5) Various coefficients

① **Load factors**

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

Table 2.5 Load factor fw

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

② **Hardness coefficient**

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

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

C_H : Basic dynamic load rating adjusted by hardness coefficient

f_H : Hardness coefficient (Refer to Fig. 2.6)

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

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

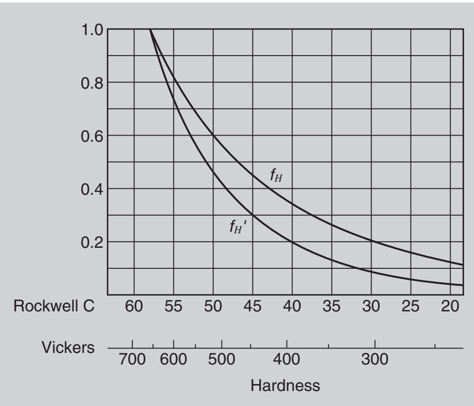


Fig. 2.6 Hardness coefficient

③ **Reliability coefficient**

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

(6) Calculation of rating life

Life Calculating Formula

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

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

Ball linear guide bearing which uses balls n = 3

Roller linear guide bearing which uses rollers n = 10/3

f_H : Hardness coefficient

f_W : Load factor

$F\mathrm{m}$: Mean effective load

Use basic dynamic load rating C to calculate the life.

Note: Do not use basic static load rating C_0, and basic static moment rating M_{R0}, M_{P0} or M_{Y0}.

Life as an entire guide way system

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

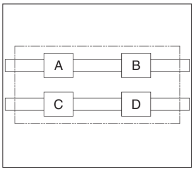


Fig. 2.7 Life of a system

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

(7) Examination of static load

① **Examine from basic static load rating**

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

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

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

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

If compressed load and lateral load are combined

$$P_0 = Fr + 1.54Fs$$

If tensile load and lateral load are combined

$$P_0 = 1.28Fr + 1.54Fs$$

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

$$P_0 = Fr + Fs$$

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

Table 2.6

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

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

② **Examining from static moment load rating**

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

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

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

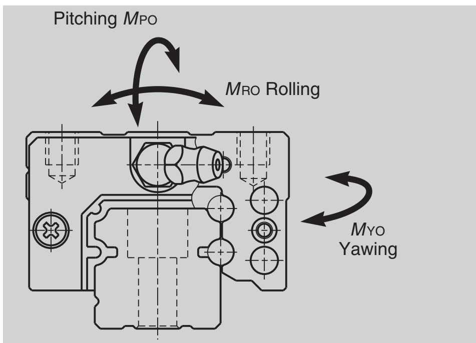


Fig. 2.8 Moment load directions

(8) Precautions for the design in examining the life

The following points must be heeded in examining the life.

In case of oscillating stroke

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

When applying pitching or yawing moment

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

When an extraordinary large load is applied during stroke

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

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

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

Application at high speed

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

A-3-3 Preload

(1) Objective of preload

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

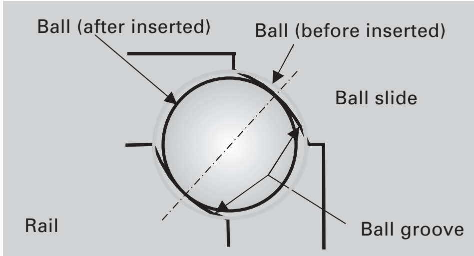


Fig.3.1 Preloading method

(2) Preload and rigidity

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

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).

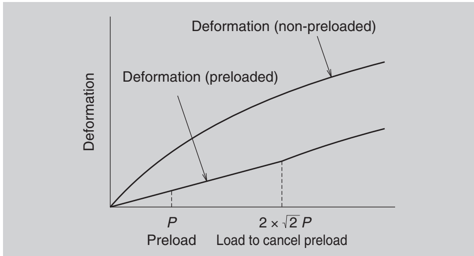


Fig. 3.2 Elastic deformation

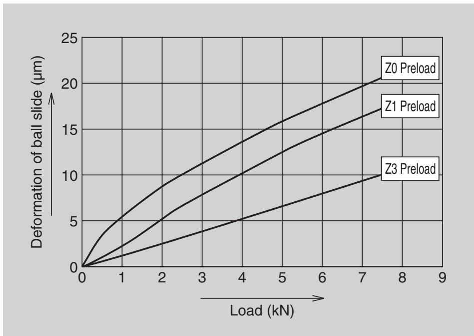


Fig. 3.3 Rigidity of SH35, downward direction load (example)

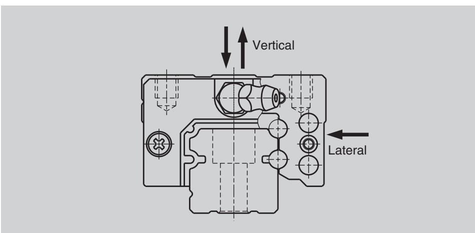


Fig. 3.4 Radial rigidity

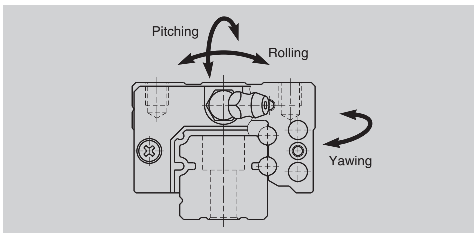


Fig. 3.5 Moment rigidity

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

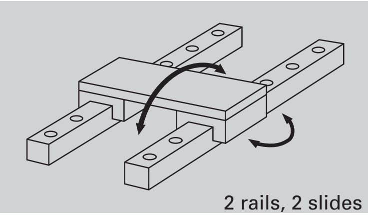


Fig. 3.6 Pitching and yawing direction

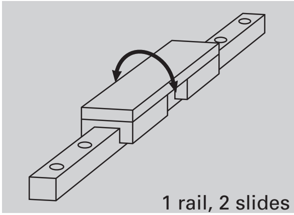


Fig. 3.7 Rolling direction

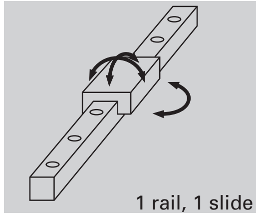


Fig. 3.8 All directions

(3) Selection of preload types

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

Table 3.1 Classification of preload in each series

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

Table 3.2 Loads

Classification of preload	Use condition	Applications
Z0, ZT, ZS (Fine clearance)	• An application in which a set of parallel two linear guides (four ball slides/two rails) is used to sustain a unidirectional load with low vibration and impact. • Application in which the accuracy is not very necessary but a friction force must be minimized.	Welding machine, Glass processing machine, Packaging/packing machines, Materials handling
Z1, ZZ (Slight preload)	• Moment loads are applied. • Application for highly accurate.	Industrial robot , Inspection/measuring equipment, Laser cutting machine, Electric discharge machine, PCB driller , Mounter
Z3, 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) Deformation Calculation

The followings are the relation between load and deformation.

• Without preload

When the rolling element is ball

The deformation is proportional to the 2/3 power of the load.

When the rolling element is roller

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

• With preload

The deformation is directly proportional to the load.

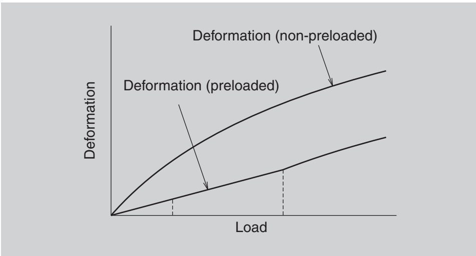


Fig. 3.9 Elastic deformation

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

<Required conditions to calculate deformation>

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

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

(5) Application examples of preload

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

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

Table 3.3 Examples of preload for specific purpose

Type of machine	Application	Preload			
		Heavy preload Z4	Medium preload Z3	Slight preload Z1, ZZ	Fine clearance Z0, ZT, ZS
Machine tools	• Machining centers	○	○		
	• Grinders	○	○		
	• Lathes	○	○		
	• Milling machines	○	○		
	• Drilling machines	○	○		
	• Boring machines		○		
	• Gear cutters	○	○		
	• Diesinking machine		○	○	
	• Laser cutting machine		○	○	
	• Electric discharge machine		○		
Industrial machines and equipment	• Punch press		○	○	
	• Press machine			○	○
	• Welding machine		○	○	○
	• Painting machine			○	○
	• Textile machine			○	○
	• Coil winder		○	○	
	• Woodworking machine		○	○	○
	• Glass processing machine			○	○
	• Stone cutting machine			○	○
	• Tire forming machine			○	○
	• ATC			○	○
	• Industrial robot		○	○	○
	• Materials handling			○	○
	• Packing machine			○	○
	• Construction machine				○
Semiconductor facilities	• Prober		○		
	• Wire bonder		○	○	
	• PCB driller		○	○	
	• Slicer		○		
	• Dicer		○		
	• Chip mounter		○	○	
	• IC handler			○	
	• Scanner			○	
	• Lithographic machine		○	○	
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 consider preload for calculation of rating life, when the Z3 (medium preload) or the Z4 (heavy preload) preload code is specified. Please consult NSK.

(7) Calculating Friction Force by Preload

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

$F = iP$

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

Use the following contact coefficient values (i).

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

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

Calculation example

In case of LH35AN - Z3

$i = 0.004$

$P = 2350$ (N) (refer to LH series preload)

$F = iP$

$= 0.004 \times 2350 = 9.4$ (N)

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

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

A-3-4 Accuracy

(1) Accuracy standard

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

(2) Definition of Accuracy

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

Table 4.1 Definition of accuracy

Characteristics	Definition (Figures 4.1 and 4.2)
Mounting height *H*	Distance from A (rail bottom datum face) to C (slide top face)
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 face) to D (slide side datum face). 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, face C to face A	Variation of C (slide top face) to A (rail bottom datum face) when slide is moving.
Running parallelism of slide, face D to face B	Variation of D (slide side datum face) to B (rail side datum face) when a slide is moving.

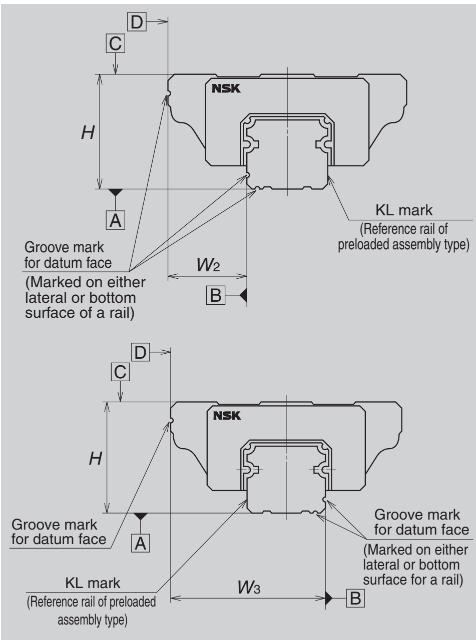


Fig. 4.1 Assembled dimensions

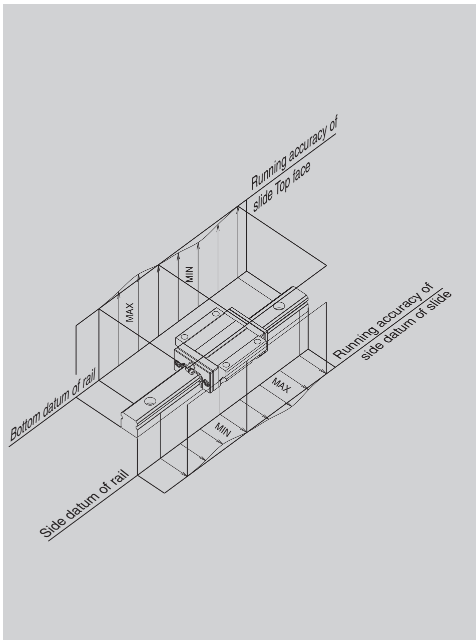


Fig. 4.2 Running parallelism of slide

Mounting width: W_2, and W_3

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

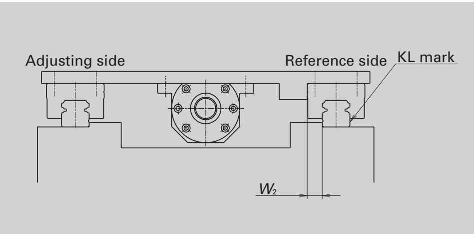


Fig. 4.3 Mounting width W_2

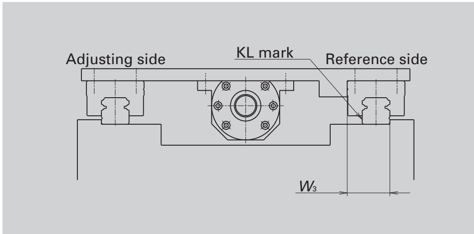


Fig. 4.4 Mounting width W_3

Running Parallelism of Ball Slide

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

Table 4.2 Running parallelism of slide

Unit: μm

Rail over all length (mm) \ Accuracy grade		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	Normal grade PC
–	50	2	2	2	4.5	6	6
50	80	2	2	3	5	6	6
80	125	2	2	3.5	5.5	6.5	6.5
125	200	2	2	4	6	7	7
200	250	2	2.5	5	7	8	8
250	315	2	2.5	5	8	9	9
315	400	2	3	6	9	11	11
400	500	2	3	6	10	12	12
500	630	2	3.5	7	12	14	14
630	800	2	4.5 (4)	8	14	16	16
800	1000	2.5	5 (4.5)	9	16	18	18
1000	1250	3	6 (5)	10	17	20	20
1250	1600	4	7 (6)	11	19	23	23
1600	2000	4.5	8 (7)	13	21	26	26
2000	2500	5	10 (8)	15	22	29	29
2500	3150	6	11 (9.5)	17	25	32	32
3150	4000	9	16	23	30	34	34

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

(3) Application examples of accuracy grade

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

Table 4.3 Application examples of accuracy grade and preload

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

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

(4) Combination of accuracy grade and preload

① Accuracy grades

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

Table 4.4 Accuracy grades and applicable series

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

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

② Preload

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

Table 4.5 Classification of preload

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

Note : 1) Z3 preload types for LW Series are LW35 and 50 only.
2) "Z" is omitted from the specification number (refer to each series).

③ Combinations of accuracy grade and preload

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

Table 4.6 Combinations of accuracy grade and preload type

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

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

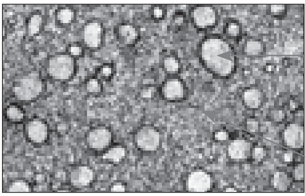
A-3-5 Lubrication

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

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

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

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



Enlarged surface of "NSK K1" Lubrication Unit

100μm

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

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

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

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

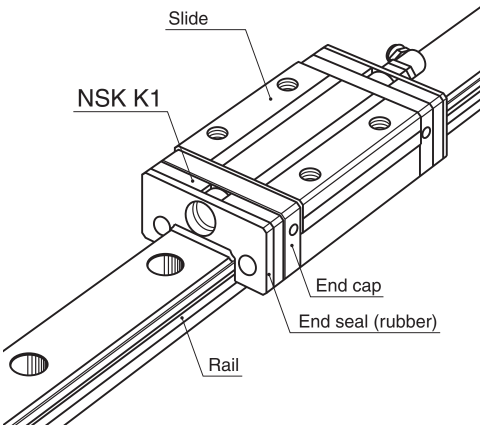


Fig. 5.1

1) Features

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

① Maintenance is required only infrequently

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

▼

For automotive component processing lines, etc.

② Does not pollute the environment

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

▼

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

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

③ Good for environments where lubricant is washed away

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

▼

Food processing equipment, housing/construction machines, etc.

④ Maintains efficiency in dusty environment

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

▼

Woodworking machines, etc.

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

2) Functions

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

① Durability test at high speed, with no other lubrication

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

Conditions: Sample ; LH30AN (preload Z1)
Travel speed ; 200 m/min
Stroke ; 1800 mm
No lubricant: Completely degreased, no lubrication
NSK K1: Completely degreased, no lubrication + NSK K1

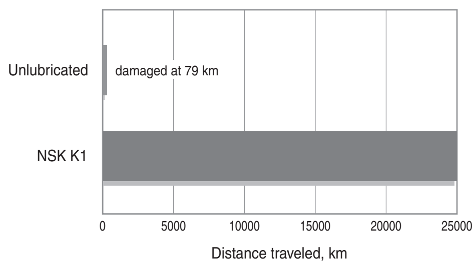


Fig. 5.2 Durability test at high speed, with no lubrication (lubricated by NSK K1 only)

② Durability test immersed in water

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

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

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

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

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

(Unit: μm)

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

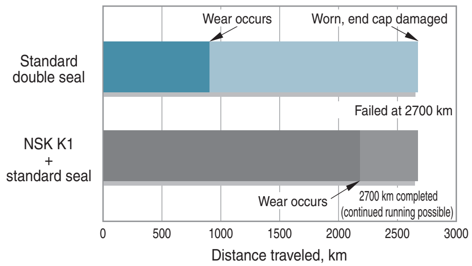


Fig. 5.3 Durability test immersed in water

④ Dust emission

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

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

③ Durability test with wood chips

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

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

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

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

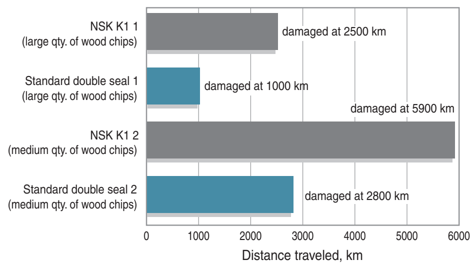


Fig. 5.4 Durability test with wood chips

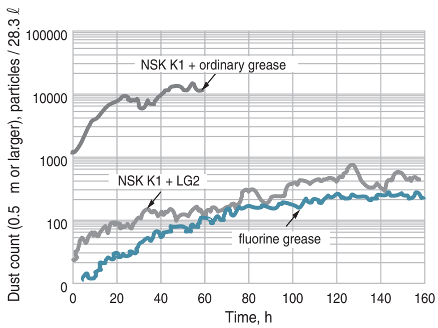


Fig. 5.5 Comparison of dust emission

3) Specifications

① Applicable series and sizes

1 Can be installed in SH, SS, LH, LS, LW, RA, LA, PU, PE, LU, LE, HA, and HS series. For VH and TS series, NSK K1 is equipped as a standard specification.

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

② Standard specifications

1 Install NSK K1 between the end seal and end cap. For TS series, it is installed inside end cap. (Double-seal specification, and specification with protector are also available on request.)

2 NSK standard grease is packed inside the slide. (Volume of grease, type of grease on request.)

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

③ Number of installed NSK K1

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

However, more NSK K1 may be required under more stringent drive and environment. Please consult NSK for details.

Precautions for handling

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

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

2. Chemicals that should not come to contact with NSK K1:
Do not leave NSK K1 in organic solvent, white kerosene such as hexane, thinner which removes oil, and rust preventive oil which contains white kerosene.

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

(2) Lubrication

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

1) Grease Lubrication

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

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

1. NSK grease lubricants

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

Table 5.2 Grease lubricant for linear guides

Type	Thickener	Base oil	Base oil kinematic viscosity mm^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 oil + mineral oil	27	–40 – 100	For fretting resistant

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

① NSK Grease AS2

● Features

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

● Application

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

● Nature

Thickener	Lithium soap base
Base oil	Mineral oil
Consistency	275
Dropping point	185°C
Volume of evaporation	0.24% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	2.8% (100°C, 24 hr)
Base oil kinematic viscosity	130 mm^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 high speed and light load.

● Application

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

● Nature

Thickener	Lithium soap base
Base oil	Synthetic oil + mineral oil
Consistency	275
Dropping point	190°C
Volume of evaporation	0.60% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	3.6% (100°C, 24 hr)
Base oil kinematic viscosity	15 mm^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 are commonly used in clean room, LG2 has several advantages such as:

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

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

● Application

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

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

● Nature

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

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

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

● Application

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

This cannot be used in vacuum.

● Nature

Thickener	Diurea
Base oil	Synthetic hydrocarbon oil
Consistency	209
Dropping point	260°C
Volume of evaporation	0.09% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.6% (100°C, 24 hr)
Base oil kinematic viscosity	100 mm^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 is suitable for linear guides of which application include oscillating operations. Allowable temperature range is –40° to 130°C.

● Nature

Thickener	Diurea
Base oil	Synthetic hydrocarbon oil
Consistency	288
Dropping point	269°C
Volume of evaporation	7.9% (177°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	0.6% (100°C, 24 hr)
Base oil kinematic viscosity	27 mm^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.
- Clean grease is exclusively used for clean environments at normal pressure.

2. How to replenish grease

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

3. Volume of grease to be replenished

Once grease is replenished, another supply is not required for a long period of time. But under some operational conditions, it is necessary to periodically replenish grease. The following are replenishing methods.
• When there is an exclusive grease supply system and the volume from the spout can be controlled, the criterion is:
All at once, replenish the amount which fills about 50% of the internal space of the slide. This method eliminates waste of grease, and is efficient.
Page A46 shows internal spaces of slide of each series for refenence.
• When replenishing using a grease gun:
Use a grease gun and fill the inside of slide with grease. Supply grease until it comes out from the slide area. Move the slide by hand while filling them with grease, so the grease permeates all areas. Do not operate the machine immediately after replenishing. Always try the system a few times to spread the grease throughout the system and to remove excess grease from inside. Trial operations are necessary because the resistance to sliding force of linear guide greatly increase immediately after replenishment (full-pack state) and may cause problems. Grease's agitating resistance is accountable for this phenomenon. Wipe off excess grease that accumulates at the end of the rail after trial runs, so the grease does not scatter to other areas.

4. Intervals of checks and replenishments

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

Table 5.3 Intervals of checks and replenishments for grease lubrication

Intervals of checks	Items to check	Intervals of replenishments
3-6 months	Dirt, foreign matters such as cutting chip	Usually once per year. Every 3000 km for material handling system which travels more than 3000 km per year. Replenish if checking results warrant it necessary.

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

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

Table 5.4 Inside space of the slide

SH, SS Series

Unit: cm³

Model No. \ Series	SH		SS	
	High-load type	Ultra-high-load type	Medium-load type	High-load type
15	2	3	1.5	2
20	5	7	3	4
25	9	12	5	7
30	11	17	7	11
35	20	27	11	17
45	42	53	–	–
55	73	93	–	–

LH, LS Series

Unit: cm³

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

VH Series

Unit: cm³

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

HA, HS Series

Unit: cm³

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

LW Series

Unit: cm³

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

TS Series

Unit: cm³

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

RA Series

Unit: cm³

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

LA Series

Unit: cm³

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

PE, PU Series

Unit: cm³

Model No. \ Series	PE		PU	
	Standard type	High-load type	Standard type	High-load type
05	0.1	–	0.1	–
07	0.2	–	0.1	–
09	0.4	0.5	0.2	0.3
12	0.5	0.7	0.3	0.4
15	1.2	1.6	0.8	1.1

LE, LU Series

Unit: cm³

Model No. \ Series	LE			LU	
	Medium-load type	Standard type	High-load type	Standard type	High-load type
05	0.1	0.1	–	0.1	–
07	0.1	0.2	0.3	0.1	–
09	0.2	0.4	0.5	0.2	0.3
12	0.3	0.5	0.7	0.3	0.4
15	0.8	1.2	1.6	0.8	1.1

5. NSK Grease Unit

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

Grease in a bellows tube

① Composition of NSK Grease Unit

Components and grease types are shown below.

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

② NSK Greases (80 g in a bellows tube)

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

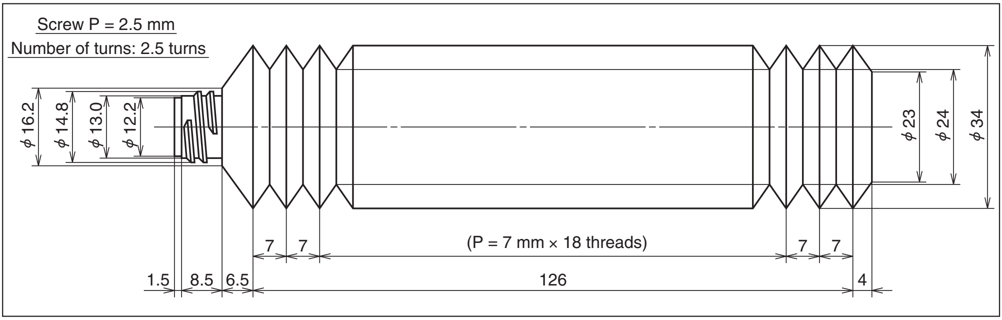


Fig. 5.6 Bellows tube

③ NSK manual Grease Pump Unit

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

●Features

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

●Specifications

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

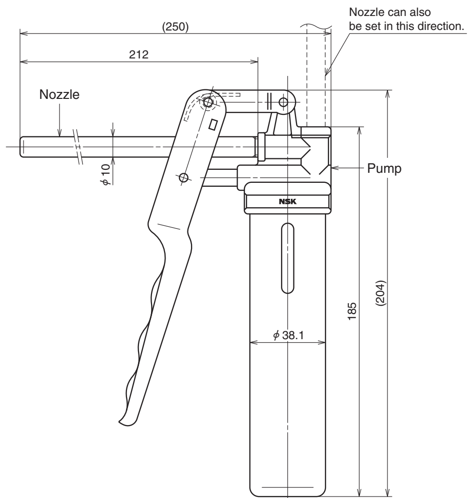


Fig. 5.7 NSK Hand Grease Pump with NSK straight nozzle

b. Nozzles

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

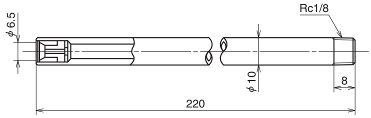
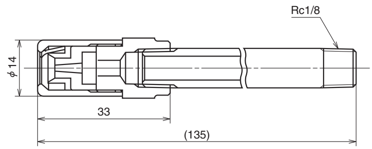
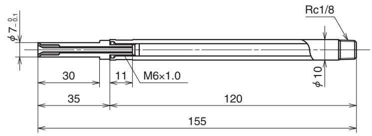
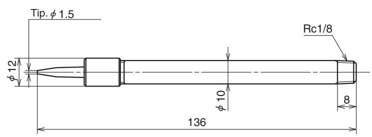
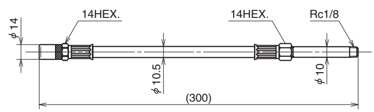
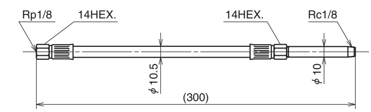
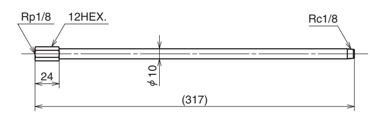
Name	Designation code	Use	Dimensions
NSK straight nozzle	NSK HGP NZ1	Can be used with grease fitting A, B, and C under JIS B1575 standard.	
NSK chuck nozzle	NSK HGP NZ2	Same as above. However, there is no need to press the hand pump because the grease fitting and the nozzle come to contact due to the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

Table 5.6 Grease fittings used for NSK linear guide

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

*) When using a chuck nozzle, make sure that it does not interfere with the table on linear guides.
Note: PU, PE, LU, and LE Series: Apply grease directly to ball groove, etc. using a point nozzle.

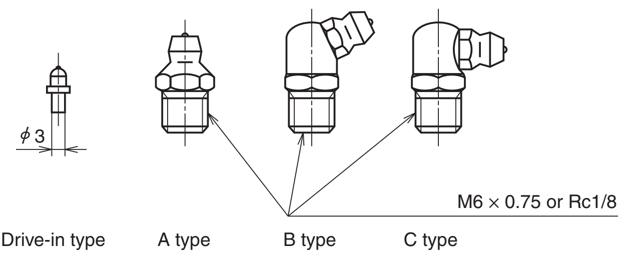


Fig. 5.8 Grease fittings

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

2) Oil Lubrication

Required amount of new oil is regularly supplied by:

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

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

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

In case of ball type linear guide except for LA series

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

In case of LA and RA series

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

n: Linear guide code

e.g. When LH45 is used,

$n = 45$,

Therefore,

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

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

Table 5.7 shows the criterion of intervals of oil checks and replenishments.

Table 5.7 Intervals of checks and replenishments

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

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

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

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

A-3-6 Dust Proof

(1) Standard Specification

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

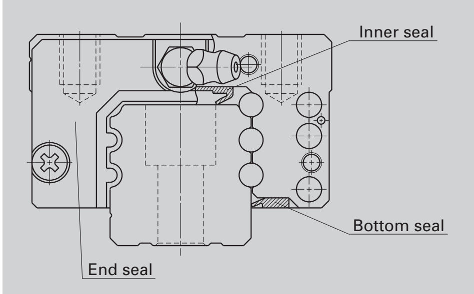


Fig. 6.1

Table 6.1 Standard seals

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

○ : Installed as standard
△ : Installed on request

(2) Dust proof components

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

Table 6.2 Optional dust proof components

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

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

1. Double seal

• A combination of two end seals to enhance seal function.

• When a double seal is installed, the end seal section becomes thicker than the standard item. Please pay attention to the increase in a slide length when designing the mounting dimension of slide and the table stroke. Please refer to the section of dust proof components for the dimensional increase in the length direction of each series due to fitting of double seal.

• Double-seal set: Can be installed to a completed standard item later on request. It comprises two end seals, a collar, and a screw for installation (Fig. 6.2). The product reference numbers of each series are described on the section of dust proof parts.

• When attaching a grease fitting to the end cap after the double seal is equipped, you require a connector shown in Figure 6.2. Please specify the connector set when ordering linear guides.

• For VH, RA, LA, HA, and HS Series, double-seal set can be installed only before shipping from the factory.

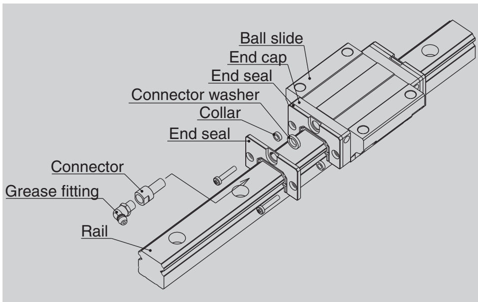


Fig. 6.2 Double seal

2. Protector

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

3. Cap to cover the bolt hole for rail mounting

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

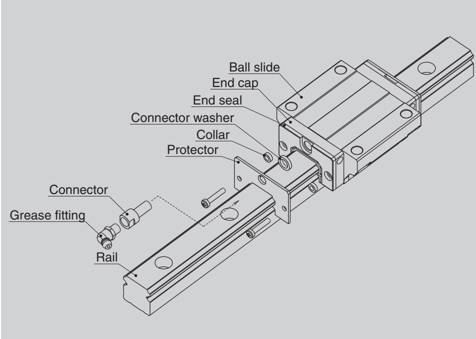


Fig. 6.3 Protector

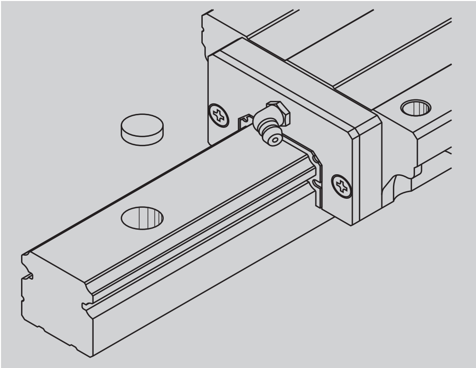


Fig. 6.4

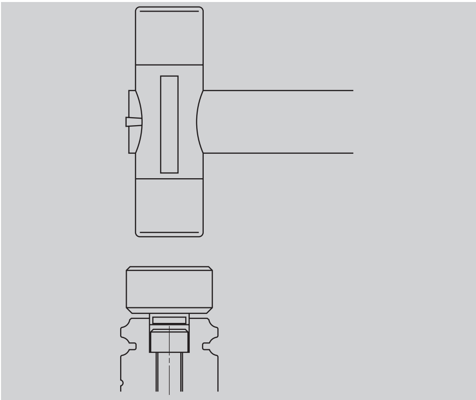


Fig. 6.5

4. Inner seal

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

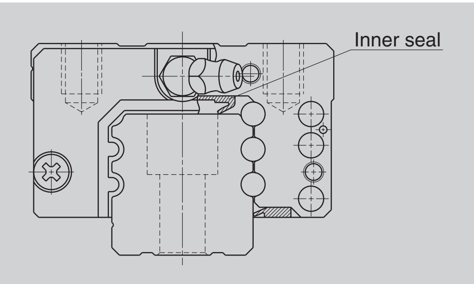


Fig. 6.6 Inner seal when installed

5. Bellows

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

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

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

- Remove two machine screws (M_2) which secure the end seals to the end of the slide (Fig. 6.7). For LS15, hold the end cap by hand. Otherwise, the end cap is detached from the ball slide, and the balls inside may spill out.
- Then place a spacer to the hole for securing end seal. Fasten the mounting plate at the end of the bellows to the slide with a slightly longer machine screw (provided with the bellows).

*** Installation in the rail**

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

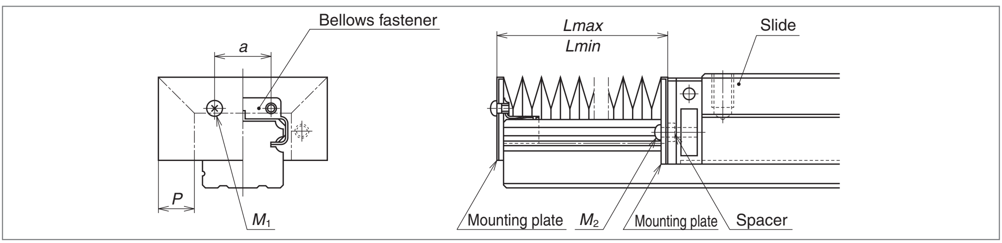


Fig. 6.7

② LA and LW Series

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

- Remove two machine screws which secure the end seal. (For LW17 and 21, hold the end cap by hand. Otherwise, the end cap is detached from the slide, and the balls inside may spill out.)
- Place a spacer in the securing hole of the end seal, fasten the mounting plate on the end of the bellows using a slightly longer machine screw (provided with the bellows).

*** Installation in the rail**

- Make tap holes to the rail end face. Fix the bellows mounting plate to the rail end face through these tap holes. Use a machine screw. NSK processes a tap hole to the rail end face when ordered with a linear guide.

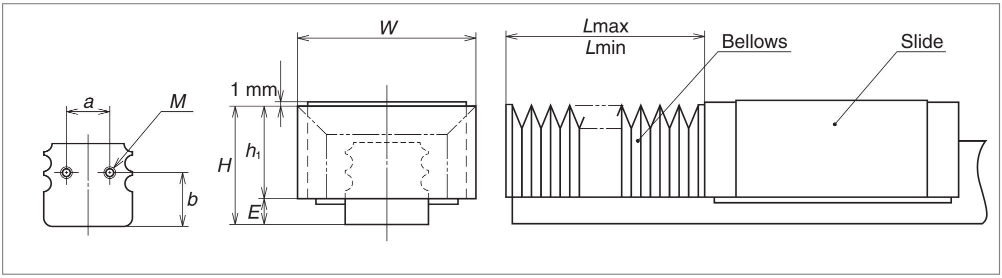


Fig. 6.8

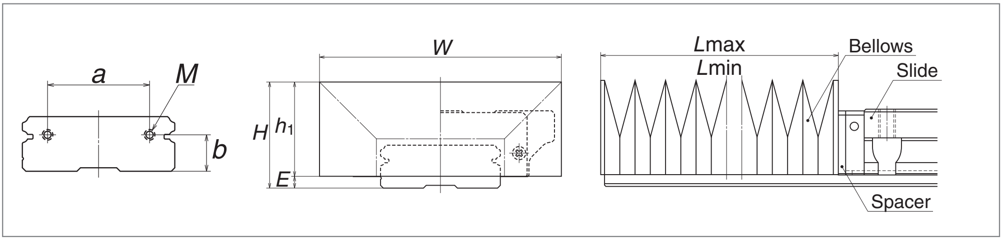


Fig. 6.9

Calculating length of bellows

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

  Lmax = 7 × P × Number of BL
- Length when contracted to minimum size :

  Lmin = 17 × Number of BL
- Stroke : **St = Lmax – Lmin**
- P and the number of BL are shown in bellows dimension table in each series.

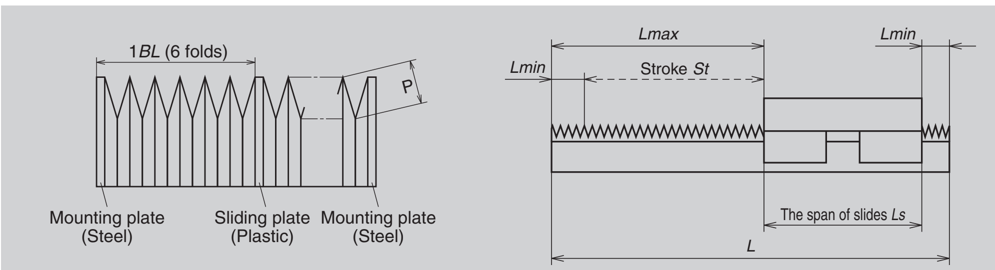


Fig. 6.10

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

(1) Stainless steel

NSK linear guide is available in stainless steel.

〇Stainless steel standard series

PU Series **PE Series**
LL Series

〇Available in stainless steel

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

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

(2) Surface Treatment

1) Recommended surface treatment

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

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

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

〇**Fluoride low temperature chrome plating**

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

2) Rust prevention of fluoride low temperature chrome plating

The use environment of NSK linear guides is expanding from general industrial machines, semiconductor and liquid crystal manufacturing systems to aerospace equipment.
Among all measures to cope with environment, rust prevention is the most challenging. Such environment includes: Moisture for washers and other equipment; Chemicals used in the wet processing of semiconductor and liquid crystal display manufacturing equipment.
NSK developed electrolytic rust prevention black film treatment (black chrome plating) which is added by fluororesin impregnating treatment. (hereinafter referred as "Fluoride low temperature chrome plating") This surface treatment methods has proved its superiority as the rust prevention of linear guides which are used in above equipment.

● What is "Fluoride low temperature chrome plating ?"

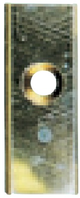
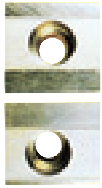
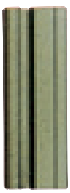
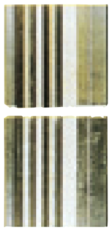
This is a type of black chrome plating which forms a black film (1–2 μm) on the metal surface. Fluoroplastic coating is added to the film to increase corrosion resistance.

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

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

● Humidity cabinet corrosion resistance test

Table 7.1 Results of the humidity cabinet test

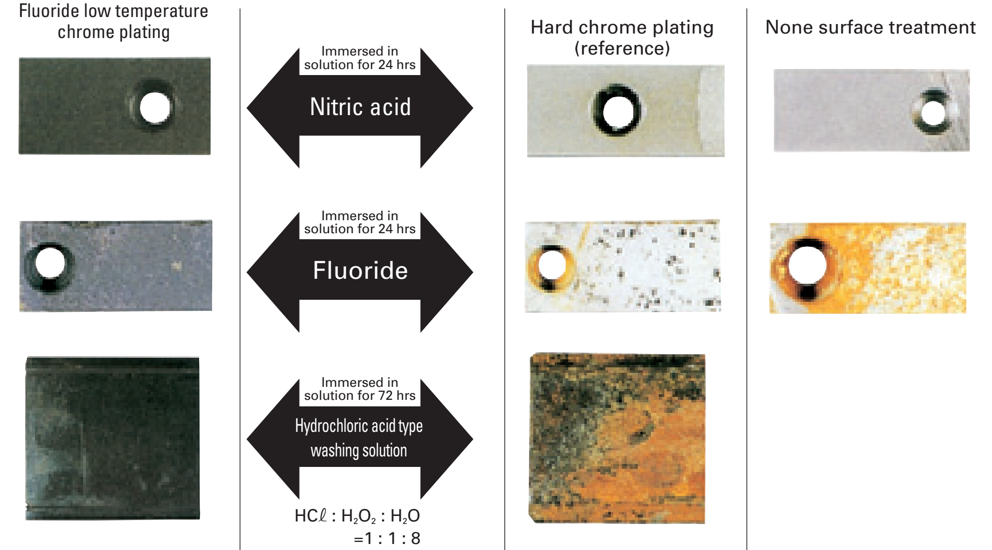
Characteristic		Test sample	Fluoride low temperature chrome plating (Recommended)	Hard chrome plating (Reference)	Electroless nickel plating (Reference)	Equivalent to SUS440C material	Standard steel
Rust prevention ability	Rusting	Top	(Ground) B	(Ground) B	(Ground) A	(Ground) C	(Ground) D
		Side	(Ground)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

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

● Corrosion resistance test against chemicals

Table 7.2 Result of the corrosion resistance test

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



Fluoride low temperature chrome plating		Hard chrome plating (reference)	None surface treatment
○	Hydrochloric acid (immersed)	○	▲
○	Sulfuric acid (immersed)	○	×
○	Ammonia or sodium hydroxide	○	△

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

● Surface treatment durability test

Life of surface treatment by peeling

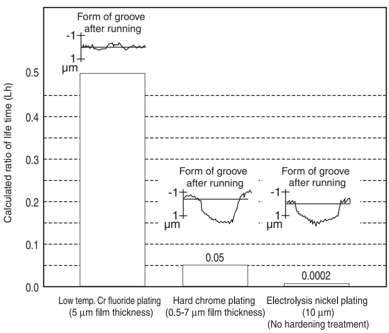


Fig. 7.1 Result of durability test

● Total evaluation

Table 7.3 Evaluation

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

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

A-3-8 Special Environment

(1) Heat-Resistant Specifications

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

Table 8.1 Comparison of materials: Standard and heat-resistant specifications

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

Heat resistant linear guides

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

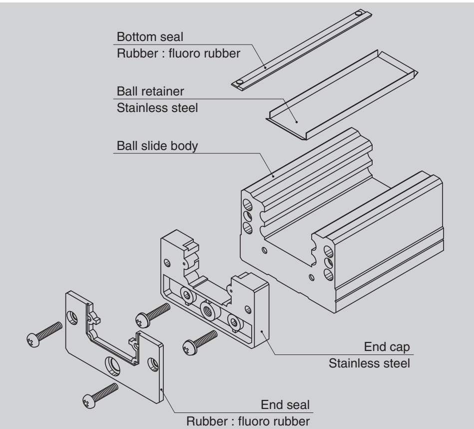


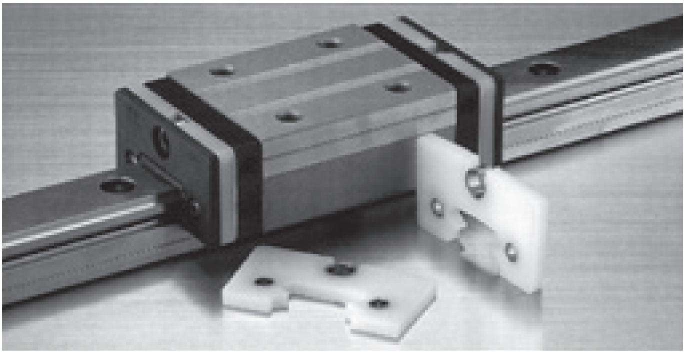
Fig. 8.1

(2) Vacuum and Clean Specifications

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

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

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



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

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

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

It also offers easy installation, mounted inside the standard end seal.

1. Features

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

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

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

<Features of grease for food processing machines>

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

• Superb water resistance and antirust capability

• Superb wear resistance

• Applicable for a centralized oiling system

◆Appropriate volume of grease

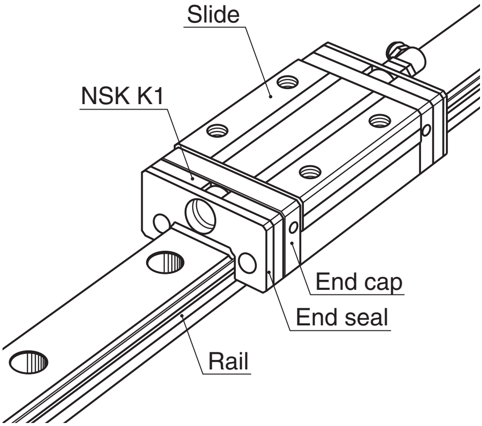
Reduces grease draining and scattering, and maintains a clean environment by supplying appropriate volume of grease.

2. Available models

Table 8.2 shows available models.

Table 8.2

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



Precautions for use

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

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

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

(4) Specifications for Special Environments

Table 8.3 Linear guide specifications

Environment	Condition	NSK linear guide specifications				Technical Explanation Page No.
		Rail, slide	Steel balls/rollers	Ball Recirculation component	Lubrication/surface treatment	
Clean	Atmosphere, normal temperature	Standard material	Standard material	Standard material	LG2 Grease, LGU Grease	D8
					NSK K1 lubrication unit	D10
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	LG2 Grease, LGU Grease	D8
					NSK K1 lubrication unit	D10
					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 –	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. 8.2 Lubrication in clean environment

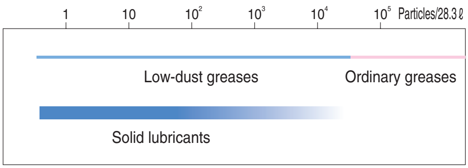


Fig. 8.3 Lubrication in vacuum

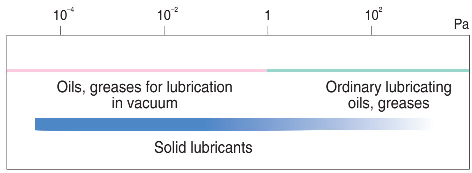


Fig. 8.4 Lubrication in corrosive environment

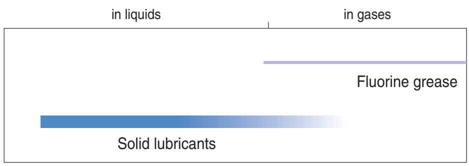


Fig. 8.5 Lubrication in high temperature

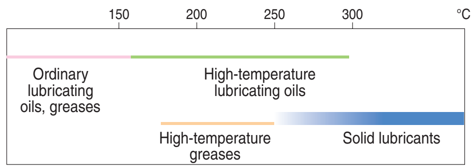


Fig. 8.6 Lubrication in low temperature

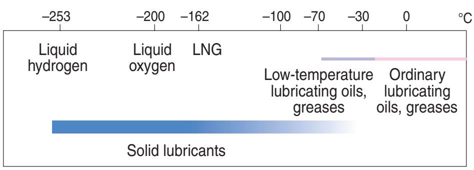


Fig. 8.7 Lubrication in radioactive environment

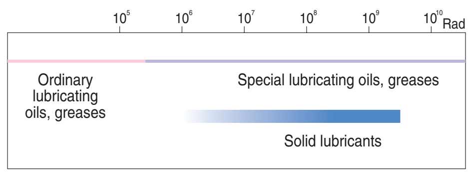
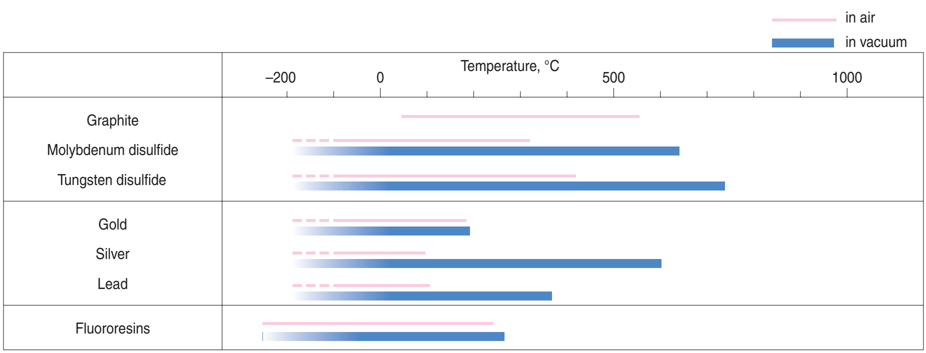


Fig. 8.8 Temperature range for using solid lubricants



2. Materials

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

Table 8.4 Characteristics of metal materials

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

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

3. Table to Cope With Special Environments

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

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

4. Precautions for Handling

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

- Products are washed to remove oil, and wrapped in a way to protect them from moisture. Use the product as soon as possible after opening the package.
- After opening, store the products in a clean, air-tight container such as 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.

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

A-3-9 Arrangement and Mounting of Linear Guide

(1) Arrangement

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

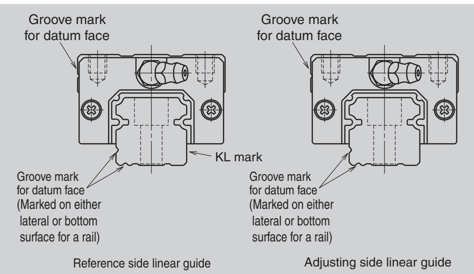


Fig. 9.1 Datum face

Example of arrangement

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

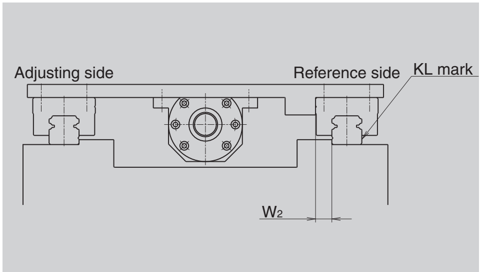


Fig. 9.2 Most common setting of the reference side rail

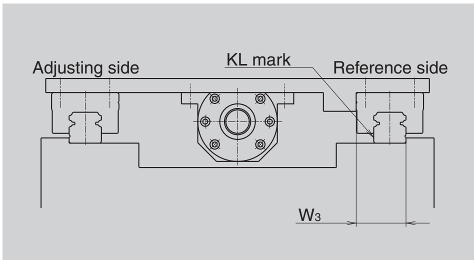


Fig. 9.3 Setting of the reference side rail in certain occasions

Table 9.1 Marks on the rail datum faces in each series

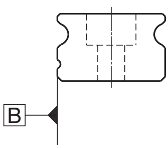
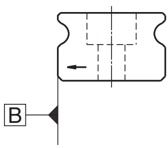
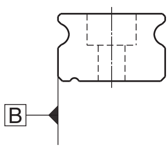
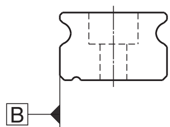
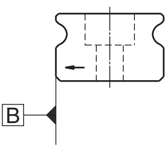
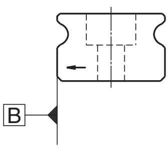
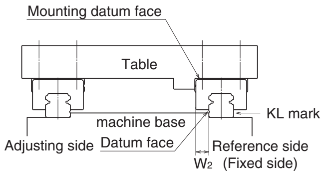
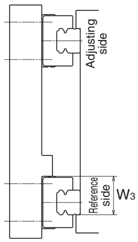
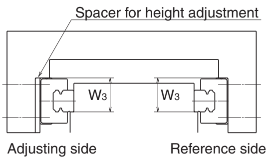
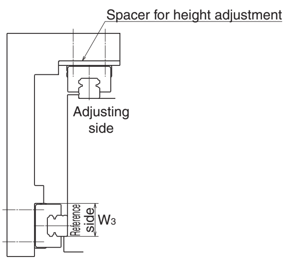
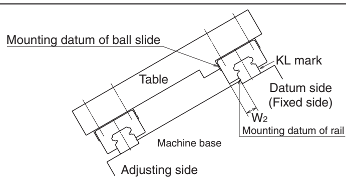
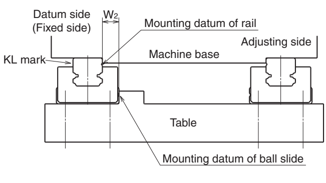
Model No. / Material	Standard	LU05, 07, 09 PU05, 09, 12, 15 LE07, 09, 12	LU12, 15, LH15	PU07 LE05, 15 LE09, 12 (with a ball retainer) PE series LH08, 10, 12 LW17, 21 RA15
Special high carbon steel				
Stainless steel				

Table 9.2 Arrangement example

Arrangement	Features/Precautions
	• Easy in highly-accurate installation (recommended arrangement)
	• Easy in highly-accurate installation • Lubricant oil may not be supplied to slide. Precaution is required in the oil supply design.
	• Slightly difficult for highly-accurate installation • Life of linear guide is affected by mounting accuracy. • When oil lubricant is used, precaution is required in oil supply design.
	• Difficult for highly-accurate installation • For a linear guide mounted in sideways, precaution is required in oil supply design if oil lubricant is used.
	• Rather easy in highly-accurate installation • When oil lubricant is used, precaution is required in oil supply design.
	• Easy in highly-accurate installation if the linear guide is installed to the machine base first, then hung upside down along with the machine base. • Slide may detach from the rail and fall down if the linear guide is damaged and rolling element in the slide fall out. It is necessary to take preventive measures against the falling of the ball slide.

(2) Mounting Accuracy

1. Accuracy of the mounting base of machine

- Mounting accuracy of linear guide usually copies the accuracy of the machine base.
- However, when two or more slides are assembled to each rail, the table stroke becomes shorter than the mounting surface. This, along with the fact that the mounting error is evenly spread, contributes to a higher table accuracy than the mounting face accuracy, reducing the error to about 1/3 in average (Fig. 9.4).

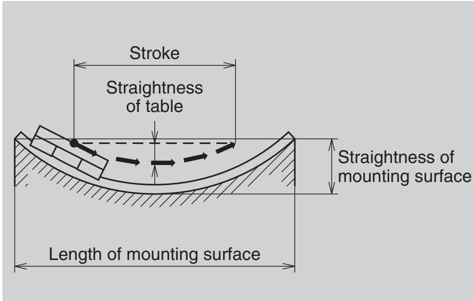
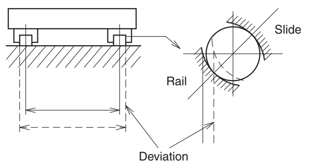
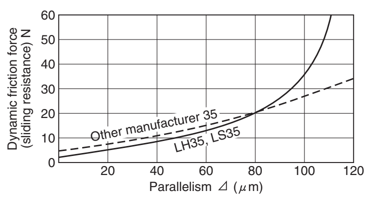
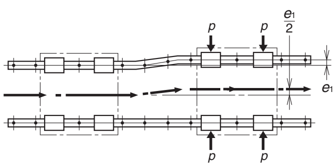


Fig. 9.4

2. Installation error

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

Table 9.3 Influence of mounting error

Factor	Influence	
Life		• 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, lowering rigidity.
Friction		• SH, SS, LH and LS Series are affected very little by mounting error thanks to their small friction. (self alignment) • However, because of off-set Gothic arch grooves, their friction suddenly soars once the mounting error exceeds a certain level. • Mounting error severely affects friction of LA Series with heavy preload.
Accuracy		• When rigidity of four slides are equal, the theoretical straightness becomes 1/2 of the installation error e_1. • However, this value becomes slightly larger due to deformation of the rail and the machine base.

3. Permissible values of mounting error

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

For ball guide

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

For roller guide

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

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

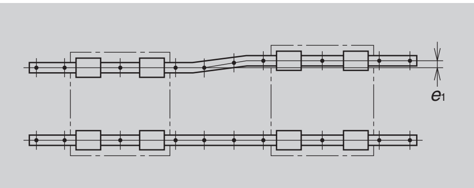


Fig. 9.5

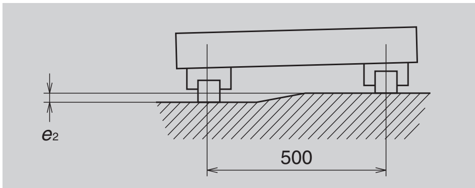


Fig. 9.6

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

• When installed in a machine base, the linear guide is affected by the flatness of the mounting face of the machine base. However, in the case of two-rails/four-slides specification, which is most widely used, the straightness as a table unit is generally less than the straightness as a single component. This is due to the even-off effect generated by the shorter stroke, compared to rail length, as well as by interaction between the rails, and slides.

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

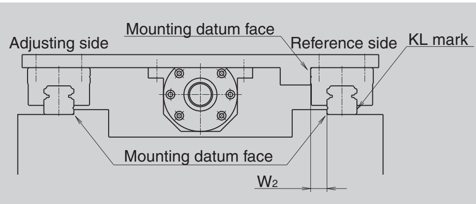


Fig. 9.7

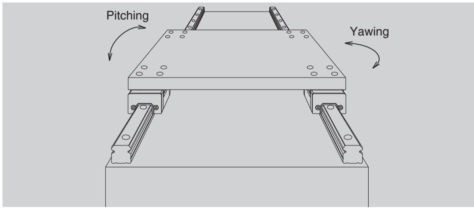


Fig. 9.8

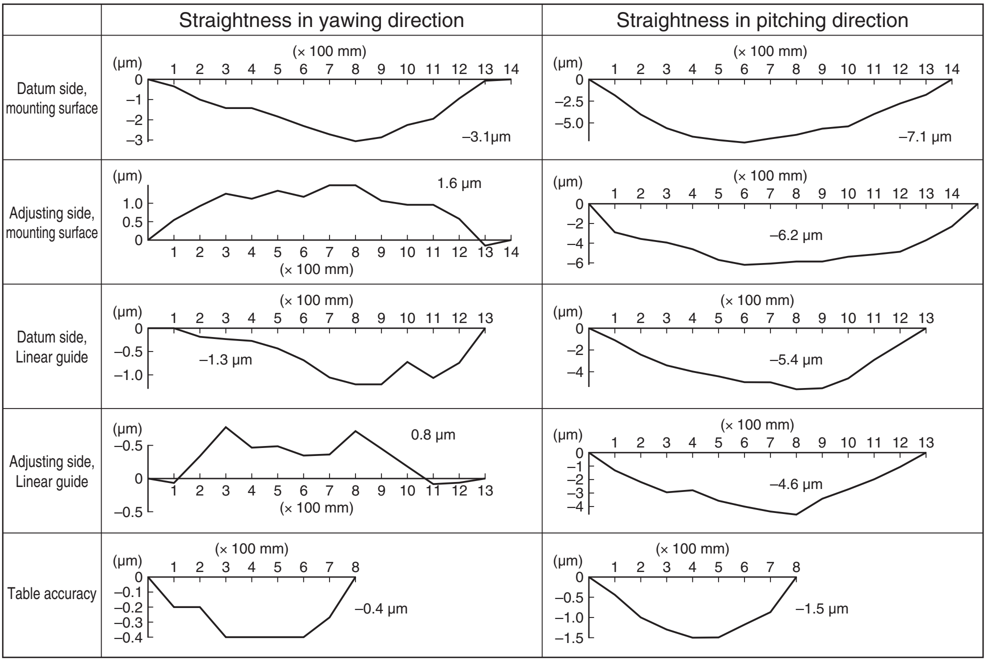


Fig. 9.9 Straightness of the table equipped with linear guide

(3) Installation

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

- Fig. 9.10 and 9.11, show shoulder height of the mounting face of the machine base and the size of corner r. These figures are relevant when the linear guide is pressed to the shoulder of the machine base or table (the raised section from where the mounting face begins), and horizontally secured to it. Recommended sizes are shown in "Shoulder hight and corner radius r" of each series introduction.
- The shoulder should be thick (wide) enough, so it is not deformed by the pressing force.

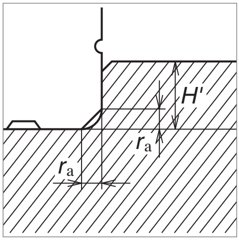


Fig. 9.10 Shoulder for the rail datum face

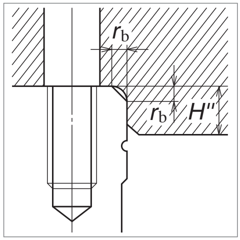


Fig. 9.11 Shoulder for the slide datum face

2. Tightening torque of the bolt

- Table 9.4 shows tightening torque of the bolt when the rail is secured to the fixture of race way interface grinding machine.
- Apply same torque in this table when securing the rail to the machine base. Equal accuracy at the time of grinding can be obtained.

Table 9.4 Bolt tightening torque (Bolt material: High carbon chromium steel)

Unit: N·m

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

3. Installation procedures

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

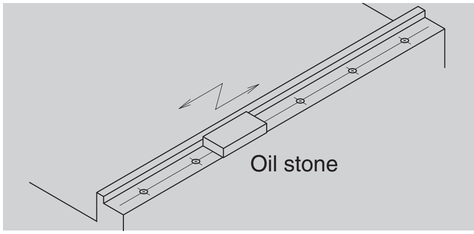


Fig. 9.12

A Highly accurate installation

ⓐ Rail installation procedures

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

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

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

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

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

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

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

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

④ If there is no shoulder on the mounting face of the machine base for the adjusting side rail: Secure a measuring table to the slides of the reference side rail (Fig. 9.15). Use this to adjust the parallelism of the adjusting side rail. Check parallelism of the adjusting side rail with a dial gauge from one end of the rail, tightening the bolts one by one.

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

Parallelism between two rails can also be checked by the same method in Fig. 9.15 when there is a shoulder on the face where the adjusting side rail is installed.

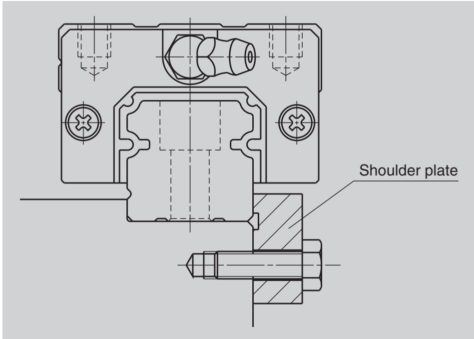


Fig. 9.13 Pressing the rail from sideways

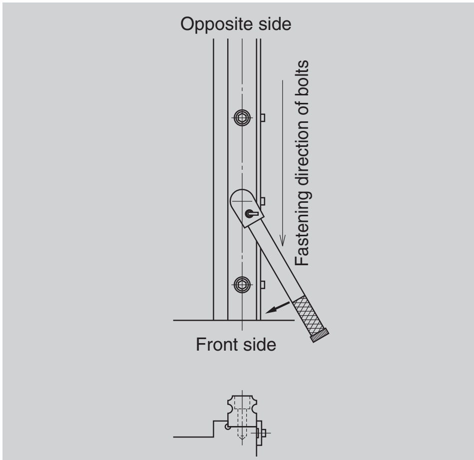


Fig. 9.14 Rail installation

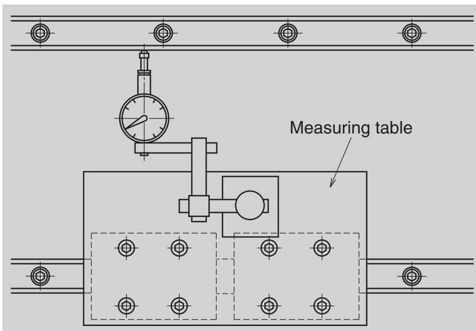


Fig. 9.15 Measuring parallelism

ⓐ-2) When machine base does not have a shoulder on the side where the reference side rail is installed

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

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

③ Once the position of the straight edge is determined, use it as the reference. With a dial gauge, check parallelism with the rail, and adjust the rail if necessary. Then tighten the bolts.
Ensure that the straight edge does not move while the bolts are being tightened.
This procedure should be carried out starting from one end of the rail to the other end. (Fig. 9.16).

④ Finally tighten all bolts with specified torque.

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

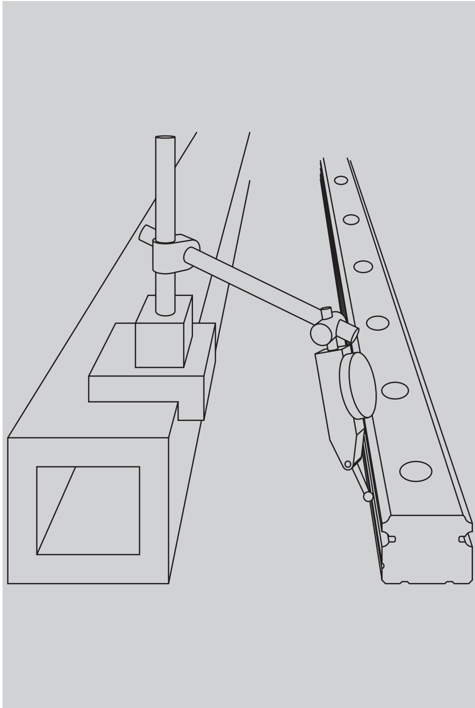


Fig. 9.16

ⓑ Procedures of slide installation

ⓑ-1) When table has a shoulder

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

② While pressing the table from sideways, further tighten the bolts which secure the slides on the reference side, so the table shoulder and the slide's mounting datum face are sufficiently tightly pressed.
If a shoulder plate is provided, first tighten the bolts of the plate, then further tighten the bolts to the slides (Fig. 9.17).

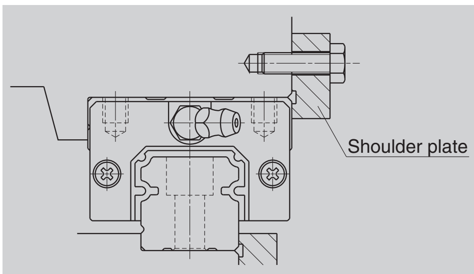


Fig. 9.17 Pressing slide from sideways

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.

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

B Easy installation
① Carefully place the reference side rail on the machine base. Then tighten the bolts for installation with specified torque.
② Temporarily tighten the bolts on the adjusting side rail.
③ Tighten the slides on the reference side rail and one slide on the adjustment side rail with specified torque. Leave the rest of the slide on the adjusting side rail temporarily tightened (Fig. 9.18).
④ While moving the table with each pitch of the bolt for rail: With specified torque, tighten the rail mounting bolt which is located immediately adjacent to the slide on the adjusting side rail that had been finally tightened.
Take this procedure from one end to the other.
⑤ Return the table to the original position once. Then with standard torque, tighten the rest of the slides on the adjusting side. Then, by the same procedure as in ④, tighten the rest of the rail mounting bolts with standard torque. Move the table to check any abnormality such as large friction force.

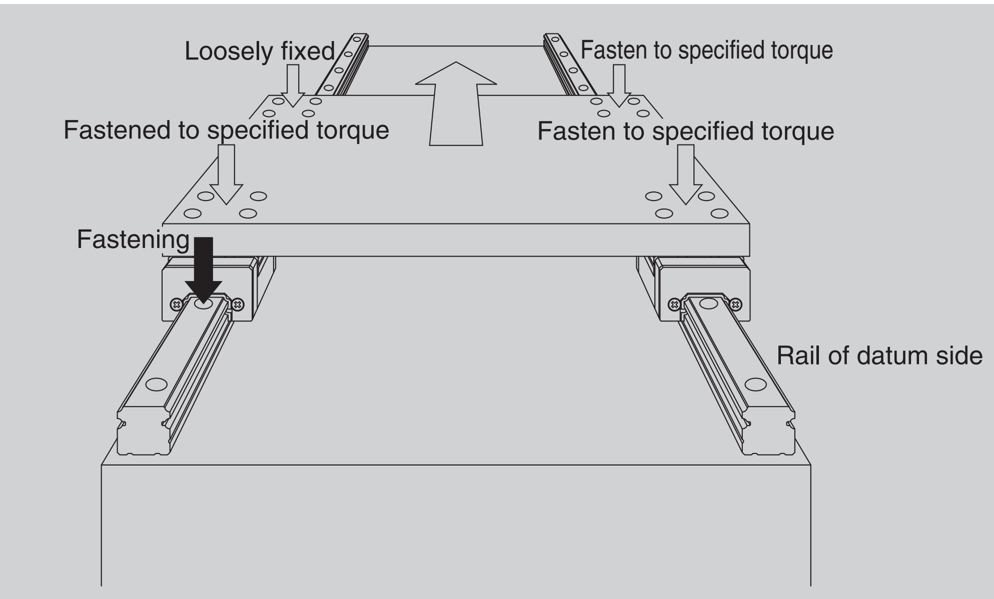


Fig. 9.18 Easy installation

4. Various methods to press linear guide sideways

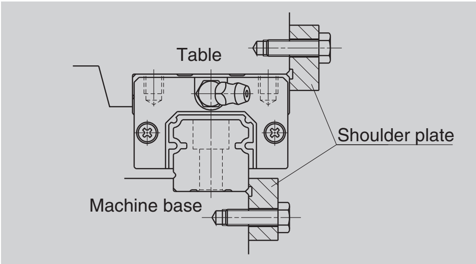


Fig. 9.19 Recommended method

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

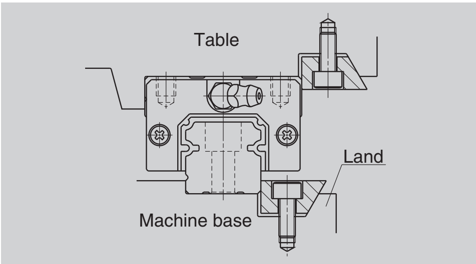


Fig. 9.20 Installation that requires caution

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

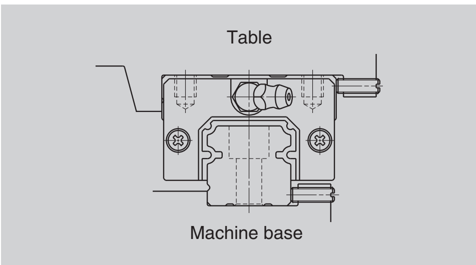


Fig. 9.21

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

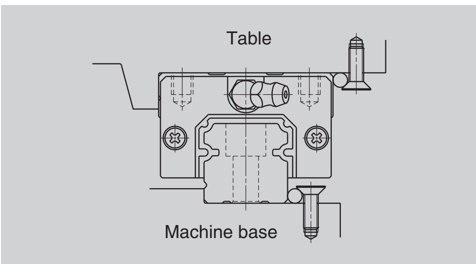


Fig. 9.22

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

(4) Assemble Random-Matching Linear Guide

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

Assembly procedures of random-matching linear guide

Follow steps as described below.

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

② Please match an groove mark for datum face of slide and rail to become an assembling state desired.

③ Align the provisional rail to the rail in the bottom and side faces. Press the provisional rail lightly against the rail, and move the slide over the rail (Fig. 9.23).

(5) Butting Rail Specification

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

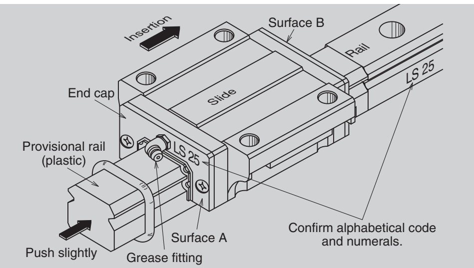


Fig. 9.23 Inserting slide into the rail

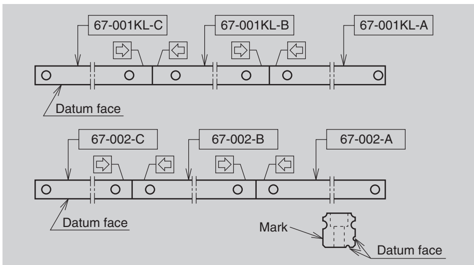


Fig. 9.25

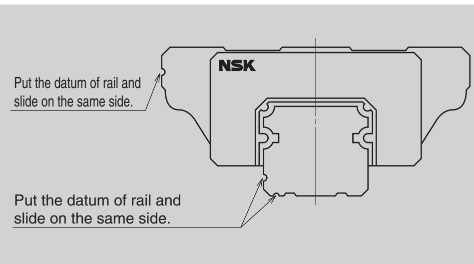


Fig. 9.24

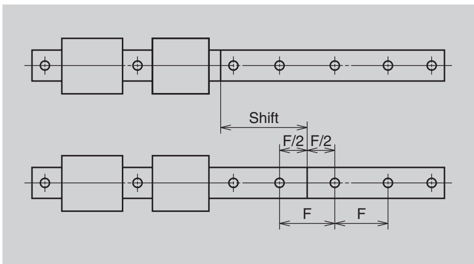


Fig. 9.26

(6) Handling Preloaded Assembly

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

Mark for assembling ball slide and rail

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

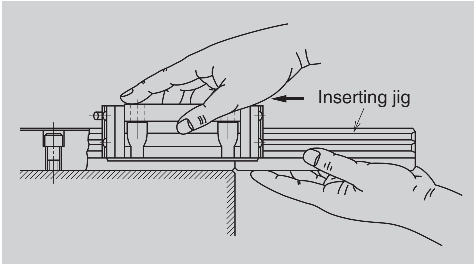


Fig. 9.27

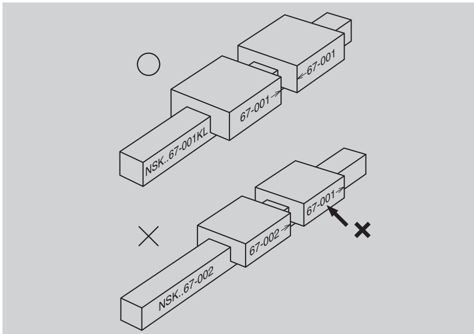


Fig. 9.28

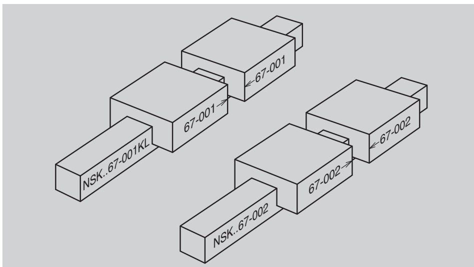


Fig. 9.29 When two rails have the same reference number

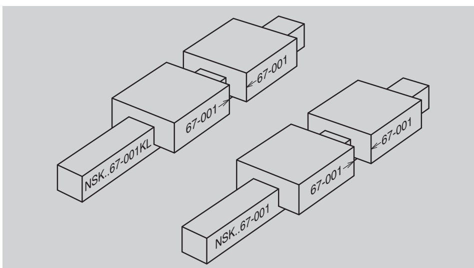


Fig. 9.30 When two rails have different reference number

A-3-10 Drills to Select Linear Guide

(1) Single Axis Material Handling System

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

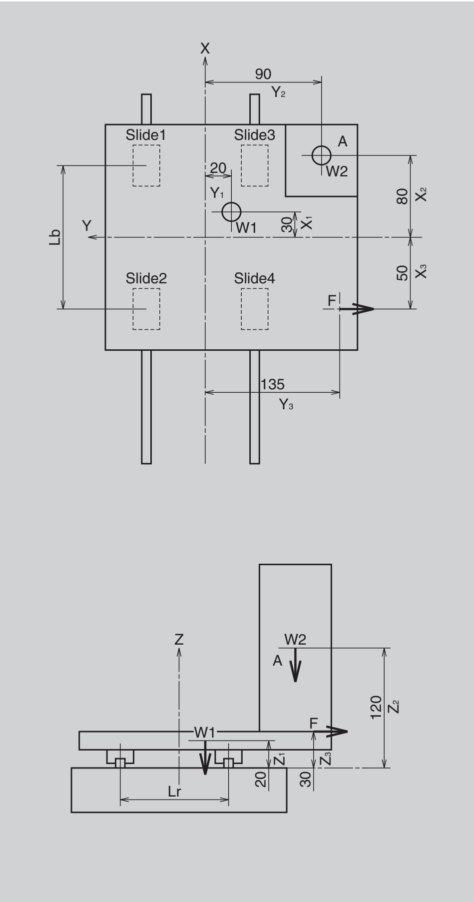


Fig. 10.1 Single axis material handling system

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

Specification of single axis material handling system

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

Load point coordinates from the table center (mm)

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

Stroke: 1000 mm
(1 cycle: 2000 mm)

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

(1)-1 Selection of linear guide model

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

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

(1)-2 Calculating life

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

Linear guide LU15AL

Basic dynamic load rating : 5550 (N)
Basic static load rating : 6600 (N)

Load conditions of the linear guide

Table weight	W1	: 150 (N)
Weight of the work	W2	: 200 (N)
Applied load	F	: 200 (N)
Rail span	L_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 table mass.

Calculation of the load applied to ball slide

Calculate two occasions:

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

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

There is a work mounted on the table

Vertical direction loads

$$
\begin{aligned}
M1 &= \sum_{j=1}^{n}\left(F_{yj}\cdot Z_{yj}\right)+\sum_{k=1}^{n}\left(F_{zk}\cdot Y_{zk}\right)\\
&= F\cdot Z_3 + W1\cdot Y_1 + W2\cdot Y_2\\
&= -200\times 30 + 150\times(-20) + 200\times(-90)\\
&= -27000\ (\mathrm{N\cdot mm})
\end{aligned}
$$

$$
\begin{aligned}
M2 &= \sum_{i=1}^{n}\left\{F_{xi}\cdot\left(Z_{xi}-Z_b\right)\right\}+\sum_{k=1}^{n}\left(F_{zk}\cdot X_{zk}\right)\\
&= W1\cdot X_1 + W2\cdot X_2\\
&= 150\times 30 + 200\times 80\\
&= 20500\ (\mathrm{N\cdot mm})
\end{aligned}
$$

$$
\begin{aligned}
F_{r1} &= \frac{\sum_{k=1}^{n} F_{zk}}{4}+\frac{M1}{2\cdot L}+\frac{M2}{2\cdot \ell}\\
&= \frac{W1+W2}{4}+\frac{M1}{2\cdot L_r}+\frac{M2}{2\cdot L_b}\\
&= \frac{150+200}{4}+\frac{-27000}{2\times 90}+\frac{20500}{2\times 100}\\
&= 40\ (\mathrm{N})
\end{aligned}
$$

Similarly

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

Lateral direction loads

$$
\begin{aligned}
M3 &= -\sum_{i=1}^{n}\left\{F_{xi}\cdot\left(Y_{xi}-Y_b\right)\right\}+\sum_{j=1}^{n}\left(F_{yj}\cdot X_{yj}\right)\\
&= F\cdot X_3\\
&= -200\times(-50)\\
&= 10000\ (\mathrm{N\cdot mm})
\end{aligned}
$$

$$F_{s1} = F_{s3} = \frac{\sum_{j=1}^{n} F_{yj}}{4} + \frac{M3}{2 \cdot \ell}$$
$$= \frac{F}{4} + \frac{M3}{2L_b}$$
$$= \frac{-200}{4} + \frac{10000}{2 \times 100}$$
$$= 0 \text{ (N)}$$

Similarly

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

No work mounted on the table
Vertical direction load

$$M1 = \sum_{j=1}^{n} \left(F_{yj} \cdot Z_{yj}\right) + \sum_{k=1}^{n} \left(F_{zk} \cdot Y_{zk}\right)$$
$$= F \cdot Z_3 + W1 \cdot Y_1$$
$$= -200 \times 30 + 150 \times (-20)$$
$$= -9000 \text{ (N·mm)}$$

$$M2 = \sum_{i=1}^{n} \left\{F_{xi}\left(Z_{xi} - Z_b\right)\right\} + \sum_{k=1}^{n} \left(F_{zk} \cdot X_{zk}\right)$$
$$= W1 \cdot X_1$$
$$= 150 \times 30$$
$$= 4500 \text{ (N·mm)}$$

$$F_{r1} = \frac{\sum_{k=1}^{n} F_{zk}}{4} + \frac{M1}{2 \cdot L} + \frac{M2}{2 \cdot \ell}$$
$$= \frac{W1}{4} + \frac{M1}{2 \cdot L_r} + \frac{M2}{2 \cdot L_b}$$
$$= \frac{150}{4} + \frac{-9000}{2 \times 90} + \frac{4500}{2 \times 100}$$
$$= 10 \text{ (N)}$$

Similarly

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

$F_{r3} = 110$ (N)

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

Lateral direction loads

$$M3 = -\sum_{i=1}^{n} \left\{F_{xi} \cdot \left(Y_{xi} - Y_b\right)\right\} + \sum_{j=1}^{n} \left(F_{yj} \cdot X_{yj}\right)$$
$$= F \cdot X_3$$
$$= -200 \times (-50)$$
$$= 10000 \text{ (N·mm)}$$

$$F_{s1} = F_{s3} = \frac{\sum_{j=1}^{n} F_{yj}}{4} + \frac{M3}{2 \cdot \ell}$$
$$= \frac{F}{4} + \frac{M3}{2 \cdot L_b}$$
$$= \frac{-200}{4} + \frac{10000}{2 \times 100}$$
$$= 0 \text{ (N)}$$

Similarly

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

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

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.

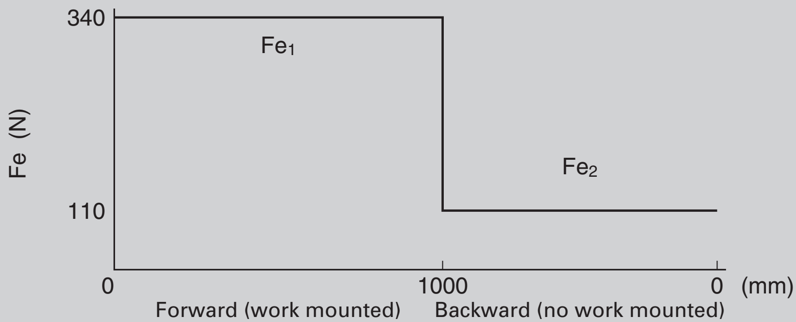
Therefore;

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

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

Calculation of mean effective load

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



Cycle patterns of full dynamic equivalent load

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

$$Fm = \sqrt[3]{\frac{1}{L}\left(F_{e1}^3 L_1 + F_{e2}^3 L_2\right)}$$
$$= \sqrt[3]{\frac{1}{2000}\left(340^3 \times 1000 + 110^3 \times 1000\right)}$$
$$= 273\ (\mathrm{N})$$

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 (0.082G). As the load factor f_w is in the range of 1.0 to 1.5, use common value $\boldsymbol{f_w = 1.2}$.

Hardness coefficient

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

Calculate rating life

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

The basic dynamic load rating (C) of linear guide LU15AL : 5550 (N)
Mean effective load F_m : 273 (N)
Load factor f_w : 1.2
Hardness coefficient f_H : 1

$$\text{Rating fatigue life } L = 50 \times \left[\frac{f_H \cdot C}{f_w \cdot F_m}\right]^3$$
$$= 50 \times \left[\frac{1 \times 5550}{1.2 \times 273}\right]^3$$
$$= \text{approximately } 243110\ (\mathrm{km})$$

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

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

Examine static load

Based on **"A-3-2.2 (7) Examination of static load,"** find out on which ball slide the static equivalent load P_0 becomes largest.

The basic static load rating (C_0) of linear guide LU15AL: 6600 (N)

Ball slide No. 3 bears the largest load.
P_0 at this time:

$$P_0 = F_r + F_s = 340$$

Therefore, static permissible load coefficient fs is:

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

There is no problem at this value.

(1)-3 Selection of accuracy grade and preload

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

(1)-4 Calculation of deformation

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

$\boldsymbol{K_s = K_r}$ **= 45 (N/μm) = 45000 (N/mm)**

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

From Pattern 4 in Table 2.2 (Page A19)

Work mounted:

$$\delta_{x1} = Y_d \cdot \frac{F_{s2} - F_{s1}}{L_b \cdot K_s} + Z_d \cdot \frac{F_{r1} - F_{r2}}{L_b \cdot K_r}$$
$$= -90 \times \frac{-100 - 0}{100 \times 45000} + 120 \times \frac{40 - (-165)}{100 \times 45000}$$
$$= 0.0075\ (\mathrm{mm}) = 7.5\ (\mu\mathrm{m})$$

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

No work mounted:

$$\delta_{x2} = Y_d \cdot \frac{F_{s2} - F_{s1}}{L_b \cdot K_s} + Z_d \cdot \frac{F_{r1} - F_{r2}}{L_b \cdot K_r}$$
$$= -90 \times \frac{-100 - 0}{100 \times 45000} + 120 \times \frac{10 - (-35)}{100 \times 45000}$$
$$= 0.0032\,(\text{mm}) = 3.2\ (\mu\text{m})$$

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

Operating conditions

Dimensions and load conditions are:

X axis column's weight	Wx	: 7500 (N)
Y axis spindle head's weight	Wy	: 2500 (N)
Z axis table's weight	Wz	: 5500 (N)
X axis rail span	XL_r	: 450 (mm)
X axis ball slide span	XL_b	: 310 (mm)
Y axis rail span	YL_r	: 410 (mm)
Y axis ball slide span	YL_b	: 308 (mm)
Z axis rail span	ZL_r	: 660 (mm)
Z axis ball slide span	ZL_b	: 420 (mm)

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

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

Cutting load

Milling process	Fx = Fy = 1000 (N)
Drilling process	Fz = 3000 (N)

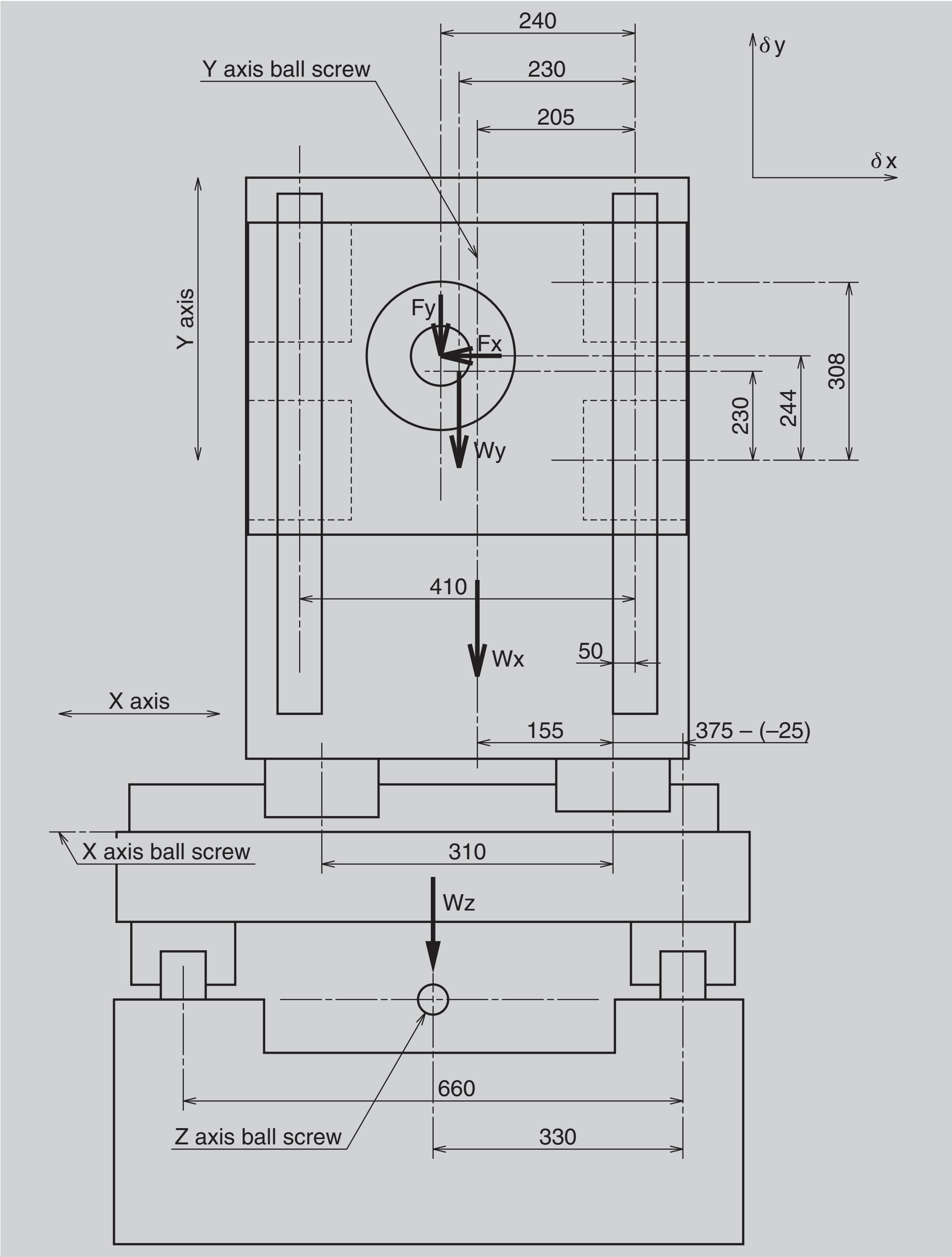


Fig. 10.2 Machining center (front view)

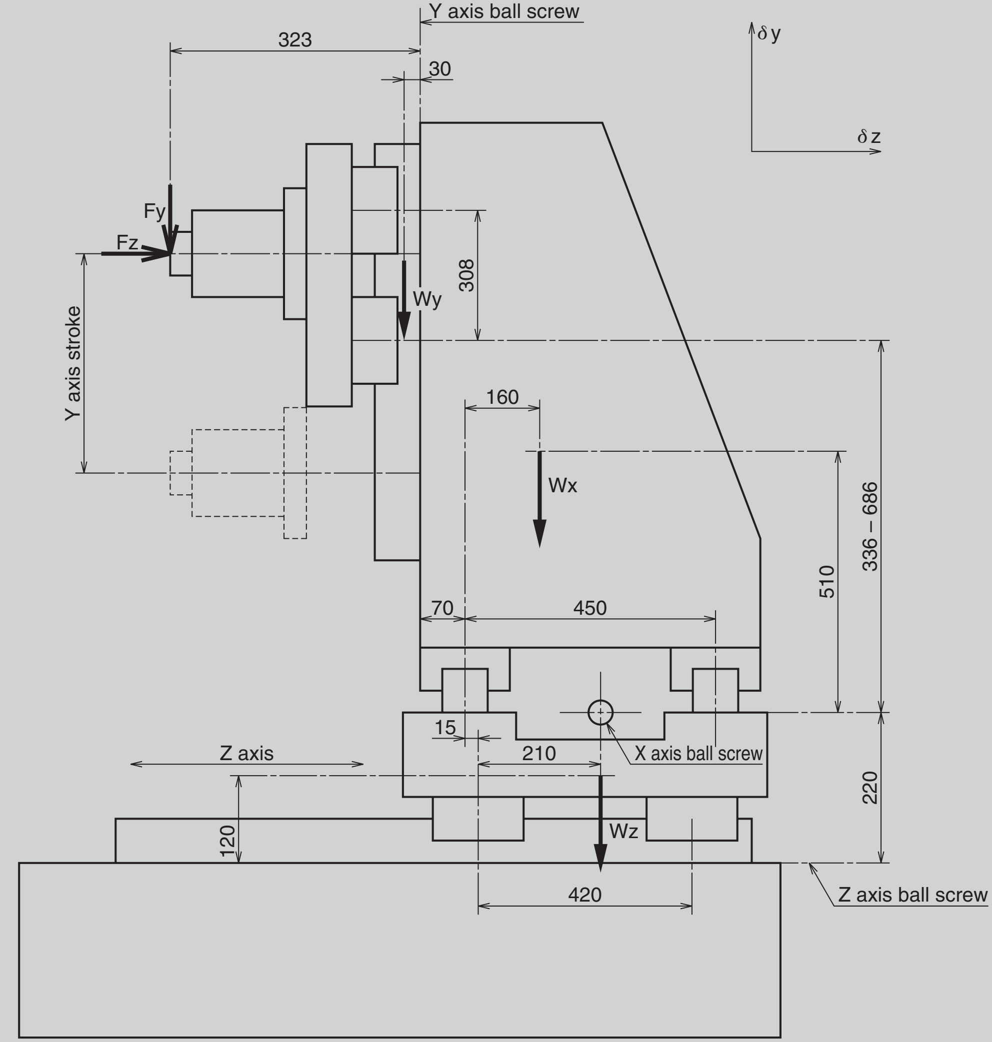


Fig. 10.3 Machining center (side view)

(2)-1 Selection of linear guide model

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

Select below temporaly from shaft diameter of ball screw:

X axis LA55
Y axis LA35
Z axis LA65

(2)-2 Calculation of life expectation

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

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

Calculation of the loads that apply to the ball slide

In case of no cutting load: *F*x = *F*y = *F*z = 0

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

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

Unit: N

Axis	Load direction	Slide1	Slide2	Slide3	Slide4
X axis	Vertical direction *F*r	1156	955	4045	3844
	Lateral direction *F*s	0	0	0	0
Y axis	Vertical direction *F*r	122	–122	122	–122
	Lateral direction *F*s	102	–102	102	–102
Z axis	Vertical direction *F*r	765	3860	3890	6985
	Lateral direction *F*s	0	0	0	0

In case of milling process: *F*x = *F*y = 1000 (N)

Similarly,

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

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

Unit: N

Axis	Load direction	Slide1	Slide2	Slide3	Slide4
X axis	Vertical direction *F*r	2277	–1039	6539	3224
	Lateral direction *F*s	997	–997	997	–997
Y axis	Vertical direction *F*r	252	–1040	1040	–252
	Lateral direction *F*s	54	–554	54	–554
Z axis	Vertical direction *F*r	–771	3796	4453	9020
	Lateral direction *F*s	486	–986	486	–986

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

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

Y axis: Loads to consider W_y and F_z

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

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

Unit: N

Axis	Load direction	Slide1	Slide2	Slide3	Slide4
X axis	Vertical direction F_r	4256	4055	945	744
	Lateral direction F_s	919	581	919	581
Y axis	Vertical direction F_r	305	938	561	1195
	Lateral direction F_s	102	–102	102	–102
Z axis	Vertical direction F_r	4872	–247	7997	2878
	Lateral direction F_s	839	–839	839	–839

Calculation of dynamic equivalent load

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

Vertical dynamic equivalent load

$$F_r = F_r$$

Lateral dynamic equivalent load

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

From above, calculate F_e using formulas for full dynamic equivalent loads shown in Page A23.

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

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

Calculation of mean effective load

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

Therefore,

X axis: 7038 × 0.7 = 4927 (N)

Y axis: 1317 × 0.7 = 922 (N)

Z axis: 9513 × 0.7 = 6659 (N)

Determine various coefficients

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

In this occasion,

Load coefficient f_W : 1.5

Hardness coefficient f_H : 1

Calculation of rating life

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

Basic dynamic load rating C
(X axis linear guide LA55): 139000 (N)
Basic dynamic load rating C
(Y axis linear guide LA35): 61500 (N)
Basic dynamic load rating C
(Z axis linear guide LA65): 260000 (N)

Load coefficient f_W: **1.5**

Hardness coefficient f_H: **1**

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

From this,

In case of X axis Lx **= 332650 (km)**
In case of Y axis Ly **= 4396720 (km)**
In case of Z axis Lz **= 881830 (km)**

In case of roller, shown in **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): 215000 (N)
Basic static load rating C_0
(Y axis linear guide LA35): 98000 (N)
Basic static load rating C_0
(Z axis linear guide LA65): 420000 (N)

Examine for milling process with large load.

X axis $fs = \dfrac{C_0}{P_0} = \dfrac{C_0}{(F_r + F_s)} = \dfrac{215000}{(6539 + 997)} = 28.5$

Similarly,

Y axis fs = 61.5

Z axis fs = 42.0

Therefore, there is no problem.

(2)-3 Selection of accuracy grade and preload

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

(2)-4 Calculation of deformation

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

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

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

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

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 milling:

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

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

A-3-11 Reference

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

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

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

A-4 NSK Linear Guides™

(1) Structure of NSK Linear Guides

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

(2) Characteristics of NSK Linear Guides

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

1. High precision and quality

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

2. High reliability and durability

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

3. Abundant in type for any purpose

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

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

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

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

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

6. Lineup of extremely high-load capacity series

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

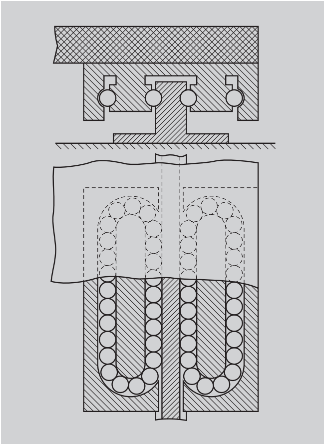


Fig. 1 • French Patent in 1932.
• Inventor : Gretsh (German)

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

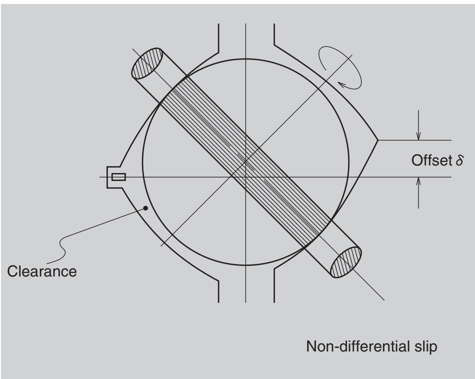


Fig. 3 Two contact point at offset Gothic arch groove

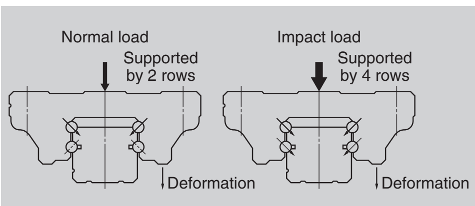


Fig. 5 Shock-resistance

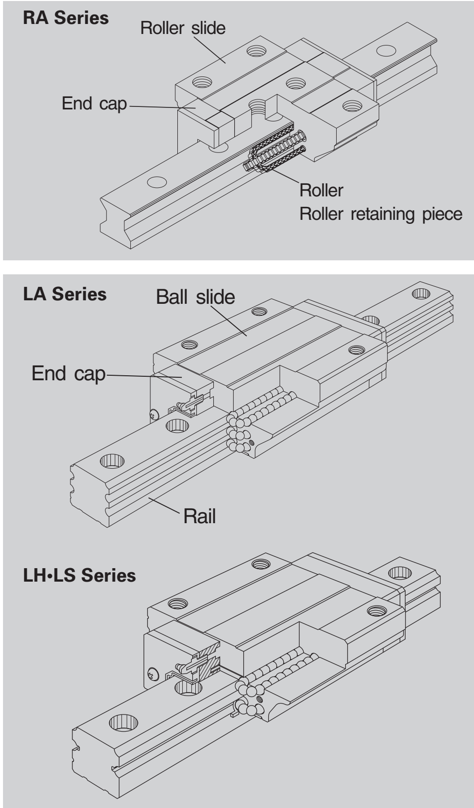


Fig. 2 Structure of NSK linear guides

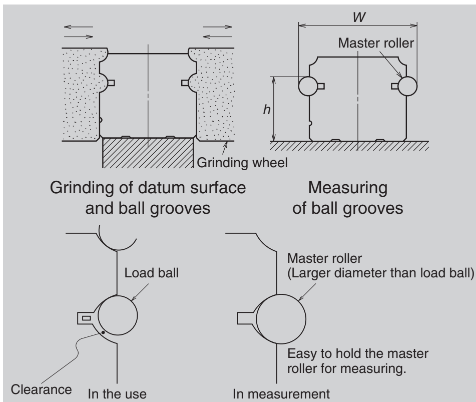
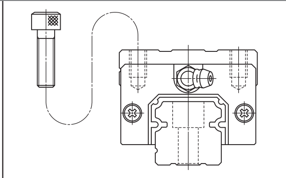
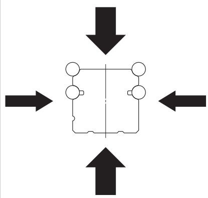
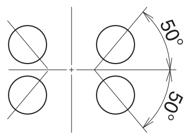
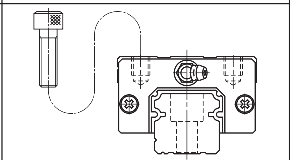
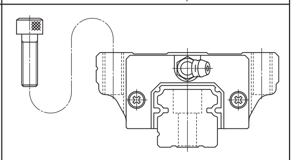
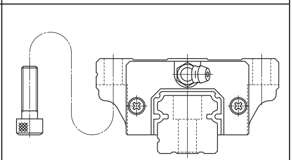
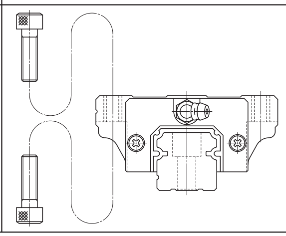
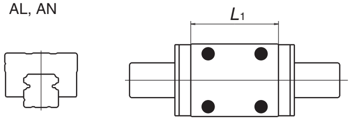
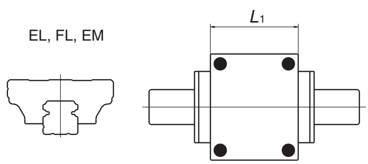


Fig. 4 Processing and measuring grooves

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

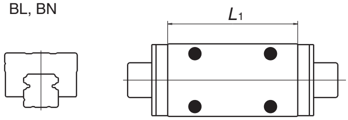
(3) Types and Characteristics of NSK Linear Guides

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

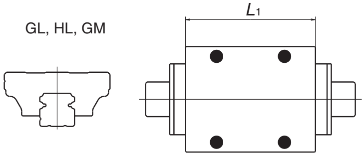
Characteristics	Applications	Page
The SH series has achieved lower noise, gentler tone, and smoother motion. Random assembly products of rails and ball slides are available as a standard. ● Lower noise and gentler tone. ● The contact angle between the ball and ball groove is set at 50 degrees. The load carrying capacity against the vertical directions, which is practical in most operations, increases by this design. ● The DF contact structure greatly absorbs the error in the perpendicular direction to rail at the time of installation. ● Balls make contacts at two points thanks to the offset Gothic arch groove. This keeps friction to a minimum. ● Structural resistance against shock load. ● Gothic arch groove renders measuring of ball grooves accurate and easy. ● Standardized random-matching type allows separate purchase of rails and ball slides. ● Stainless steel type is also available (- #30).	• Semiconductor manufacturing equipment • Liquid crystal display manufacturing equipment • Cartesian type robots • Robots that remove plastic molds from injection machine • Material hardling • Food processing machines • Packaging/packing machines • Printing machines • Woodworking machines • Paper machines • Measuring equipment • Inspecting equipment • Medical equipment • Electric discharge machines • Laser cutting machines • Press • Tool grinders • Flat surface grinders • NC lathes • Machining centers • ATC	A115

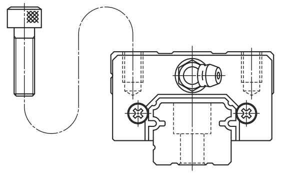
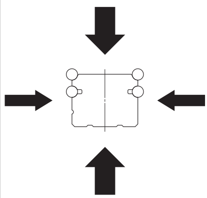
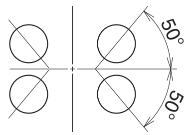
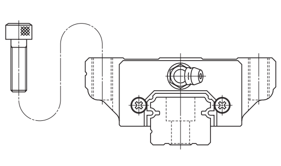
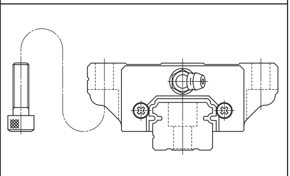
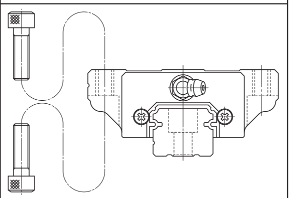
Super-high-load type

BL, BN



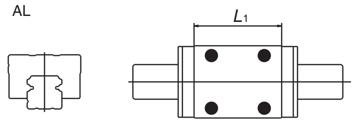
GL, HL, GM



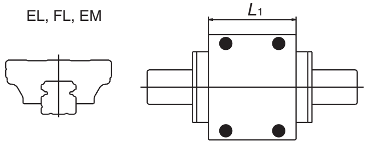
Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure
High vertical load carrying capacity type	Self-aligning type	SS	CL AL			
			JL EL			
			KL FL			
			JM EM			

High-load type

AL



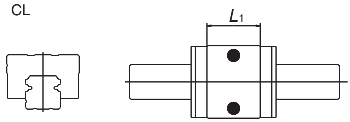
EL, FL, EM



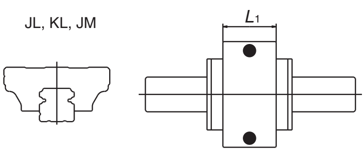
Characteristics	Applications	Page
The SS series has achieved lower noise, gentler tone, and smoother motion, and has a low and compact design. Random assembly products of rails and ball slides are available as a standard. ● Lower noise and gentler tone. ● Compact, low in height ● The contact angle between the ball and the ball groove is set at 50 degrees. The load carrying capacity against vertical directions, which is prevalent in most operations, increases by this design. ● The DF contact structure greatly absorbs the error in the perpendicular direction of rail at time of installation. ● Thanks to the offset Gothic arch groove, balls make contacts at two points. This keeps friction small. ● Great resistance against shock load. ● Gothic arch groove renders measuring groove accurate and easy. ● Standardized random-matching type allows separate purchase of rails and ball slide. ● Stainless steel type is also available.	• Semiconductor manufacturing equipment • Liquid crystal display manufacturing equipment • Cartesian type robots • Robots that remove plastic molds from injection machine • Material handling • Food processing machines • Packaging/packing machines • Printing machines • Woodworking machines • Paper machines • Measuring equipment • Inspection equipment • Medical equipment • Electric discharge machines • Laser cutting machines • Press	A139

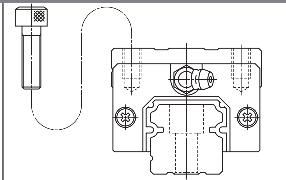
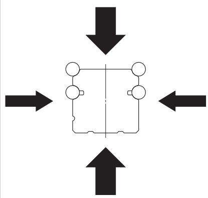
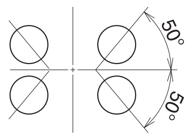
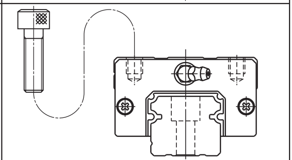
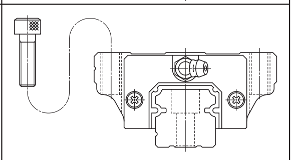
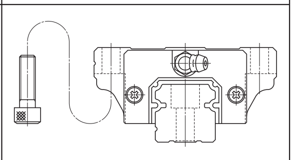
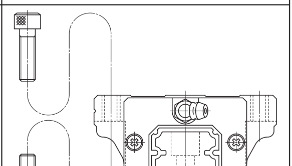
Medium-load type

CL



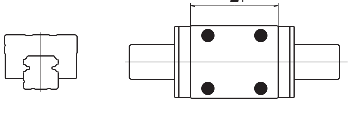
JL, KL, JM



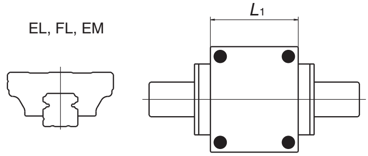
Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure
High vertical load carrying capacity type	Self-aligning type	LH	AN BN			
			AL BL			
			EL GL			
			FL HL			
			EM GM			

High-load type

AL, AN



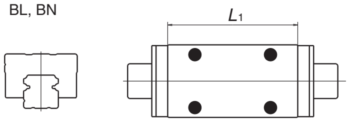
EL, FL, EM



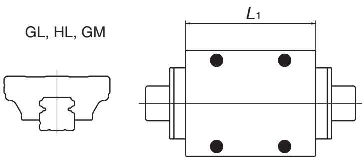
Characteristics	Applications	Page
The LH series is applicable to a wide range of uses from general industrial use to high-accuracy application. Random assembly products of rails and ball slides are available as a standard. ● The contact angle between the ball and ball groove is set at 50 degrees. The load carrying capacity against the vertical directions, which is practical in most operations, increases by this design. ● The DF contact structure greatly absorbs the error in the perpendicular direction to rail at the time of installation. ● Balls make contacts at two points thanks to the offset Gothic arch groove. This keeps friction to a minimum. ● Structural resistance against shock load. ● Gothic arch groove renders measuring of ball grooves accurate and easy. ● Standardized random-matching type allows separate purchase of rails and ball slides. ● Stainless steel type is also available (- #30).	• Cartesian type robots • Robots that remove plastic molds from injection machine • Material handling • Food processing machines • Packaging/packing machines • Printing machines • Woodworking machines • Paper machines • Measuring equipment • Inspecting equipment • Semiconductor manufacturing equipment • Liquid crystal display manufacturing equipment • Medical equipment • Electric discharge machines • Laser cutting machines • Press • Tool grinders • Flat surface grinders • NC lathes • Machining centers • ATC	A161

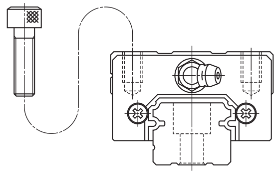
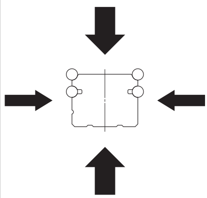
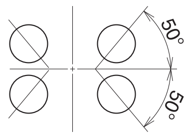
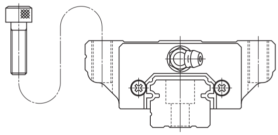
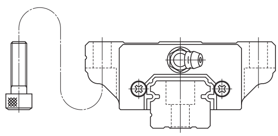
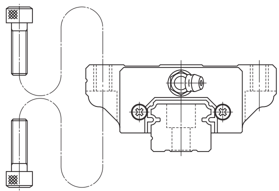
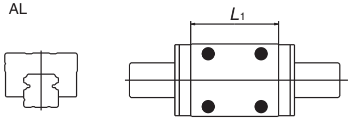
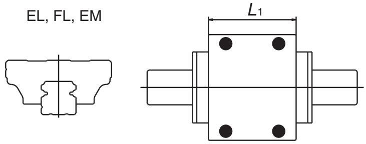
Super-high-load type

BL, BN



GL, HL, GM



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

<table>
<tr><th>Characteristics</th><th>Applications</th><th>Page</th></tr>
<tr><td>The LS series is low in height, and applicable to a wide range of uses from general industrial use to high-accuracy application.
Random assembly products of rails and ball slides are available as a standard.

● Compact, low in height
● The contact angle between the ball and the groove is set at 50 degrees. The load carrying capacity against vertical directions, which is prevalent in most operations, increases by this design.
● The DF contact structure greatly absorbs the error in the perpendicular direction of rail at time of installation.
● Thanks to the offset Gothic arch groove, balls make contacts at two points. This keeps friction small.
● Great resistance against shock load.
● Gothic arch groove renders measuring groove accurate and easy.
● Standardized random-matching type allows separate purchase of rails and ball slide.
● Stainless steel type is also available.</td><td>• Cartesian type robots
• Robots that remove plastic molds from injection machine
• Material handling
• Food processing machines
• Packaging/packing machines
• Printing machines
• Woodworking machines
• Paper machines
• Measuring equipment
• Inspection equipment
• Semiconductor manufacturing equipment
• Liquid crystal display manufacturing equipment
• Medical equipment
• Electric discharge machines
• Laser cutting machines
• Press</td><td rowspan="2">A185</td></tr>
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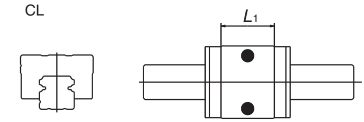
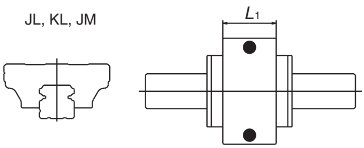
CL

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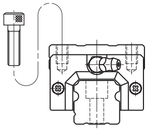
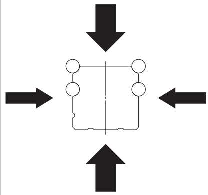
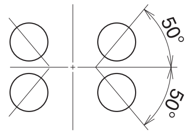
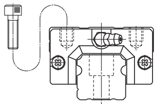
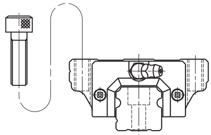
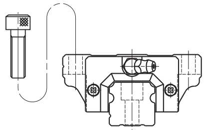
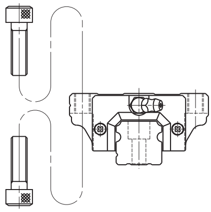
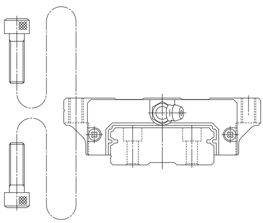
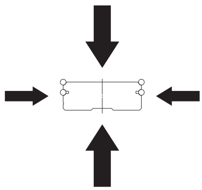
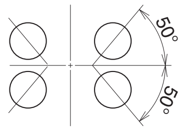
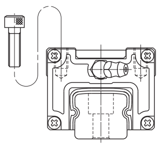
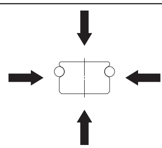
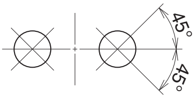
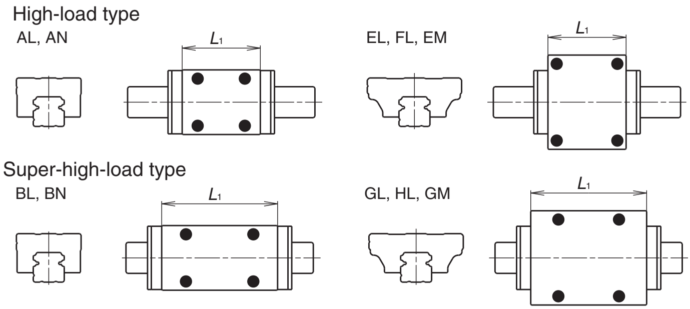
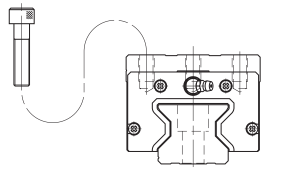
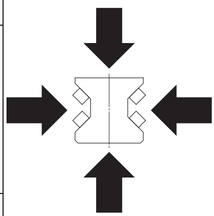
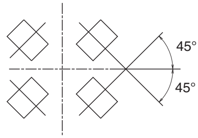
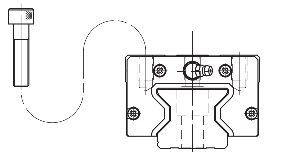
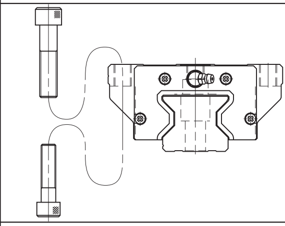
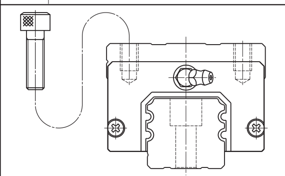
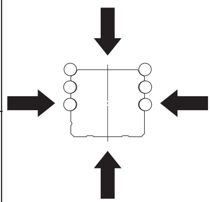
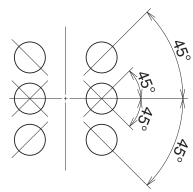
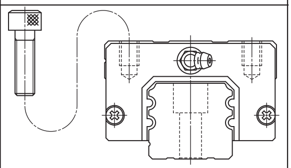
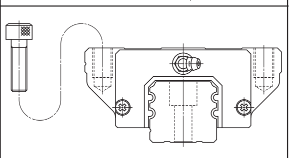
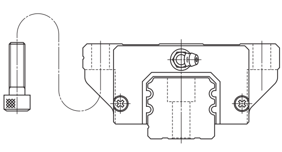
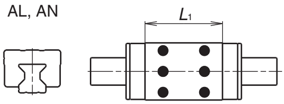
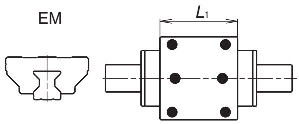
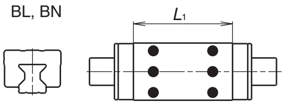
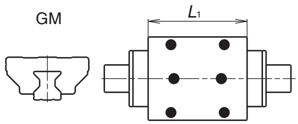
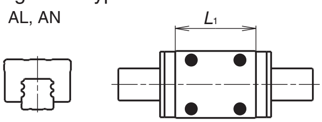
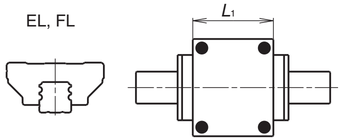
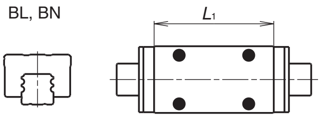
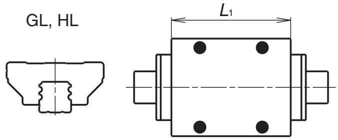
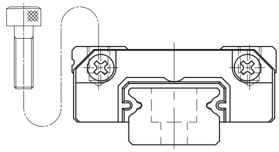
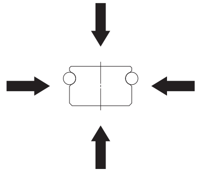
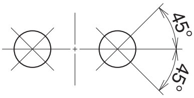
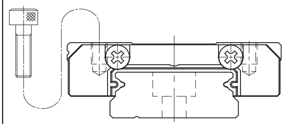
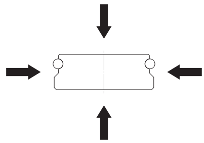
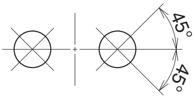
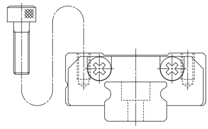
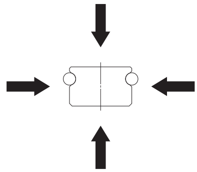
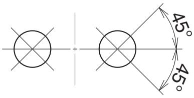
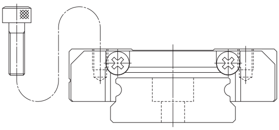
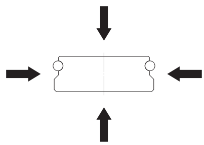
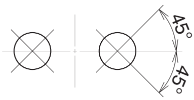
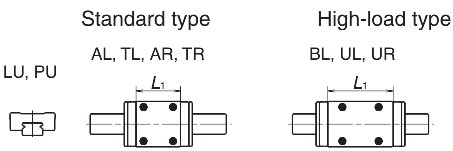
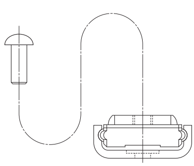
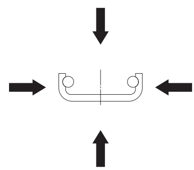
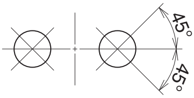
Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure
High vertical load carrying capacity type	Self-aligning type	VH	AN BN			
			AL BL			
			EL GL			
			FL HL			
			EM GM			
High vertical load carrying capacity type	High moment capacity type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

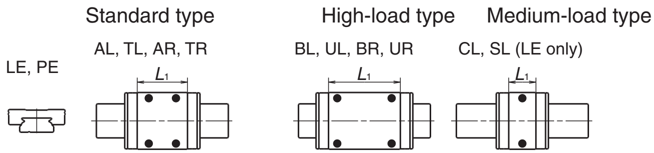
Characteristics	Applications	Page
The VH series delivers outstanding functionality and long operating life under contaminated environments. Random assembly products of rails and ball slides are available as a standard. ● The contact angle between the ball and the raceway is set at 50 degrees. The load carrying capacity against vertical directions, which is prevalent in most operations, increases by this design. ● The DF contact structure greatly absorbs the error in the perpendicular direction of rail at time of installation. ● Thanks to the offset Gothic arch groove, balls make contacts at two points. This keeps friction small. ● Great resistance against shock load. ● Gothic arch groove renders measuring groove accurate and easy. ● Standardized random-matching type allows separate purchase of rails and ball slide. ● Less than 1/10 the level of fine contaminants. ● Operating life under contaminated environments is more than 5 times longer.	• Automotive manufacturing equipment • Press • Machine tools loader/un-loader • Tire molding machine • Woodworking machine • Automatic doors	A207
		
High-moment rigidity and low profile products are most suited for a single linear guideway system. Random assembly products of rails and ball slides are available as a standard. ● The rail is wide. This contributes to a high rolling moment carrying capacity and to great moment rigidity when only single linear guide is in use. ● Balls contact at two points in the offset Gothic arch groove, keeping friction small. ● High resistance against shock load ● Standardized random-matching assemblies allows separate purchase of rails and ball slides.	• Semiconductor manufacturing equipment • Liquid crystal display manufacturing equipment • Conveyor systems • Medical equipment • Microscope XY stage	A229
The TS series is suitable for transfer equipment. ● Newly developed manufacturing process contribute to low cost. ● Standardized random-matching assemblies allows separate purchase of rails and ball slides.	• Automotive manufacturing equipment • Press • Machine tools loader/un-loader • Tire molding machine • Woodworking machine • Automatic doors	A243

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

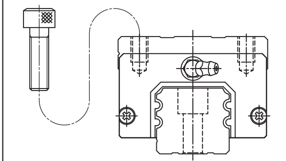
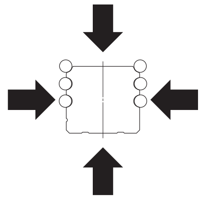
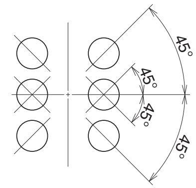
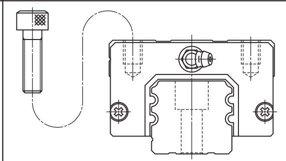
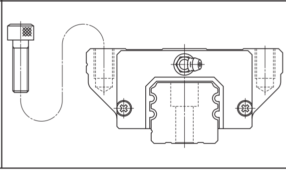
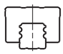
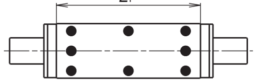
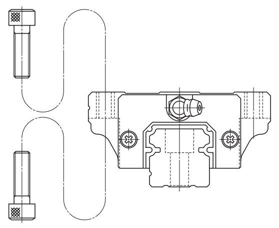
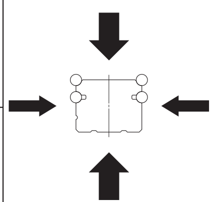
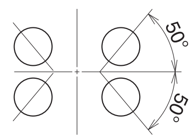
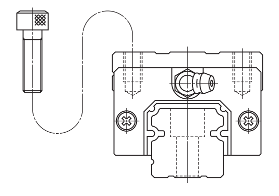
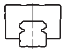
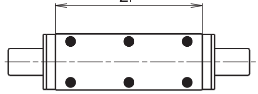
Characteristics	Applications	Page
The RA series roller guides have realized the world highest load capacity. Super-high rigidity and smooth motion contribute to high performance of machine tools. ● Unique design of rollers and optimum parts design facilitate the high-load capacity and high rigidity. ● High-performance seals, a standard feature in the roller guides, maintain the initial performance for a prolonged time. ● The installation of retaining piece achieves smooth motion. ● Random assembly products of rails and roller slides are available as a standard.	• Machining centers • NC lathes • Heavy cutting machine tools • Gear cutters • Electric discharge machines • Press • Grinders	A251
High-load type AL, AN  EM  Super-high-load type BL, BN  GM 		
The LA series provides a top class high-load capacity for the ball linear guides, even with not high friction. The series is most suited for machine tools. ● The contact angle between the ball and the raceway is set at 45 degrees. This makes load carrying capacity and rigidity equal in vertical and lateral directions. ● Six-row ball grooves support load from vertical and lateral directions, enhancing rigidity and increasing load carrying capacity. ● Appropriate friction ● Best for machine tools.	• Machining centers • NC lathes • Heavy cutting machine tools • Gear cutters • Electric discharge machines • Press • Grinders	A269
High-load type AL, AN  EL, FL  Super-high-load type BL, BN  GL, HL 		

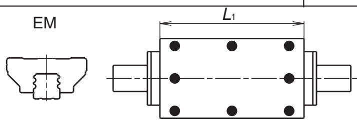
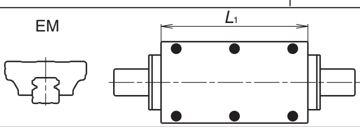
Category		Series	Slide shape	Shape/installation method	Load direction/capacity	Rolling element contact structure
Miniature type	Standard type	PU	AL AR TR UR BL			
	High moment capacity type	PE	AR TR UR BR			
	Standard type	LU	AL TL AR TR BL UL			
	High moment capacity type	LE	AL TL AR TR BL UL CL SL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

Characteristics	Applications	Page
Low inertia and low dust generation miniature series. ● Low dust generation, highly smooth operation ● Super-small size ● Stainless steel ● Series with a ball retainer ● Standardized random matching allows separate purchase of rails and ball slides.	• Semiconductor manufacturing equipment • Liquid crystal display manufacturing equipment • Medical equipment • Optical stage • Microscope XY stage • Conveying optical fiber • Small robots • Computer peripheral equipment • Pneumatic equipment	A289
Low inertia and low dust generation miniature wide series. ● Low dust generation, highly smooth operation ● Super-small size ● Stainless steel is standard as the material. ● Series with a ball retainer is standardized. ● Standardized random matching allows separate purchase of rails and ball slides.		A299
Miniature series ● Super-small size ● Stainless steel is standard as the material. ● Series with a ball retainer is standardized. ● Standardized random matching allows separate purchase of rails and ball slides.	• Semiconductor manufacturing equipment • Liquid crystal display manufacturing equipment • Medical equipment • Optical stage • Microscope XY stage • Conveying optical fiber • Small robots • Computer peripheral equipment • Pneumatic equipment	A309
Miniature wide series ● Super-small size in wide rail type ● Stainless steel is standard as the material. ● Series with a ball retainer is standardized. ● Standardized random matching allows separate purchase of rails and ball slides.		A321



The LL series is a compact and lightweight miniature linear guide for press molding. ● Rails and ball slides are thin steel plate, therefore they are lightweight. ● Stainless steel as a standard material	• Part of platter pen head • Robot hand • Pneumatic equipment	A335

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

Characteristics	Applications	Page
The HA Series ball guide with high-precision and high-load carrying capacity, featuring high-motion accuracy equivalent to hydrostatic 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 super-finished ball groove feature (option). ● End seal, bottom seal, and inner seal of high dust proof specification are available as a standard. ● Best for high-grade working machine.	• Die and mold tooling machine center • Precision processing machine • Heavy cutting machine tools • Gear cutters • Press machines • Grinders	A341
EM 		
The HS Series ball guide with high-precision featuring high-motion accuracy equivalent to hydrostatic 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 prevalent in most operations, increases by this design. ● The DF contact structure greatly absorbs the error in the perpendicular direction of rail at time of installation. ● Thanks to the offset Gothic arch groove, balls make contacts at two points. This keeps friction small.	• Precision processing machine • Electric discharge machines • Grinders • Liquid crystal display manufacturing equipment	A355
EM 		

(4) Guide to Technical Services

CAD drawing data

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

NSK website

http://www.nsk.com

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

Data offered by CAD

NSK linear guides

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

(2) Telephone consultation with NSK engineers

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

(5) Linear Guides: Handling Precautions

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

1. Lubrication

Confirm lubrication.

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.

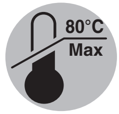
Do not drop.

Do not give impact.

a. Random-matching slides 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 guide unless absolutely necessary. Not only does it allow dust to enter, but it lessens precision.
c. 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, but it can be mitigated.
• A grease which prevents fretting is recommended for oscillating stroke operations. Using a standard grease, life can be markedly prolonged by adding a normal stroke travel (about the slide length) once every several thousand cycles.

When applying pitching or yawing moment

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

When an extraordinary large load is applied during stroke

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

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

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

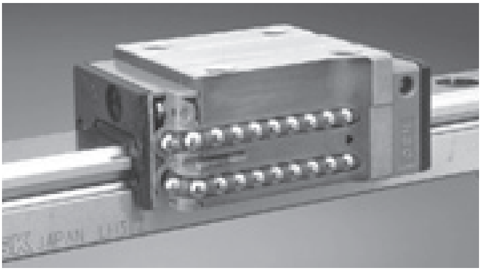
Application at high speed

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

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

A-5-1 General Industrial Use

A-5-1.1 SH Series



(1) Features

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

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

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

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

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

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

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

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

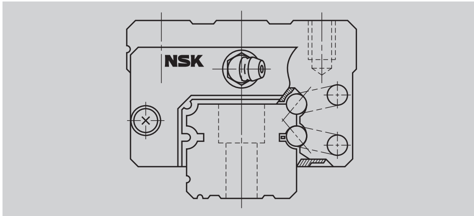


Fig. 1 SH Series

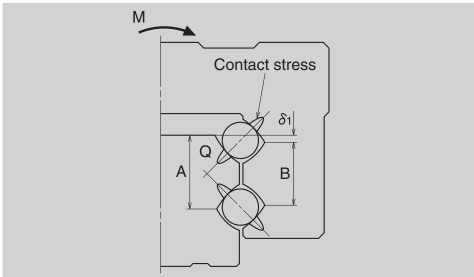


Fig. 2 Enlarged illustration of the offset Gothic arch groove

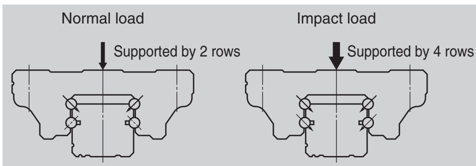


Fig. 3 When load is applied

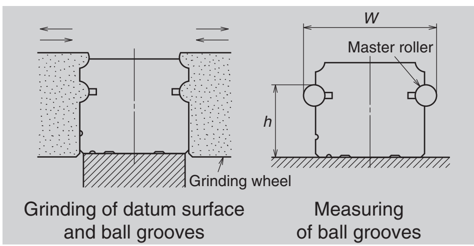
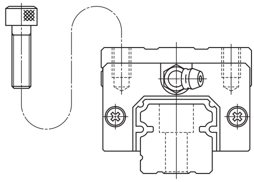
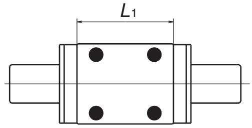
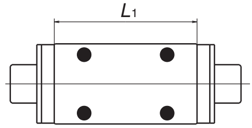
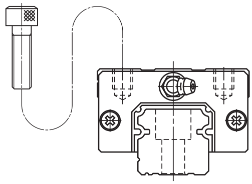
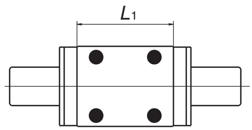
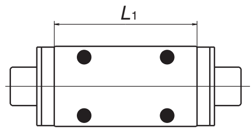
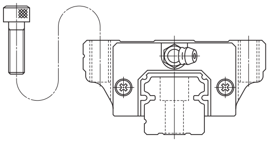
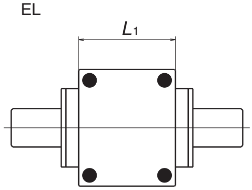
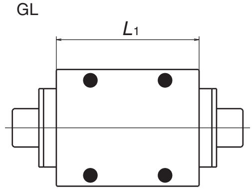
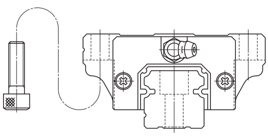
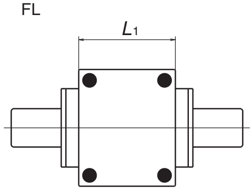
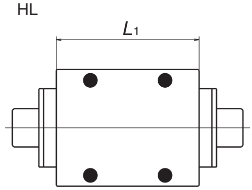
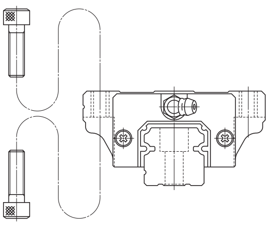
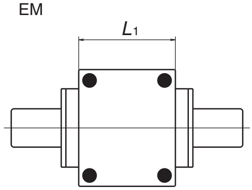
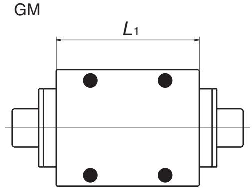


Fig. 4 Rail grinding and measuring

(2) Ball slide shape

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

(3) Accuracy and preload

1. Running parallelism of ball slide

Table 1

Unit: μm

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

2. Accuracy standard

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

• **Tolerance of preloaded assembly**

Table 2

Unit: 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 face C to face A Running parallelism of face D to face B	Shown in Table 1, Fig. 5 and Fig. 6				

• **Toerance of random-matching type; Normal grade, PC**

Table 3

Unit: μm

Characteristics \ Model No.	SH15, 20, 25, 30, 35	SH45, 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 face C to face A Running parallelism of face D to face B	See Table 1, Fig. 5 and Fig. 6	

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

3. Combinations of accuracy and preload

Table 4

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

4. Assembled accuracy

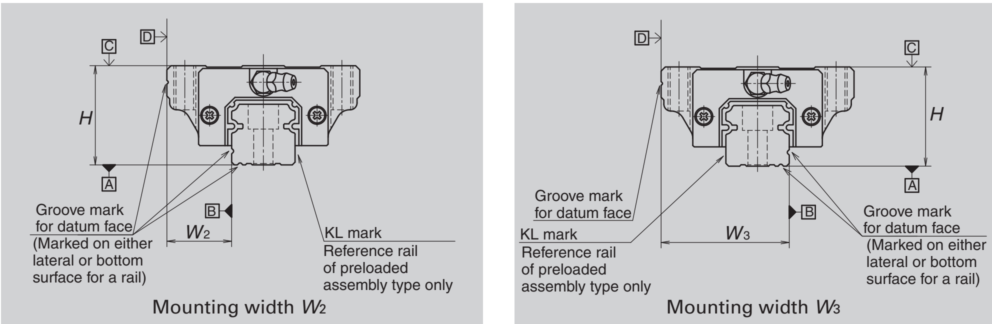


Fig. 5 Special high carbon steel

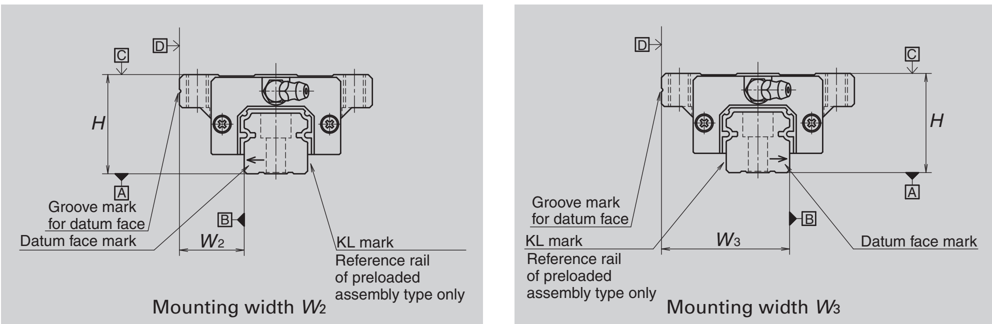


Fig. 6 Stainless steel

5. Preload and rigidity

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

• Preload and rigidity of preloaded assembly

Table 5

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

Note: Clearance for fine clearance Z0 is 0 to 3 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
SH15	–4 – 0
SH20	–5 – 0
SH25	–5 – 0
SH30	–7 – 0
SH35	–7 – 0
SH45	–7 – 0
SH55	–8 – 0

(4) Available length of rail

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

Table 7 Length limitation of rails

Unit : mm

Series	Size / Material	15	20	25	30	35	45	55
SH	Special high carbon steel	2000	3960	3960	4000	4000	3990	3960
	Stainless steel	1800	3500	3500	3500			

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

(5) Installation

1. Permissible values of mounting error

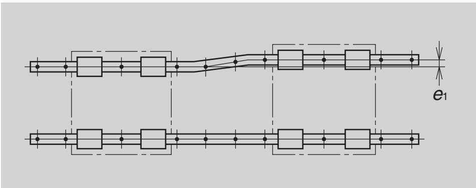


Fig. 7

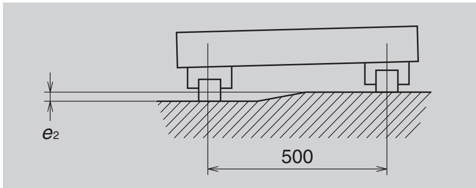


Fig. 8

Table 8

Unit : μm

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

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

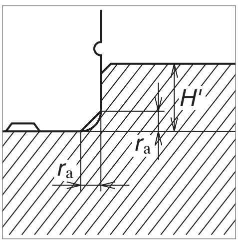


Fig. 9 Shoulder for the rail datum face

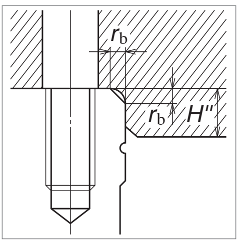


Fig. 10 Shoulder for the ball slide datum face

Table 9

Unit : mm

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

(6) Lubrication components

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

1. Types of lubrication accessories

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

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

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

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

Please ask NSK for stainless lubrication accessories.

2. Mounting position of lubrication accessories

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

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

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

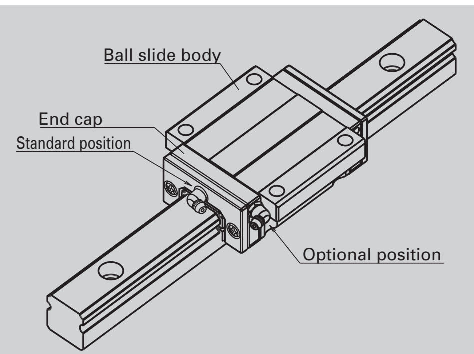


Fig. 12 Mounting position of lubrication accessories

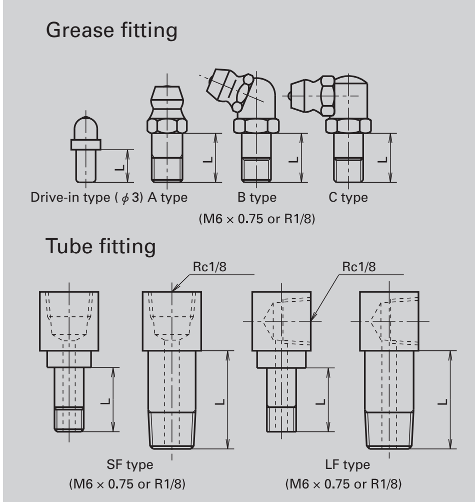


Fig. 11 Grease fitting and tube fitting

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	6**
	With NSK K1	12	11**
	Double seal	10	9**
	Protector	10	9**
SH30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
SH35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
SH45	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
SH55	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17

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

(7) Dust proof components

1. Standard specification

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

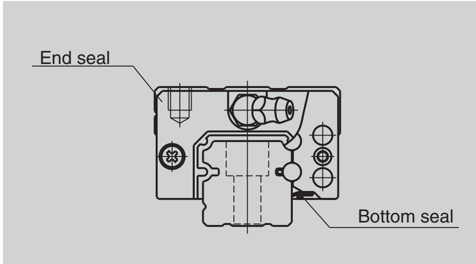


Fig. 13

Table 11 Seal friction per ball slide (maximum value)

Unit : N

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

2. NSK K1™

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

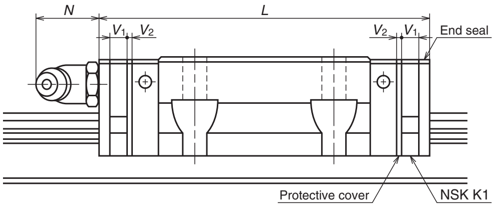


Table 12

Unit: mm

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

Note: Ball slide length equipped with NSK K1 = (Standard ball slide length) + (Thickness of NSK K1, V_1 × 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 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 is required.

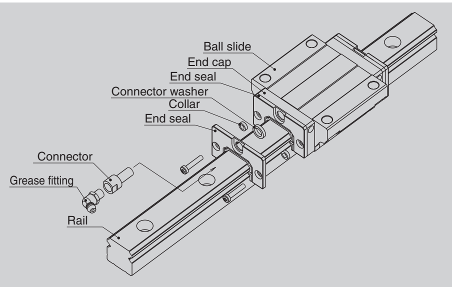


Fig. 14 Double seal

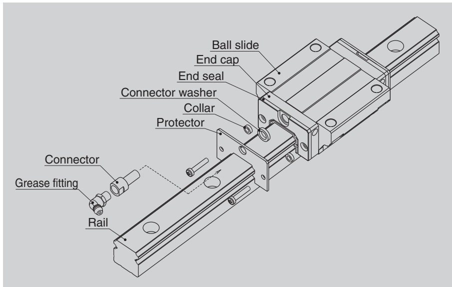


Fig. 15 Protector

Table 13 Double-seal set

Model No.	Reference No.		Increased
	Without connector	With connector	thickness V_1
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
	Without connector	With connector	thickness V_2
SH15	LH15PT-01	*	2.7
SH20	LH20PT-01	LH20PTC-01	2.9
SH25	LH25PT-01	LH25PTC-01	3.2
SH30	LH30PT-01	LH30PTC-01	4.2
SH35	LH35PT-01	LH35PTC-01	4.2
SH45	LH45PT-01	LH45PTC-01	4.9
SH55	LH55PT-01	LH55PTC-01	4.9

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

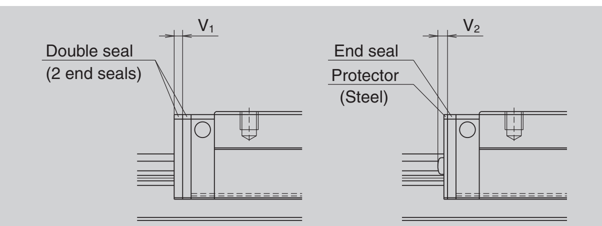


Fig. 16

5. Cap to cover the bolt hole for rail mounting

Table 15 Caps to cover rail bolt hole

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

6. Inner seal

Inner seal can be manufactured for models shown below.

Table 16

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

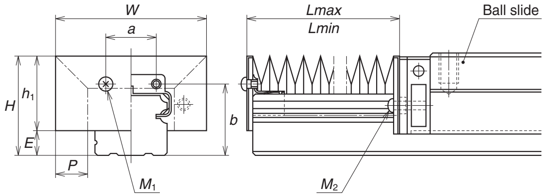
7. Bellows

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.

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



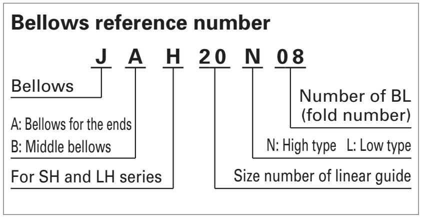


Fig. 17 Dimensions of bellows

Table 18 Dimensions of bellows

Unit: mm

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

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

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

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

(8) Reference number

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

1. Reference number for preloaded assembly

SH 30 1000 AN C 2 - P5 3**

- SH: Series name
- 30: Size
- 1000: Rail length (mm)
- AN: Ball slide shape code (See page A116)
- C: Material/surface treatment code (See Table 20)
- 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)

2. Reference number for random-matching type

Ball slide

SAH 30 AN C - PC Z**

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

Rail

L1H 30 1200 L C N - PC Z**

- L1H: Random-matching rail series code
  L1H : LH/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 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
  Z: Slight preload only (See page A118)

*Please consult with NSK for butting rail specification.

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

Table 20 Material/surface treatment code

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

Table 21 Accuracy code

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

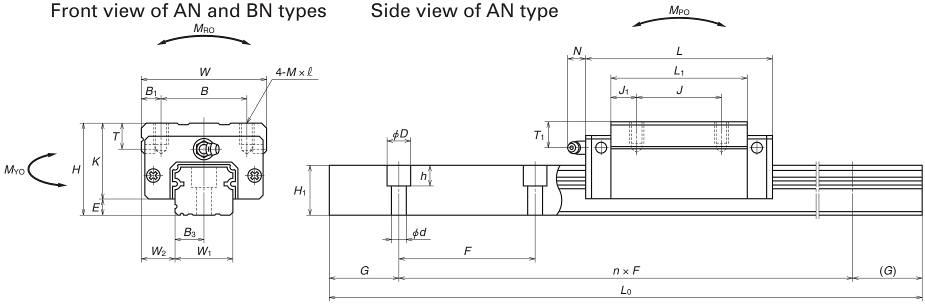
Note: Refer to Page A38 for NSK K1 lubrication unit.

(9) Dimensions
SH-AN (High-load type)
SH-BN (Super-high-load type)

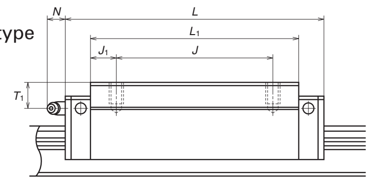
SH 30 1000 AN C 2 - P5 3**

- SH: Series name
- 30: Size
- 1000: Rail length (mm)
- AN: Ball slide shape code (See page A116)
- C: Material/surface treatment code (See Table 20)
- 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)

Front view of AN and BN types　　Side view of AN type



Side view of BN type



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

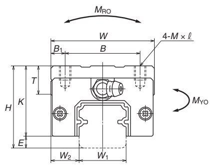
Remarks: 1) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Reference number for ball slide of random-matching type

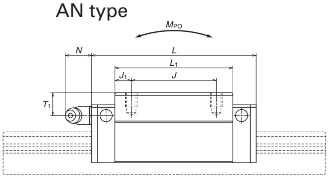
Ball slide **SAH 30 AN C -∗∗PC Z**

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

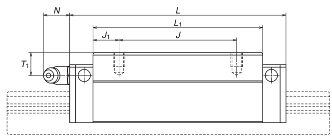
AN and BN types



AN type



BN type

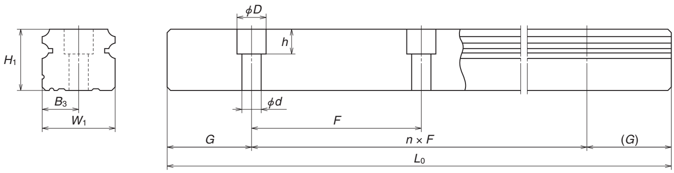


Reference number for rail of random-matching type

Rail **L1H 30 1200 L C N -∗∗ PC Z**

- Random-matching rail series code
  L1H : LH/SH Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code: L
  L : Standard
- Material/surface treatment code (See Table 20)
- Preload code
  Z: Slight preload only (See page A118)
- 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					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole		G	Max. length	Dynamic	Static	Static moment				Ball slide	Rail
W_1	H_1	F	$d \times D \times h$	B_3	(reference)	L_{0max} ( ) for stainless	C (N)	C_0 (N)	M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	(kg)	(kg/m)
15	15	60	4.5×7.5×5.3	7.5	20	2 000 (1 800)	10 100 13 400	18 800 28 200	98 147	87 193	73 162	3.175	0.18 0.26	1.6
20	18	60	6×9.5×8.5	10	20	3 960 (3 500)	16 300 21 600	29 600 44 500	199 298	167 360	141 305	3.968	0.33 0.48	2.6
23	22	60	7×11×9	11.5	20	3 960 (3 500)	22 400 32 000	37 500 62 500	295 490	246 615	207 515	4.762	0.55 0.82	3.6
28	26	80	9×14×12	14	20	4 000 (3 500)	31 000 46 000	51 500 91 500	490 870	365 1 060	305 885	5.556	0.77 1.3	5.2
34	29	80	9×14×12	17	20	4 000	47 500 61 500	80 500 117 000	950 1 380	780 1 600	655 1 340	6.35	1.5 2.1	7.2
45	38	105	14×20×17	22.5	22.5	3990	76 500 94 500	128 000 175 000	1 970 2 680	1 550 2 760	1 300 2 320	7.937	3.0 3.9	12.3
53	44	120	16×23×20	26.5	30	3960	113 000 140 000	181 000 247 000	3 300 4 550	2 640 4 800	2 210 4 050	9.525	4.7 6.1	16.9

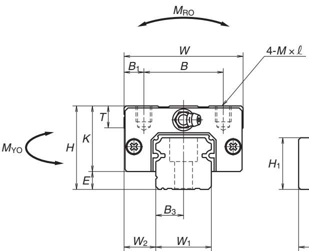
2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

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

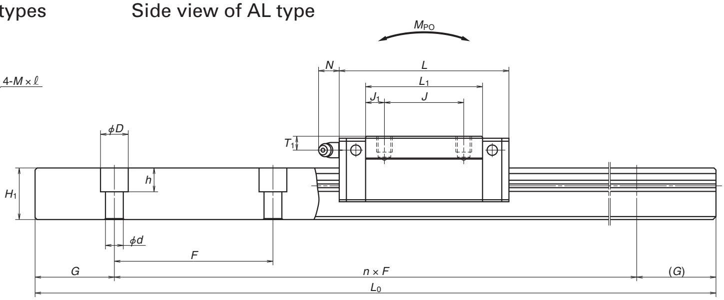
SH 30 1000 AL C 2 -✻✻ P5 3

- Series name (SH)
- Size (30)
- Rail length (mm) (1000)
- Ball slide shape code (See page A116) (AL)
- Material/surface treatment code (See Table 20) (C)
- Number of ball slides per rail (2)
- Design serial number (-✻✻) — Added to the reference number.
- Accuracy code (See Table 21) (P5)
- Preload code (See page A118) (3)

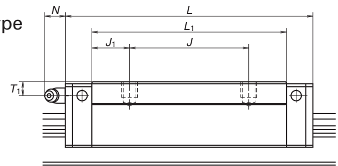
Front view of AL and BL types



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
SH25AL **SH25BL**	36	7	12.5	48	79 107	35	35 50	M6×1×6	6.5	58 86	11.5 18	29	12	M6×0.75	6	11
SH30AL **SH30BL**	42	9	16	60	85.6 124.6	40	40 60	M8×1.25×8	10	59 98	9.5 19	33	14	M6×0.75	7	11
SH35AL **SH35BL**	48	9.5	18	70	109 143	50	50 72	M8×1.25×8	10	80 114	15 21	38.5	15	M6×0.75	8	11
SH45AL **SH45BL**	60	14	20.5	86	139 171	60	60 80	M10×1.5×10	13	105 137	22.5 28.5	46	17	Rc1/8	10	13
SH55AL **SH55BL**	70	15	23.5	100	163 201	75	75 95	M12×1.75×13	12.5	126 164	25.5 34.5	55	15	Rc1/8	11	13

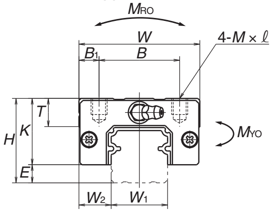
Remarks: 1) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Reference number for ball slide of random-matching type

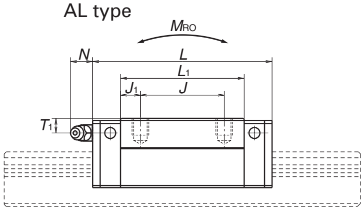
Ball slide **SAH 30 AL C -✻✻PC Z**

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

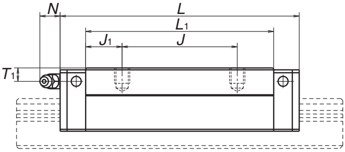
AL and BL types



AL type



BL type

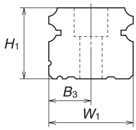


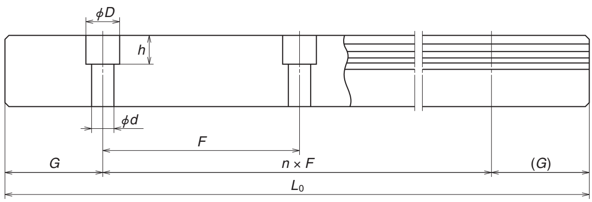
Reference number for rail of random-matching type

Rail **L1H 30 1200 L C N -✻✻ PC Z**

- Random-matching rail series code
  L1H : LH/SH Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code: L
  L : Standard
- Material/surface treatment code (See Table 20)
- Preload code
  Z: Slight preload only (See page A118)
- 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					Ball dia.	Weight	
Width W_1	Height H_1	Pitch F	Mounting bolt hole $d \times D \times h$	B_3	G (reference)	Max. length L_{0max} ( ) for stainless	Dynamic C (N)	Static C_0 (N)	Static moment M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	Ball slide (kg)	Rail (kg/m)
23	22	60	7×11×9	11.5	20	3 960 (3 500)	22 400 32 000	37 500 62 500	295 490	246 615	207 515	4.762	0.46 0.69	3.6
28	26	80	9×14×12	14	20	4 000 (3 500)	31 000 46 000	51 500 91 500	490 870	365 1 060	305 885	5.556	0.69 1.16	5.2
34	29	80	9×14×12	17	20	4 000	47 500 61 500	80 500 117 000	950 1 380	780 1 600	655 1 340	6.35	1.2 1.7	7.2
45	38	105	14×20×17	22.5	22.5	3990	76 500 94 500	128 000 175 000	1 970 2 680	1 550 2 760	1 300 2 320	7.937	3.0 3.9	12.3
53	44	120	16×23×20	26.5	30	3960	113 000 140 000	181 000 247 000	3 300 4 550	2 640 4 800	2 210 4 050	9.525	4.7 6.1	16.9

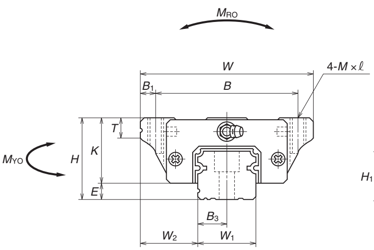
2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

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

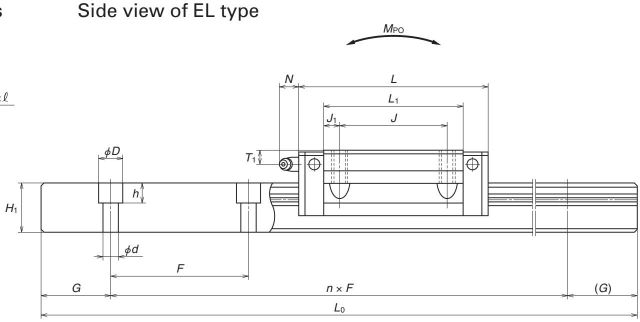
SH 30 1000 EL C 2 -✻✻ P5 3

- SH — Series name
- 30 — Size
- 1000 — Rail length (mm)
- EL — Ball slide shape code (See page A116)
- C — Material/surface treatment code (See Table 20)
- 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)

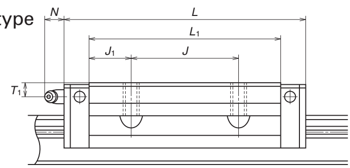
Front view of EL and GL types



Side view of EL type



Side view of GL type



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

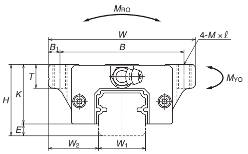
Remarks: 1) Parenthesized dimensions are applicable to stainless steel products.
2) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Reference number for ball slide of random-matching type

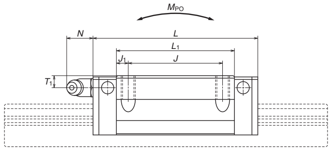
Ball slide SAH 30 EL C -✻✻PC Z

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

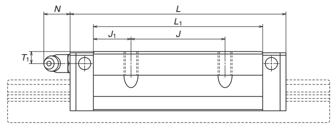
EL and GL types



EL type



GL type

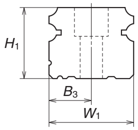


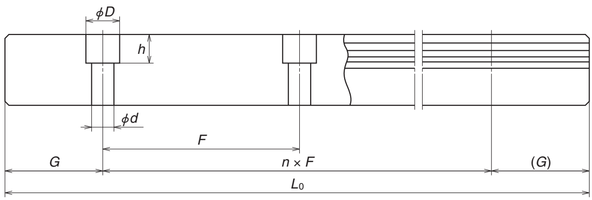
Reference number for rail of random-matching type

Rail L1H 30 1200 L C N -✻✻ PC Z

- Random-matching rail series code
  L1H : LH/SH Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code: L
  L : Standard
- Material/surface treatment code (See Table 20)
- Preload code
  Z: Slight preload only (See page A118)
- 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: Width W_1	Height H_1	Pitch F	Mounting bolt hole $d \times D \times h$	B_3	G (reference)	Max. length L_{0max} ( ) for stainless	Basic load rating: Dynamic C (N)	Static C_0 (N)	Static moment M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	Ball dia. D_W	Weight: Ball slide (kg)	Rail (kg/m)
15	15	60	4.5×7.5×5.3	7.5	20	2 000	10 100	18 800	98	87	73	3.175	0.17	1.6
						(1 800)	13 400	28 200	147	193	162		0.25	
20	18	60	6×9.5×8.5	10	20	3 960	16 300	29 600	199	167	141	3.968	0.45	2.6
						(3 500)	21 600	44 500	298	360	305		0.65	
23	22	60	7×11×9	11.5	20	3 960	22 400	37 500	295	246	207	4.762	0.63	3.6
						(3 500)	32 000	62 500	490	615	515		0.93	
28	26	80	9×14×12	14	20	4 000	35 500	63 000	600	540	450	5.556	1.2	5.2
						(3 500)	46 000	91 500	870	1 060	885		1.6	
34	29	80	9×14×12	17	20	4 000	47 500	80 500	950	780	655	6.35	1.7	7.2
							61 500	117 000	1 380	1 600	1 340		2.4	
45	38	105	14×20×17	22.5	22.5	3 990	76 500	128 000	1 970	1 550	1 300	7.937	3.0	12.3
							94 500	175 000	2 680	2 760	2 320		3.9	
53	44	120	16×23×20	26.5	30	3 960	113 000	181 000	3 300	2 640	2 210	9.525	5.0	16.9
							140 000	247 000	4 550	4 800	4 050		6.5	

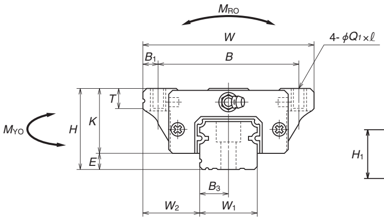
3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

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

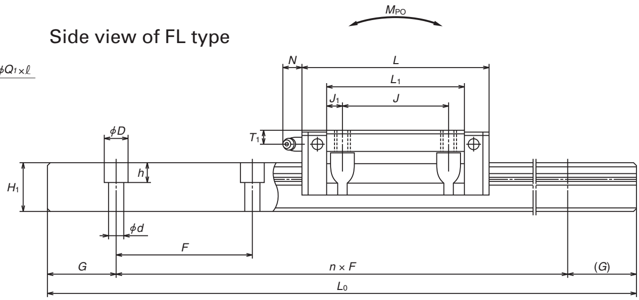
SH 30 1000 FL C 2 -✽✽ P5 3

- Series name — SH
- Size — 30
- Rail length (mm) — 1000
- Ball slide shape code (See page A116) — FL
- Material/surface treatment code (See Table 20) — C
- Number of ball slides per rail — 2
- Design serial number — ✽✽ (Added to the reference number.)
- Accuracy code (See Table 21) — P5
- Preload code (See page A118) — 3

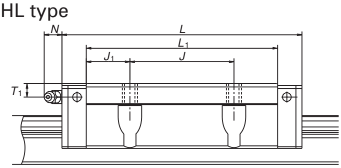
Front view of FL and HL types



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	$Q_1×\ell$	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

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

Reference number for ball slide of random-matching type

Ball slide **SAH 30 FL C -∗∗PC Z**

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

Size

Ball slide shape code (See page A116)

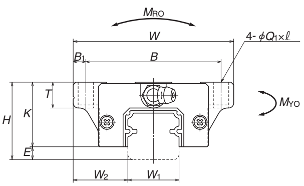
Material/surface treatment code (See Table 20)

Preload code
Z: Slight preload only (See page A118)

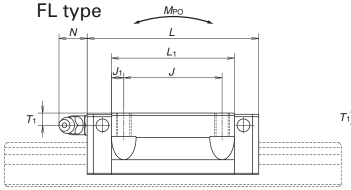
Accuracy code : PC
PC: Normal grade is only available

Design serial number
Added to the reference number.

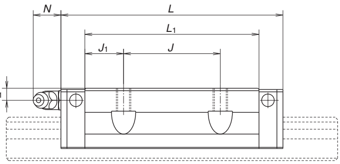
FL and HL types



FL type



HL type



Reference number for rail of random-matching type

Rail **L1H 30 1200 L C N -∗∗ PC Z**

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

Size

Rail length (mm)

Rail shape code: L
L : Standard

Material/surface treatment code (See Table 20)

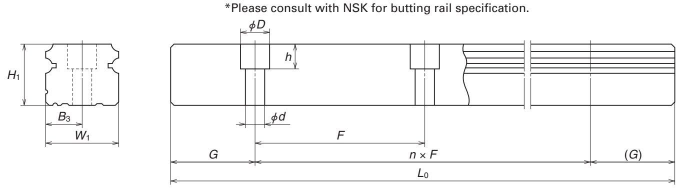
Preload code
Z: Slight preload only (See page A118)

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					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole		G	Max. length	Dynamic	Static	Static moment				Ball slide	Rail
W_1	H_1	F	$d \times D \times h$	B_3	(reference)	L_{0max} ( ) for stainless	C (N)	C_0 (N)	M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	(kg)	(kg/m)
15	15	60	4.5×7.5×5.3	7.5	20	2000 (1800)	10100 13400	18800 28200	98 147	87 193	73 162	3.175	0.17 0.25	1.6
20	18	60	6×9.5×8.5	10	20	3960 (3500)	16300 21600	29600 44500	199 298	167 360	141 305	3.968	0.45 0.65	2.6
23	22	60	7×11×9	11.5	20	3960 (3500)	22400 32000	37500 62500	295 490	246 615	207 515	4.762	0.63 0.93	3.6
28	26	80	9×14×12	14	20	4000 (3500)	35500 46000	63000 91500	600 870	540 1060	450 885	5.556	1.2 1.6	5.2
34	29	80	9×14×12	17	20	4000	47500 61500	80500 117000	950 1380	780 1600	655 1340	6.35	1.7 2.4	7.2
45	38	105	14×20×17	22.5	22.5	3990	76500 94500	128000 175000	1970 2680	1550 2760	1300 2320	7.937	3 3.9	12.3
53	44	120	16×23×20	26.5	30	3960	113000 140000	181000 247000	3300 4550	2640 4800	2210 4050	9.525	5 6.5	16.9

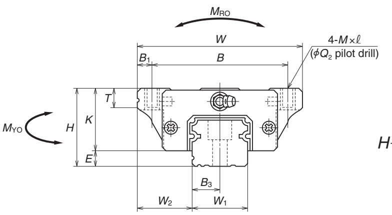
3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

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

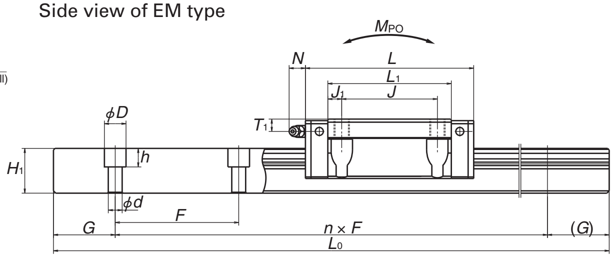
SH 30 1000 EM C 2 - P5 3**

- SH — Series name
- 30 — Size
- 1000 — Rail length (mm)
- EM — Ball slide shape code (See page A116)
- C — Material/surface treatment code (See Table 20)
- 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)

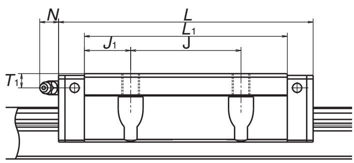
Front view of EM and GM types



Side view of EM type



Side view of GM type



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

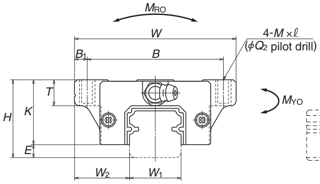
Remarks: 1) Parenthesized dimensions are applicable to stainless steel products.
2) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Reference number for ball slide of random-matching type

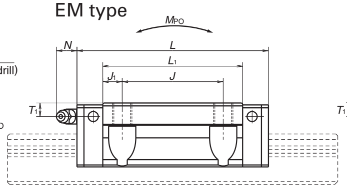
Ball slide **SAH 30 E M C -✻✻PC Z**

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

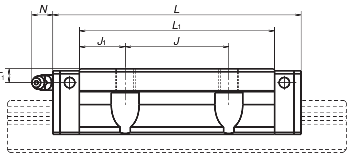
EM and GM types



EM type



GM type

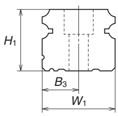


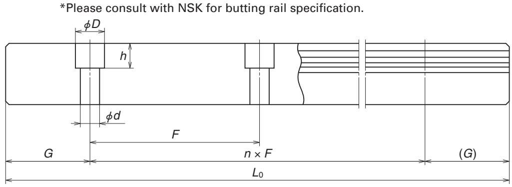
Reference number for rail of random-matching type

Rail **L1H 30 1200 L C N -✻✻ PC Z**

- Random-matching rail series code
  - L1H : LH/SH Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code: L
  - L : Standard
- Material/surface treatment code (See Table 20)
- Preload code
  - Z: Slight preload only (See page A118)
- 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.



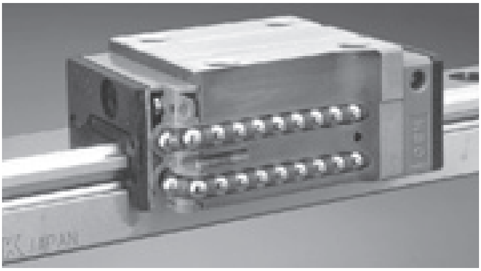


Unit: mm

Rail							Basic load rating					Ball dia.	Weight	
Width W_1	Height H_1	Pitch F	Mounting bolt hole $d \times D \times h$	B_3	G (reference)	Max. length L_{0max} ( ) for stainless	Dynamic C (N)	Static C_0 (N)	Static moment M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	Ball slide (kg)	Rail (kg/m)
15	15	60	4.5×7.5×5.3	7.5	20	2000 (1800)	10100 13400	18800 28200	98 147	87 193	73 162	3.175	0.17 0.25	1.6
20	18	60	6×9.5×8.5	10	20	3960 (3500)	16300 21600	29600 44500	199 298	167 360	141 305	3.968	0.45 0.65	2.6
23	22	60	7×11×9	11.5	20	3960 (3500)	22400 32000	37500 62500	295 490	246 615	207 515	4.762	0.63 0.93	3.6
28	26	80	9×14×12	14	20	4000 (3500)	35500 46000	63000 91500	600 870	540 1060	450 885	5.556	1.2 1.6	5.2
34	29	80	9×14×12	17	20	4000	47500 61500	80500 117000	950 1380	780 1600	655 1340	6.35	1.7 2.4	7.2
45	38	105	14×20×17	22.5	22.5	3990	76500 94500	128000 175000	1970 2680	1550 2760	1300 2320	7.937	3 3.9	12.3
53	44	120	16×23×20	26.5	30	3960	113000 140000	181000 247000	3300 4550	2640 4800	2210 4050	9.525	5 6.5	16.9

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

A-5-1.2 SS Series



(1) Features

1. Lower noise and gentler tone

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

2. Smoother motion

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

3. Low dust generation

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

4. High self-aligning capability (rolling direction)

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

5. High load carrying capacity to vertical direction

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

6. High resistance against impact load

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

7. High accuracy

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

8. Fast delivery

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

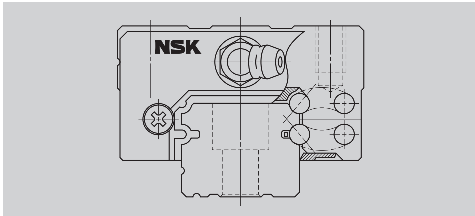


Fig. 1 SS Series

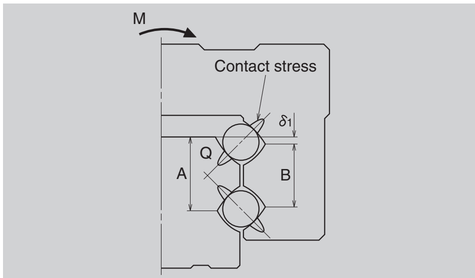


Fig. 2 Enlarged illustration of the offset Gothic arch groove

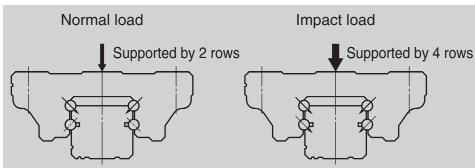


Fig. 3 When load is applied

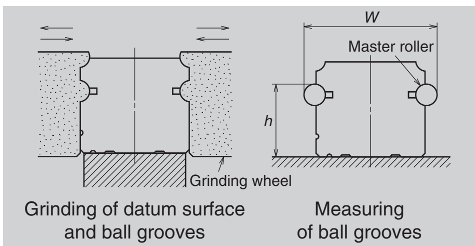
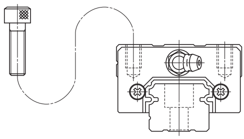
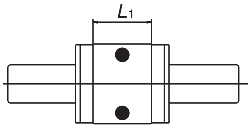
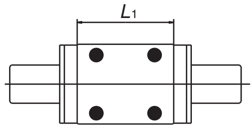
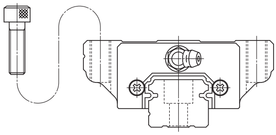
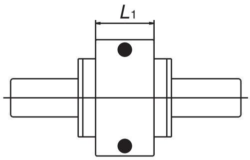
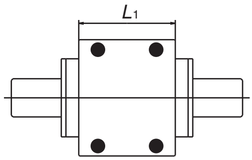
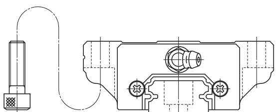
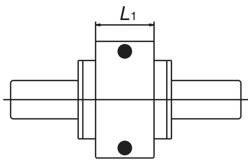
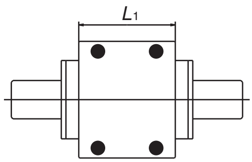
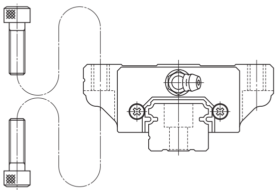
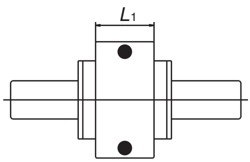
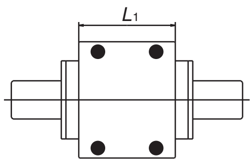


Fig. 4 Rail grinding and measuring

(2) Ball slide shape

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

(3) Accuracy and preload

1. Running parallelism of ball slide

Table 1

Unit: μm

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

2. Accuracy standard

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

• Tolerance of preloaded assembly

Table 2

Unit: 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 face C to face A Running parallelism of face D to face B	Shown in Table 1, Fig. 5, and Fig. 6				

• Tolerance of random-matching type; Normal grade PC

Table 3

Unit: μm

Characteristics \ Model No.	SS15, 20, 25, 30, 35
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 face C to face A Running parallelism of face D to face B	See Table 1, Fig. 5, and Fig. 6

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

3. Combinations of accuracy and preload

Table 4

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

4. Assembled accuracy

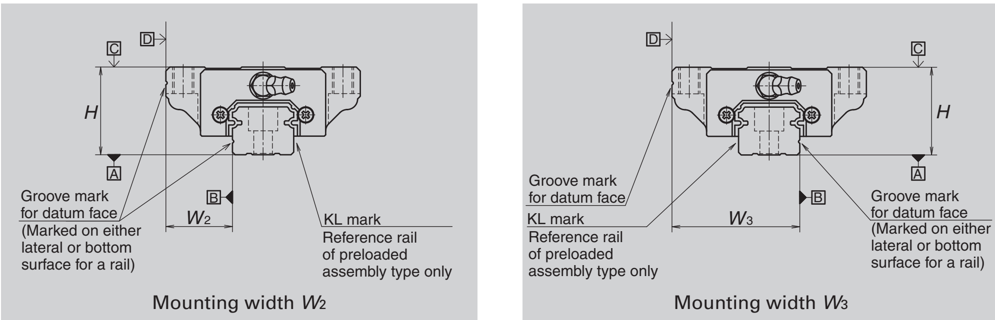


Fig. 5 Special high carbon steel

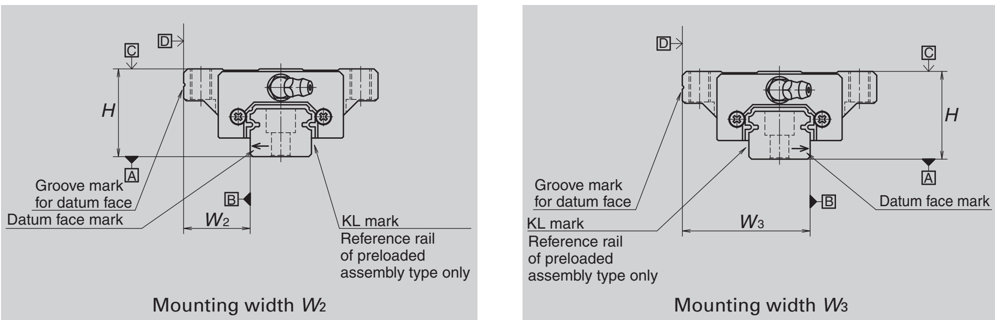


Fig. 6 Stainless steel

5. Preload and rigidity

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

• Preload and rigidity of preloaded assembly

Table 5

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

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

• Clearance and preload of random-matching type

Table 6 unit: μm

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

(4) Available length of rail

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

Table 7 Length limitation of rails

Unit : mm

Series	Size / Material	15	20	25	30	35
SS	Special high carbon steel	2000	3960	3960	4000	4000
	Stainless steel	1700	3500	3500	3500	3500

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

(5) Installation

1. Permissible values of mounting error

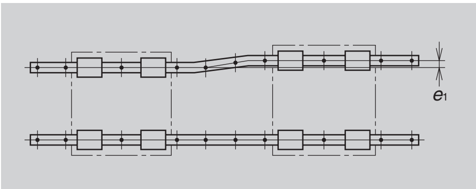


Fig. 7

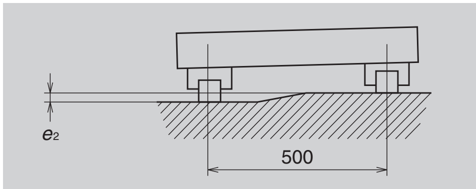


Fig. 8

Table 8

Unit : µm

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

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

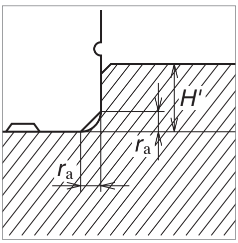


Fig. 9 Shoulder for the rail datum face

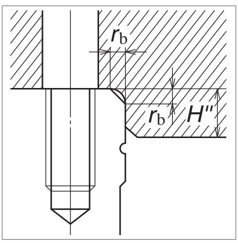


Fig. 10 Shoulder for the ball slide datum face

Table 9

Unit : mm

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

(6) Lubrication components

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

1. Types of lubrication accessories

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

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

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

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

Please ask NSK for stainless lubrication accessories.

2. Mounting position of lubrication accessories

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

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

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

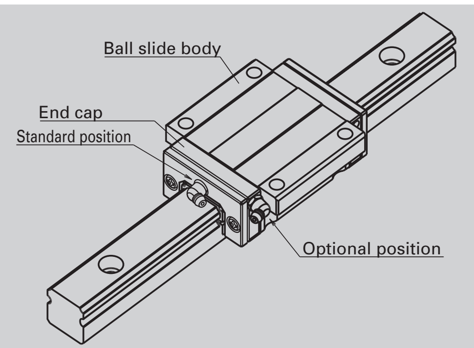


Fig. 12 Mounting position of lubrication accessories

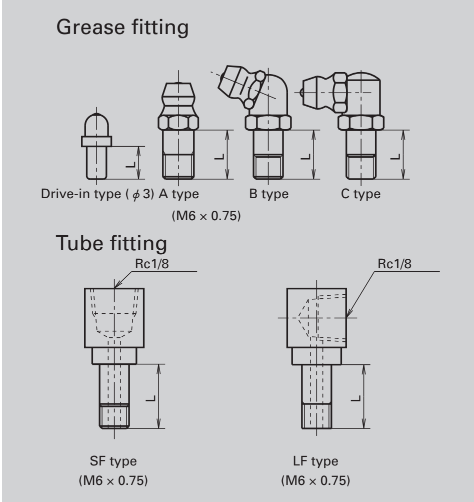


Fig. 11 Grease fitting and tube fitting

Table 10 Unit : mm

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

*) Please contact NSK as a connector is required.

(7) Dust proof components

1. Standard specification

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

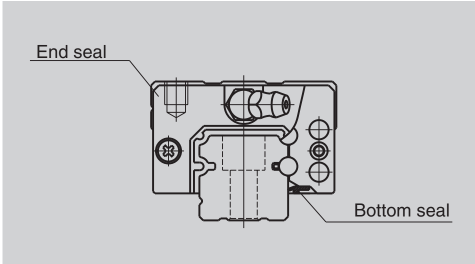


Fig. 13

Table 11 Seal friction per ball slide (maximum value)

Unit : N

Series \ Size	15	20	25	30	35
SS	8	9	9	9	10

2. NSK K1™

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

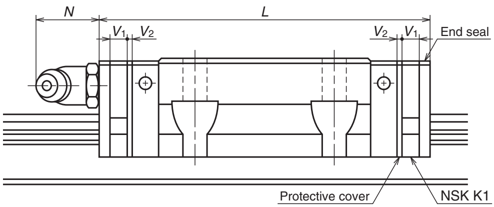


Table 12

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, EL, FL, EM	56.8	66.4	4.0	0.8	(5)
	Short	CL, JL, KL, JM	40.4	50			
SS20	Standard	AL, EL, FL, EM	65.2	75.8	4.5	0.8	(14)
	Short	CL, JL, KL, JM	47.2	57.8			
SS25	Standard	AL, EL, FL, EM	81.6	92.2	4.5	0.8	(14)
	Short	CL, JL, KL, JM	59.6	70.2			
SS30	Standard	AL, EL, FL, EM	96.4	108.4	5.0	1.0	(14)
	Short	CL, JL, KL, JM	67.4	79.4			
SS35	Standard	AL, EL, FL, EM	108	121	5.5	1.0	(14)
	Short	CL, JL, KL, JM	77	90			

Note: Ball slide length equipped with NSK K1 = (Standard ball slide length) + (Thickness of NSK K1, V_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 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 is required.

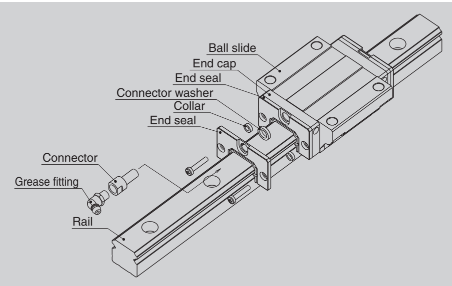


Fig. 14 Double seal

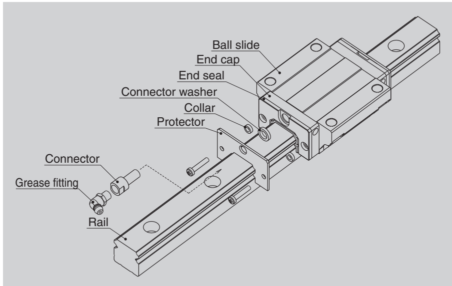


Fig. 15 Protector

Table 13 Double-seal set

Model No.	Reference No.		Increased
	Without connector	With connector	thickness V_1
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
	Without connector	With connector	thickness V_2
SS15	LS15PT-01	*	3
SS20	LS20PT-01	LS20PTC-01	2.7
SS25	LS25PT-01	LS25PTC-01	3.2
SS30	LS30PT-01	LS30PTC-01	4.2
SS35	LS35PT-01	LS35PTC-01	4.2

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

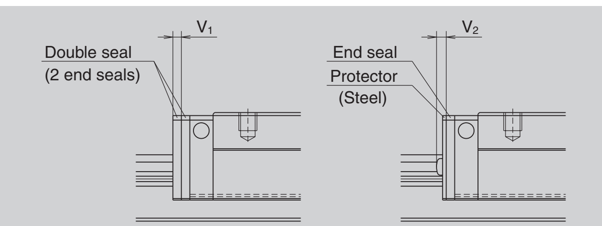


Fig. 16

5. Cap to cover the bolt hole for rail mounting

Table 15 Caps to cover rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
SS15	M3	LG-CAP/M3	20
SS15	M4	LG-CAP/M4	20
SS20	M5	LG-CAP/M5	20
SS25, SS30	M6	LG-CAP/M6	20
SS35	M8	LG-CAP/M8	20

6. Inner seal

Inner seal can be manufactured for models shown below.

Table 16

Series	Model No.
SS	SS20, SS25, SS30, SS35

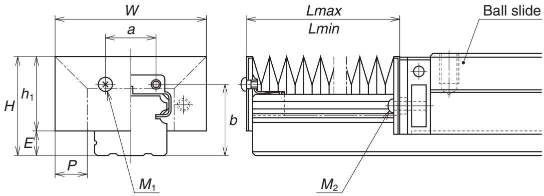
7. Bellows

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.

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



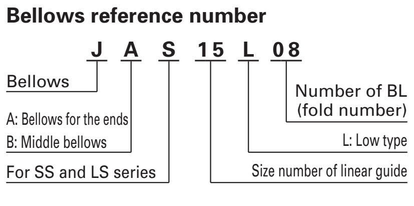


Fig. 17 Dimension of bellows

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	1060
	L_{max}	140	280	420	560	700	840	980	1120	1260	1400
JAS20L	Stroke	106	212	318	424	530	636	742	848	954	1060
	L_{max}	140	280	420	560	700	840	980	1120	1260	1400
JAS25L	Stroke	106	212	318	424	530	636	742	848	954	1060
	L_{max}	140	280	420	560	700	840	980	1120	1260	1400
JAS30L	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
	L_{max}	210	420	630	840	1050	1260	1470	1680	1890	2100
JAS35L	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
	L_{max}	210	420	630	840	1050	1260	1470	1680	1890	2100

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

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

(8) Reference number

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

1. Reference number for preloaded assembly

SS 30 1000 AL C 2 -＊＊ P5 3

- SS: Series name
- 30: Size
- 1000: Rail length (mm)
- AL: Ball slide shape code (See page A140)
- C: Material/surface treatment code (See Table 20)
- 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 A142)

2. Reference number for random-matching type

Ball slide

SAS 30 AL C -＊＊ PC Z

- SAS: Random-matching ball slide series code
  SAS : SS Series random-matching ball slide
- 30: Size
- AL: Ball slide shape code (See page A140)
- C: Material/surface treatment code (See Table 20)
- -＊＊: Design serial number
  Added to the reference number.
- PC: Accuracy code : PC
  PC: Normal grade is only available
- Z: Preload code
  Z: Slight preload only (See page A142)

Rail

L1S 30 1200 L C N -＊＊ PC Z

- L1S: Random-matching rail series code
  L1S : LS/SS Series random-matching rail
- 30: Size
- 1200: Rail length (mm)
- L: Rail shape code
  L: Standard, LS15 with mounting hole for M3
  T: LS15 with mounting hole 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 : PC
  PC: Normal grade is only available
- Z: Preload code
  Z: Slight preload only (See page A142)

*Please consult with NSK for butting rail specification.

Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is slight preload "Z" (Refer to page A142).

Table 20 Material/surface treatment code

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

Table 21 Accuracy code

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

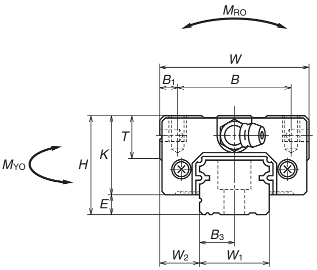
Note: Refer to Page A38 for NSK K1 lubrication unit.

(9) Dimensions
SS-CL (Medium-load type)
SS-AL (High-load type)

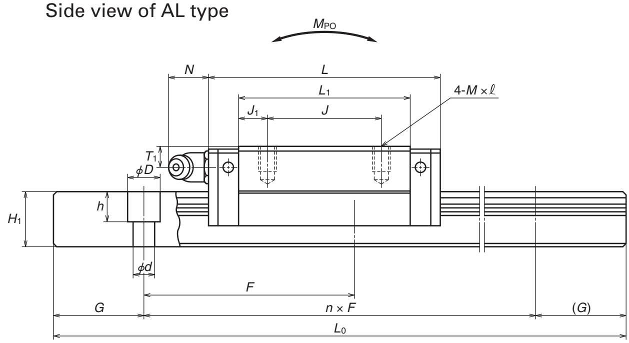
SS 30 1000 AL C 2 -✱✱ P5 3

- SS — Series name
- 30 — Size
- 1000 — Rail length (mm)
- AL — Ball slide shape code (See page A140)
- C — Material/surface treatment code (See Table 20)
- 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 A142)

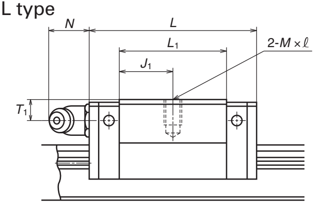
Front view of AL and CL types



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	M40.76	4	23.6 40	11.8 7	19.4	10	ϕ3	6	3
SS20CL **SS20AL**	28	6	11	42	47.2 65.2	32	– 32	M50.87	5	30 48	15 8	22	12	M60.75	5.5	11
SS25CL **SS25AL**	33	7	12.5	48	59.6 81.6	35	– 35	M619	6.5	38 60	19 12.5	26	12	M60.75	7	11
SS30CL **SS30AL**	42	9	16	60	67.4 96.4	40	– 40	M81.2512	10	42 71	21 15.5	33	13	M60.75	8	11
SS35CL **SS35AL**	48	10.5	18	70	77 108	50	– 50	M81.2512	10	49 80	24.5 15	37.5	14	M60.75	8.5	11

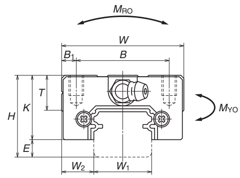
Remarks: 1) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Reference number for ball slide of random-matching type

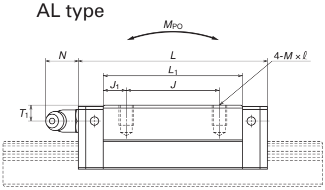
Ball slide **SAS 30 AL C -✻✻PC Z**

- Random-matching ball slide series code — SAS : SS Series random-matching ball slide
- Size
- Ball slide shape code (See page A140)
- Material/surface treatment code (See Table 20)
- Preload code — Z: Slight preload only (See page A142)
- Accuracy code : PC — PC: Normal grade is only available
- Design serial number — Added to the reference number.

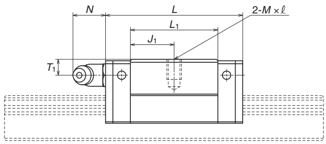
AL and CL types



AL type



CL type

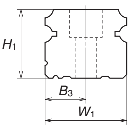


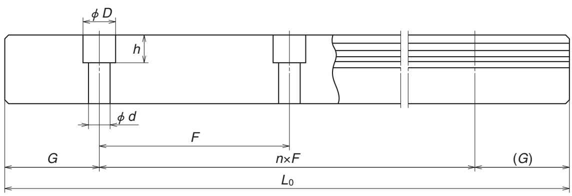
Reference number for rail of random-matching type

Rail **L1S 30 1200 L C N -✻✻ PC Z**

- Random-matching rail series code — L1S : LS/SS Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code — L: Standard, LS15 with mounting hole for M3; T: LS15 with mounting hole for M4
- Material/surface treatment code (See Table 20)
- Preload code — Z: Slight preload only (See page A142)
- 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					Ball dia.	Weight	
Width W_1	Height H_1	Pitch F	Mounting bolt hole $d \times D \times h$	B_3	G (reference)	Max. length L_{0max} ( ) for stainless	Dynamic C (N)	Static C_0 (N)	Static moment M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	Ball slide (kg)	Rail (kg/m)
15	12.5	60	✻3.5×6×4.5 4.5×7.5×5.3	7.5	20	2 000 (1 700)	4 900 7 900	7 800 15 600	39 78	21.1 73.5	17.7 61.5	2.778	0.14 0.2	1.4
20	15.5	60	6×9.5×8.5	10	20	3 960 (3 500)	7 250 11 100	11 800 21 800	80 149	40.5 124	34 104	3.175	0.19 0.28	2.3
23	18	60	7×11×9	11.5	20	3 960 (3 500)	12 700 17 900	20 800 33 500	164 266	96.5 242	81 203	3.968	0.34 0.51	3.1
28	23	80	7×11×9	14	20	4 000 (3 500)	18 700 27 300	29 600 50 500	282 480	153 415	128 350	4.762	0.58 0.85	4.8
34	27.5	80	9×14×12	17	20	4 000 (3 500)	26 000 38 000	40 000 68 500	465 800	234 620	196 520	5.556	0.86 1.3	7

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

✻ Standard mounting hole of SS15 rail is for M3 bolts (Hole size: 3.5×6×4.5). If you require the mounting hole for M4 bolts (Hole size: 4.5×7.5×5.3), please specify it when ordering.

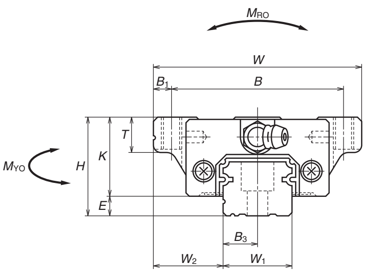
SS-JL (Medium-load type)
SS-EL (High-load type)

SS 30 1000 EL C 2 - ** **P5 3**

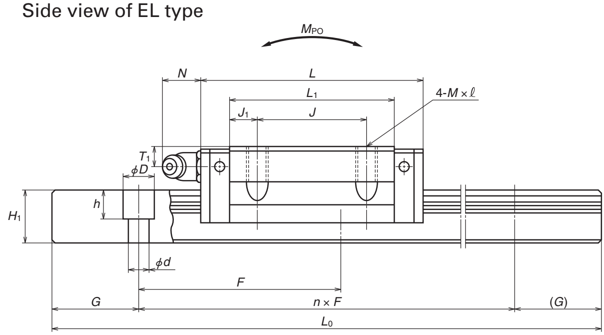
Series name
Size
Rail length (mm)
Ball slide shape code (See page A140)
Material/surface treatment code (See Table 20)

Preload code (See page A142)
Accuracy code (See Table 21)
Design serial number
Added to the reference number.
Number of ball slides per rail

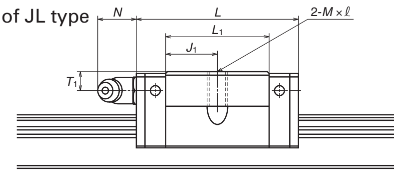
Front view of EL and JL types



Side view of EL type



Side view of JL type



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
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	φ3	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

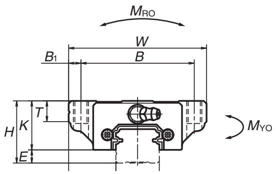
Remarks: 1) Parenthesized dimensions are applicable to stainless steel products.
2) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Reference number for ball slide of random-matching type

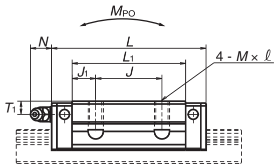
Ball slide SAS 30 EL C -✱✱PC Z

- Random-matching ball slide series code
  SAS : SS Series random-matching ball slide
- Size
- Ball slide shape code (See page A140)
- Material/surface treatment code (See Table 20)
- Design serial number
  Added to the reference number.
- Accuracy code : PC
  PC: Normal grade is only available
- Preload code
  Z: Slight preload only (See page A142)

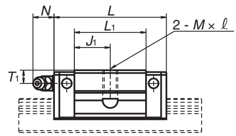
EL and JL types



EL type



JL type

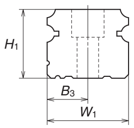


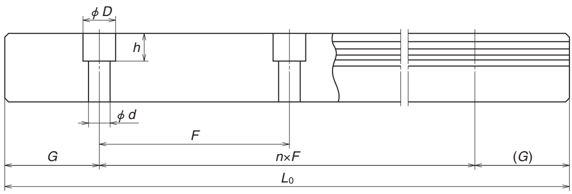
Reference number for rail of random-matching type

Rail L1S 30 1200 L C N -✱✱ PC Z

- Random-matching rail series code
  L1S : LS/SS Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code
  L: Standard, LS15 with mounting hole for M3
  T: LS15 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 : PC
  PC: Normal grade is only available
- Preload code
  Z: Slight preload only (See page A142)

*Please consult with NSK for butting rail specification.





Unit: mm

Rail: Width W_1	Height H_1	Pitch F	Mounting bolt hole $d \times D \times h$	B_3	G (reference)	Max. length L_{0max} ( ) for stainless	Basic load rating: Dynamic C (N)	Static C_0 (N)	Static moment M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	Ball dia. D_W	Weight: Ball slide (kg)	Rail (kg/m)
15	12.5	60	✱3.5×6×4.5 4.5×7.5×5.3	7.5	20	2 000 (1 700)	4 900 7 900	7 800 15 600	39 78	21.1 73.5	17.7 61.5	2.778	0.17 0.26	1.4
20	15.5	60	6×9.5×8.5	10	20	3 960 (3 500)	7 250 11 100	11 800 21 800	80 149	40.5 124	34 104	3.175	0.24 0.35	2.3
23	18	60	7×11×9	11.5	20	3 960 (3 500)	12 700 17 900	20 800 33 500	164 266	96.5 242	81 203	3.968	0.44 0.66	3.1
28	23	80	7×11×9	14	20	4 000 (3 500)	18 700 27 300	29 600 50 500	282 480	153 415	128 350	4.762	0.76 1.2	4.8
34	27.5	80	9×14×12	17	20	4 000 (3 500)	26 000 38 000	40 000 68 500	465 800	234 620	196 520	5.556	1.2 1.7	7

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

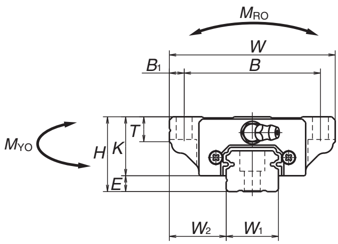
✱ Standard mounting hole of SS15 rail is for M3 bolts (Hole size: 3.5×6×4.5).
If you require the mounting hole for M4 bolts (Hole size: 4.5×7.5×5.3), please specify it when ordering.

SS-KL (Medium-load type)
SS-FL (High-load type)

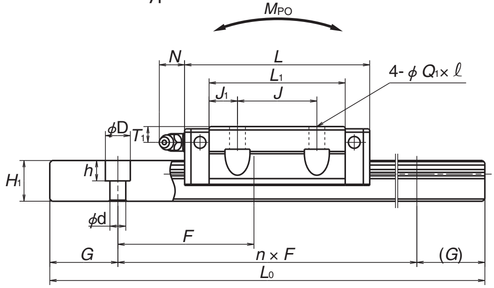
SS 30 1000 FL C 2 -✻✻ P5 3

- SS — Series name
- 30 — Size
- 1000 — Rail length (mm)
- FL — Ball slide shape code (See page A140)
- C — Material/surface treatment code (See Table 20)
- 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 A142)

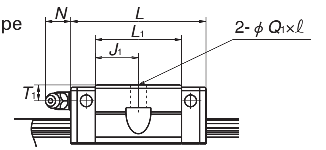
Front view of FL and KL types



Side view of FL type



Side view of KL type



Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	$Q_1 \times \ell$	B_1	L_1	J_1	K	T	Grease fitting Hole size	T_1	N
SS15KL **SS15FL**	24	4.6	18.5	52	40.4 56.8	41	– 26	4.5×7	5.5	23.6 40	11.8 7	19.4	8	φ3	6	3
SS20KL **SS20FL**	28	6	19.5	59	47.2 65.2	49	– 32	5.5×9(5.5×9.5)	5	30 48	15 8	22	10	M6×0.75	5.5	11
SS25KL **SS25FL**	33	7	25	73	59.6 81.6	60	– 35	7×10(7×11.5)	6.5	38 60	19 12.5	26	11 (12)	M6×0.75	7	11
SS30KL **SS30FL**	42	9	31	90	67.4 96.4	72	– 40	9×12(9×14.5)	9	42 71	21 15.5	33	11 (15)	M6×0.75	8	11
SS35KL **SS35FL**	48	10.5	33	100	77 108	82	– 50	9×13(9×14.5)	9	49 80	24.5 15	37.5	12 (15)	M6×0.75	8.5	11

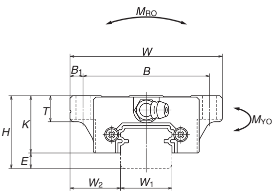
Remarks: 1) Parenthesized dimensions are applicable to stainless steel products.
2) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Reference number for ball slide of random-matching type

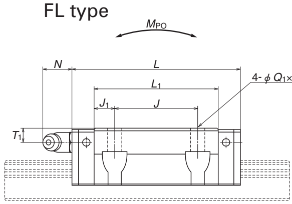
Ball slide **SAS 30 FL C -**PC Z**

- SAS — Random-matching ball slide series code (SAS : SS Series random-matching ball slide)
- 30 — Size
- FL — Ball slide shape code (See page A140)
- C — Material/surface treatment code (See Table 20)
- -** — Design serial number (Added to the reference number.)
- PC — Accuracy code : PC (PC: Normal grade is only available)
- Z — Preload code (Z: Slight preload only (See page A142))

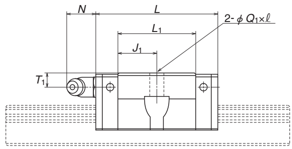
FL and KL types



FL type



KL type

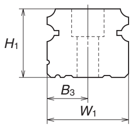


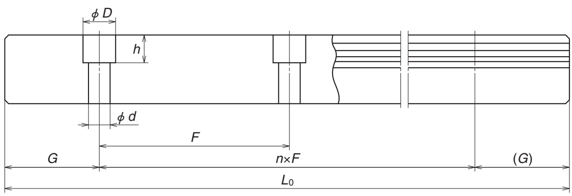
Reference number for rail of random-matching type

Rail **L1S 30 1200 L C N -** PC Z**

- L1S — Random-matching rail series code (L1S : LS/SS Series random-matching rail)
- 30 — Size
- 1200 — Rail length (mm)
- L — Rail shape code (L: Standard, LS15 with mounting hole for M3; T: LS15 with mounting hole 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 : PC (PC: Normal grade is only available)
- Z — Preload code (Z: Slight preload only (See page A142))

*Please consult with NSK for butting rail specification.





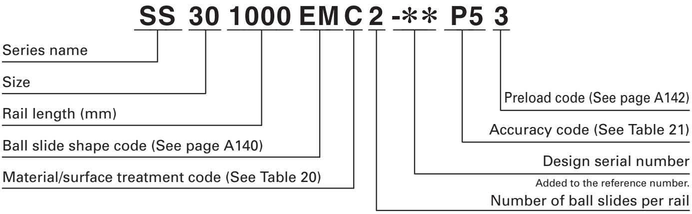
Unit: mm

Rail: Width W_1	Height H_1	Pitch F	Mounting bolt hole $d \times D \times h$	B_3	G (reference)	Max. length L_{0max} ( ) for stainless	Basic load rating: Dynamic C (N)	Static C_0 (N)	Static moment M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	Ball dia. D_W	Weight: Ball slide (kg)	Rail (kg/m)
15	12.5	60	* 3.5×6×4.5 4.5×7.5×5.3	7.5	20	2000 (1700)	4900 7900	7800 15600	39 78	21.1 73.5	17.7 61.5	2.778	0.17 0.26	1.4
20	15.5	60	6×9.5×8.5	10	20	3960 (3500)	7250 11100	11800 21800	80 149	40.5 124	34 104	3.175	0.24 0.35	2.3
23	18	60	7×11×9	11.5	20	3960 (3500)	12700 17900	20800 33500	164 266	96.5 242	81 203	3.968	0.44 0.66	3.1
28	23	80	7×11×9	14	20	4000 (3500)	18700 27300	29600 50500	282 480	153 415	128 350	4.762	0.76 1.2	4.8
34	27.5	80	9×14×12	17	20	4000 (3500)	26000 38000	40000 68500	465 800	234 620	196 520	5.556	1.2 1.7	7

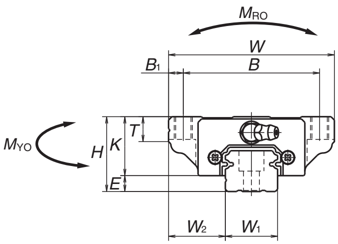
3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

* Standard mounting hole of SS15 rail is for M3 bolts (Hole size: 3.5×6×4.5). If you require the mounting hole for M4 bolts (Hole size: 4.5×7.5×5.3), please specify it when ordering.

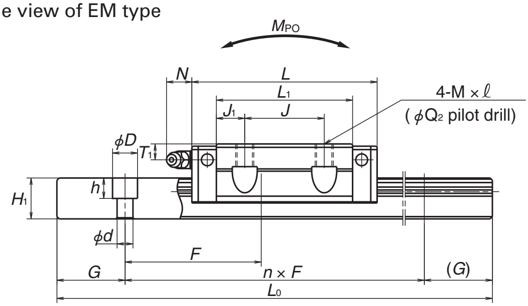
SS-JM (Medium-load type)
SS-EM (High-load type)



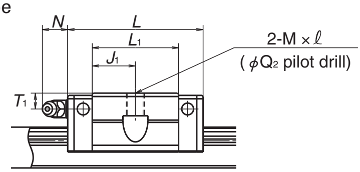
Front view of EM and JM types



Side view of EM type



Side view of JM type



Model No.	Assembly			Ball slide											Grease fitting		
	Height			Width	Length	Mounting hole											
	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
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	φ3	6	3
SS20JM **SS20EM**	28	6	19.5	59	47.2 65.2	49	– 32	M6×1×9 (M6×1×9.5)	5.3	5	30 48	15 8	22	10	M6×0.75	5.5	11
SS25JM **SS25EM**	33	7	25	73	59.6 81.6	60	– 35	M8×1.25×10 (M8×1.25×11.5)	6.8	6.5	38 60	19 12.5	26	11 (12)	M6×0.75	7	11
SS30JM **SS30EM**	42	9	31	90	67.4 96.4	72	– 40	M10×1.5×12 (M10×1.5×14.5)	8.6	9	42 71	21 15.5	33	11 (15)	M6×0.75	8	11
SS35JM **SS35EM**	48	10.5	33	100	77 108	82	– 50	M10×1.5×13 (M10×1.5×14.5)	8.6	9	49 80	24.5 15	37.5	12 (15)	M6×0.75	8.5	11

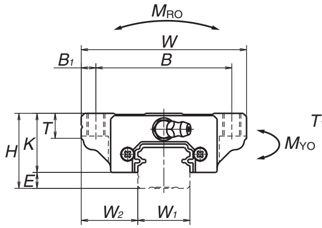
Remarks: 1) Parenthesized dimensions are applicable to stainless steel products.
2) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Reference number for ball slide of random-matching type

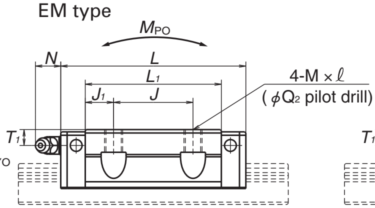
Ball slide **SAS 30 E M C -∗∗PC Z**

- SAS: Random-matching ball slide series code
  - SAS : SS Series random-matching ball slide
- 30: Size
- E: Ball slide shape code (See page A140)
- M: Material/surface treatment code (See Table 20)
- C: Design serial number
  - Added to the reference number.
- ∗∗: Accuracy code : PC
  - PC: Normal grade is only available
- Z: Preload code
  - Z: Slight preload only (See page A142)

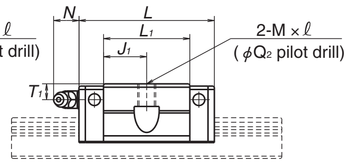
EM and JM types



EM type



JM type

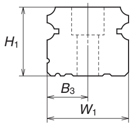


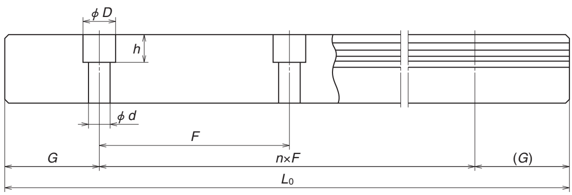
Reference number for rail of random-matching type

Rail **L1S 30 1200 L C N -∗∗ PC Z**

- L1S: Random-matching rail series code
  - L1S : LS/SS Series random-matching rail
- 30: Size
- 1200: Rail length (mm)
- L: Rail shape code
  - L: Standard, LS15 with mounting hole for M3
  - T: LS15 with mounting hole 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 : PC
  - PC: Normal grade is only available
- Z: Preload code
  - Z: Slight preload only (See page A142)

*Please consult with NSK for butting rail specification.





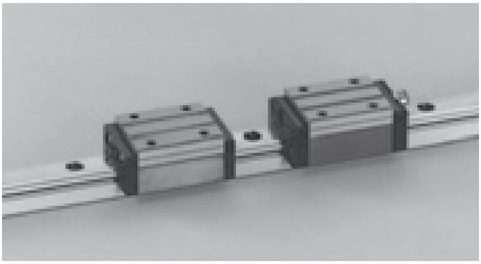
Unit: mm

Rail							Basic load rating					Ball dia.	Weight	
Width W_1	Height H_1	Pitch F	Mounting bolt hole $d \times D \times h$	B_3	G (reference)	Max. length L_{0max} ( ) for stainless	Dynamic C (N)	Static C_0 (N)	Static moment M_{RO} (N·m)	Static moment M_{PO} (N·m)	Static moment M_{YO} (N·m)	D_W	Ball slide (kg)	Rail (kg/m)
15	12.5	60	∗ 3.5×6×4.5 4.5×7.5×5.3	7.5	20	2000 (1700)	4900 7900	7800 15600	39 78	21.1 73.5	17.7 61.5	2.778	0.17 0.26	1.4
20	15.5	60	6×9.5×8.5	10	20	3960 (3500)	7250 11100	11800 21800	80 149	40.5 124	34 104	3.175	0.24 0.35	2.3
23	18	60	7×11×9	11.5	20	3960 (3500)	12700 17900	20800 33500	164 266	96.5 242	81 203	3.968	0.44 0.66	3.1
28	23	80	7×11×9	14	20	4000 (3500)	18700 27300	29600 50500	282 480	153 415	128 350	4.762	0.76 1.2	4.8
34	27.5	80	9×14×12	17	20	4000 (3500)	26000 38000	40000 68500	465 800	234 620	196 520	5.556	1.2 1.7	7

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

∗ Standard mounting hole of SS15 rail is for M3 bolts (Hole size: 3.5×6×4.5).
If you require the mounting hole for M4 bolts (Hole size: 4.5×7.5×5.3), please specify it when ordering.

A-5-1.3 LH Series



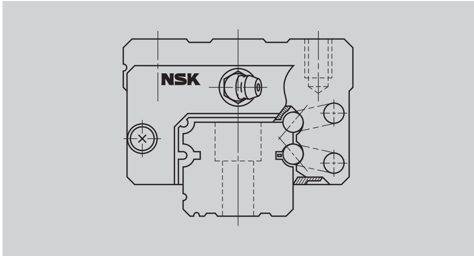


Fig. 1 LH Series

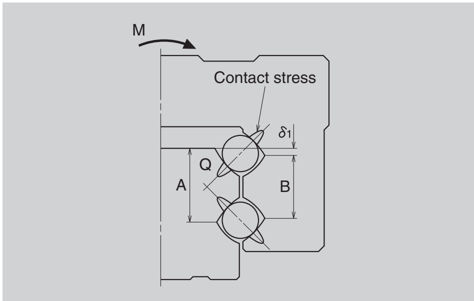


Fig. 2 Enlarged illustration of the offset Gothic arch groove

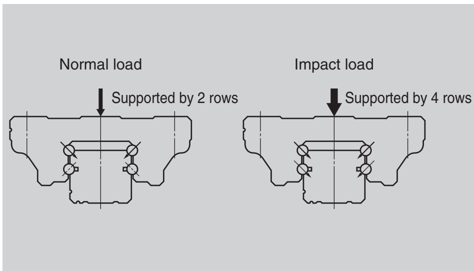


Fig. 3 When load is applied

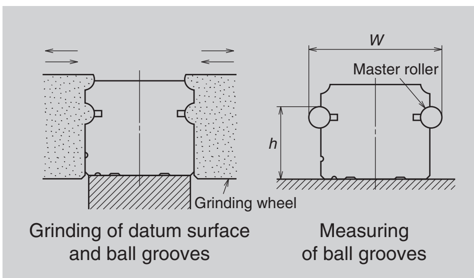


Fig. 4 Rail grinding and measuring

(1) Features

1. High self-aligning capability (rolling direction)

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

This increases the capacity to absorb errors in installation.

2. High load carrying capacity to vertical direction

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

3. High resistance against impact load

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

4. High accuracy

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

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

Balls are retained in the retainer, therefore they do not fall out when the ball slide is withdrawn from the rail. (LH10 to LH65)

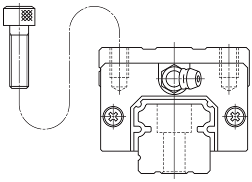
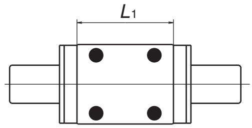
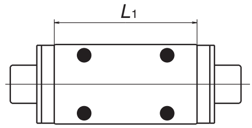
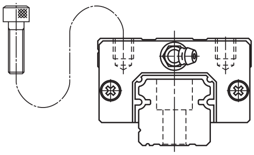
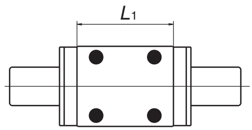
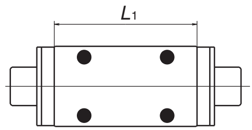
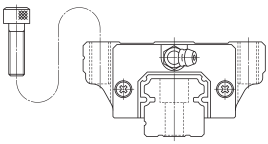
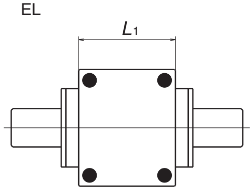
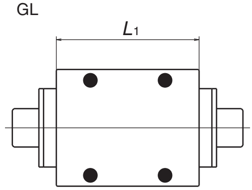
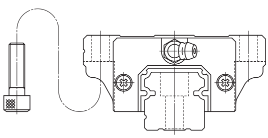
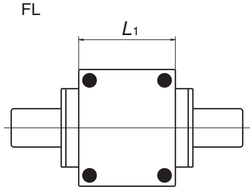
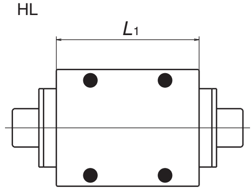
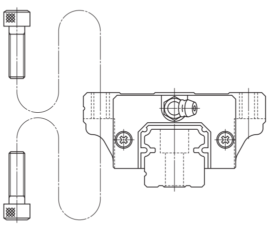
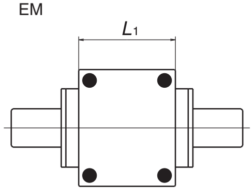
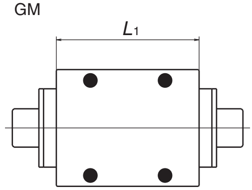
6. Abundant models and sizes

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

7. Fast delivery

Lineup of random-matching rails and ball slides supports and facilitates fast delivery. (LH15 to LH65)

(2) Ball slide shape

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

(3) Accuracy and preload

1. Running parallelism of ball slide

Table 1

Unit: μm

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

Note: LH08, 10, and 12 are not available in random matching. For LH08,10, and 12, P4, P5, P6, and PN grades are available.

2. Accuracy standard

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

• Tolerance of preloaded assembly

Table 2

Unit: μm

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

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

• Tolerance of random-matching type: Normal grade PC

Table 3

Unit: μm

Characteristics \ Model No.	LH15, 20, 25, 30, 35	LH45, 55, 65
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 face C to face A Running parallelism of face D to face B	See Table 1, Fig. 5 and Fig. 6	

Note: 1) LH08, 10, 12 are not available in random matching. 2) ① Variation on the same rail ② Variation on multiple rails

3. Combinations of accuracy and preload

Table 4

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

4. Assembled accuracy

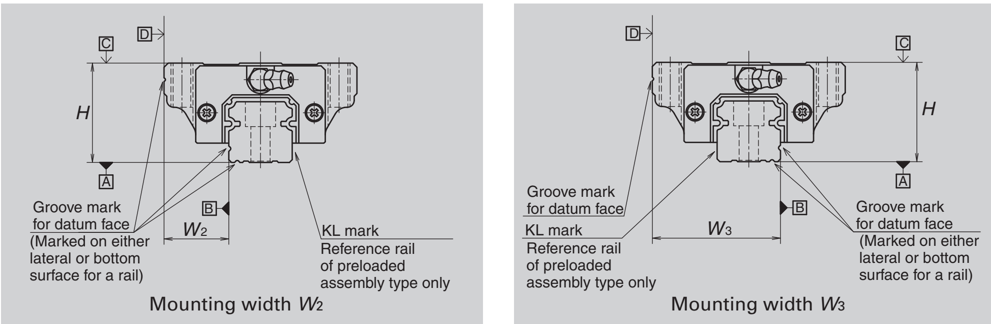


Fig. 5 Special high carbon steel

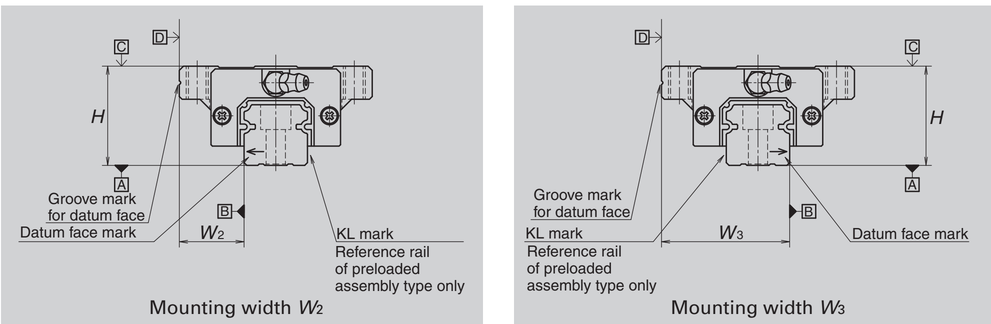


Fig. 6 Stainless steel

5. Preload and rigidity

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

• **Preload and rigidity of preloaded assembly**

Table 5

Model No.		Preload (N)		Rigidity (N/μm) Vertical direction		Rigidity (N/μm) 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, EL, FL, EM	78	490	137	226	98	186
	LH20 AN, EL, FL, EM	147	835	186	335	137	245
	LH25 AN, AL, EL, FL, EM	196	1270	206	380	147	284
	LH30 AN, AL	245	1570	216	400	157	294
	LH30 EL, FL, EM	294	1770	265	480	186	355
	LH35 AN, AL, EL, FL, EM	390	2350	305	560	216	390
	LH45 AN, AL, BL, EL, FL, EM	635	3900	400	745	284	540
	LH55 AN, AL, EL, FL, EM	980	5900	490	910	345	645
	LH65 AN, EL, FL, EM	1470	8900	580	1070	400	755
Super-high-load type	LH15 BN, GL, HL, GM	98	685	196	345	137	284
	LH20 BN, GL, HL, GM	196	1080	265	480	196	355
	LH25 BN, BL, GL, HL, GM	245	1570	294	560	216	400
	LH30 BN, BL, GL, HL, GM	390	2260	360	665	265	480
	LH35 BN, BL, GL, HL, GM	490	2940	430	795	305	570
	LH45 BN, BL, GL, HL, GM	785	4800	520	960	370	695
	LH55 BN, BL, GL, HL, GM	1180	7050	635	1170	440	835
	LH65 BN, GL, HL, GM	1860	11300	805	1480	550	1040

Note: Clearance for fine clearance Z0 is 0 to 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
LH15	–4 – 15	–4 – 0
LH20	–5 – 15	–5 – 0
LH25		–5 – 0
LH30		–7 – 0
LH35		–7 – 0
LH45		–7 – 0
LH55		–9 – 0
LH65		–9 – 0

Note: 1) Minus sign denotes that a value is an amount of preload (elastic deformation of balls).
2) LH08, 10, and 12 are not available in random matching.

(4) Available length of rail

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

Table 7 Length limitations of rails

Unit: mm

Series	Material \ Size	08	10	12	15	20	25	30	35	45	55	65
LH	Special high carbon steel				2000	3960	3960	4000	4000	3990	3960	3900
	Stainless steel	375	600	800	1800	3500	3500	3500				

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

(5) Installation

1. Permissible values of mounting error

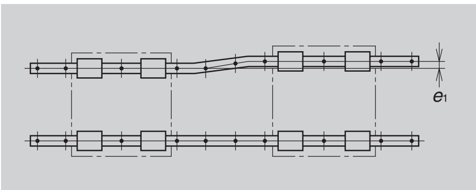


Fig. 7

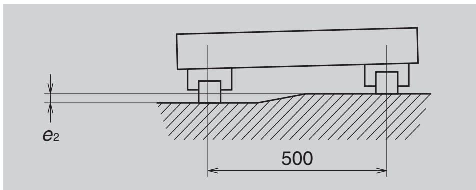


Fig. 8

Table 8

Unit: 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	–	–	–	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	330 μm/500 mm										

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

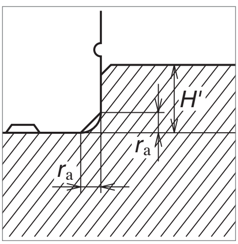


Fig. 9 Shoulder for the rail datum face

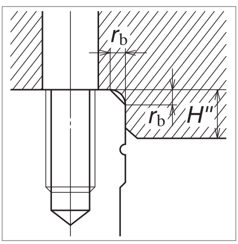


Fig. 10 Shoulder for the ball slide datum face

Table 9

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
LH08	0.3	0.5	1.8	3
LH10	0.3	0.5	2.1	4
LH12	0.5	0.5	2.7	4
LH15	0.5	0.5	4	4
LH20	0.5	0.5	4.5	5
LH25	0.5	0.5	5	5
LH30	0.5	0.5	6	6
LH35	0.5	0.5	6	6
LH45	0.7	0.7	8	8
LH55	0.7	0.7	10	10
LH65	1	1	11	11

(6) Lubrication components

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

1. Types of lubrication accessories

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

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

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

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

Please ask NSK for stainless lubrication accessories.

2. Mounting position of lubrication accessories

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

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

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

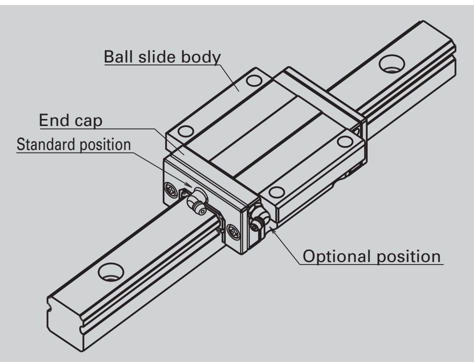


Fig. 12 Mounting position of lubrication accessories

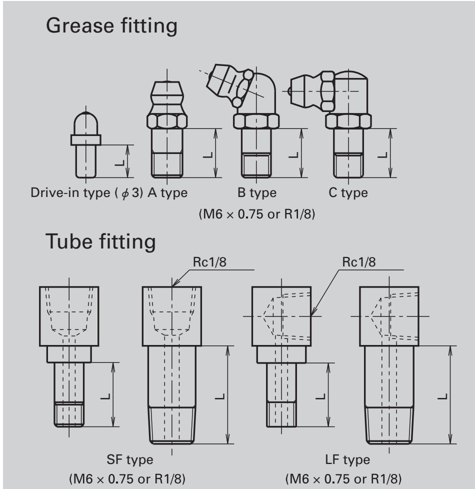


Fig. 11 Grease fitting and tube fitting

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	6**
	With NSK K1	12	11**
	Double seal	10	9**
	Protector	10	9**
LH30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
LH35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
LH45	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
LH55	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
LH65	Standard	8	17
	With NSK K1	20	25.5
	Double seal	16	19
	Protector	16	17

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

(7) Dust proof components

1. Standard specification

To keep foreign matters from entering inside the ball slide, LH Series has an end seal on both ends, and bottom seals at the bottom.
However, the bottom seals are not used to LH08 and 10.

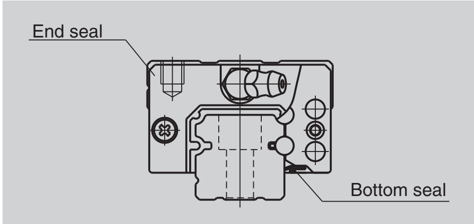


Fig. 13

Table 11 Seal friction per ball slide (maximum value)

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™

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

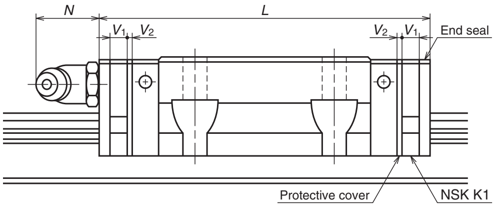


Table 12

Unit : mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_1	Protective cover thickness V_2	Protruding area of the grease fitting N
LH08	Standard	AN	24	31	3	0.5	—
LH10	Standard	AN	31	40	4	0.5	—
LH12	Standard	AN	45	54	4	0.5	(4)
LH15	Standard	AN, EL, FL, EM	55	65.6	4.5	0.8	(5)
	Long	BN, GL, HL, GM	74	84.6			
LH20	Standard	AN, EL, FL, EM	69.8	80.4	4.5	0.8	(14)
	Long	BN, GL, HL, GM	91.8	102.4			
LH25	Standard	AL, AN, EL, FL, EM	79.0	90.6	5.0	0.8	(14)
	Long	BL, BN, GL, HL, GM	107	118.6			
LH30	Standard	AL, AN	85.6	97.6	5.0	1.0	(14)
	Flange type	EL, FL, EM	98.6	110.6			
	Long	BL, BN, GL, HL, GM	124.6	136.6			
LH35	Standard	AL, AN, EL, FL, EM	109	122	5.5	1.0	(14)
	Long	BL, BN, GL, HL, GM	143	156			
LH45	Standard	AL, AN, EL, FL, EM	139	154	6.5	1.0	(15)
	Long	BL, BN, GL, HL, GM	171	186			
LH55	Standard	AL, AN, EL, FL, EM	163	178	6.5	1.0	(15)
	Long	BL, BN, GL, HL, GM	201	216			
LH65	Standard	AN, EL, FL, EM	193	211	8.0	1.0	(16)
	Long	BN, GL, HL, GM	253	271			

Note: 1) NSK K1 for food and medical equipments are available for LH12 to LH35.
2) Ball slide length equipped with NSK K1 = (Standard ball slide length) + (Thickness of NSK K1, V_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 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 is required.

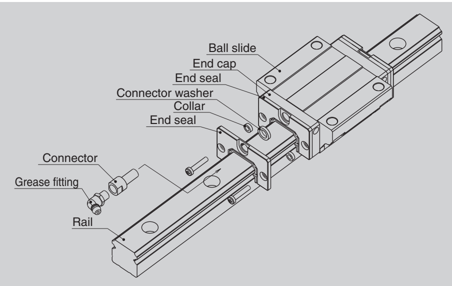


Fig. 14 Double seal

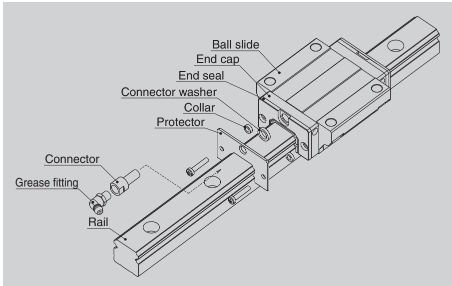


Fig. 15 Protector

Table 13 Double-seal set

Model No.	Reference No.		Increased
	Without connector	With connector	thickness V_1
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
	Without connector	With connector	thickness V_2
LH15	LH15PT-01	∗	2.7
LH20	LH20PT-01	LH20PTC-01	2.9
LH25	LH25PT-01	LH25PTC-01	3.2
LH30	LH30PT-01	LH30PTC-01	4.2
LH35	LH35PT-01	LH35PTC-01	4.2
LH45	LH45PT-01	LH45PTC-01	4.9
LH55	LH55PT-01	LH55PTC-01	4.9
LH65	LH65PT-01	LH65PTC-01	5.5

∗) For installation of a connector to a drive-in type grease fitting, contact NSK.
Note: Double seal and protector for LH08, 10, and 12, please consult NSK.

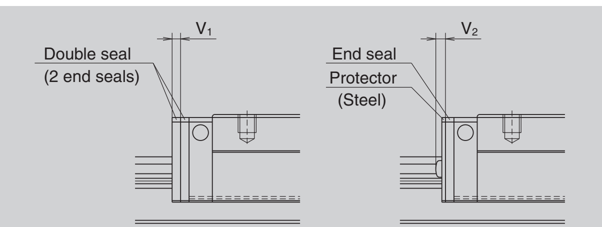


Fig. 16

5. Cap to cover the bolt hole for rail mounting

Table 15 Caps to cover rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
LH10, LH12	M3	LG-CAP/M3	20
LH15	M4	LG-CAP/M4	20
LH20	M5	LG-CAP/M5	20
LH25	M6	LG-CAP/M6	20
LH30, LH35	M8	LG-CAP/M8	20
LH45	M12	LG-CAP/M12	20
LH55	M14	LG-CAP/M14	20
LH65	M16	LG-CAP/M16	20

6. Inner seal

Inner seal can be manufactured for models shown below.

Table 16

Series	Model No.
LH	LH20, LH25, LH30, LH35, LH45, LH55, LH65

7. Bellows

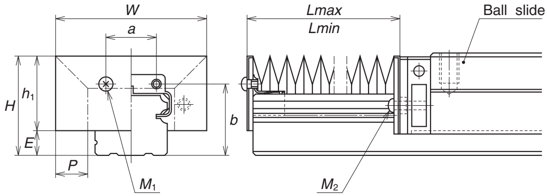
Use a bellows fastener kit as showing Table 17, when installing bellows to completed standard products. A bellows fastener kit is supplied with one of bellows fastener, two of M1 set screws, two of M2 set screws, and two collars for M2 set screw.

The bellows for LH08, 10, 12, and 15, please consult NSK.

Table 17 Bellows fastner kit reference No.

Model No.	Kit reference No.
LH20	LH20FS-01
LH25	LH25FS-01
LH30	LH30FS-01
LH35	LH35FS-01
LH45	LH45FS-01
LH55	LH55FS-01
LH65	LH65FS-01

Dimension tables of bellows
LH Series



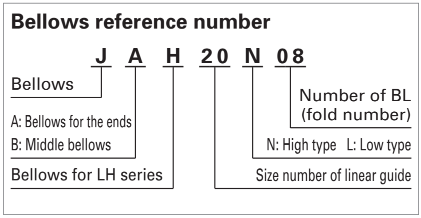


Fig. 17 Dimensions of bellows

Table 18 Dimensions of bellows

Unit: mm

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

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

Unit: mm

Model No.	Number of BL	2	4	6	8	10	12	14	16	18	20
	L_{min}	34	68	102	136	170	204	238	272	306	340
JAH20N	Stroke	106	212	318	424	530	636	742	848	954	1060
	L_{max}	140	280	420	560	700	840	980	1120	1260	1400
JAH25L	Stroke	106	212	318	424	530	636	742	848	954	1060
	L_{max}	140	280	420	560	700	840	980	1120	1260	1400
JAH25N	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
	L_{max}	210	420	630	840	1050	1260	1470	1680	1890	2100
JAH30L	Stroke	134	268	402	536	670	804	938	1072	1206	1340
	L_{max}	168	336	504	672	840	1008	1176	1344	1512	1680
JAH30N	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
	L_{max}	210	420	630	840	1050	1260	1470	1680	1890	2100
JAH35L	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
	L_{max}	210	420	630	840	1050	1260	1470	1680	1890	2100
JAH35N	Stroke	246	492	738	984	1230	1476	1722	1968	2214	2460
	L_{max}	280	560	840	1120	1400	1680	1960	2240	2520	2800
JAH45L	Stroke	176	352	528	704	880	1058	1232	1408	1584	1760
	L_{max}	210	420	630	840	1050	1260	1470	1680	1890	2100
JAH45N	Stroke	316	632	948	1264	1580	1896	2212	2528	2844	3160
	L_{max}	350	700	1050	1400	1750	2100	2450	2800	3150	3500
JAH55L	Stroke	246	492	738	984	1230	1476	1722	1968	2214	2460
	L_{max}	280	560	840	1120	1400	1680	1960	2240	2520	2800
JAH55N	Stroke	386	772	1158	1544	1930	2316	2702	3088	3474	3860
	L_{max}	420	840	1260	1680	2100	2520	2940	3360	3780	4200
JAH65N	Stroke	386	772	1158	1544	1930	2316	2702	3088	3474	3860
	L_{max}	420	840	1260	1680	2100	2520	2940	3360	3780	4200

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

(8) Reference number

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

1. Reference number for preloaded assembly

LH 30 1000 AN C 2 - P5 3**

- LH — Series name
- 30 — Size
- 1000 — Rail length (mm)
- AN — Ball slide shape code (See page A162)
- C — Material/surface treatment code (See Table 20)
- 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 A164)

2. Reference number for random-matching type

Ball slide

LAH 30 AN C - PC Z**

- LAH — Random-matching ball slide series code
  LAH : LH Series random-matching ball slide
- 30 — Size
- AN — Ball slide shape code (See page A162)
- C — Material/surface treatment code (See Table 20)
- -** — Design serial number
  Added to the reference number.
- PC — Accuracy code : PC
  PC: Normal grade is only available
- Z — Preload code
  T: Fine clearance. Z: Slight preload (See page A164)

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
  T: Fine clearance. Z: Slight preload (See page A164)

*Please consult with NSK for butting rail specification.

Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is fine clearance "T" or slight preload "Z" (Refer to page A164).

Table 20 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
K	Stainless steel (LH08 to LH30 only)
D	Special high carbon steel with surface treatment
H	Stainless steel with surface treatment
Z	Other, special

Table 21 Accuracy code

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

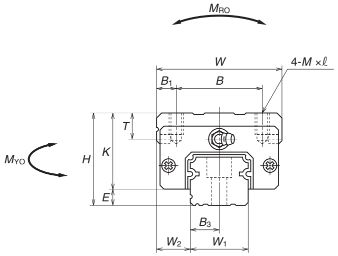
Note: Refer to Page A38 and A61 for NSK K1 lubrication unit.

(9) Dimensions
LH-AN (High-load type)
LH-BN (Super-high-load type)

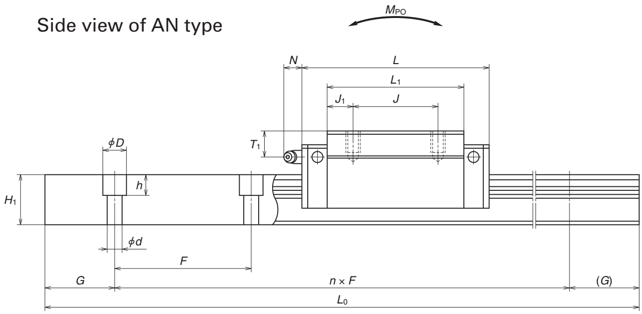
LH 30 1000 AN C 2 - P5 3**

- LH: Series name
- 30: Size
- 1000: Rail length (mm)
- AN: Ball slide shape code (See page A162)
- C: Material/surface treatment code (See Table 20)
- 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 A164)

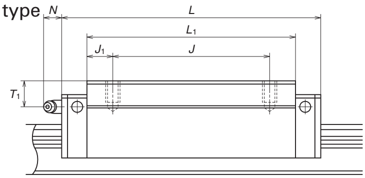
Front view of AN and BN types



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	ϕ3	5	4
LH15AN **LH15BN**	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
LH20AN **LH20BN**	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
LH25AN **LH25BN**	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
LH30AN **LH30BN**	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
LH35AN **LH35BN**	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
LH45AN **LH45BN**	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
LH55AN **LH55BN**	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
LH65AN **LH65BN**	90	16	31.5	126	193 253	76	70 120	M16×2×20	25	147 207	38.5 43.5	74	23	Rc1/8	19	13

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

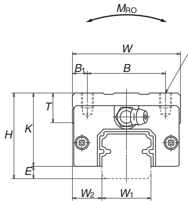
Reference number for ball slide of random-matching type

Ball slide **LAH 30 AN C -✻✻PC Z**

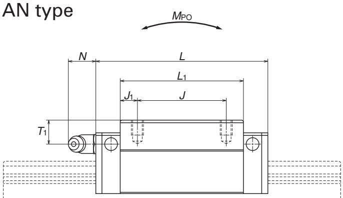
Random-matching ball slide series code
LAH : LH Series random-matching ball slide
Size
Ball slide shape code (See page A162)
Material/surface treatment code (See Table 20)

Preload code
T: Fine clearance. Z: Slight preload (See page A164)
Accuracy code : PC
PC: Normal grade is only available
Design serial number
Added to the reference number.

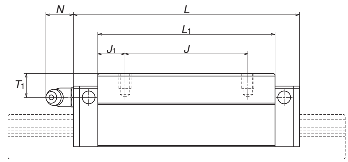
AN and BN types



AN type



BN type



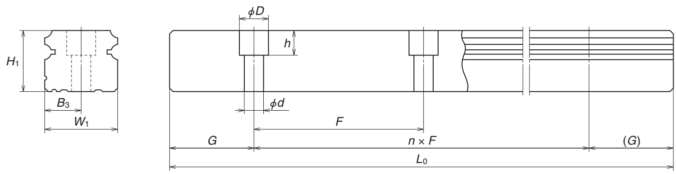
Reference number for rail of random-matching type

Rail **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
T: Fine clearance. Z: Slight preload (See page A164)
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					Ball dia.	Weight	
Width W_1	Height H_1	Pitch F	Mounting bolt hole $d \times D \times h$	B_3	G (reference)	Max. length L_{0max}. ( ) for stainless	Dynamic C (N)	Static C_0 (N)	Static moment M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	Ball slide (kg)	Rail (kg/m)
8	5.5	20	2.4×4.2×2.3	4	7.5	(375)	1240	2630	7.25	4.55	3.8	1.2000	0.013	0.31
10	6.5	25	3.5×6×3.5	5	10	(600)	2250	4500	16.2	10.5	8.8	1.5875	0.026	0.44
12	10.5	40	3.5×6×4.5	6	15	(800)	5650	11300	47.5	41.5	35	2.3812	0.082	0.88
15	15	60	4.5×7.5×5.3	7.5	20	2000	10800	20700	108	94.5	79.5	3.175	0.18	1.6
						(1800)	14600	32000	166	216	181		0.26	
20	18	60	6×9.5×8.5	10	20	3960	17400	32500	219	185	155	3.968	0.33	2.6
						(3500)	23500	50500	340	420	355		0.48	
23	22	60	7×11×9	11.5	20	3960	25600	46000	360	320	267	4.762	0.55	3.6
						(3500)	34500	71000	555	725	610		0.82	
28	26	80	9×14×12	14	20	4000	31000	51500	490	350	292	5.556	0.77	5.2
						(3500)	46000	91500	870	1030	865		1.3	
34	29	80	9×14×12	17	20	4000	47500	80500	950	755	630	6.350	1.5	7.2
							61500	117000	1380	1530	1280		2.1	
45	38	105	14×20×17	22.5	22.5	3990	81000	140000	2140	1740	1460	7.937	3.0	12.3
							99000	187000	2860	3000	2520		3.9	
53	44	120	16×23×20	26.5	30	3960	119000	198000	3600	3000	2510	9.525	4.7	16.9
							146000	264000	4850	5150	4350		6.1	
63	53	150	18×26×22	31.5	35	3900	181000	281000	6150	4950	4150	11.906	7.7	24.3
							235000	410000	8950	10100	8450		10.8	

4) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

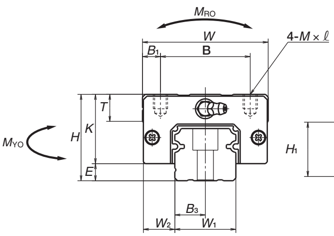
5) Random matching is available for LH15 to LH65.

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

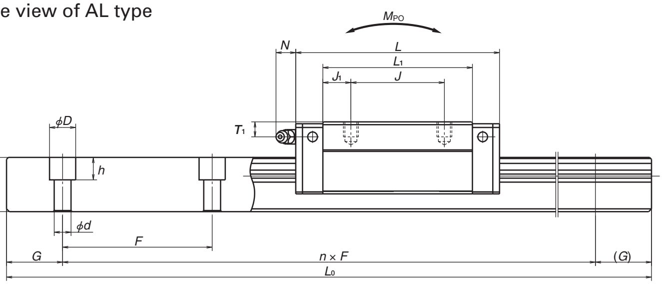
LH 30 1000 AL C 2 - ** **P5 3**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A162)
- Material/surface treatment code (See Table 20)
- Number of ball slides per rail
- Design serial number — Added to the reference number.
- Accuracy code (See Table 21)
- Preload code (See page A164)

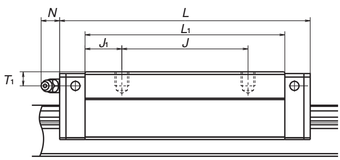
Front view of AL and BL types



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*
LH25AL **LH25BL**	36	7	12.5	48	79 107	35	35 50	M6×1×6	6.5	58 86	11.5 18	29	12	M6×0.75	6	11
LH30AL **LH30BL**	42	9	16	60	85.6 124.6	40	40 60	M8×1.25×8	10	59 98	9.5 19	33	14	M6×0.75	7	11
LH35AL **LH35BL**	48	9.5	18	70	109 143	50	50 72	M8×1.25×8	10	80 114	15 21	38.5	15	M6×0.75	8	11
LH45AL **LH45BL**	60	14	20.5	86	139 171	60	60 80	M10×1.5×10	13	105 137	22.5 28.5	46	17	Rc1/8	10	13
LH55AL **LH55BL**	70	15	23.5	100	163 201	75	75 95	M12×1.75×13	12.5	126 164	25.5 34.5	55	15	Rc1/8	11	13

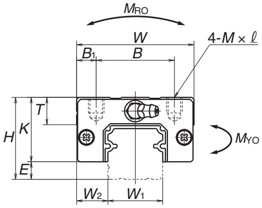
Remarks : 1) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Reference number for ball slide of random-matching type

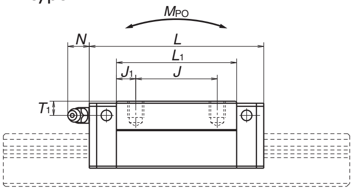
Ball slide **LAH 30 AL C -✻✻PC Z**

- Random-matching ball slide series code — LAH : LH Series random-matching ball slide
- Size
- Ball slide shape code (See page A162)
- Material/surface treatment code (See Table 20)
- Preload code — T: Fine clearance. Z: Slight preload (See page A164)
- Accuracy code : PC — PC: Normal grade is only available
- Design serial number — Added to the reference number.

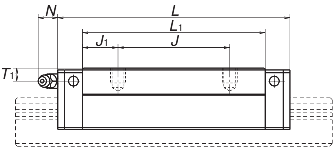
AL and BL types



AL type



BL type



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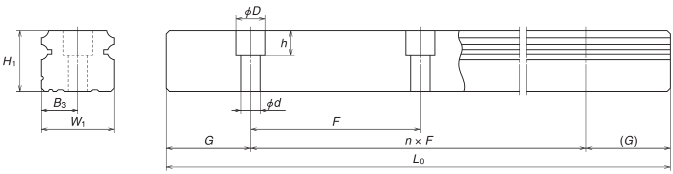
Reference number for rail of random-matching type

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 — T: Fine clearance. Z: Slight preload (See page A164)
- 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					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole		G	Max. length	Dynamic	Static	Static moment				Ball slide	Rail
W_1	H_1	F	$d \times D \times h$	B_3	(reference)	$L_{0max.}$ ( ) for stainless	C (N)	C_0 (N)	M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	(kg)	(kg/m)
23	22	60	7×11×9	11.5	20	3960 (3500)	25600 34500	46000 71000	360 555	320 725	267 610	4.762	0.46 0.69	3.6
28	26	80	9×14×12	14	20	4000 (3500)	31000 46000	51500 91500	490 870	350 1030	292 865	5.556	0.69 1.16	5.2
34	29	80	9×14×12	17	20	4000	47500 61500	80500 117000	950 1380	755 1530	630 1280	6.350	1.2 1.7	7.2
45	38	105	14×20×17	22.5	22.5	3990	81000 99000	140000 187000	2140 2860	1740 3000	1460 2520	7.937	2.2 2.9	12.3
53	44	120	16×23×20	26.5	30	3960	119000 146000	198000 264000	3600 4850	3000 5150	2510 4350	9.525	3.7 4.7	16.9

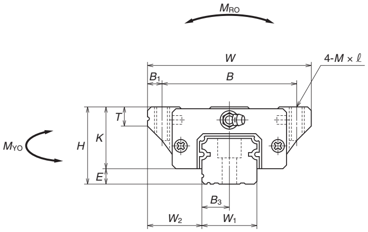
2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface.
When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

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

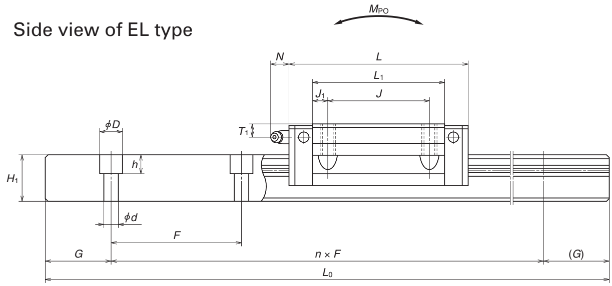
LH 30 1000 EL C 2 -✻✻ P5 3

- LH — Series name
- 30 — Size
- 1000 — Rail length (mm)
- EL — Ball slide shape code (See page A162)
- C — Material/surface treatment code (See Table 20)
- 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 A164)

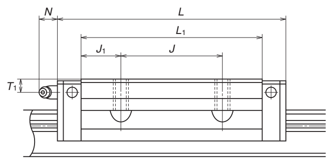
Front view of EL and GL types



Side view of EL type



Side view of GL 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
LH15EL **LH15GL**	24	4.6	16	47	55 74	38	30	M5×0.8×8	4.5	39 58	4.5 14	19.4	8	ϕ3	4.5	3.3
LH20EL **LH20GL**	30	5	21.5	63	69.8 91.8	53	40	M6×1×10	5	50 72	5 16	25	10	M6×0.75	5	11
LH25EL **LH25GL**	36	7	23.5	70	79 107	57	45	M8×1.25×16 (M8×1.25×12)	6.5	58 86	6.5 20.5	29	11 (12)	M6×0.75	6	11
LH30EL **LH30GL**	42	9	31	90	98.6 124.6	72	52	M10×1.5×18 (M10×1.5×15)	9	72 98	10 23	33	11 (15)	M6×0.75	7	11
LH35EL **LH35GL**	48	9.5	33	100	109 143	82	62	M10×1.5×20	9	80 114	9 26	38.5	12	M6×0.75	8	11
LH45EL **LH45GL**	60	14	37.5	120	139 171	100	80	M12×1.75×24	10	105 137	12.5 28.5	46	13	Rc1/8	10	13
LH55EL **LH55GL**	70	15	43.5	140	163 201	116	95	M14×2×28	12	126 164	15.5 34.5	55	15	Rc1/8	11	13
LH65EL **LH65GL**	90	16	53.5	170	193 253	142	110	M16×2×24	14	147 207	18.5 48.5	74	23	Rc1/8	19	13

Remarks: 1) Parenthesized dimensions are for items made of stainless steel.
2) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Reference number for ball slide of random-matching type

Ball slide **LAH 30 EL C -✱✱PC Z**

Random-matching ball slide series code
LAH : LH Series random-matching ball slide

Size

Ball slide shape code (See page A162)

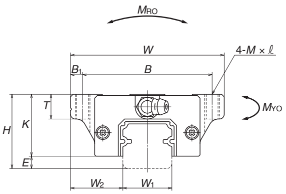
Material/surface treatment code (See Table 20)

Preload code
T: Fine clearance. Z: Slight preload (See page A164)

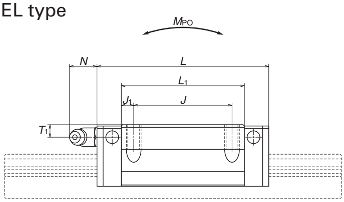
Accuracy code : PC
PC: Normal grade is only available

Design serial number
Added to the reference number.

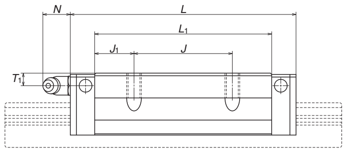
EL and GL types



EL type



GL type



Reference number for rail of random-matching type

Rail **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)

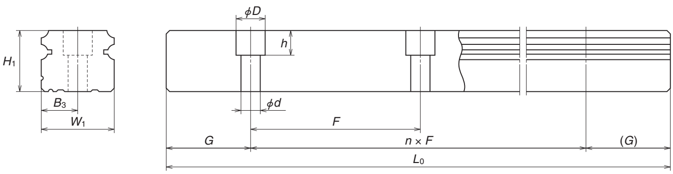
Preload code
T: Fine clearance. Z: Slight preload (See page A164)

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					Ball dia.	Weight	
Width W_1	Height H_1	Pitch F	Mounting bolt hole $d \times D \times h$	B_3	G (reference)	Max. length L_{0max}. ( ) for stainless	Dynamic C (N)	Static C_0 (N)	Static moment M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	Ball slide (kg)	Rail (kg/m)
15	15	60	4.5×7.5×5.3	7.5	20	2000 (1800)	10800 14600	20700 32000	108 166	94.5 216	79.5 181	3.175	0.17 0.25	1.6
20	18	60	6×9.5×8.5	10	20	3960 (3500)	17400 23500	32500 50500	219 340	185 420	155 355	3.968	0.45 0.65	2.6
23	22	60	7×11×9	11.5	20	3960 (3500)	25600 34500	46000 71000	360 555	320 725	267 610	4.762	0.63 0.93	3.6
28	26	80	9×14×12	14	20	4000 (3500)	35500 46000	63000 91500	600 870	505 1030	425 865	5.556	1.2 1.6	5.2
34	29	80	9×14×12	17	20	4000	47500 61500	80500 117000	950 1380	755 1530	630 1280	6.350	1.7 2.4	7.2
45	38	105	14×20×17	22.5	22.5	3990	81000 99000	140000 187000	2140 2860	1740 3000	1460 2520	7.937	3.0 3.9	12.3
53	44	120	16×23×20	26.5	30	3960	119000 146000	198000 264000	3600 4850	3000 5150	2510 4350	9.525	5.0 6.5	16.9
63	53	150	18×26×22	31.5	35	3900	181000 235000	281000 410000	6150 8950	4950 10100	4150 8450	11.906	10.0 14.1	24.3

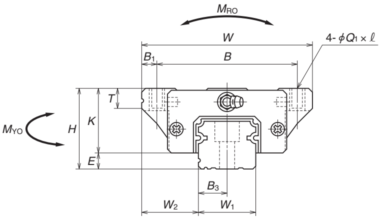
3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

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

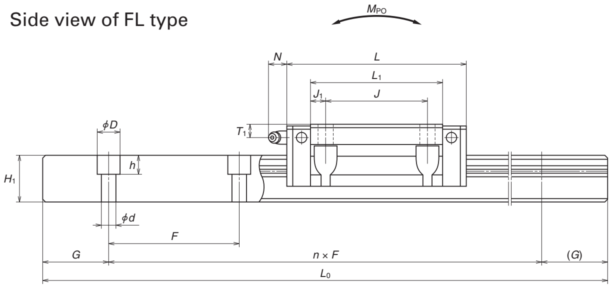
LH 30 1000 FL C 2 - P5 3**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A162)
- Material/surface treatment code (See Table 20)
- Number of ball slides per rail
- Design serial number (Added to the reference number.)
- Accuracy code (See Table 21)
- Preload code (See page A164)

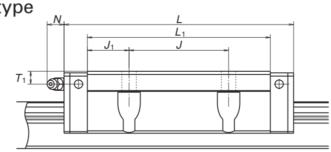
Front view of FL and HL types



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
LH15FL **LH15HL**	24	4.6	16	47	55 74	38	30	4.5×7	4.5	39 58	4.5 14	19.4	8	ϕ3	4.5	3.3
LH20FL **LH20HL**	30	5	21.5	63	69.8 91.8	53	40	6×9.5	5	50 72	5 16	25	10	M6×0.75	5	11
LH25FL **LH25HL**	36	7	23.5	70	79 107	57	45	7×10 (7×11.5)	6.5	58 86	6.5 20.5	29	11 (12)	M6×0.75	6	11
LH30FL **LH30HL**	42	9	31	90	98.6 124.6	72	52	9×12 (9×14.5)	9	72 98	10 23	33	11 (15)	M6×0.75	7	11
LH35FL **LH35HL**	48	9.5	33	100	109 143	82	62	9×13	9	80 114	9 26	38.5	12	M6×0.75	8	11
LH45FL **LH45HL**	60	14	37.5	120	139 171	100	80	11×15	10	105 137	12.5 28.5	46	13	Rc1/8	10	13
LH55FL **LH55HL**	70	15	43.5	140	163 201	116	95	14×18	12	126 164	15.5 34.5	55	15	Rc1/8	11	13
LH65FL **LH65HL**	90	16	53.5	170	193 253	142	110	16×24	14	147 207	18.5 48.5	74	23	Rc1/8	19	13

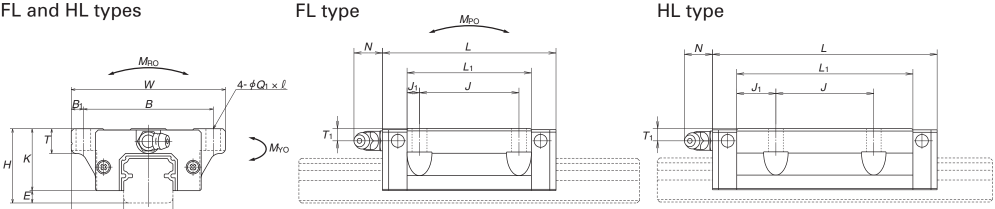
Remarks: 1) Parenthesized dimensions are for items made of stainless steel.
2) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Reference number for ball slide of random-matching type

Ball slide **LAH 30 FL C -✻✻PCZ**

- Random-matching ball slide series code — LAH : LH Series random-matching ball slide
- Size
- Ball slide shape code (See page A162)
- Material/surface treatment code (See Table 20)
- Preload code — T: Fine clearance. Z: Slight preload (See page A164)
- Accuracy code : PC — PC: Normal grade is only available
- Design serial number — Added to the reference number.

FL and HL types FL type HL type

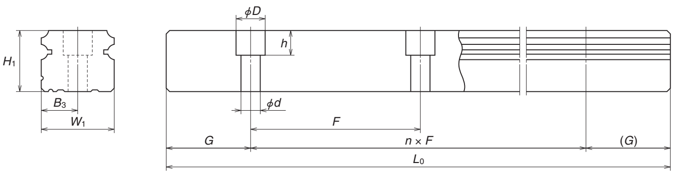


Reference number for rail of random-matching type

Rail **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 — T: Fine clearance. Z: Slight preload (See page A164)
- 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					Ball dia.	Weight	
Width W_1	Height H_1	Pitch F	Mounting bolt hole $d \times D \times h$	B_3	G (reference)	Max. length L_{0max}. ( ) for stainless	Dynamic C (N)	Static C_0 (N)	Static moment M_{RO} (N·m)	Static moment M_{PO} (N·m)	Static moment M_{YO} (N·m)	D_W	Ball slide (kg)	Rail (kg/m)
15	15	60	4.5×7.5×5.3	7.5	20	2000 (1800)	10800 14600	20700 32000	108 166	94.5 216	79.5 181	3.175	0.17 0.25	1.6
20	18	60	6×9.5×8.5	10	20	3960 (3500)	17400 23500	32500 50500	219 340	185 420	155 355	3.968	0.45 0.65	2.6
23	22	60	7×11×9	11.5	20	3960 (3500)	25600 34500	46000 71000	360 555	320 725	267 610	4.762	0.63 0.93	3.6
28	26	80	9×14×12	14	20	4000 (3500)	35500 46000	63000 91500	600 870	505 1030	425 865	5.556	1.2 1.6	5.2
34	29	80	9×14×12	17	20	4000	47500 61500	80500 117000	950 1380	755 1530	630 1280	6.35	1.7 2.4	7.2
45	38	105	14×20×17	22.5	22.5	3990	81000 99000	140000 187000	2140 2860	1740 3000	1460 2520	7.937	3 3.9	12.3
53	44	120	16×23×20	26.5	30	3990	119000 146000	198000 264000	3600 4850	3000 5150	2510 4350	9.525	5 6.5	16.9
63	53	150	18×26×22	31.5	35	3900	181000 235000	281000 410000	6150 8950	4950 10100	4150 8450	11.906	10 14.1	24.3

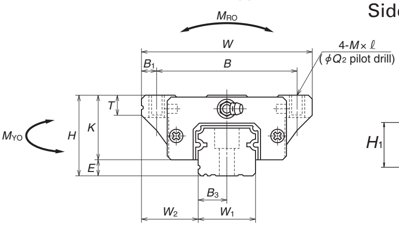
3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

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

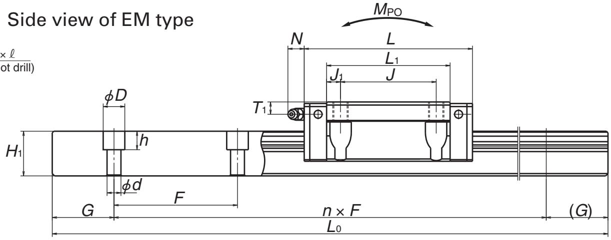
LH 30 1000 EM C 2 -∗∗ P5 3

- LH: Series name
- 30: Size
- 1000: Rail length (mm)
- EM: Ball slide shape code (See page A162)
- C: Material/surface treatment code (See Table 20)
- 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 A164)

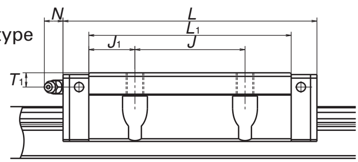
Front view of EM and GM types



Side view of EM type



Side view of GM type



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

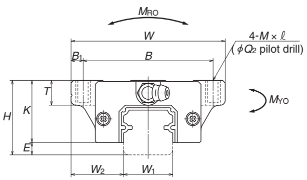
Remarks: 1) Parenthesized dimensions are for items made of stainless steel.
2) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Reference number for ball slide of random-matching type

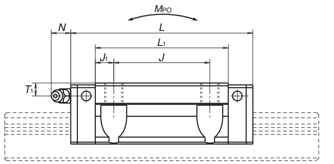
Ball slide **LAH 30 EM C -✻✻PCZ**

- Random-matching ball slide series code
  LAH : LH Series random-matching ball slide
- Size
- Ball slide shape code (See page A162)
- Material/surface treatment code (See Table 20)
- Preload code
  T: Fine clearance. Z: Slight preload (See page A164)
- Accuracy code : PC
  PC: Normal grade is only available
- Design serial number
  Added to the reference number.

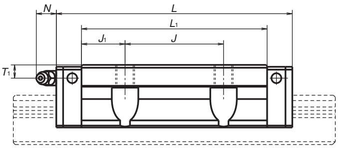
EM and GM types



EM type



GM type

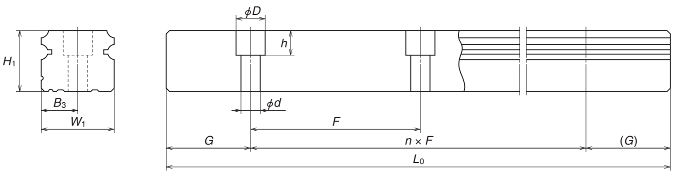


Reference number for rail of random-matching type

Rail **L1H 30 1200 L C N -✻✻ PC Z**

- Random-matching rail series code
  L1H : LH Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code: L
  L : Standard
- Material/surface treatment code (See Table 20)
- Preload code
  T: Fine clearance. Z: Slight preload (See page A164)
- 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.

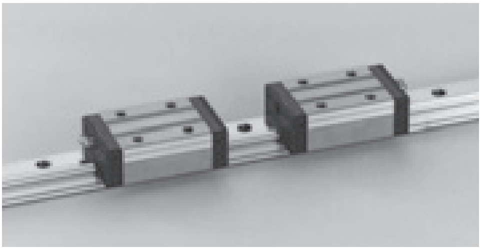


Unit: mm

Rail							Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole		G	Max. length	Dynamic	Static	Static moment				Ball slide	Rail
W_1	H_1	F	$d \times D \times h$	B_3	(reference)	L_{0max}. ( ) for stainless	C (N)	C_0 (N)	M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	(kg)	(kg/m)
15	15	60	4.5×7.5×5.3	7.5	20	2000 (1800)	10800 14600	20700 32000	108 166	94.5 216	79.5 181	3.175	0.17 0.25	1.6
20	18	60	6×9.5×8.5	10	20	3960 (3500)	17400 23500	32500 50500	219 340	185 420	155 355	3.968	0.45 0.65	2.6
23	22	60	7×11×9	11.5	20	3960 (3500)	25600 34500	46000 71000	360 555	320 725	267 610	4.762	0.63 0.93	3.6
28	26	80	9×14×12	14	20	4000 (3500)	35500 46000	63000 91500	600 870	505 1030	425 865	5.556	1.2 1.6	5.2
34	29	80	9×14×12	17	20	4000	47500 61500	80500 117000	950 1380	755 1530	630 1280	6.35	1.7 2.4	7.2
45	38	105	14×20×17	22.5	22.5	3990	81000 99000	140000 187000	2140 2860	1740 3000	1460 2520	7.937	3 3.9	12.3
53	44	120	16×23×20	26.5	30	3990	119000 146000	198000 264000	3600 4850	3000 5150	2510 4350	9.525	5 6.5	16.9
63	53	150	18×26×22	31.5	35	3900	181000 235000	281000 410000	6150 8950	4950 10100	4150 8450	11.906	10 14.1	24.3

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

A-5-1.4 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, reducing moment rigidity. This increases the capacity to absorb errors in installation.

2. High load carrying capacity to vertical direction

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

3. High resistance against impact load

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

4. High accuracy

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

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

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

6. Abundant models and sizes come in series.

Each series has several ball slide models, rendering the linear guide available for numerous uses. The LS Series also has standardized long stainless- steel rail (maximum: 3 500 mm).

7. Fast delivery

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

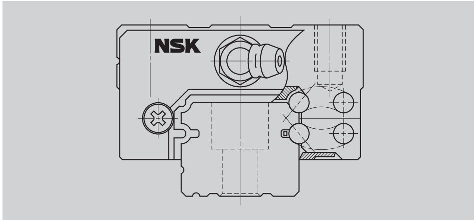


Fig. 1 LS Series

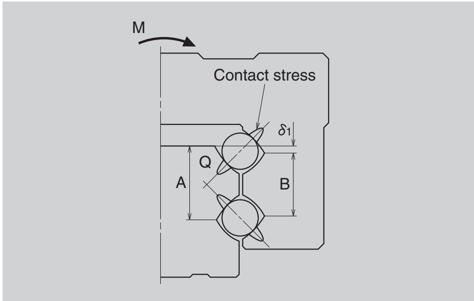


Fig. 2 Enlarged illustration of the offset Gothic arch groove

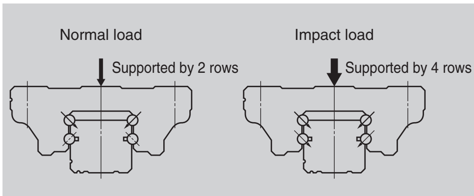


Fig. 3 When load is applied

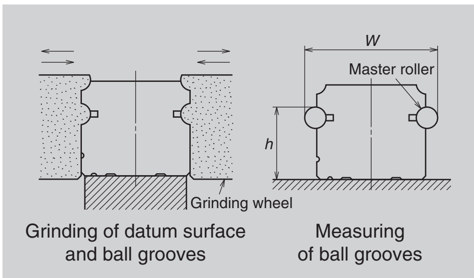
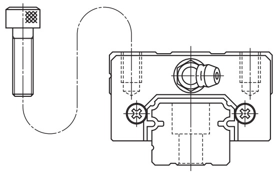
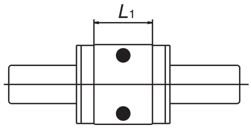
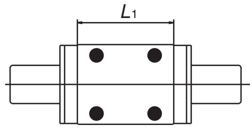
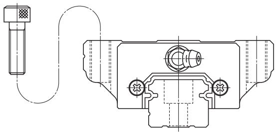
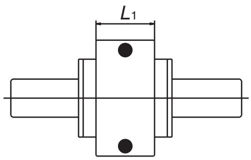
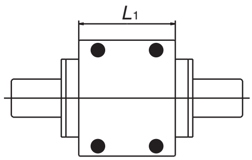
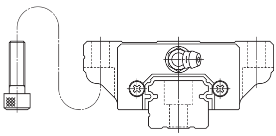
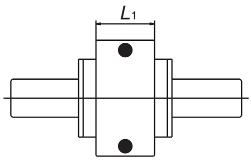
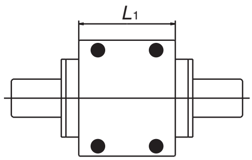
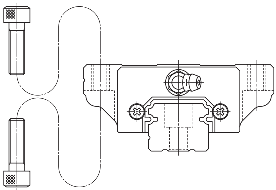
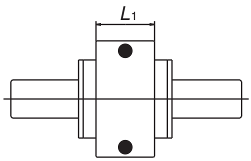
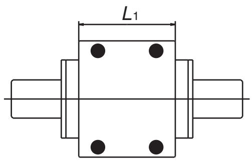


Fig. 4 Rail-grinding and measuring

(2) Ball slide shape

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

(3) Accuracy and preload

1. Running parallelism of ball slide

Table 1

Unit: μm

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

2. Accuracy standard

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

• Tolerance of preloaded assembly

Table 2

Unit: μm

Characteristics \ Accuracy grade	Ultra precision P3	Super precision P4	High precision P5	Precision grade P6	Normal glade 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 face C to face A Running parallelism of face D to face B	See Table 1, Fig. 5 and Fig. 6				

• Tolerance of random-matching type: Normal grade PC

Table 3

Unit: μm

Characteristics \ Model No.	LS15, 20, 25, 30, 35
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 face C to face A Running parallelism of face D to face B	See Table 1, Fig. 5 and Fig. 6

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

3. Combinations of accuracy and preload

Table 4

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

4. Assembled accuracy

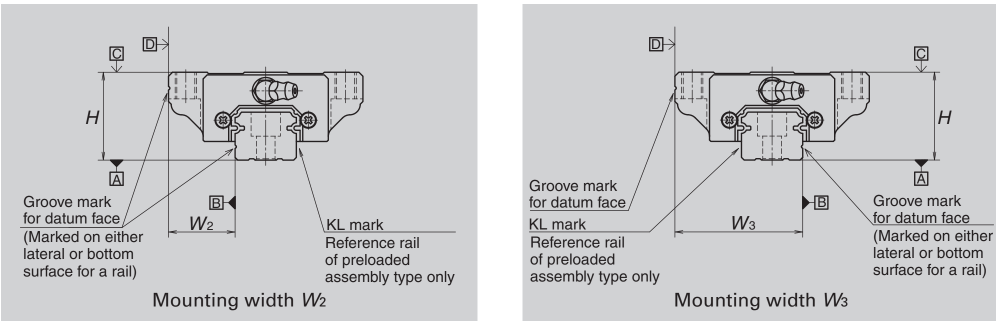


Fig. 5 Special high carbon steel

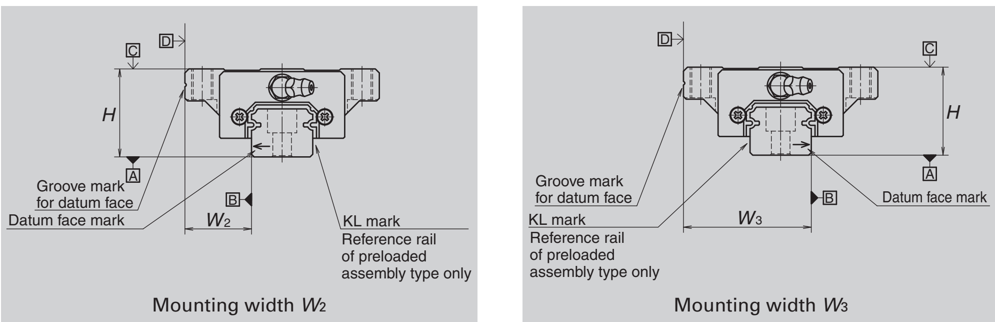


Fig. 6 Stainless steel

5. Preload and rigidity

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

• Preload and rigidity of preloaded assembly

Table 5

Model No.		Preload (N)		Rigidity (N/μm)			
				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	LS15 AL, EL, FL, EM	69	390	127	226	88	167
	LS20 AL, EL, FL, EM	88	540	147	284	108	206
	LS25 AL, EL, FL, EM	147	880	206	370	147	275
	LS30 AL, EL, FL, EM	245	1370	255	460	186	345
	LS35 AL, EL, FL, EM	345	1960	305	550	216	400
Medium-load type	LS15 CL, JL, KL, JM	49	294	78	147	59	108
	LS20 CL, JL, KL, JM	69	390	108	186	78	137
	LS25 CL, JL, KL, JM	98	635	127	235	88	177
	LS30 CL, JL, KL, JM	147	980	147	275	108	206
	LS35 CL, JL, KL, JM	245	1370	186	335	137	245

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

• Clearance and preload of random-matching type

Table 6

Unit: μm

Model No.	Fine clearance ZT	Slight preload ZZ
LS15	–4 – 15	–4 – 0
LS20	–4 – 15	–4 – 0
LS25	–5 – 15	–5 – 0
LS30	–5 – 15	–5 – 0
LS35	–5 – 15	–6 – 0

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

(4) Available length of rail

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

Table 7 Length limitations of rails

Unit: mm

Series	Size / Material	15	20	25	30	35
LS	Special high carbon steel	2000	3960	3960	4000	4000
	Stainless steel	1700	3500	3500	3500	3500

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

(5) Installation

1. Permissible values of mounting error

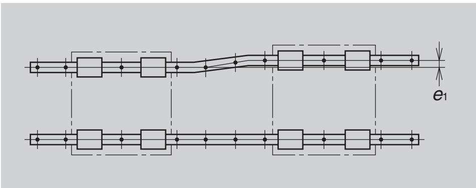


Fig. 7

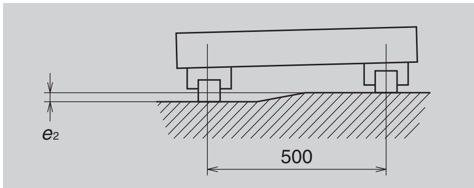


Fig. 8

Table 8

Unit: μm

Value	Preload	Model No. LS15	LS20	LS25	LS30	LS35
Permissible values of parallelism in two rails e_1	Z0, ZT	20	22	30	35	40
	Z1, ZZ	15	17	20	25	30
	Z3	12	15	15	20	25
Permissible values of parallelism (height) in two rails e_2	Z0, ZT	375 μm/500 mm				
	Z1, ZZ, Z3	330 μm/500 mm				

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

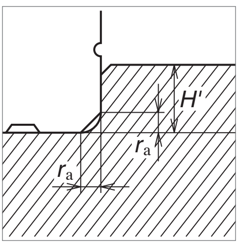


Fig. 9 Shoulder for the rail datum face

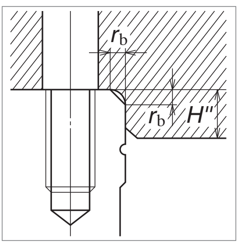


Fig. 10 Shoulder for the ball slide datum face

Table 9

Unit: mm

Model No.	Corner radius (maximum) r_a	Corner radius (maximum) r_b	Shoulder height H'	Shoulder height H''
LS15	0.5	0.5	4	4
LS20	0.5	0.5	4.5	5
LS25	0.5	0.5	5	5
LS30	0.5	0.5	6	6
LS35	0.5	0.5	6	6

(6) Lubrication components

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

1. Types of lubrication accessories

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

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

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

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

Please ask NSK for stainless lubrication accessories.

2. Mounting position of lubrication accessories

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

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

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

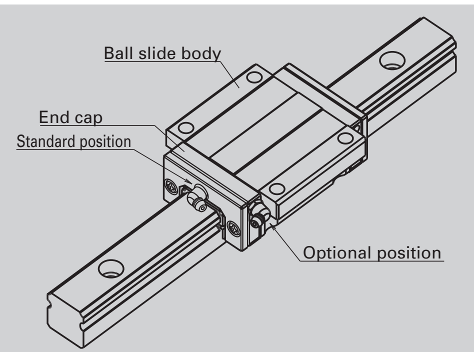


Fig. 12 Mounting position of lubrication accessories

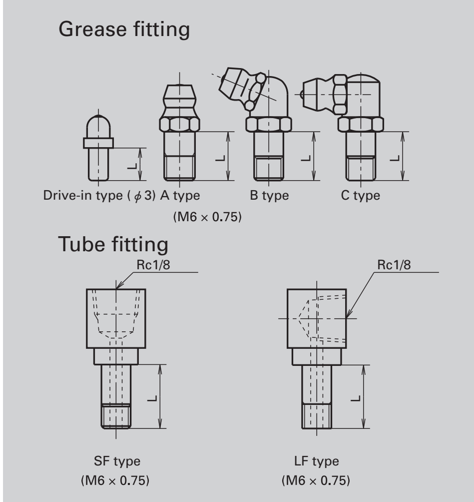


Fig. 11 Grease fitting and tube fitting

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

*) Please contact NSK as a connector is required.

(7) Dust proof components

1. Standard specification

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

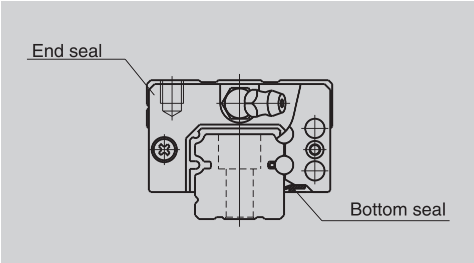


Fig. 13

Table 11 Seal friction per ball slide (maximum value)

Unit : N

Series \ Size	15	20	25	30	35
LS	8	9	9	9	10

2. NSK K1™

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

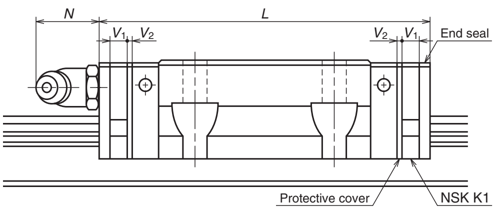


Table 12

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, EL, FL, EM	56.8	66.4	4.0	0.8	(5)
	Short	CL, JL, KL, JM	40.4	50			
LS20	Standard	AL, EL, FL, EM	65.2	75.8	4.5	0.8	(14)
	Short	CL, JL, KL, JM	47.2	57.8			
LS25	Standard	AL, EL, FL, EM	81.6	92.2	4.5	0.8	(14)
	Short	CL, JL, KL, JM	59.6	70.2			
LS30	Standard	AL, EL, FL, EM	96.4	108.4	5.0	1.0	(14)
	Short	CL, JL, KL, JM	67.4	79.4			
LS35	Standard	AL, EL, FL, EM	108	121	5.5	1.0	(14)
	Short	CL, JL, KL, JM	77	90			

Note: Ball slide length equipped with NSK K1 = (Standard ball slide length) + (Thickness of NSK K1, V_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 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 is required.

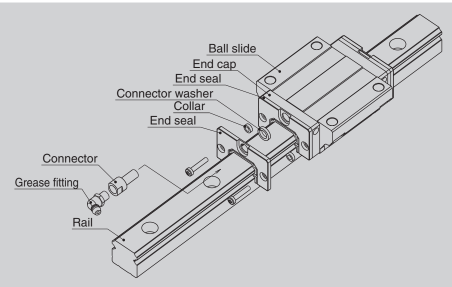


Fig. 14 Double seal

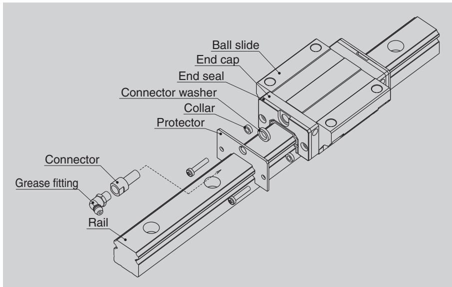


Fig. 15 Protector

Table 13 Double-seal set

Model No.	Reference No.		Increased
	Without connector	With connector	thickness V_1
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
	Without connector	With connector	thickness V_2
LS15	LS15PT-01	*	3
LS20	LS20PT-01	LS20PTC-01	2.7
LS25	LS25PT-01	LS25PTC-01	3.2
LS30	LS30PT-01	LS30PTC-01	4.2
LS35	LS35PT-01	LS35PTC-01	4.2

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

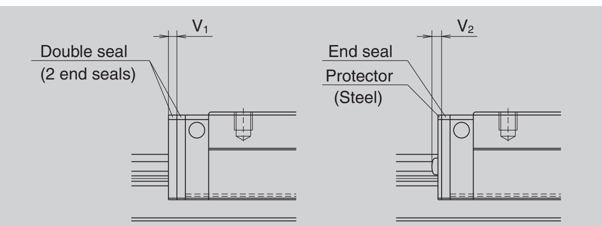


Fig. 16

5. Cap to cover the bolt hole for rail mounting

Table 15 Caps to cover rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
LS15	M3	LG-CAP/M3	20
LS15	M4	LG-CAP/M4	20
LS20	M5	LG-CAP/M5	20
LS25, LS30	M6	LG-CAP/M6	20
LS35	M8	LG-CAP/M8	20

6. Inner seal

Inner seal can be manufactured for 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.

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

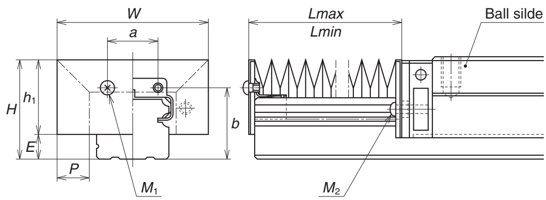


Fig. 17 Dimensions of bellows

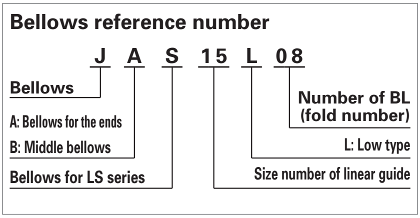


Table 18 Dimensions of bellows

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	1060
	L_{max}	140	280	420	560	700	840	980	1120	1260	1400
JAS20L	Stroke	106	212	318	424	530	636	742	848	954	1060
	L_{max}	140	280	420	560	700	840	980	1120	1260	1400
JAS25L	Stroke	106	212	318	424	530	636	742	848	954	1060
	L_{max}	140	280	420	560	700	840	980	1120	1260	1400
JAS30L	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
	L_{max}	210	420	630	840	1050	1260	1470	1680	1890	2100
JAS35L	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
	L_{max}	210	420	630	840	1050	1260	1470	1680	1890	2100

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

(8) Reference number

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

1. Reference number for preloaded assembly

LS 30 1000 AL C 2 - ** **P5 3**

- LS: Series name
- 30: Size
- 1000: Rail length (mm)
- AL: Ball slide shape code (See page A186)
- C: Material/surface treatment code (See Table 20)
- 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 A188)

2. Reference number for random-matching type

Ball slide

LAS 30 AL C - **PC Z**

- LAS: Random-matching ball slide series code
  LAS : LS Series random-matching ball slide
- 30: Size
- AL: Ball slide shape code (See page A186)
- C: Material/surface treatment code (See Table 20)
- -**: Design serial number
  Added to the reference number.
- PC: Accuracy code : PC
  PC: Normal grade is only available
- Z: Preload code
  T: Fine clearance. Z: Slight preload (See page A188)

Rail

L1S 30 1000 L C N - ** **PC Z**

- L1S: Random-matching rail series code
  L1S : LS Series random-matching rail
- 30: Size
- 1000: Rail length (mm)
- L: Rail shape code
  L: Standard, LS15 with mounting holes for M3
  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 : PC
  PC: Normal grade is only available
- Z: Preload code
  T: Fine clearance. Z: Slight preload (See page A188)

*Please consult with NSK for butting rail specification.

Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is fine clearance "T" or slight preload "Z" (Refer to page A188).

Table 20 Material/surface treatment code

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

Table 21 Accuracy code

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

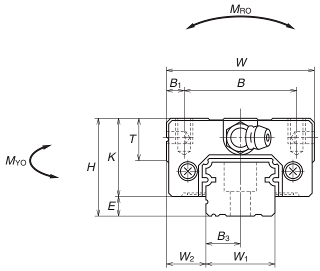
Note: Refer to Page A38 and A61 for NSK K1 lubrication unit.

(9) Dimensions
LS-CL (Medium-load type)
LS-AL (High-load type)

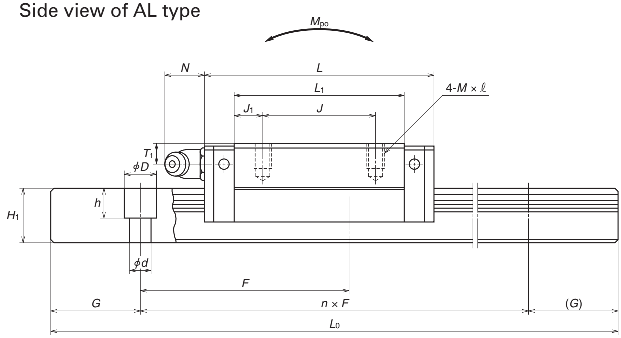
LS 30 1000 AL C 2 -∗∗ P5 3

- LS: Series name
- 30: Size
- 1000: Rail length (mm)
- AL: Ball slide shape code (See page A186)
- C: Material/surface treatment code (See Table 20)
- 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 A188)

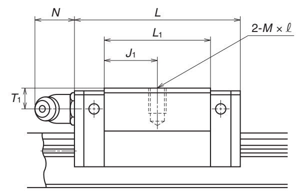
Front view of AL and CL type



Side view of AL type



Side view of CL 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
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

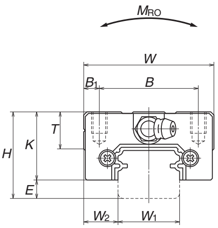
Remarks: 1) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Reference number for ball slide of random-matching type

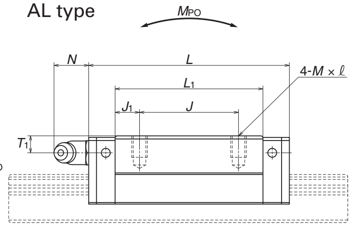
Ball slide **LAS 30 AL C -**PC Z**

- Random-matching ball slide series code
  - LAS : LS Series random-matching ball slide
- Size
- Ball slide shape code (See page A186)
- Material/surface treatment code (See Table 20)
- Preload code
  - T: Fine clearance. Z: Slight preload (See page A188)
- Accuracy code : PC
  - PC: Normal grade is only available
- Design serial number
  - Added to the reference number.

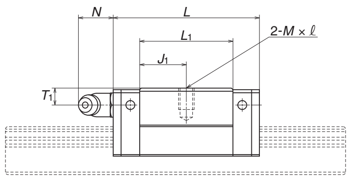
AL and CL types



AL type



CL type

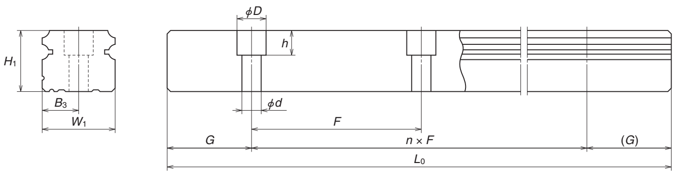


Reference number for rail of random-matching type

Rail **L1S 30 1000 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, LS15 with mounting holes for M3
  - T: LS15 with mounting holes for M4
- Material/surface treatment code (See Table 20)
- Preload code
  - T: Fine clearance. Z: Slight preload (See page A188)
- 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					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole		G	Max. length L_{0max}. ( ) for stainless	Dynamic	Static	Static moment				Ball slide	Rail
W_1	H_1	F	$d \times D \times h$	B_3	(reference)		C (N)	C_0 (N)	M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	(kg)	(kg/m)
15	12.5	60	*3.5×6×4.5 4.5×7.5×5.3	7.5	20	2000 (1700)	5400 8350	9100 16900	45.5 84.5	24.5 77	20.5 64.5	2.778	0.14 0.20	1.4
20	15.5	60	6×9.5×8.5	10	20	3960 (3500)	7900 11700	13400 23500	91.5 160	46.5 133	39 111	3.175	0.19 0.28	2.3
23	18	60	7×11×9	11.5	20	3960 (3500)	12700 18800	20800 36500	164 286	91 258	76 217	3.968	0.34 0.51	3.1
28	23	80	7×11×9	14	20	4000 (3500)	18700 28800	29600 55000	282 520	139 435	116 365	4.762	0.58 0.85	4.8
34	27.5	80	9×14×12	17	20	4000 (3500)	26000 40000	40000 74500	465 865	220 695	185 580	5.556	0.86 1.3	7.0

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

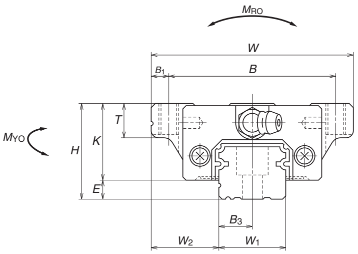
* Standard mounting hole of LS15 rail is for M3 bolts (Hole size: 3.5×6×4.5).
If you require the mounting hole for M4 bolts (Hole size: 4.5×7.5×5.3), please specify it when ordering.

LS-JL (Medium-load type)
LS-EL (High-load type)

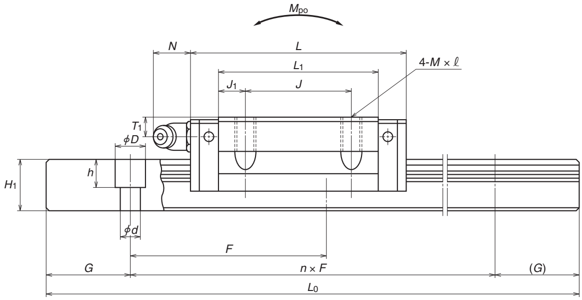
LS 30 1000 EL C 2 -＊＊ P5 3

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A186)
- Material/surface treatment code (See Table 20)
- Number of ball slides per rail
- Design serial number
  Added to the reference number.
- Accuracy code (See Table 21)
- Preload code (See page A188)

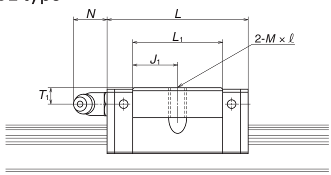
Front view of EL and JL type



Side view of EL type



Side view of JL 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
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	ϕ 3	6	3
LS20JL **LS20EL**	28	6	19.5	59	47.2 65.2	49	— 32	M6×1×10	5	30 48	15 8	22	10	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

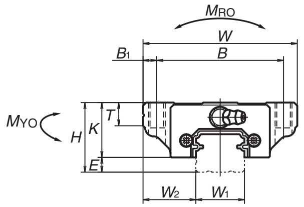
Remarks: 1) The external appearance of stainless steel ball slides differs from those of standard material ball slide.
2) Parenthesized dimensions are for items made of stainless steel.

Reference number for ball slide of random-matching type

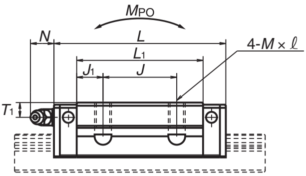
Ball slide **LAS 30 A L C -∗∗PC Z**

- Random-matching ball slide series code
  - LAS : LS Series random-matching ball slide
- Size
- Ball slide shape code (See page A186)
- Material/surface treatment code (See Table 20)
- Preload code
  - T: Fine clearance. Z: Slight preload (See page A188)
- Accuracy code : PC
  - PC: Normal grade is only available
- Design serial number
  - Added to the reference number.

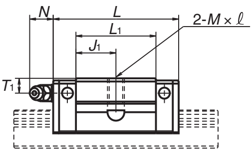
EL and JL types



EL type



JL type

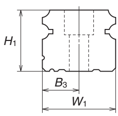


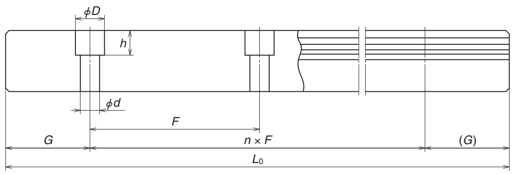
Reference number for rail of random-matching type

Rail **L1S 30 1000 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, LS15 with mounting holes for M3
  - T: LS15 with mounting holes for M4
- Material/surface treatment code (See Table 20)
- Preload code
  - T: Fine clearance. Z: Slight preload (See page A188)
- 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					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole		G	Max. length	Dynamic	Static	Static moment				Ball slide	Rail
W_1	H_1	F	$d \times D \times h$	B_3	(reference)	$L_{0max.}$ ( ) for stainless	C (N)	C_0 (N)	M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	(kg)	(kg/m)
15	12.5	60	∗3.5×6×4.5 4.5×7.5×5.3	7.5	20	2000 (1700)	5400 8350	9100 16900	45.5 84.5	24.5 77	20.5 64.5	2.778	0.17 0.26	1.4
20	15.5	60	6×9.5×8.5	10	20	3960 (3500)	7900 11700	13400 23500	91.5 160	46.5 133	39 111	3.175	0.24 0.35	2.3
23	18	60	7×11×9	11.5	20	3960 (3500)	12700 18800	20800 36500	164 286	91 258	76 217	3.968	0.44 0.66	3.1
28	23	80	7×11×9	14	20	4000 (3500)	18700 28800	29600 55000	282 520	139 435	116 365	4.762	0.76 1.2	4.8
34	27.5	80	9×14×12	17	20	4000 (3500)	26000 40000	40000 74500	465 865	220 695	185 580	5.556	1.2 1.7	7.0

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

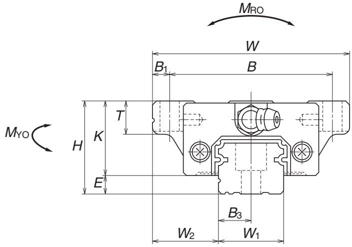
∗ Standard mounting hole of LS15 rail is for M3 bolts (Hole size: 3.5×6×4.5).
If you require the mounting hole for M4 bolts (Hole size: 4.5×7.5×5.3), please specify it when ordering.

LS-KL (Medium-load type)
LS-FL (High-load type)

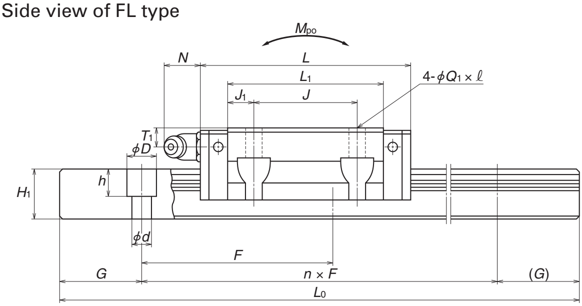
LS 30 1000 FL C 2 -✻✻ P5 3

- Series name (LS)
- Size (30)
- Rail length (mm) (1000)
- Ball slide shape code (See page A186) (FL)
- Material/surface treatment code (See Table 20) (C)
- Number of ball slides per rail (2)
- Design serial number (✻✻) — Added to the reference number.
- Accuracy code (See Table 21) (P5)
- Preload code (See page A188) (3)

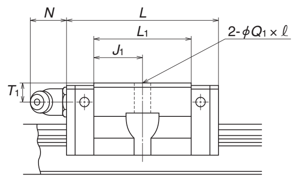
Front view of FL and KL type



Side view of FL type



Side view of KL type



Model No.	Assembly			Ball slide										Grease fitting		
	Height			Width	Length	Mounting hole										
	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

Remarks: 1) The external appearance of stainless steel ball slides differs from those of standard material ball slide.
2) Parenthesized dimensions are for items made of stainless steel.

Reference number for ball slide of random-matching type

Ball slide **LAS 30 AL C -**PC Z**

Random-matching ball slide series code
LAS : LS Series random-matching ball slide

Size

Ball slide shape code (See page A186)

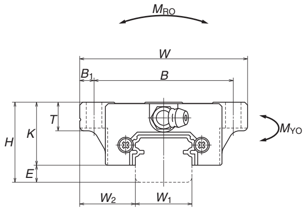
Material/surface treatment code (See Table 20)

Preload code
T: Fine clearance. Z: Slight preload (See page A188)

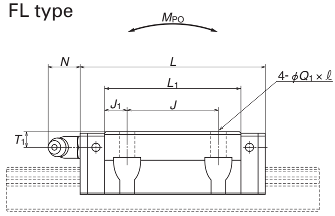
Accuracy code : PC
PC: Normal grade is only available

Design serial number
Added to the reference number.

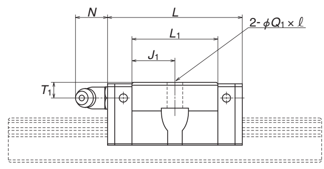
FL and KL types



FL type



KL type



Reference number for rail of random-matching type

Rail **L1S 30 1000 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, LS15 with mounting holes for M3
T: LS15 with mounting holes for M4

Material/surface treatment code (See Table 20)

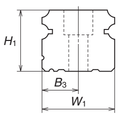
Preload code
T: Fine clearance. Z: Slight preload (See page A188)

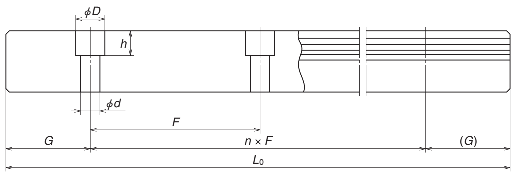
Accuracy code : PC
PC: Normal grade is only available

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					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole		G	Max. length	Dynamic	Static	Static moment				Ball slide	Rail
W_1	H_1	F	$d \times D \times h$	B_3	(reference)	$L_{0max.}$ ( ) for stainless	C (N)	C_0 (N)	M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	(kg)	(kg/m)
15	12.5	60	*3.5×6×4.5 4.5×7.5×5.3	7.5	20	2000 (1700)	5400 8350	9100 16900	45.5 84.5	24.5 77	20.5 64.5	2.778	0.17 0.26	1.4
20	15.5	60	6×9.5×8.5	10	20	3960 (3500)	7900 11700	13400 23500	91.5 160	46.5 133	39 111	3.175	0.24 0.35	2.3
23	18	60	7×11×9	11.5	20	3960 (3500)	12700 18800	20800 36500	164 286	91 258	76 217	3.968	0.44 0.66	3.1
28	23	80	7×11×9	14	20	4000 (3500)	18700 28800	29600 55000	282 520	139 435	116 365	4.762	0.76 1.2	4.8
34	27.5	80	9×14×12	17	20	4000 (3500)	26000 40000	40000 74500	465 865	220 695	185 580	5.556	1.2 1.7	7

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

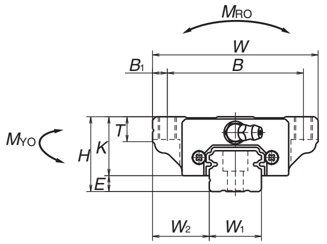
* Standard mounting hole of LS15 rail is for M3 bolts (Hole size: 3.5×6×4.5).
If you require the mounting hole for M4 bolts (Hole size: 4.5×7.5×5.3), please specify it when ordering.

LS-JM (Medium-load type)
LS-EM (High-load type)

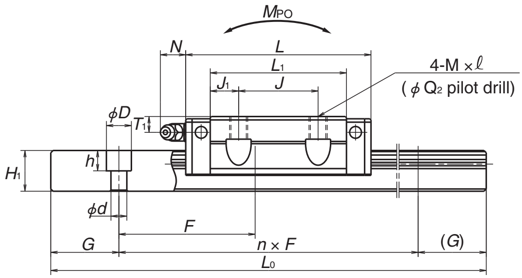
LS 30 1000 EM C 2 -∗∗ P5 3

- LS: Series name
- 30: Size
- 1000: Rail length (mm)
- EM: Ball slide shape code (See page A186)
- C: Material/surface treatment code (See Table 20)
- 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 A188)

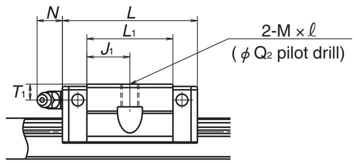
Front view of EM and JM type



Side view of EM type



Side view of JM type



Model No.	Assembly			Ball slide											Grease fitting		
	Height			Width	Length	Mounting hole											
	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
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
LS20JM **LS20EM**	28	6	19.5	59	47.2 65.2	49	— 32	M6×1×9 (M6×1×9.5)	5.3	5	30 48	15 8	22	10	M6×0.75	5.5	11
LS25JM **LS25EM**	33	7	25	73	59.6 81.6	60	— 35	M8×1.25×10 (M8×1.25×11.5)	6.8	6.5	38 60	19 12.5	26	11 (12)	M6×0.75	7	11
LS30JM **LS30EM**	42	9	31	90	67.4 96.4	72	— 40	M10×1.5×12 (M10×1.5×14.5)	8.6	9	42 71	21 15.5	33	11 (15)	M6×0.75	8	11
LS35JM **LS35EM**	48	10.5	33	100	77 108	82	— 50	M10×1.5×13 (M10×1.5×14.5)	8.6	9	49 80	24.5 15	37.5	12 (15)	M6×0.75	8.5	11

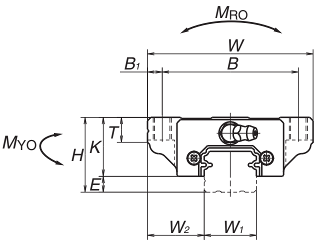
Remarks: 1) The external appearance of stainless steel ball slides differs from those of standard material ball slide.
2) Parenthesized dimensions are for items made of stainless steel.

Reference number for ball slide of random-matching type

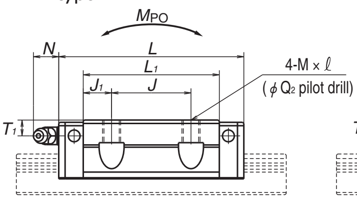
Ball slide **LAS 30 A L C -✻✻PC Z**

- Random-matching ball slide series code
  - LAS : LS Series random-matching ball slide
- Size
- Ball slide shape code (See page A186)
- Material/surface treatment code (See Table 20)
- Preload code
  - T: Fine clearance. Z: Slight preload (See page A188)
- Accuracy code : PC
  - PC: Normal grade is only available
- Design serial number
  - Added to the reference number.

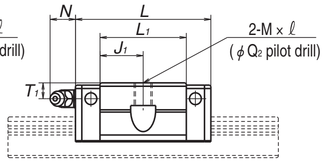
EM and JM types



EM type



JM type

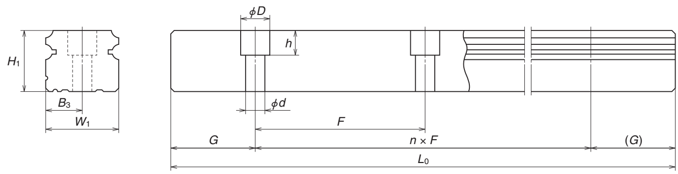


Reference number for rail of random-matching type

Rail **L1S 30 1000 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, LS15 with mounting holes for M3
  - T: LS15 with mounting holes for M4
- Material/surface treatment code (See Table 20)
- Preload code
  - T: Fine clearance. Z: Slight preload (See page A188)
- 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.



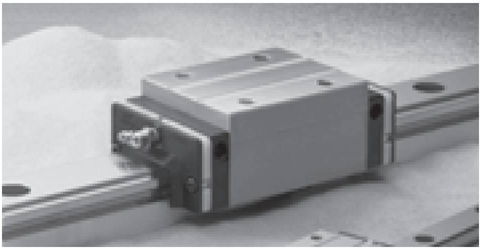
Unit: mm

Rail							Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole		G	Max. length	Dynamic	Static	Static moment				Ball slide	Rail
W_1	H_1	F	$d \times D \times h$	B_3	(reference)	$L_{0max.}$ ( ) for stainless	C (N)	C_0 (N)	M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	(kg)	(kg/m)
15	12.5	60	✻3.5×6×4.5 4.5×7.5×5.3	7.5	20	2000 (1700)	5400 8350	9100 16900	45.5 84.5	24.5 77	20.5 64.5	2.778	0.17 0.26	1.4
20	15.5	60	6×9.5×8.5	10	20	3960 (3500)	7900 11700	13400 23500	91.5 160	46.5 133	39 111	3.175	0.24 0.35	2.3
23	18	60	7×11×9	11.5	20	3960 (3500)	12700 18800	20800 36500	164 286	91 258	76 217	3.968	0.44 0.66	3.1
28	23	80	7×11×9	14	20	4000 (3500)	18700 28800	29600 55000	282 520	139 435	116 365	4.762	0.76 1.2	4.8
34	27.5	80	9×14×12	17	20	4000 (3500)	26000 40000	40000 74500	465 865	220 695	185 580	5.556	1.2 1.7	7

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

✻ Standard mounting hole of LS15 rail is for M3 bolts (Hole size: 3.5×6×4.5).
If you require the mounting hole for M4 bolts (Hole size: 4.5×7.5×5.3), please specify it when ordering.

A-5-1.5 VH Series



(1) Features

1. High-performance end seals

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

2. NSK K1™ lubrication unit (standard)

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

3. Tapped holes on a rail bottom face (optional)

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

4. High self-aligning capability (rolling direction)

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

5. High load carrying capacity to vertical direction

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

6. High resistance against impact load

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

7. High accuracy

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

8. Fast delivery

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

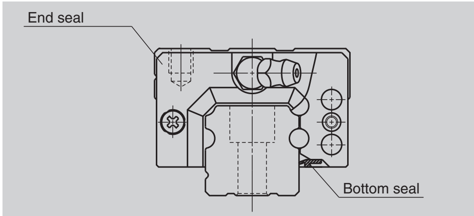


Fig. 1 VH Series

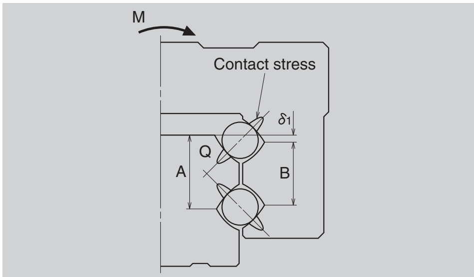


Fig. 2 Enlarged illustration of the offset Gothic arch groove

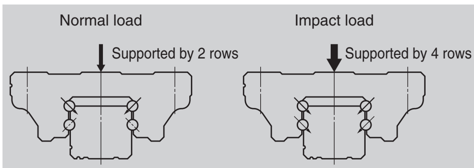


Fig. 3 When load is applied

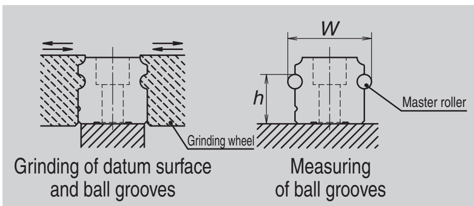


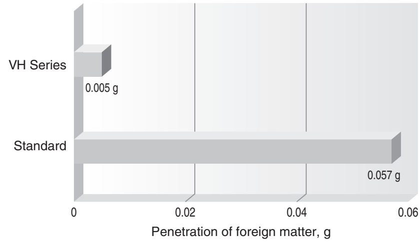
Fig. 4 Rail grinding and measuring

●Comparison with NSK standard products

Less than 1/10 the level of fine contaminants

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

Specimen	: VH30AN
Speed	: 16.7 mm/sec
Foreign matter	: Graphite powder (average grain size: 0.037 mm) + Grease

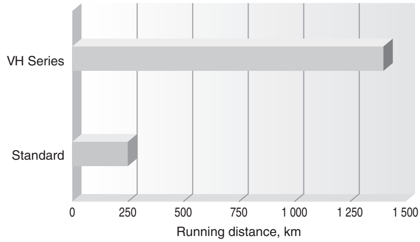


Opereting life under contaminated environments is more than 5 times longer

Durability test with rubber fragments

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

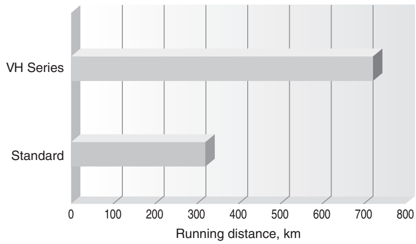
Specimen	: VH30AN, preload with Z1 (preload of 245 N)
Rail orientation	: Horizontal (wall mount)
Speed	: 500 mm/sec
Lubrication	: AS2 Grease (charged only at the beginning)
Foreign matter	: Rubber fragments

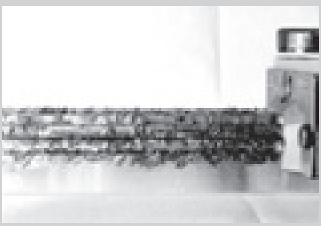


Durability test with fine wood particles

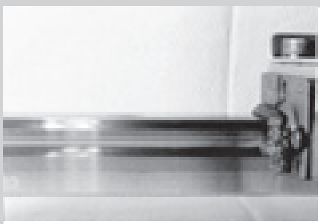
Extreme durability tests in a contaminated environment using fine wood particles show that durability of the VH Series is more than doubled compared to the standard series, as shown in the graph.

Specimen	: VH30AN (preload of 3 200 N)
Rail orientation	: Horizontal (wall mount)
Feed rate	: 400 mm/sec
Lubrication	: AS2 Grease (charged only at the beginning)
Foreign matter	: Fine wood particles



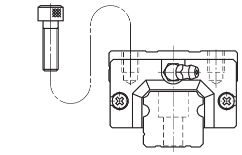
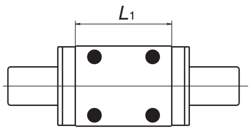
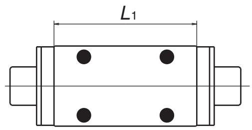
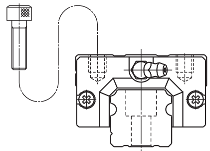
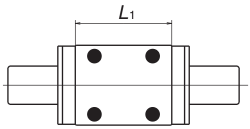
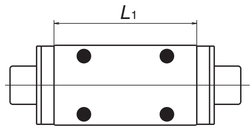
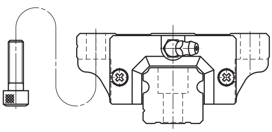
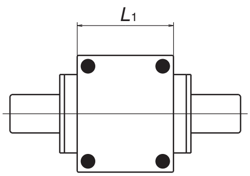
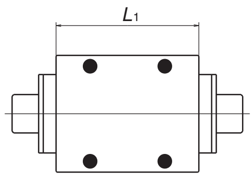
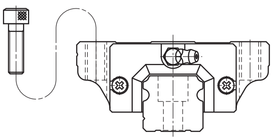
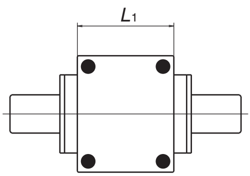
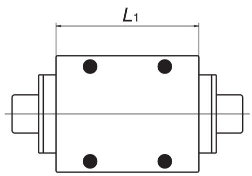
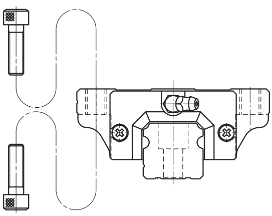
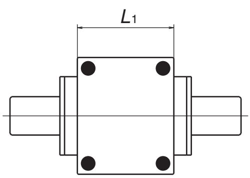
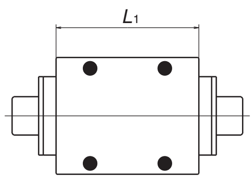


Before passage of ball slide
(Significant foreign matter remains)



After passage of ball slide
(All foreign matter is swept away)

(2) Ball slide shape

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

(3) Accuracy and preload

1. Running parallelism of ball slide

Table 1

Unit: μm

Rail over all length (mm) over – or less	Preloaded assembly (not random matching) Ultra precision K3	Super precision K4	High precision K5	Precision grade K6	Normal grade KN	Random-matching type Normal grade KC
– 50	2	2	2	4.5	6	6
50 – 80	2	2	3	5	6	6
80 – 125	2	2	3.5	5.5	6.5	6.5
125 – 200	2	2	4	6	7	7
200 – 250	2	2.5	5	7	8	8
250 – 315	2	2.5	5	8	9	9
315 – 400	2	3	6	9	11	11
400 – 500	2	3	6	10	12	12
500 – 630	2	3.5	7	12	14	14
630 – 800	2	4.5	8	14	16	16
800 – 1000	2.5	5	9	16	18	18
1000 – 1250	3	6	10	17	20	20
1250 – 1600	4	7	11	19	23	23
1600 – 2000	4.5	8	13	21	26	26
2000 – 2500	5	10	15	22	29	29
2500 – 3150	6	11	17	25	32	32
3150 – 4000	9	16	23	30	34	34

2. Accuracy standard

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

• **Tolerance of preloaded assembly**

Table 2

Unit: μm

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

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

Table 3

Unit: μm

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

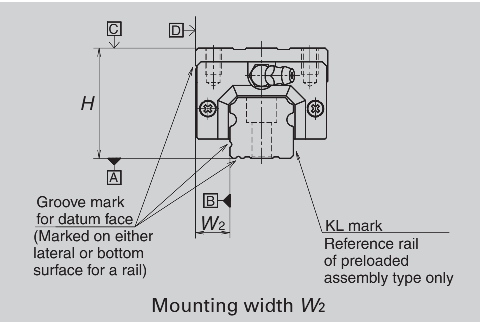
Note: ① Variation on the same rail ② Variation on multiple rails

3. Combinations of accuracy and preload

Table 4

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

4. Assembled accuracy



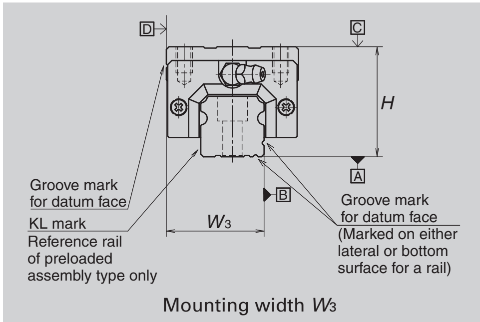
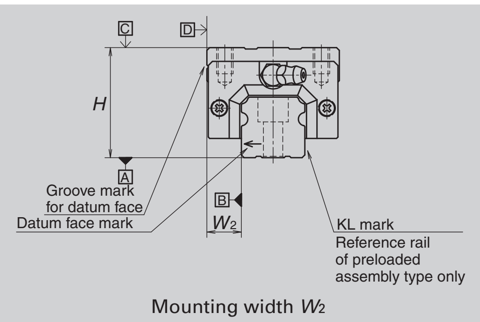


Fig. 5 Special high carbon steel



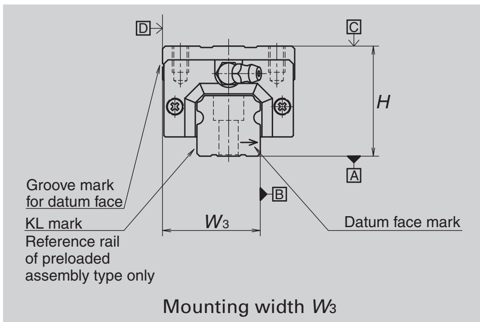


Fig. 6 Stainless steel

5. Preload and rigidity

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

• Preload and rigidity of preloaded assembly

Table 5

	Model No.	Preload (N)		Rigidity (N/μm)			
				Vertical directions		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, EL, FL, EM	78	490	137	226	98	186
	VH20 AN, EL, FL, EM	147	835	186	335	137	245
	VH25 AN, AL, EL, FL, EM	196	1270	206	380	147	284
	VH30 AN, AL	245	1570	216	400	157	294
	VH30 EL, FL, EM	294	1770	265	480	186	355
	VH35 AN, AL, EL, FL, EM	390	2350	305	560	216	390
	VH45 AN, AL, EL, FL, EM	635	3900	400	745	284	540
	VH55 AN, AL, EL, FL, EM	980	5900	490	910	345	645
Super-high-load type	VH15 BN, GL, HL, GM	98	685	196	345	137	284
	VH20 BN, GL, HL, GM	196	1080	265	480	196	355
	VH25 BN, BL, GL, HL, GM	245	1570	294	560	216	400
	VH30 BN, BL, GL, HL, GM	390	2260	360	665	265	480
	VH35 BN, BL, GL, HL, GM	490	2940	430	795	305	570
	VH45 BN, BL, GL, HL, GM	785	4800	520	960	370	695
	VH55 BN, BL, GL, HL, GM	1180	7050	635	1170	440	835

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

· Preload of random-matching type

Table 6 Unit: μm

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

(4) Available length of rail

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

Table 7 Length limitations of rails Unit: mm

Series	Material \ Size	15	20	25	30	35	45	55
VH	Special high carbon steel	2000	3960	3960	4000	4000	3990	3960
	Stainless steel	1800	3500	3500	3500			

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

(5) Installation

1. Permissible values of mounting error

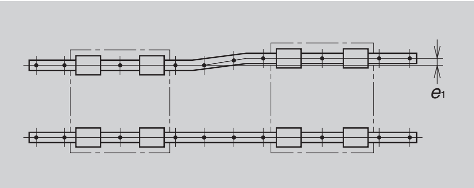


Fig. 7

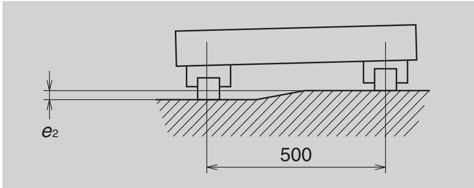


Fig. 8

Table 8

Unit: 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 face and corner radius r

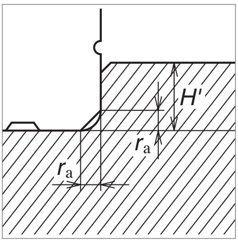


Fig. 9 Shoulder for the rail datum face

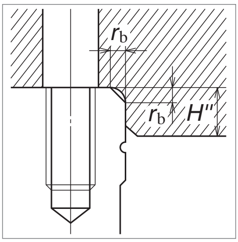


Fig. 10 Shoulder for the ball slide datum face

Table 9

Unit: mm

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

3. Specification for tapped holes on a rail bottom surface

- Accuracy grades are precision grade (K6) and normal grades (KN and KC).
- Minimum rail length for production is 400 mm.
- Tapping pitch is the same as the pitch for regular mounting bolt holes. Please refer to the dimension table.

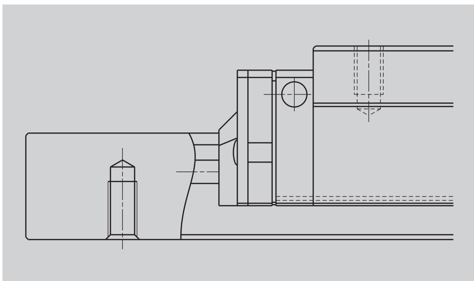


Fig. 11

(6) Lubrication components

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

1. Types of lubrication accessories

Figure 12 and Table 10 show grease fittings and tube fittings.

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

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

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

Please ask NSK for stainless lubrication accessories.

2. Mounting position of lubrication accessories

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

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

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

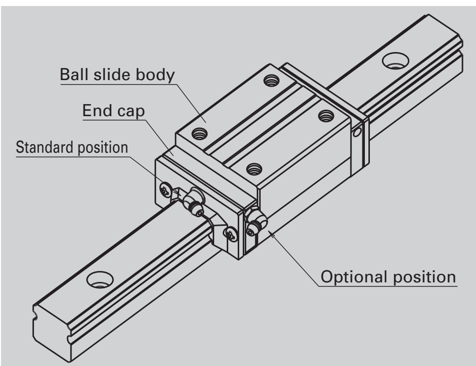


Fig. 13 Mounting position of lubrication accessories

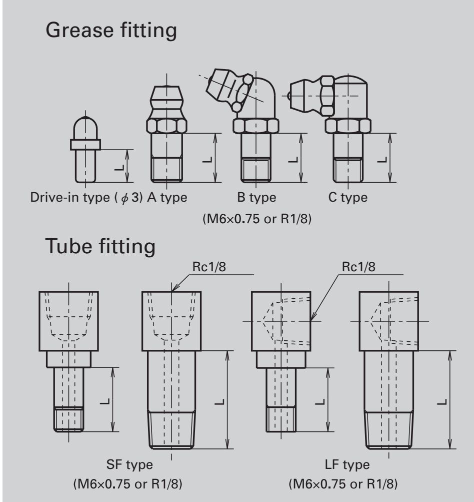


Fig. 12 Grease fitting and tube fitting

Table 10 Unit: mm

Model No.	Dust proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
VH15	Standard	10*	–
	With NSK K1	–	–
	Double seal	**	–
	Protector	**	–
VH20	Standard	12*	–
	With NSK K1	–	–
	Double seal	18	–
	Protector	18	–
VH25	Standard	12*	17***
	With NSK K1	–	–
	Double seal	18	23***
	Protector	18	19***
VH30	Standard	14*	18
	With NSK K1	–	–
	Double seal	22	25
	Protector	22	19
VH35	Standard	14*	15
	With NSK K1	–	–
	Double seal	22	25
	Protector	22	22
VH45	Standard	18*	21.5
	With NSK K1	–	–
	Double seal	22	32
	Protector	28	30
VH55	Standard	18*	20
	With NSK K1	–	–
	Double seal	22	32
	Protector	28	30

*) NSK K1 units are mounted as a standard specification for VH series.
**) Please contact NSK as a connector is required.
***) Only available for AN and BN type ball slides.

(7) Dust proof components

1. Standard specification

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

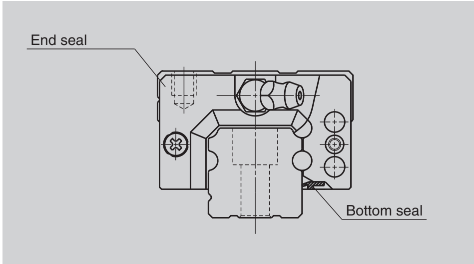


Fig. 14

Table 11 Seal friction per ball slide (maximum value)

Unit : N

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

2. Double seal and protector

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

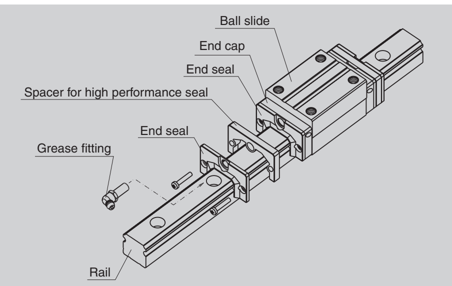


Fig. 15 Double seal

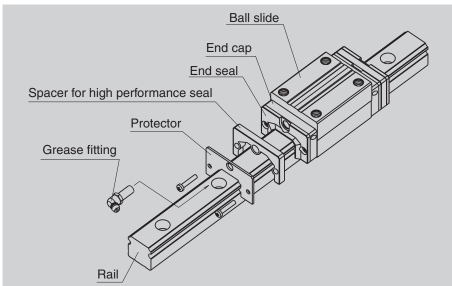


Fig. 16 Protector

Table 12 Dimension of installing dust proof optional components

Unit: mm

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

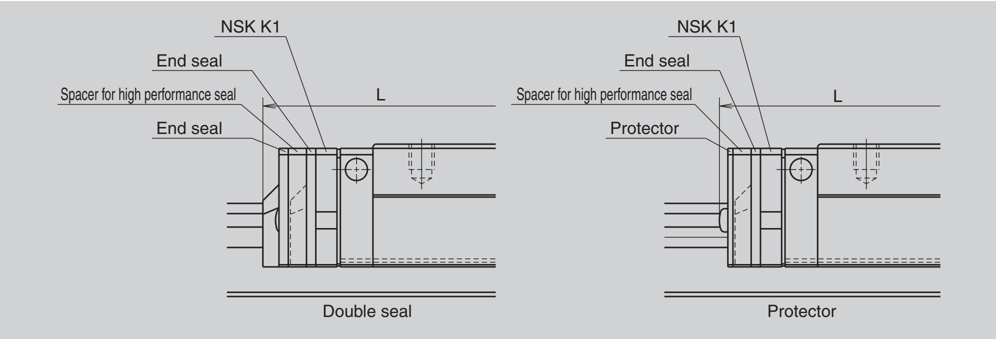


Fig. 17

3. Cap to cover the bolt hole for rail mounting

Table 13 Caps to cover rail bolt hole

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

4. Inner seal

Inner seal can be manufactured for models shown below.

Table 14

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

(8) Reference number

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

1. Reference number for preloaded assembly

VH 30 1000 AN C 2 - ** **K5 3**

- VH: Series name
- 30: Size
- 1000: Rail length (mm)
- AN: Ball slide shape code (See page A209)
- C: Material/surface treatment code (See Table 15)
- 2: Number of ball slides per rail
- -**: Design serial number
  Added to the reference number.
- K5: Accuracy code (See Table 16)
- 3: Preload code (See page A211)

2. Reference number for random-matching type

Ball slide

VAH 30 AN C -KC Z**

- VAH: Random-matching ball slide series code
  VAH : VH Series random-matching ball slide
- 30: Size
- AN: Ball slide shape code (See page A209)
- 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
  T: Fine clearance. Z: Slight preload (See page A211)

Rail

V1H 30 1000 L C N - KC 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.
- KC: Accuracy code : KC
  KC: Normal grade is only available
- Z: Preload code
  T: Fine clearance. Z: Slight preload (See page A211)

*Please consult with NSK for butting rail specification.

Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is fine clearance "T" or slight preload "Z" (Refer to page A211).

Table 15 Material/surface treatment code

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

Table 16 Accuracy code

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

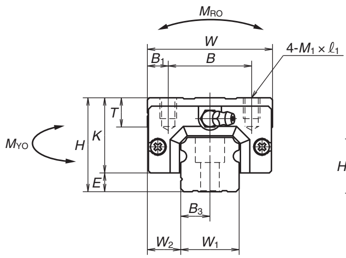
Note: Refer to Page A38 for NSK K1 lubrication unit.

(9) Dimensions
VH-AN (High-load type)
VH-BN (Super-high-load type)

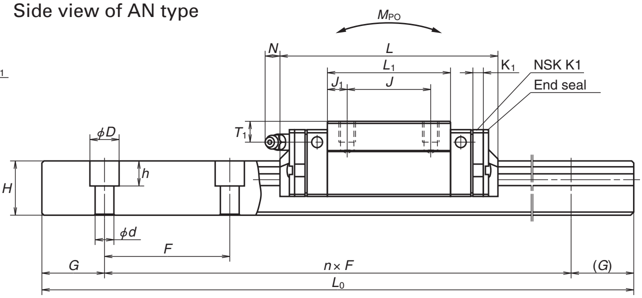
VH 30 1000 AN C 2 - ✻✻ **K5 3**

- VH: Series name
- 30: Size
- 1000: Rail length (mm)
- AN: Ball slide shape code (See page A209)
- C: Material/surface treatment code (See Table 15)
- 2: Number of ball slides per rail
- ✻✻: Design serial number (Added to the reference number.)
- K5: Accuracy code (See Table 16)
- 3: Preload code (See page A211)

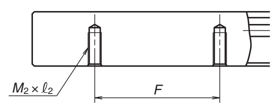
Front view of AN and BN type



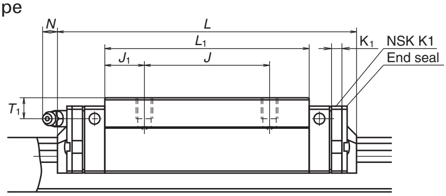
Side view of AN type



Specification for tapped holes on a rail bottom face



Side view of BN type



Model No.	Assembly Height			Ball slide 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	K_1	Hole size	T_1	N
VH15AN **VH15BN**	28	4.6	9.5	34	70.6 ⟨ 77⟩ 89.6 ⟨ 96⟩	26	26	M4×0.7×6	4	39 58	6.5 16	23.4	8	4.5	ϕ3	8.5	1 ⟨ 8.2⟩
VH20AN **VH20BN**	30	5	12	44	87.4 ⟨ 94.2⟩ 109.4 ⟨116.2⟩	32	36 50	M5×0.8×6	6	50 72	7 11	25	12	4.5	M6×0.75	5	11.1 ⟨12.3⟩
VH25AN **VH25BN**	40	7	12.5	48	97 ⟨104.4⟩ 125 ⟨132.4⟩	35	35 50	M6×1×9	6.5	58 86	11.5 18	33	12	5	M6×0.75	10	9.6 ⟨12.9⟩
VH30AN **VH30BN**	45	9	16	60	104.4 ⟨114.8⟩ 143.4 ⟨153.8⟩	40	40 60	M8×1.25×10	10	59 98	9.5 19	36	14	5	M6×0.75	10	11.4 ⟨14.2⟩
VH35AN **VH35BN**	55	9.5	18	70	128.8 ⟨139.2⟩ 162.8 ⟨173.2⟩	50	50 72	M8×1.25×12	10	80 114	15 21	45.5	15	5.5	M6×0.75	15	10.9 ⟨13.7⟩
VH45AN **VH45BN**	70	14	20.5	86	161.4 ⟨174.2⟩ 193.4 ⟨206.2⟩	60	60 80	M10×1.5×17	13	105 137	22.5 28.5	56	17	6.5	Rc1/8	20	12.5 ⟨14.1⟩
VH55AN **VH55BN**	80	15	23.5	100	185.4 ⟨198.2⟩ 223.4 ⟨236.2⟩	75	75 95	M12×1.75×18	12.5	126 164	25.5 34.5	65	18	6.5	Rc1/8	21	12.5 ⟨14.1⟩

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

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 A209)

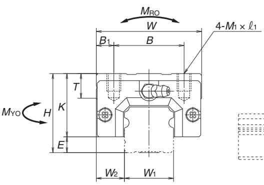
Material/surface treatment code (See Table 15)

Preload code
T: Fine clearance. Z: Slight preload (See page A211)

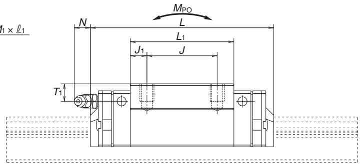
Accuracy code : KC
KC: Normal grade is only available

Design serial number
Added to the reference number.

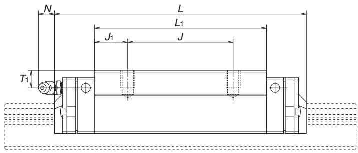
AN and BN types



AN type



BN type



Reference number for rail of random-matching type

Rail **V1H 30 1000 L C N -✻✻ KC 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)

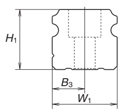
Preload code
T: Fine clearance. Z: Slight preload (See page A211)

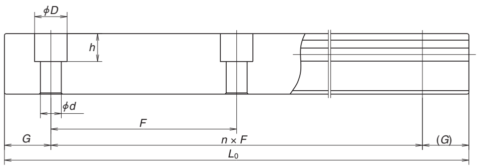
Accuracy code : KC
KC: Normal grade is only available

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					Ball dia.	Weight	
Width W_1	Height H_1	Pitch F	Counterbore $d \times D \times h$	Tapped hole $M \times$ pitch $\times \ell_2$	B_3	G (reference)	Maximum length L_{0max} ( ) for stainless	Dynamic C (N)	Static C_0 (N)	Static moment M_{RO} (N·m)	Static moment M_{PO} (N·m)	Static moment M_{YO} (N·m)	D_W	Ball slide (kg)	Rail (kg/m)
15	15	60	4.5×7.5×5.3	M5×0.8×8	7.5	20	2 000	10 800	20 700	108	94.5	79.5	3.175	0.18	1.6
							[1 800]	14 600	32 000	166	216	181		0.26	
20	18	60	6×9.5×8.5	M6×1×10	10	20	3 960	17 400	32 500	219	185	155	3.968	0.33	2.6
							[3 500]	23 500	50 500	340	420	355		0.48	
23	22	60	7×11×9	M6×1×12	11.5	20	3 960	25 600	46 000	360	320	267	4.762	0.55	3.6
							[3 500]	34 500	71 000	555	725	610		0.82	
28	26	80	9×14×12	M8×1.25×15	14	20	4 000	31 000	51 500	490	350	292	5.556	0.77	5.2
							[3 500]	46 000	91 500	870	1 030	865		1.3	
34	29	80	9×14×12	M8×1.25×17	17	20	4 000	47 500	80 500	950	755	630	6.350	1.5	7.2
								61 500	117 000	1 380	1 530	1 280		2.1	
45	38	105	14×20×17	M12×1.75×24	22.5	22.5	3 990	81 000	140 000	2 140	1 740	1 460	7.937	3.0	12.3
								99 000	187 000	2 860	3 000	2 520		3.9	
53	44	120	16×23×20	M14×2×24	26.5	30	3 960	119 000	198 000	3 600	3 000	2 510	9.525	4.7	16.9
								146 000	264 000	4 850	5 150	4 350		6.1	

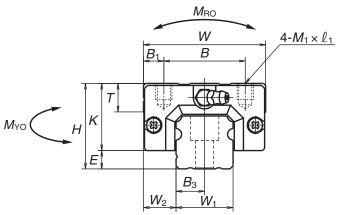
4) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

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

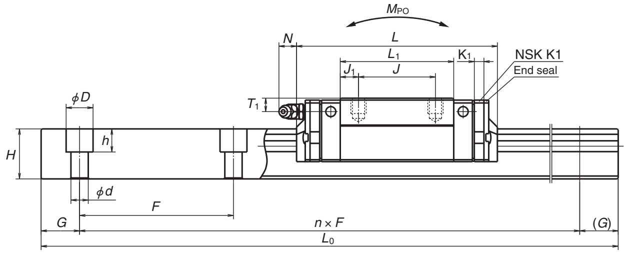
VH 30 1000 AL C 2 -✱✱ K5 3

- VH: Series name
- 30: Size
- 1000: Rail length (mm)
- AL: Ball slide shape code (See page A209)
- C: Material/surface treatment code (See Table 15)
- 2: Number of ball slides per rail
- ✱✱: Design serial number (Added to the reference number.)
- K5: Accuracy code (See Table 16)
- 3: Preload code (See page A211)

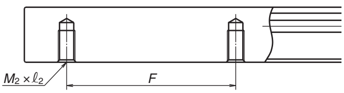
Front view of AL and BL type



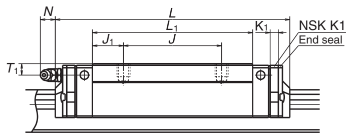
Side view of AL type



Specification for tapped holes on a rail bottom face



Side view of BL type



Model No.	Assembly			Ball slide													
	Height			Width	Length	Mounting hole									Grease fitting		
	H	E	W_2	W	L	B	J	M × pitch × ℓ	B_1	L_1	J_1	K	T	K_1	Hole size	T_1	N
VH25AL **VH25BL**	36	7	12.5	48	97 ⟨104.4⟩ 125 ⟨132.4⟩	35	35 50	M6×1×6	6.5	58 86	11.5 18	29	12	5	M6×0.75	6	9.6 ⟨12.9⟩
VH30AL **VH30BL**	42	9	16	60	104.4 ⟨114.8⟩ 143.4 ⟨153.8⟩	40	40 60	M8×1.25×8	10	59 98	9.5 19	33	14	5	M6×0.75	7	11.4 ⟨14.2⟩
VH35AL **VH35BL**	48	9.5	18	70	128.8 ⟨139.2⟩ 162.8 ⟨173.2⟩	50	50 72	M8×1.25×8	10	80 114	15 21	38.5	15	5.5	M6×0.75	8	10.9 ⟨13.7⟩
VH45AL **VH45BL**	60	14	20.5	86	161.4 ⟨174.2⟩ 193.4 ⟨206.2⟩	60	60 80	M10×1.5×10	13	105 137	22.5 28.5	46	17	6.5	Rc1/8	10	12.5 ⟨14.1⟩
VH55AL **VH55BL**	70	15	23.5	100	185.4 ⟨198.2⟩ 223.4 ⟨236.2⟩	75	75 95	M12×1.75×12	12.5	126 164	25.5 34.5	55	18	6.5	Rc1/8	11	12.5 ⟨14.1⟩

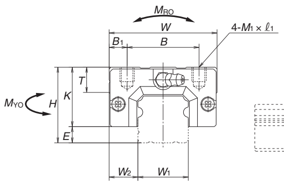
Remarks: 1) Figure inside ⟨ ⟩ is the dimension when equipped with the protector.
2) VH Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.
3) The external appearance of stainless steel ball slides differs from those of standard material ball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

Reference number for ball slide of random-matching type

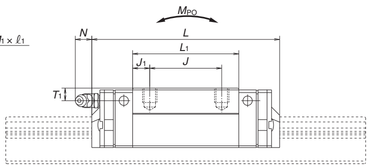
Ball slide **VAH 30 AL C -✱✱KC Z**

- Random-matching ball slide series code
  - VAH : VH Series random-matching ball slide
- Size
- Ball slide shape code (See page A209)
- 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 A211)

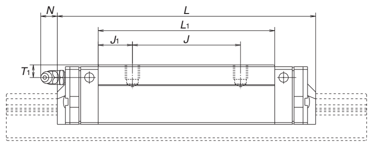
AL and BL types



AL type



BL type

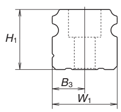


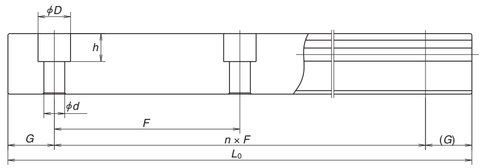
Reference number for rail of random-matching type

Rail **V1H 30 1000 L C N -✱✱ KC 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 : KC
  - KC: Normal grade is only available
- Preload code
  - T: Fine clearance. Z: Slight preload (See page A211)

*Please consult with NSK for butting rail specification.





Unit: mm

Rail								Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Counterbore	Tapped hole		G	Maximum length L_{0max} ( ) for stainless	Dynamic	Static	Static moment				Ball slide	Rail
W_1	H_1	F	$d \times D \times h$	$M \times$ pitch $\times \ell_2$	B_3	(reference)		C (N)	C_0 (N)	M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	(kg)	(kg/m)
23	22	60	7×11×9	M6×1×12	11.5	20	3 960 [3 500]	25 600 34 500	46 000 71 000	360 555	320 725	267 610	4.762	0.46 0.69	3.6
28	26	80	9×14×12	M8×1.25×15	14	20	4 000 [3 500]	31 000 46 000	51 500 91 500	490 870	350 1 030	292 865	5.556	0.69 1.16	5.2
34	29	80	9×14×12	M8×1.25×17	17	20	4 000	47 500 61 500	80 500 117 000	950 1 380	755 1 530	630 1 280	6.350	1.2 1.7	7.2
45	38	105	14×20×17	M12×1.75×24	22.5	22.5	3 990	81 000 99 000	140 000 187 000	2 140 2 860	1 740 3 000	1 460 2 520	7.937	2.2 2.9	12.3
53	44	120	16×23×20	M14×2×24	26.5	30	3 960	119 000 146 000	198 000 264 000	3 600 4 850	3 000 5 150	2 510 4 350	9.525	3.7 4.7	16.9

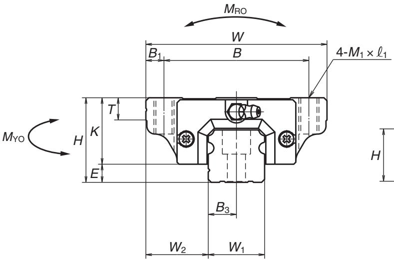
4) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

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

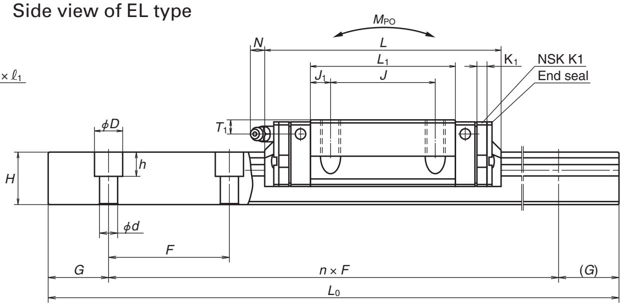
VH 30 1000 EL C 2 -✻✻ K5 3

- VH: Series name
- 30: Size
- 1000: Rail length (mm)
- EL: Ball slide shape code (See page A209)
- C: Material/surface treatment code (See Table 15)
- 2: Number of ball slides per rail
- ✻✻: Design serial number (Added to the reference number.)
- K5: Accuracy code (See Table 16)
- 3: Preload code (See page A211)

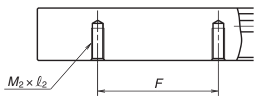
Front view of EL and GL type



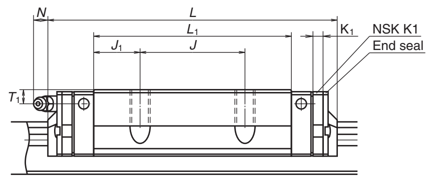
Side view of EL type



Specification for tapped holes on a rail bottom face



Side view of GL type



Model No.	Assembly Height H	Assembly E	Assembly W_2	Ball slide Width W	Ball slide Length L	Mounting hole B	Mounting hole J	Mounting hole M_1 × pitch × ℓ_1	B_1	L_1	J_1	K	T	K_1	Grease fitting Hole size	Grease fitting T_1	Grease fitting 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⟩

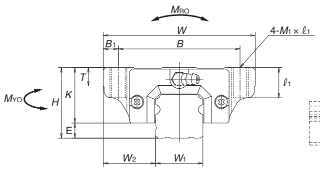
Remarks: 1) Figure inside ⟨ ⟩ is the dimension when equipped with the protector.
2) Figure inside [ ] is applied to stainless products.
3) VH Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.
4) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

Reference number for ball slide of random-matching type

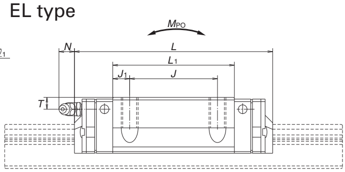
Ball slide **VAH 30 EL C -∗∗KC Z**

- Random-matching ball slide series code
  - VAH : VH Series random-matching ball slide
- Size
- Ball slide shape code (See page A209)
- 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 A211)

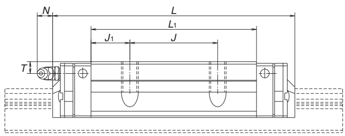
EL and GL types



EL type



GL type

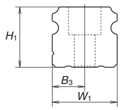


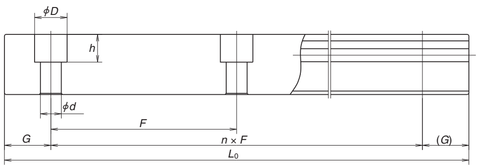
Reference number for rail of random-matching type

Rail **V1H 30 1000 L C N -∗∗ KC 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 : KC
  - KC: Normal grade is only available
- Preload code
  - T: Fine clearance. Z: Slight preload (See page A211)

*Please consult with NSK for butting rail specification.





Unit: mm

Rail								Basic load rating					Ball dia.	Weight	
Width W_1	Height H_1	Pitch F	Counterbore $d \times D \times h$	Tapped hole M_2 × pitch × ℓ_2	B_3	G (reference)	Maximum length L_{0max} ( ) for stainless	Dynamic C (N)	Static C_0 (N)	Static moment M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	Ball slide (kg)	Rail (kg/m)
15	15	60	4.5×7.5×5.3	M5×0.8×8	7.5	20	2 000 [1 800]	10 800 14 600	20 700 32 000	108 166	94.5 216	79.5 181	3.175	0.17 0.25	1.6
20	18	60	6×9.5×8.5	M6×1×10	10	20	3 960 [3 500]	17 400 23 500	32 500 50 500	219 340	185 420	155 355	3.968	0.45 0.65	2.6
23	22	60	7×11×9	M6×1×12	11.5	20	3 960 [3 500]	25 600 34 500	46 000 71 000	360 555	320 725	267 610	4.762	0.63 0.93	3.6
28	26	80	9×14×12	M8×1.25×15	14	20	4 000 [3 500]	35 500 46 000	63 000 91 500	600 870	505 1 030	425 865	5.556	1.2 1.6	5.2
34	29	80	9×14×12	M8×1.25×17	17	20	4 000	47 500 61 500	80 500 117 000	950 1 380	755 1 530	630 1 280	6.350	1.7 2.4	7.2
45	38	105	14×20×17	M12×1.75×24	22.5	22.5	3 990	81 000 99 000	140 000 187 000	2 140 2 860	1 740 3 000	1 460 2 520	7.937	3.0 3.9	12.3
53	44	120	16×23×20	M14×2×24	26.5	30	3 960	119 000 146 000	198 000 264 000	3 600 4 850	3 000 5 150	2 510 4 350	9.525	5.0 6.5	16.9

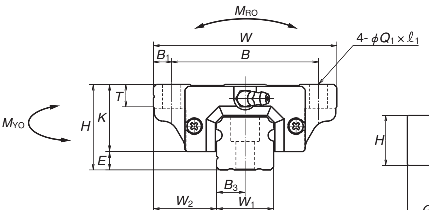
5) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

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

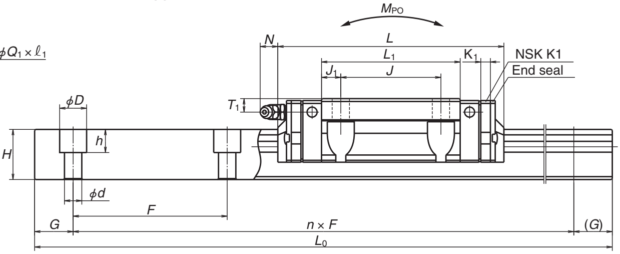
VH 30 1000 FL C 2 - ** **K5 3**

- VH — Series name
- 30 — Size
- 1000 — Rail length (mm)
- FL — Ball slide shape code (See page A209)
- C — Material/surface treatment code (See Table 15)
- 2 — Number of ball slides per rail
- ** — Design serial number (Added to the reference number.)
- K5 — Accuracy code (See Table 16)
- 3 — Preload code (See page A211)

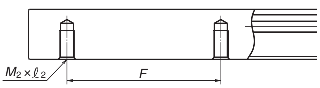
Front view of FL and HL type



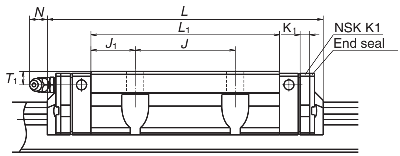
Side view of FL type



Specification for tapped holes on a rail bottom face



Side view of HL type



Model No.	Assembly			Ball slide													
	Height			Width	Length	Mounting hole									Grease fitting		
	H	E	W_2	W	L	B	J	$Q_1 \times \ell_1$	B_1	L_1	J_1	K	T	K_1	Hole size	T_1	N
VH15FL **VH15HL**	24	4.6	16	47	70.6 ⟨77⟩ 89.6 ⟨96⟩	38	30	4.5×7	4.5	39 58	4.5 14	19.4	8	4.5	ϕ3	4.5	1 ⟨8.2⟩
VH20FL **VH20HL**	30	5	21.5	63	87.4 ⟨94.2⟩ 109.4 ⟨116.2⟩	53	40	6×9.5	5	50 72	5 16	25	10	4.5	M6×0.75	5	11.1 ⟨12.3⟩
VH25FL **VH25HL**	36	7	23.5	70	97 ⟨104.4⟩ 125 ⟨132.4⟩	57	45	7×10[7×11.5]	6.5	58 86	6.5 20.5	29	11 [12]	5	M6×0.75	6	9.6 ⟨12.9⟩
VH30FL **VH30HL**	42	9	31	90	117.4 ⟨127.8⟩ 143.4 ⟨153.8⟩	72	52	9×12[9×14.5]	9	72 98	10 23	33	11 [15]	5	M6×0.75	7	11.4 ⟨14.2⟩
VH35FL **VH35HL**	48	9.5	33	100	128.8 ⟨139.2⟩ 162.8 ⟨173.2⟩	82	62	9×13	9	80 114	9 26	38.5	12	5.5	M6×0.75	8	10.9 ⟨13.7⟩
VH45FL **VH45HL**	60	14	37.5	120	161.4 ⟨174.2⟩ 193.4 ⟨206.2⟩	100	80	11×15	10	105 137	12.5 28.5	46	13	6.5	Rc1/8	10	12.5 ⟨14.1⟩
VH55FL **VH55HL**	70	15	43.5	140	185.4 ⟨198.2⟩ 223.4 ⟨236.2⟩	116	95	14×18	12	126 164	15.5 34.5	55	15	6.5	Rc1/8	11	12.5 ⟨14.1⟩

Remarks: 1) Figure inside ⟨ ⟩ is the dimension when equipped with the protector.
2) Figure inside [ ] is applied to stainless products.
3) VH Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.
4) The external appearance of stainless steel ball slides differs from those of standard material ball slide.

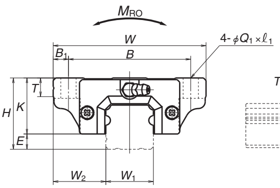
Reference number for ball slide of random-matching type

Ball slide **VAH 30 FL C -✽✽KCZ**

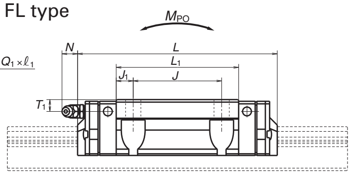
Random-matching ball slide series code
VAH : VH Series random-matching ball slide
Size
Ball slide shape code (See page A209)
Material/surface treatment code (See Table 15)

Preload code
T: Fine clearance. Z: Slight preload (See page A211)
Accuracy code : KC
KC: Normal grade is only available
Design serial number
Added to the reference number.

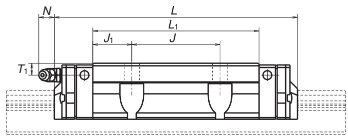
FL and HL types



FL type



HL type



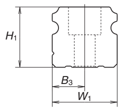
Reference number for rail of random-matching type

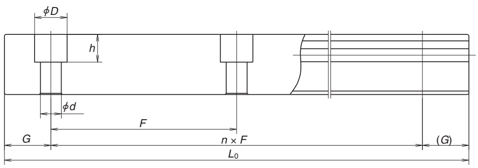
Rail **V1H 30 1000 L C N -✽✽ KC Z**

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
T: Fine clearance. Z: Slight preload (See page A211)
Accuracy code : KC
KC: 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.



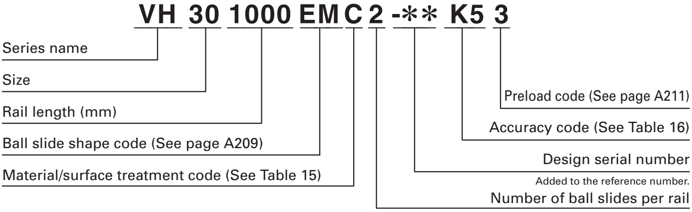


Unit: mm

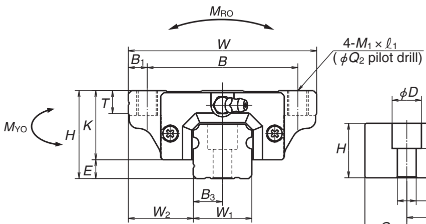
Rail								Basic load rating					Ball dia.	Weight	
Width W_1	Height H_1	Pitch F	Counterbore $d \times D \times h$	Tapped hole $M_2 \times$ pitch $\times \ell_2$	B_3	G (reference)	Maximum length L_{0max} ( ) for stainless	Dynamic C (N)	Static C_0 (N)	Static moment M_{RO} (N·m)	Static moment M_{PO} (N·m)	Static moment M_{YO} (N·m)	D_W	Ball slide (kg)	Rail (kg/m)
15	15	60	4.5×7.5×5.3	M5×0.8×8	7.5	20	2 000 [1 800]	10 800 14 600	20 700 32 000	108 166	94.5 216	79.5 181	3.175	0.17 0.25	1.6
20	18	60	6×9.5×8.5	M6×1×10	10	20	3 960 [3 500]	17 400 23 500	32 500 50 500	219 340	185 420	155 355	3.968	0.45 0.65	2.6
23	22	60	7×11×9	M6×1×12	11.5	20	3 960 [3 500]	25 600 34 500	46 000 71 000	360 555	320 725	267 610	4.762	0.63 0.93	3.6
28	26	80	9×14×12	M8×1.25×15	14	20	4 000 [3 500]	35 500 46 000	63 000 91 500	600 870	505 1 030	425 865	5.556	1.2 1.6	5.2
34	29	80	9×14×12	M8×1.25×17	17	20	4 000	47 500 61 500	80 500 117 000	950 1 380	755 1 530	630 1 280	6.350	1.7 2.4	7.2
45	38	105	14×20×17	M12×1.75×24	22.5	22.5	3 990	81 000 99 000	140 000 187 000	2 140 2 860	1 740 3 000	1 460 2 520	7.937	3.0 3.9	12.3
53	44	120	16×23×20	M14×2×24	26.5	30	3 960	119 000 146 000	198 000 264 000	3 600 4 850	3 000 5 150	2 510 4 350	9.525	5.0 6.5	16.9

5) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

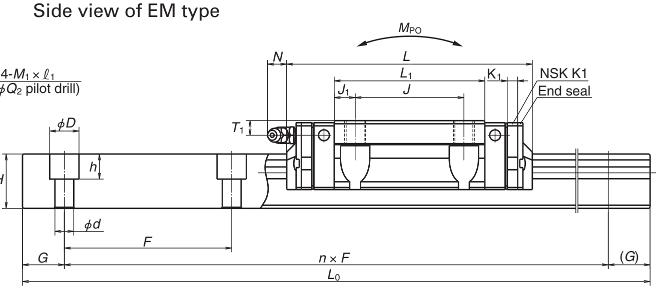
VH-EM (High-load type)
VH-GM (Super-high-load type)



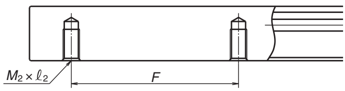
Front view of EM and GM type



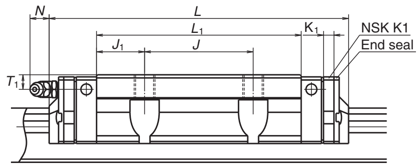
Side view of EM type



Specification for tapped holes on a rail bottom face



Side view of GM type



Model No.	Assembly			Ball slide														
	Height			Width	Length	Mounting hole										Grease fitting		
								$Q_1 \times \ell_1$										
	H	E	W_2	W	L	B	J	M_1 × pitch × ℓ_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〉

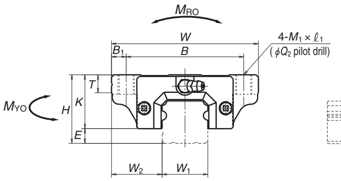
Remarks: 1) Figure inside 〈 〉 is the dimension when equipped with the protector.
2) Figure inside [ ] is applied to stainless products.
3) VH Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.
4) The external appearance of stainless steel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

Reference number for ball slide of random-matching type

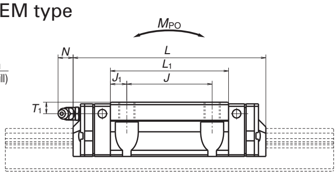
Ball slide **VAH 30 E M C -✻✻KC Z**

- Random-matching ball slide series code
  VAH : VH Series random-matching ball slide
- Size
- Ball slide shape code (See page A209)
- Material/surface treatment code (See Table 15)
- Preload code
  T: Fine clearance. Z: Slight preload (See page A211)
- Accuracy code : KC
  KC: Normal grade is only available
- Design serial number
  Added to the reference number.

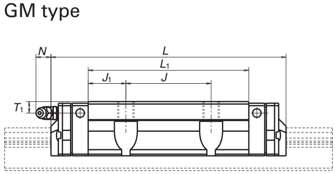
EM and GM types



EM type



GM type

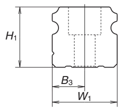


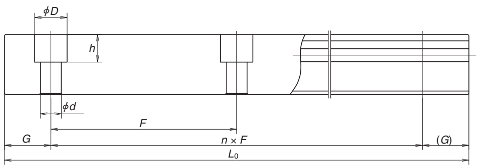
Reference number for rail of random-matching type

Rail **V1H 30 1000 L C N -✻✻ KC 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
  T: Fine clearance. Z: Slight preload (See page A211)
- Accuracy code : KC
  KC: 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.



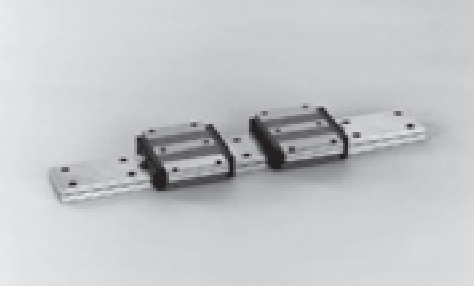


Unit: mm

Rail								Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Counterbore	Tapped hole		G	Maximum length	Dynamic	Static	Static moment				Ball slide	Rail
W_1	H_1	F	d × D × h	M_2 × pitch × ℓ_2	B_3	(reference)	L_{0max} ( ) for stainless	C (N)	C_0 (N)	M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	(kg)	(kg/m)
15	15	60	4.5×7.5×5.3	M5×0.8×8	7.5	20	2 000 [1 800]	10 800 14 600	20 700 32 000	108 166	94.5 216	79.5 181	3.175	0.17 0.25	1.6
20	18	60	6×9.5×8.5	M6×1×10	10	20	3 960 [3 500]	17 400 23 500	32 500 50 500	219 340	185 420	155 355	3.968	0.45 0.65	2.6
23	22	60	7×11×9	M6×1×12	11.5	20	3 960 [3 500]	25 600 34 500	46 000 71 000	360 555	320 725	267 610	4.762	0.63 0.93	3.6
28	26	80	9×14×12	M8×1.25×15	14	20	4 000 [3 500]	35 500 46 000	63 000 91 500	600 870	505 1 030	425 865	5.556	1.2 1.6	5.2
34	29	80	9×14×12	M8×1.25×17	17	20	4 000	47 500 61 500	80 500 117 000	950 1 380	755 1 530	630 1 280	6.350	1.7 2.4	7.2
45	38	105	14×20×17	M12×1.75×24	22.5	22.5	3 990	81 000 99 000	140 000 187 000	2 140 2 860	1 740 3 000	1 460 2 520	7.937	3.0 3.9	12.3
53	44	120	16×23×20	M14×2×24	26.5	30	3 960	119 000 146 000	198 000 264 000	3 600 4 850	3 000 5 150	2 510 4 350	9.525	5.0 6.5	16.9

5) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

A-5-1.6 LW Series



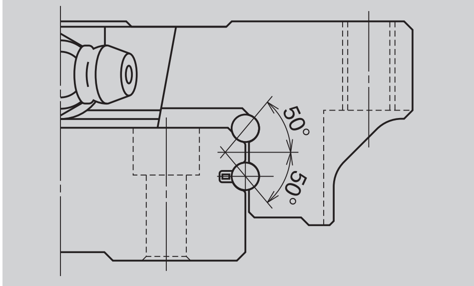


Fig. 1 Balls in contact

(1) Features

1. Ideal for use of single rail

Thanks to the wide rail, rigidity and load carrying capacity are high against moment load from rolling direction. This makes LW Series ideal in use of single rail as the linear guide.

2. High load carrying capacity to vertical direction

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

3. High resistance against impact load

Same as the LH and LS series, the offset Gothic arch grooves support a large load, such as an impact, by four rows.

4. High accuracy

Fixing master rollers is easy thanks to the Gothic arch groove. This makes easy and accurate measuring of ball grooves.

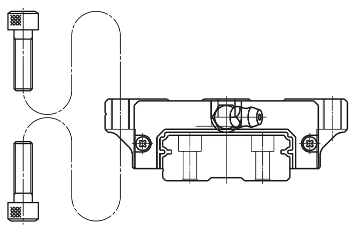
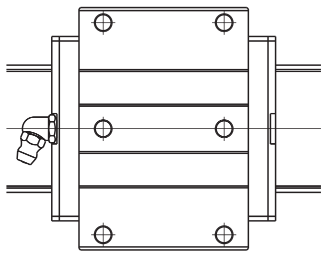
5. Easy to handle, and designed with safety in mind.

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

6. Fast delivery

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

(2) Ball slide shape

Ball slide Model	Shape / installation method	Type
EL		EL 

(3) Accuracy and preload

1. Running parallelism of ball slide

Table 1

Unit: μm

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

2. Accuracy standard

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

• Tolerance of preloaded assembly type

Table 2

Unit: μm

Characteristics \ Accuracy grade	High precision P5	Precision glade P6	Normal glade 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 face C to face A Running parallelism of face D to face B	Shown in Table 1 and Fig. 2		

• Tolerance of random-matching type: Normal grade PC

Table 3

Unit: 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 face C to face A Running parallelism of face D to face B	See Table 1 and Fig. 2

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

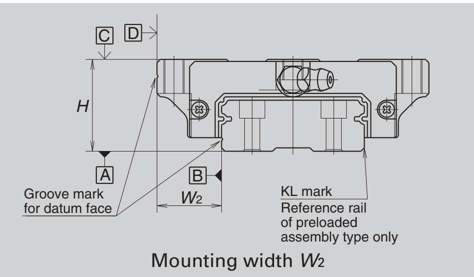
3. Combination of accuracy and preload

Table 4

		Accuracy grade			
		High precision	Precision grade	Normal grade	Random matching
Without NSK K1 lubrication unit		P5	P6	PN	PC
With NSK K1 lubrication unit		K5	K6	KN	KC
With NSK K1 for food and medical equipment		F5	F6	FN	FC
Preload	Fine clearance Z0	○	○	○	—
	Slight preload Z1	○	○	○	—
	Medium preload Z3	○	○	—	—
	Random-matching type with fine clearance ZT	—	—	—	○
	Random-matching type with slight preload ZZ	—	—	—	○

Note: Z3 medium preload are LW35 and 50 only

4. Assembled accuracy



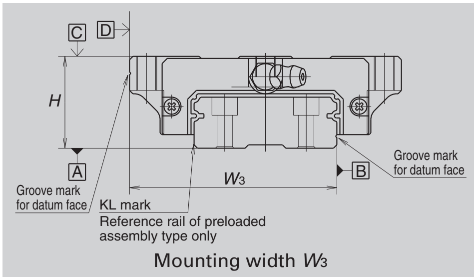


Fig. 2

5. Preload and rigidity

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

• **Preload and rigidity of preloaded assembly**

Table 5

Model No.	Preload (N)		Rigidity (N/μm)			
			Vertical directions		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	1470	345	600	246	425

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

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

Table 6 Unit: μm

Model No.	Fine clearance	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 that a value is an amount of preload (elastic deformation of balls).

(4) Available length of rail

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

Table 7 Length limitations of rails Unit: mm

Series	Size / Material	17	21	27	35	50
LW	Special high carbon steel	1000	1600	2000	2400	3000

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

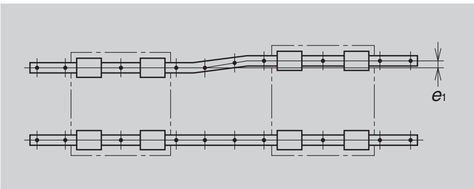


Fig. 3

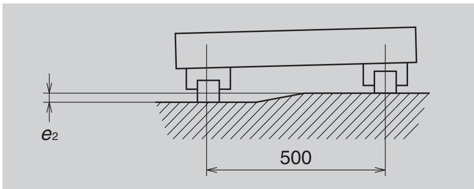


Fig. 4

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	9	9	13	23	34
Permissible values of parallelism (height) in two rails e_2	Z0, ZT	100 μm/500 mm				
	Z1	45 μm/500 mm				

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

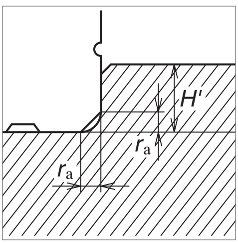


Fig. 5 Shoulder for the rail datum face

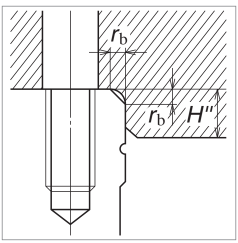


Fig. 6 Shoulder for the ball slide datum face

Table 9 Unit: mm

Model No.	Corner radius (maximum) r_a	r_b	Shoulder height H'	H''
LW17	0.3	0.3	2.2	4
LW21	0.3	0.3	2.5	5
LW27	0.5	0.5	3.5	5
LW35	0.5	0.8	3.5	5
LW50	0.8	0.8	4	6

(6) Lubrication components

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

1. Types of lubrication accessories

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

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

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

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

Please ask NSK for stainless lubrication accessories.

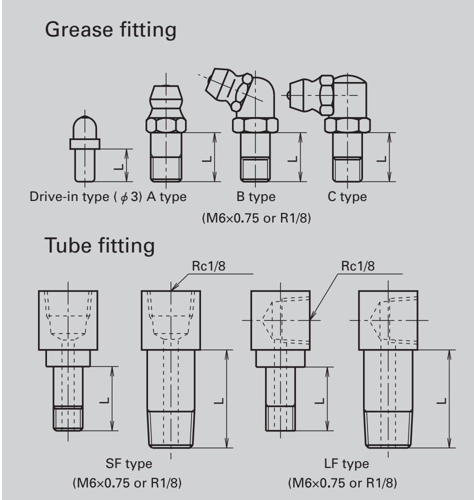


Fig. 7 Grease fitting and tube fitting

Table 10 Unit: mm

Model No.	Dust proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
LW17	Standard	5	–
	With NSK K1	10	–
	Double seal	*	–
	Protector	*	–
LW21	Standard	5	–
	With NSK K1	12	–
	Double seal	10	–
	Protector	10	–
LW27	Standard	5	–
	With NSK K1	12	–
	Double seal	10	–
	Protector	10	–
LW35	Standard	5	6
	With NSK K1	14	13
	Double seal	10	9
	Protector	10	9
LW50	Standard	8	17
	With NSK K1	18	19
	Double seal	14	17
	Protector	14	17

*) Please contact NSK as a connector is required.

2. Mounting position of lubrication accessories

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

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

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

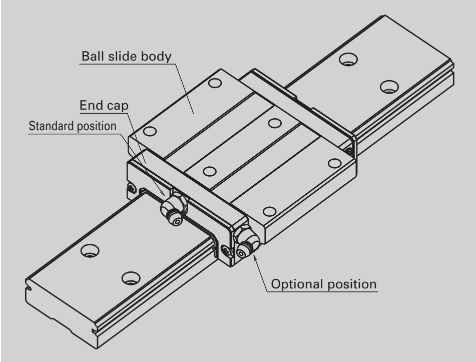


Fig. 8 Mounting position of lubrication accessories

(7) Dust proof components

1. Standard Specification

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

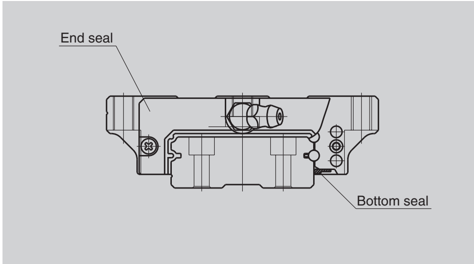


Fig. 9

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

Series \ Size	17	21	27	35	50
LW	6	8	12	16	20

2. NSK K1™

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

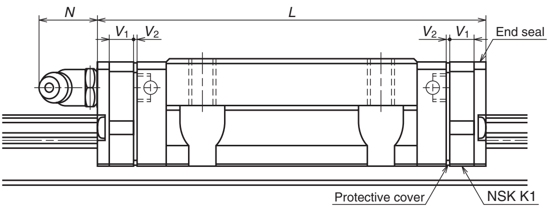


Table 12 (Unit : mm)

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_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: NSK K1 for food and medical equipments are available for LW17 to LW35.

3. Double seal

Use a double seal set as showing in Table 13, when installing an extra seal to completed standard products. (Fig. 10)

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

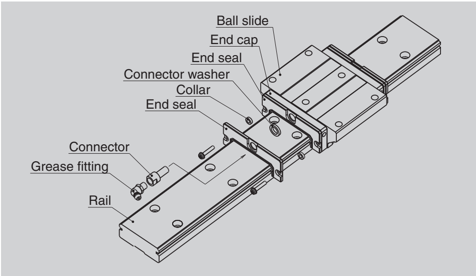


Fig. 10 Double seal

Table 13 Double-seal set

Unit: mm

Model No.	Reference No. Without connector	Reference No. With connector	Increased thickness V_1
LW17	LW17WS-01	*	2.6
LW21	LW21WS-01	LW21WSC-01	2.8
LW27	LW27WS-01	LW27WSC-01	2.5
LW35	LW35WS-01	LW35WSC-01	3
LW50	LW50WS-01	LW50WSC-01	3.6

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

4. Protector

Use a protector set as showing Table 14, when installing a protector to completed standard products. (Fig.11)

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

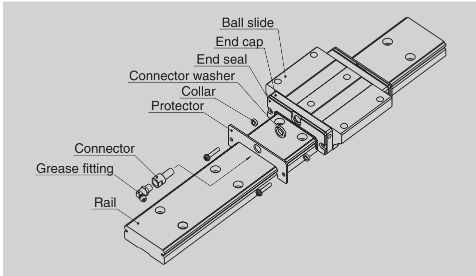


Fig. 11 Protector seal

Table 14 Protector set

Unit: mm

Model No.	Reference No. Without connector	Reference No. With connector	Increased thickness V_2
LW17	LW17PT-01	*	3.2
LW21	LW21PT-01	LW21PTC-01	3.2
LW27	LW27PT-01	LW27PTC-01	2.9
LW35	LW35PT-01	LW35PTC-01	3.6
LW50	LW50PT-01	LW50PTC-01	4.2

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

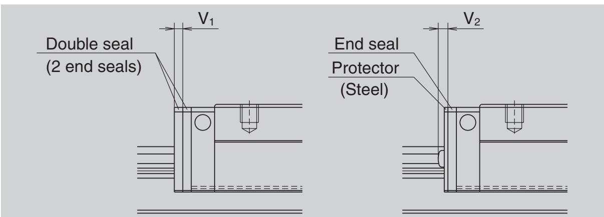


Fig. 12

5. Cap to cover the bolt hole for rail mounting

Table 15 Caps to cover rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
LW17, LW21, LW27	M4	LG-CAP/M4	20
LW35	M6	LG-CAP/M6	20
LW50	M8	LG-CAP/M8	20

6. Bellows

· While removing machine screws which secure the end seal to install the bellows to the slide, for LW17 and 21, hold the end cap by hand not to be detached from the slide.

· Make tap holes to the rail end face to fix the bellows mounting plate. NSK processes tap holes to the rail end face when ordered with a linear guide.

Dimension tables of bellows
LW series

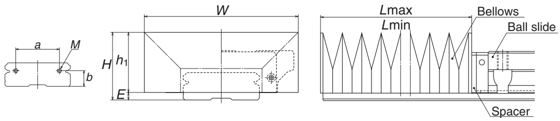


Fig. 13

Bellows reference number

J A W 21 L 08

- Bellows (J)
- A: Bellows for the ends / B: Middle bellows (A)
- Bellows for LW series (W)
- Size number of linear guide (21)
- N : High type L : Low type (L)
- Number of BL (fold number) (08)

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	1056	1232	1408	1584	1760
	Lmax	210	420	630	840	1050	1260	1470	1680	1890	2100
JAW21N	Stroke	204	408	612	816	1020	1224	1428	1632	1836	2040
	Lmax	238	476	714	952	1190	1428	1666	1904	2142	2380
JAW27N	Stroke	246	492	738	984	1230	1476	1722	1968	2214	2460
	Lmax	280	560	840	1120	1400	1680	1960	2240	2520	2800
JAW35L	Stroke	162	324	486	648	810	972	1134	1296	1458	1620
	Lmax	196	392	588	784	980	1176	1372	1568	1764	1960
JAW35N	Stroke	218	436	654	872	1090	1308	1526	1744	1962	2180
	Lmax	252	504	756	1008	1260	1512	1764	2016	2268	2520
JAW50L	Stroke	246	492	738	984	1230	1476	1722	1968	2214	2460
	Lmax	280	560	840	1120	1400	1680	1960	2240	2520	2800
JAW50N	Stroke	386	772	1158	1544	1930	2316	2702	3088	3474	3860
	Lmax	420	840	1260	1680	2100	2520	2940	3360	3780	4200

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

(8) Reference number

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

1. Reference number for preloaded assembly

LW 35 1000 EL C 2 - P6 1**

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A229)
- Material/surface treatment code (See Table 18)
- Number of ball slides per rail
- Design serial number
  Added to the reference number.
- Accuracy code (See Table 19)
- Preload code (See page A231)

2. Reference number for random-matching type

Ball slide

LAW 35 EL C -PC Z**

- Random-matching ball slide series code
  LAW : LW Series random-matching ball slide
- Size
- Ball slide shape code (See page A229)
- Material/surface treatment code (See Table 19)
- Design serial number
  Added to the reference number.
- Accuracy code : PC
  PC: Normal grade is only available
- Preload code
  T: Fine clearance. Z: Slight preload (See page A231)

Rail

L1W 35 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 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
  T: Fine clearance. Z: Slight preload (See page A231)

*Please consult with NSK for butting rail specification.

Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is fine clearance "T" or slight preload "Z" (Refer to page A231).

Table 18 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
Z	Other, special

Table 19 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1	With NSK K1 for food and medical equipment
High precision grade	P5	K5	F5
Precision grade	P6	K6	F6
Normal grade	PN	KN	FN
Normal grade (random-matching type)	PC	KC	FC

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

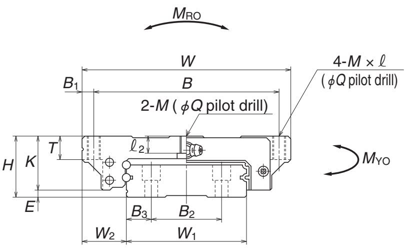
(9) Dimensions

LW-EL

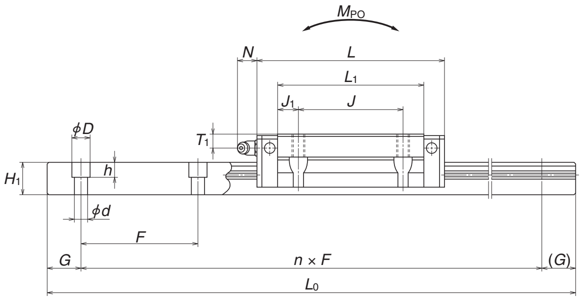
LW 35 1000 EL C 2 -∗∗ P6 1

- Series name: LW
- Size: 35
- Rail length (mm): 1000
- Ball slide shape code (See page A229): EL
- Material/surface treatment code (See Table 18): C
- Number of ball slides per rail: 2
- Design serial number: -∗∗ (Added to the reference number.)
- Accuracy code (See Table 19): P6
- Preload code (See page A231): 1

Front view of EL types



Side view of EL type



Model No.	Assembly			Ball slide														
	Height			Width	Length	Mounting hole										Grease fitting		
	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
LW17EL	17	2.5	13.5	60	51.4	53	26	M4×0.7×6	3.2	3.3	3.5	35	4.5	14.5	6	ϕ3	4	3
LW21EL	21	3	15.5	68	58.8	60	29	M5×0.8×8	3.7	4.4	4	41	6	18	8	M6×0.75	4.5	11
LW27EL	27	4	19	80	74	70	40	M6×1×10	6	5.3	5	56	8	23	10	M6×0.75	6	11
LW35EL	35	4	25.5	120	108	107	60	M8×1.25×14	9	6.8	6.5	84	12	31	14	M6×0.75	8	11
LW50EL	50	4.5	36	162	140.6	144	80	M10×1.5×18	14	8.6	9	108	14	45.5	18	Rc1/8	14	14

Reference number for ball slide of random-matching type

Ball slide **LAW 35 EL C -**PC Z**

Random-matching ball slide series code
LAW : LW Series random-matching ball slide

Size

Ball slide shape code (See page A229)

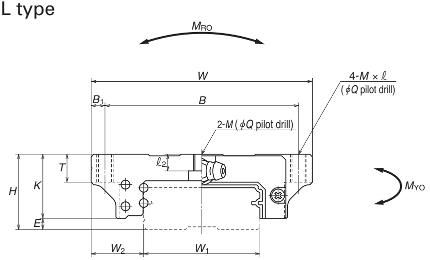
Material/surface treatment code (See Table 19)

Preload code
T: Fine clearance. Z: Slight preload (See page A231)

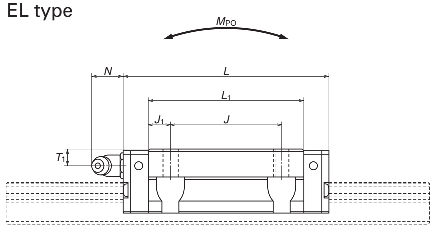
Accuracy code : PC
PC: Normal grade is only available

Design serial number
Added to the reference number.

EL type



EL type



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 15)

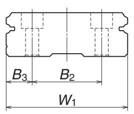
Preload code
T: Fine clearance. Z: Slight preload (See page A231)

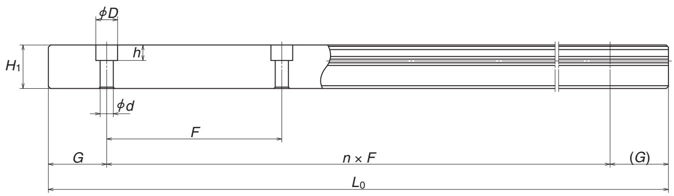
Accuracy code : PC
PC: Normal grade is only available

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.



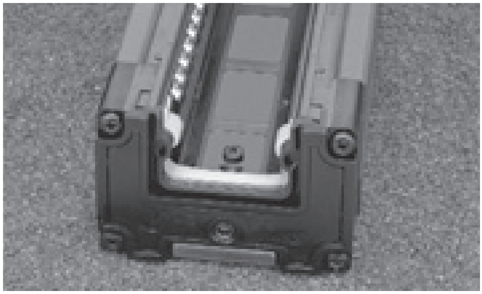


Unit: mm

Rail								Basic load rating					Ball dia.	Weight	
Width	Height		Pitch	Mounting bolt hole		G (Reference)	Maximum length	Dynamic	Static	Static moment				Ball slide	Rail
W_1	H_1	B_2	F	$d \times D \times h$	B_3		L_{0max}	C (N)	C_0 (N)	M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	(kg)	(kg/m)
33	8.7	18	40	4.5×7.5×5.3	7.5	15	1000	5600	11300	135	44	37	2.381	0.2	2.1
37	10.5	22	50	4.5×7.5×5.3	7.5	15	1600	6450	13900	185	65.5	55	2.381	0.3	2.9
42	15	24	60	4.5×7.5×5.3	9	20	2000	12800	26900	400	171	143	3.175	0.5	4.7
69	19	40	80	7×11×9	14.5	20	2400	33000	66500	1690	645	545	4.762	1.5	9.6
90	24	60	80	9×14×12	15	20	3000	61500	117000	3900	1530	1280	6.350	4.0	15.8

Remarks: 1) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface.
When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

A-5-1.7 TS Series



(1) Features

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

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

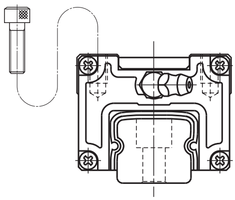
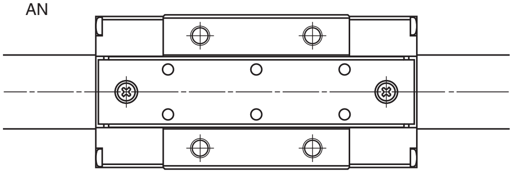
3. High dust proof capability
Dust-tight high performance end seals, bottom seals, and inner seals are built-in as a standard feature. (Optional protector is available for protection against hot debris such as welding spatters or hard contamination.)

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

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

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

(2) Ball slide shape

Ball slide Model	Shape / installation method	Type
AN		AN 

(3) Accuracy and preload

Accuracy grade: Normal grade for transportation
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) Available length of rail

Table 1 shows the limitations of rail length (maximum length).

Table 1 Length limitations of rails

Unit: mm

Series	Size / Material	15	20	25	∗ 30	∗ 35
TS	Special high carbon steel	1960	2920	4000	4040	4040

Note: Rails can be butted if user requirement exceeds the rail length shown in the Table. Please consult NSK.
∗)The maximum length of fluoride low temperature chrome plated products is 4 000 (G = 80).

(5) Lubrication components

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

1. Types of lubrication accessories

Figure 2 and Table 2 show grease fittings and tube fittings.

2. Mounting position of lubrication accessories

The standard position of grease fittings is the end face of ball slide. We mount them on a side of end cap for an option. (Fig. 2)

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

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

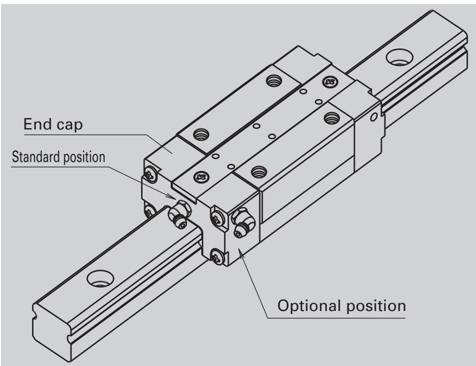


Fig. 2 Mounting position of lubrication accessories

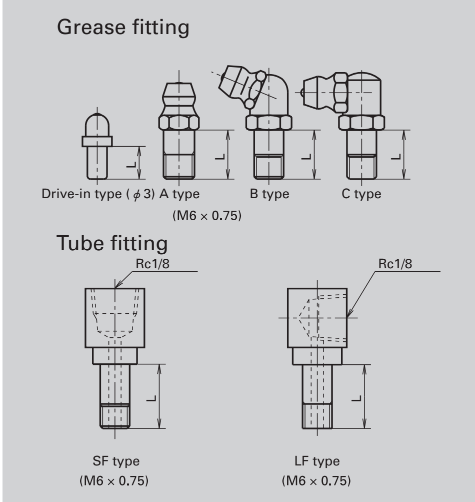


Fig. 1 Grease fitting and tube fitting

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.

(6) Dust proof components

1. Standard specification

To keep foreign matters from entering inside the ball slide, TS series has an end seal and NSK K1 on both ends, and bottom seals at the bottom. Also, the inner seal is a standard equipment.

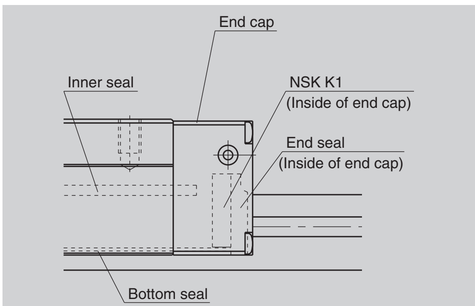


Fig. 3

2. Protector

It is possible to mount a protector to TS series as an option.
Please consult NSK as the protector for TS series can be installed only before shipping from the factory.
Fig. 4 and Table 3 show the ball slide length when protector is installed.

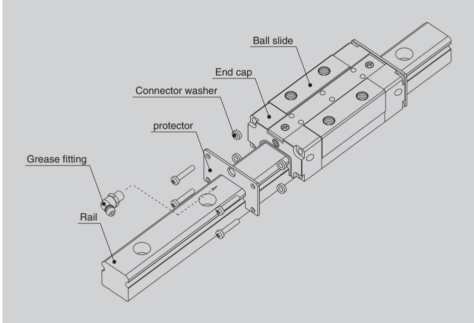


Fig. 5 Protector

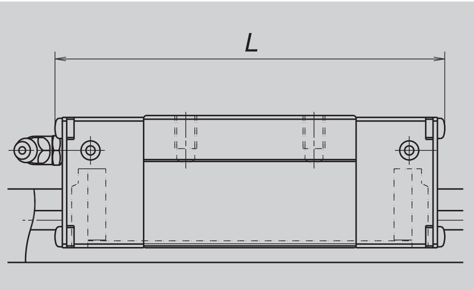


Fig. 4

Table 3 Dimension when equipped with the protector

Model No.	Ball slide length L		
	Standard length	Protector installation*	Increased thickness
TS15	72.2	77.6	2.7
TS20	87	92.8	2.9
TS25	100	106.4	3.2
TS30	115	123.4	4.2
TS35	135.8	144.2	4.2

*) Showing the ball slide length when one protector is installed in both ends.

3. Cap to cover the bolt hole for rail mounting

Table 4 Caps to cover rail bolt hole

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

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

(7) Reference number

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

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

TS 30 2400 AN P 2 -＊＊ KL S

- TS: Series name
- 30: Size
- 2400: Rail length (mm)
- AN: Ball slide shape code (See page A243)
- P: Surface treatment/Rail design code
  - P: No surface treatment/Counterbores on a rail top face (Type I)
  - V: No surface treatment/Tapped holes on a rail bottom face (Type II)
  - R: Fluoride low temperature chrome plating/Counterbores on a rail top face (Type I)
  - W: Fluoride low temperature chrome plating/Tapped holes on a rail bottom face (Type II)
- 2: Number of ball slides per rail
- -＊＊: Design serial number
  - Added to the reference number.
- KL: Accuracy code : KL
  - KL: Normal grade is only available
- S: Preload code : S
  - S: Clearance of 60 μm or less

2. Reference number for random-matching type

Ball slide

TAS 30 AN C -＊＊KL S

- TAS: Random-matching ball slide series code
  - TAS : TS Series random-matching ball slide
- 30: Size
- AN: Ball slide shape code (See page A243)
- C: Material/surface treatment code
  - C: Special high carbon steel
  - D: Special high carbon steel with surface treatment
  - Z: Other, Special
- -＊＊: Design serial number
  - Added to the reference number.
- KL: Accuracy code : KL
  - KL: Normal grade is only available
- S: Preload code : S
  - S: Clearance of 60 μm or less

Rail

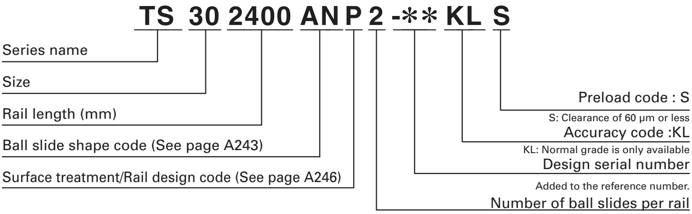
T1S 30 2400 L P N -＊＊ KL S

- T1S: Random-matching rail series code
  - T1S : TS Series random-matching rail
- 30: Size
- 2400: Rail length (mm)
- L: Rail shape code: L
  - L : Standard
- P: Surface treatment/rail design code (See above)
- N: *Butting rail specification
  - N: Non-butting. L: Butting specification
- -＊＊: Design serial number
  - Added to the reference number.
- KL: Accuracy code : KL
  - KL: Normal grade is only available
- S: Preload code : S
  - S: Clearance of 60 μm or less

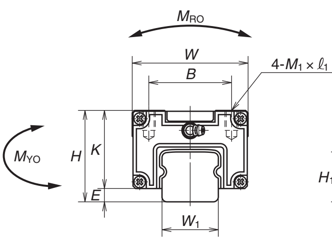
*Please consult with NSK for butting rail specification.

(8) Dimensions

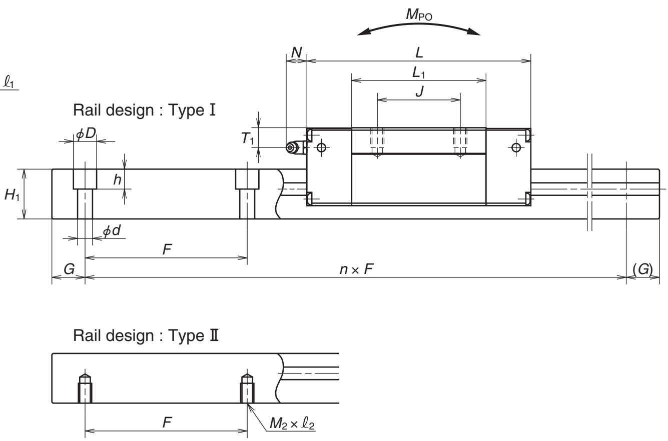
Combinations of random-matching type



Front view



Side view



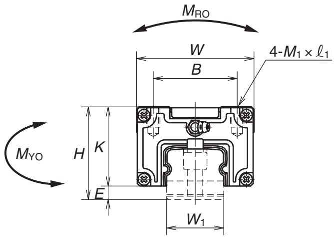
Model No.	Assembly		Ball slide												
	Height		Width	Length	Mounting hole					Grease fitting			width	height	Pitch
	$H_{\pm 0.1}$	E	W	L	B	J	M × pitch × ℓ_1	L_1	K	Hole size	T_1	N	W_1	H_1	F
TS15AN	28	3	34	72.2	26	26	M4×0.7×6	39	25	ϕ3	6.5	(5)	15	14	120
TS20AN	30	3	44	87	32	36	M5×0.8×8	50	27	M6×0.75	6.5	(14)	20	15	120
TS25AN	40	4	48	100	35	35	M6×1×9	58	36	M6×0.75	9.5	(14)	23	20	120
TS30AN	45	6.5	60	115	40	40	M8×1.25×10	70	38.5	M6×0.75	9.5	(14)	28	25	160
TS35AN	55	8	70	135.8	50	50	M8×1.25×12	81.8	47	M6×0.75	12	(14)	34	30	160

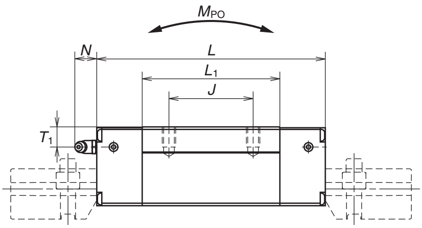
Remarks: 1) TS Series does not have a ball retainer. Be aware that balls fall out when the ball slide is withdrawn from the rail.

Reference number for ball slide of random-matching type

Ball slide **TAS 30 AN C -∗∗KL S**

- Random-matching ball slide series code
  - TAS : TS Series random-matching ball slide
- Size
- Ball slide shape code (See page A243)
- Material/surface treatment code (See page A246)
- 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.





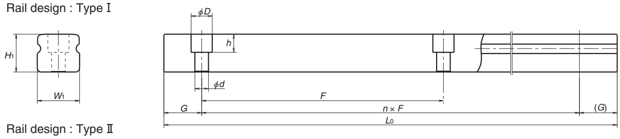
Reference number for rail of random-matching type

Rail **T1S 30 2400 L P N -∗∗ KL S**

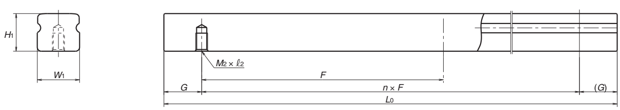
- Random-matching rail series code
  - T1S : TS Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code: L
  - L : Standard
- Surface treatment/rail design code (See A246)
- Preload code : S
  - S: Clearance of 60 μm or less
- Accuracy code : KL
  - KL: Normal grade is only available
- Design serial number
  - Added to the reference number.
- *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



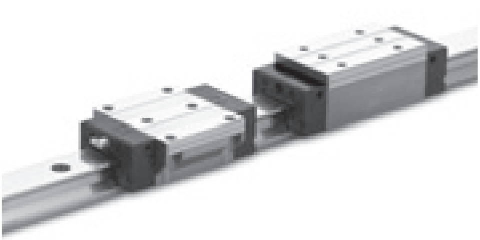
Unit: mm

Rail				Basic load rating					Ball dia.	Weight	
Mounting hole		G	Maximum	Dynamic	Static	Static moment				Ball slide	Rail
Type Ⅰ	Type Ⅱ		length	C	C_0	M_{RO}	M_{PO}	M_{YO}	D_W		
$d \times D \times h$	M_2 × pitch × ℓ_2	(Reference)	L_{0max}	(N)	(N)	(N·m)	(N·m)	(N·m)		(kg)	(kg/m)
4.5×7.5×5.3	M4×0.7×6	20	1 960	9 800	11 800	92	63.5	63.5	3.968	0.21	1.5
6×9.5×8.5	M5×0.8×8	20	2 920	15 700	19 100	196	137	137	4.762	0.37	2.1
7×11×9	M6×1×9	20	4 000	21 800	26 000	320	217	217	5.556	0.47	3.4
9×14×12	M8×1.25×12	20	4 040*	31 000	37 500	565	395	395	6.350	0.77	5.3
9×14×12	M8×1.25×12	20	4 040*	46 500	53 000	970	635	635	7.937	1.3	7.7

2) The basic dynamic load rating C is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. To convert C to C100 for a 100 km fatigue life, divide C by 1.26.
3) Consult with NSK when using a TS series in a single rail configuration.
∗ The maximum length of fluoride low temperature chrome plated products is 4 000 (G = 80).

A-5-2 Machine Tools

A-5-2.1 RA Series



(1) Features

1. Super-high load capacity

By installing rollers that are the largest possible diameter and length within the existing standard cross-section dimension in a rational layout based on analysis technology, we have realized the world's highest load capacity,* far superior to conventional roller guides. Super-long life is achieved and impact load can be sufficiently handled.

* Compared with products of the same size, as of September 1, 2003, researched by NSK.

2. Super-high rigidity

Using NSK's advanced analysis technology, we pursued a complete, optimal design, down to the detailed shape of roller slides and rails, thereby realizing super-high rigidity superior to that of competitor's roller guides.

3. Super-high motion accuracy

NSK has developed its own unique method of simulating rolling element passage vibration and method of designing optimal roller slide specifications for damping roller passage vibration. These developments have dramatically enhanced roller slide motion accuracy for the RA series.

4. Smooth motion

Installing a retaining piece between rollers and restraining the skew peculiar to roller bearings achieve smooth motion.

5. Low friction

Using rollers for rolling elements helps minimize dynamic friction.

6. Fast delivery

Lineup of random-matching rails and roller slides supports random matching and facilitates fast delivery. (RA25 to RA65)

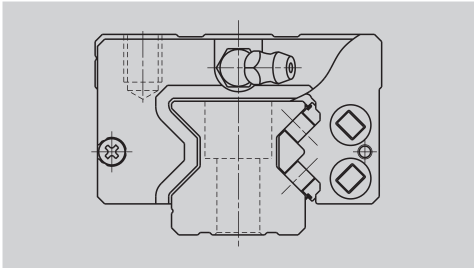


Fig. 1 RA Series

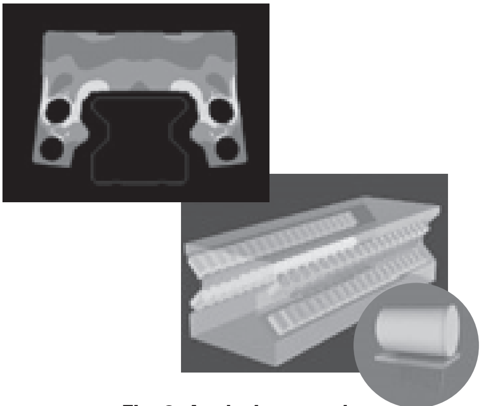


Fig. 2 Analysis example

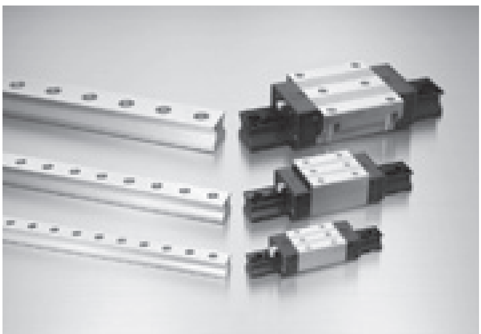
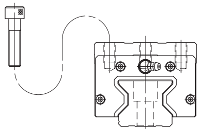
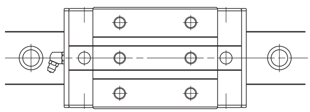
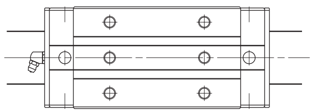
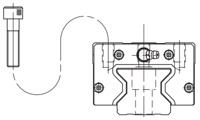
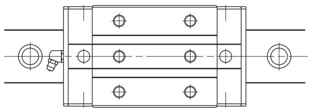
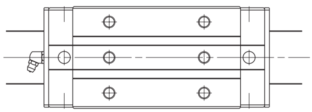
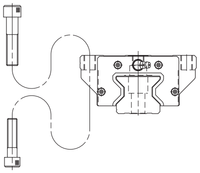
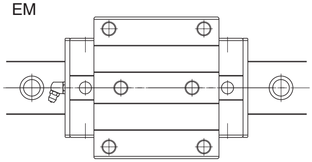
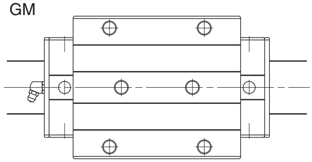


Fig. 3 Random-matching type

(2) Roller slide shape

Roller slide Model	Shape/installation method	Type: High-load type	Type: Super-high-load type
AN BN		AN 	BN 
AL BL		AL 	BL 
EM GM		EM 	GM 

(3) Accuracy and preload

1. Running parallelism of roller slide

Table 1

Unit: μm

Rail over all length (mm) over – or less	Preloaded assembly: Ultra precision P3	Preloaded assembly: Super precision P4	Preloaded assembly: High precision P5	Random-matching type: Precision grade P6
– 50	2	2	2	4.5
50 – 80	2	2	3	5
80 – 125	2	2	3.5	5.5
125 – 200	2	2	4	6
200 – 250	2	2.5	5	7
250 – 315	2	2.5	5	8
315 – 400	2	3	6	9
400 – 500	2	3	6	10
500 – 630	2	3.5	7	12
630 – 800	2	4	8	14
800 – 1 000	2.5	4.5	9	16
1 000 – 1 250	3	5	10	17
1 250 – 1 600	4	6	11	19
1 600 – 2 000	4.5	7	13	21
2 000 – 2 500	5	8	15	22
2 500 – 3 150	6	9.5	17	25
3 150 – 3 500	9	16	23	30

2. Accuracy standard

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

• Tolerance of preloaded assembly

Table 2

Unit: μm

Characteristics \ Accuracy grade	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 face C to face A Running parallelism of face D to face B	Shown in Table 1 and Fig. 4			

• Tolerance of random-matching type

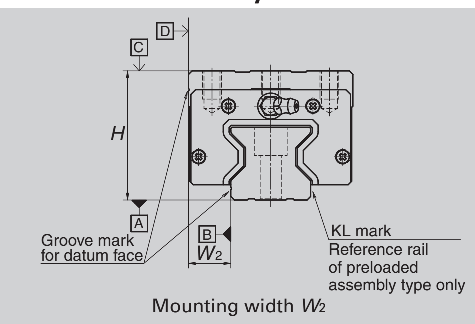
Table 3

Unit: μm

Characteristics \ Accuracy grade	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 face C to face A Running parallelism of face D to face B	See Table 1 and Fig. 4

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

3. Assembled accuracy



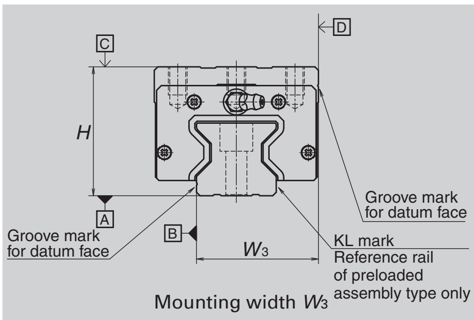


Fig. 4

4. Preload and rigidity

Preload is set for the RA series by slightly changing the size of the roller used. Applying preload enhances rigidity and minimizes elastic deformation.

With the characteristics of the roller guide, there is minimal variation in rigidity according to amount of preload, and it offers stable, high rigidity. Because of that, for the RA series, only medium preload type Z3 (preload: 10% of C, where C is the basic dynamic load rating) is set.

Preload is shown in Table 4, and theoretical rigidity lines are shown in Fig. 6 and Fig. 7.

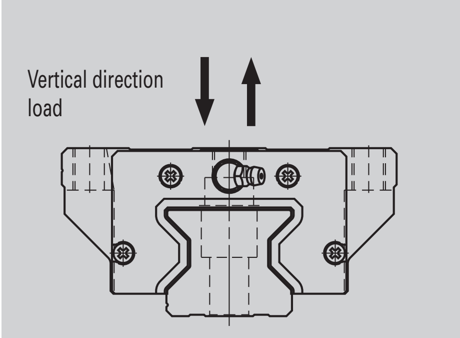
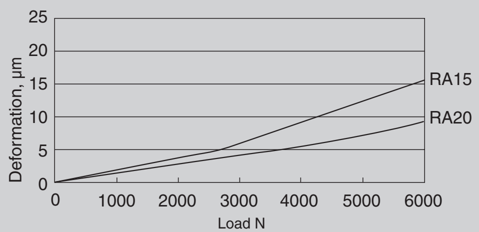


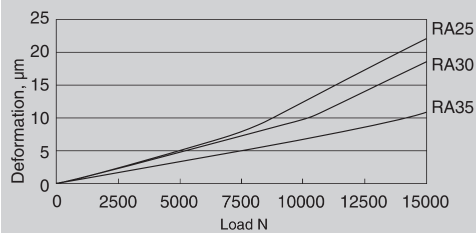
Fig. 5 Direction of load

Table 4 Preload Unit: N

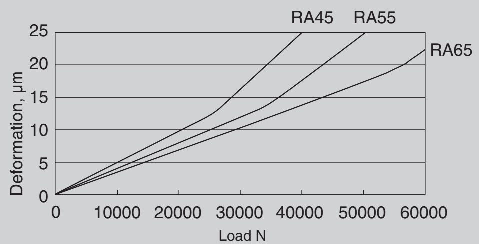
Model No.	High-load type Medium preload (Z3)	Super-high-load type Medium preload (Z3)
RA15	1 030	1 300
RA20	1 920	2 400
RA25	2 920	3 540
RA30	3 890	4 760
RA35	5 330	6 740
RA45	9 280	11 600
RA55	12 900	16 800
RA65	21 000	28 800



Vertical direction rigidity (High-load type)

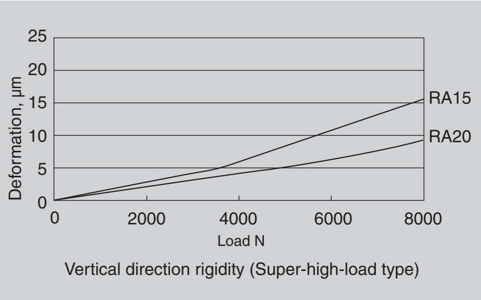


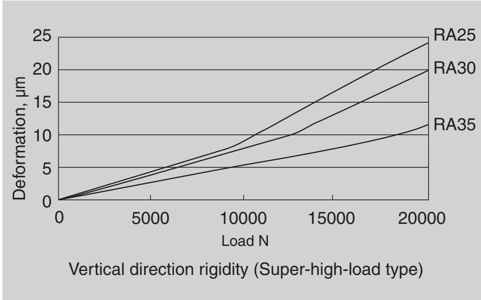
Vertical direction rigidity (High-load type)



Vertical direction rigidity (High-load type)

Fig. 6 Vertical direction theoretical rigidity line: High-load type (Roller slide shape: AN, AL, EM)





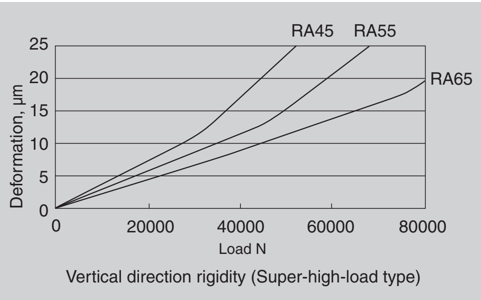


Fig. 7 Vertical direction theoretical rigidity line: Super-high-load type (Roller slide shape: BN, BL, GM)

(4) Available length of rail

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

Table 5 Length limitation of rails

Unit : mm

Series \ Size	RA15	RA20	RA25	RA30	RA35	RA45	RA55	RA65
RA	2000	3000	3000	3500	3500	3500	3500	3500

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

(5) Installation

1. Permissible values of mounting error

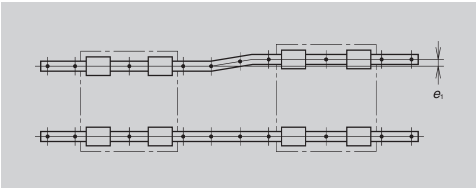


Fig. 8

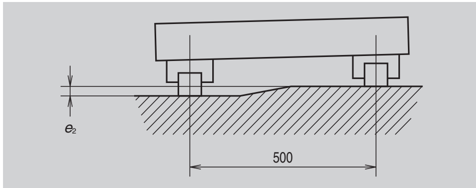


Fig. 9

Table 6

Unit : μm

Value	Preload	Model No.							
		RA15	RA20	RA25	RA30	RA35	RA45	RA55	RA65
Permissible values of parallelism in two rails e_1	Z3	5	7	9	11	13	17	19	30
Permissible values of parallelism (height) in two rails e_2	Z3	150 μm/500 mm							

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

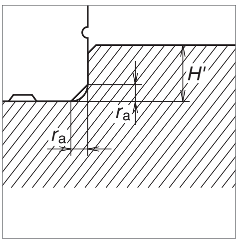


Fig. 10 Shoulder for the rail datum face

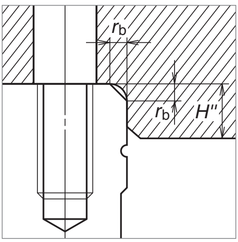


Fig. 11 Shoulder for the roller slide datum face

Table 7

Unit : mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
RA15	0.5	0.5	3	4
RA20	0.5	0.5	4	5
RA25	0.5	1	4	5
RA30	1	1	5	6
RA35	1	1	5	6
RA45	1.5	1	6	8
RA55	1.5	1.5	7	10
RA65	1.5	1.5	11	11

(6) Lubrication components

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

1. Types of lubrication accessories

Figure 14 and Table 10 show grease fittings and tube fittings.

2. Mounting position of lubrication accessories

The standard position of grease fittings is the end face of roller slide. We mount them on a side of end cap for an option. (Fig. 12) Mounting positions are shown in Fig.12, 13, Table 8 and 9.
Please consult NSK for installation of grease or tube fittings to the roller slide body or side of end cap.
When using a piping unit with thread of M6×1, you require a connector to connect to a grease fitting mounting hole with M6 × 0.75. The connector is available from NSK.
A lubrication hole can also be provided on the top of the end cap. Fig.13, Table 8 and 9 show the mounting position.
A spacer is required for AN and BN type of roller slides.

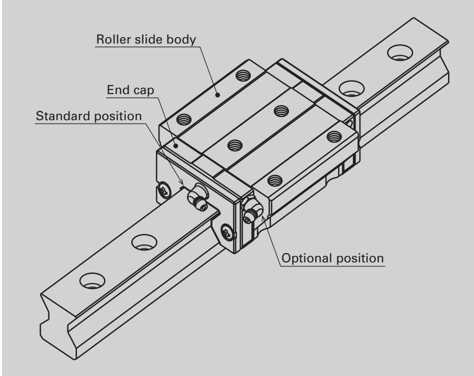


Fig. 12 Mounting position of lubrication accessories

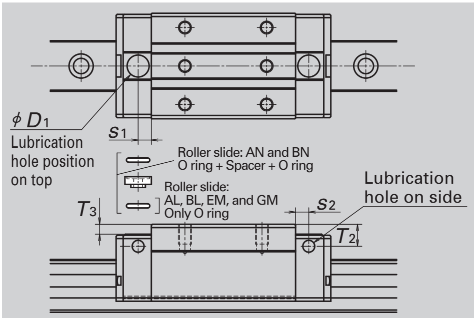


Fig.13 Top and side lubrication hole positions

Table 8 Top and side lubrication hole positions

Unit: mm

Model No.	Roller slide shape code	Grease fitting size	s_2	T_2	O ring (JIS)	Spacer	D_1	s_1	T_3
RA15	AN, BN	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 shape code	Grease fitting size	s_2	T_2	O ring (JIS)	D_1	s_1	T_3
RA15	AL, BL, EM, GM	ϕ3	4	3	P5	8.2	4.4	0.2
RA20	EM, GM	ϕ3	4	4	P6	9.2	5.4	0.2
RA25	AL, BL, EM, GM	M6×0.75	6	6	P7	10.2	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

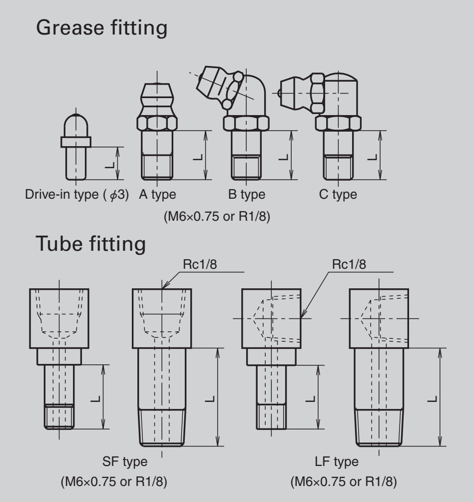


Fig. 14 Grease fitting and tube fitting

(7) Dust proof components

1. Standard specification

RA series is equipped with end, inner* and bottom seals to prevent foreign matter from entering the inside of the roller slide. Under normal applications, the RA series can be used without modification.

For severe usage conditions, optional rail covers** are available. Contact NSK for information on how to mount the cover.

*) Inner seals for RA15 and RA20 are available as options.

**) Rail cover is applicable to RA25 to RA65.

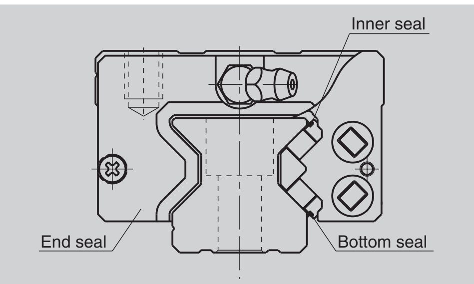


Fig. 15

Table 10

Unit: mm

Model No.	Dust-proof specification	Greas fitting Drive-in fitting Thread body length L	Tube fitting Thread body length L
RA15	Standard	5	–
	With NSK K1	10	–
	Double seal	8	–
	Protector	8	–
RA20	Standard	5	–
	With NSK K1	10	–
	Double seal	8	–
	Protector	10	–
RA25	Standard	5	5
	With NSK K1	12	12
	Double seal	10	9
	Protector	10	9
RA30	Standard	5	6
	With NSK K1	14	15
	Double seal	12	11
	Protector	12	11
RA35	Standard	5	6
	With NSK K1	14	15
	Double seal	12	11
	Protector	12	11
RA45	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
RA55	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
RA65	Standard	8	17
	With NSK K1	20	20
	Double seal	14	17
	Protector	14	17

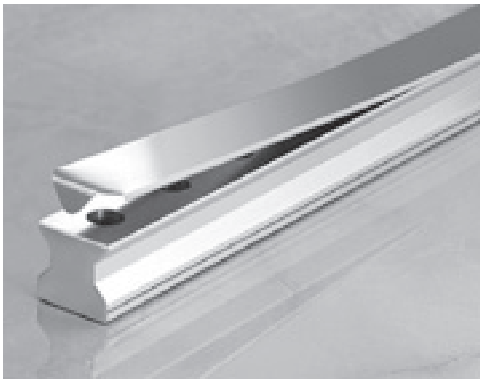


Fig. 16 Rail cover

Table 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™

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

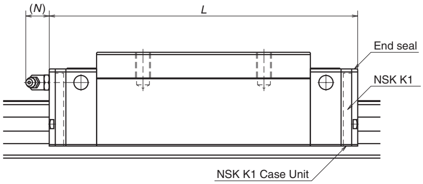


Table 12

Unit: mm

Model No.	Roller slide length	Roller slide model	Standard roller slide length	Roller slide length installed with NSK K1 Case Unit L	Per NSK K1 case unit thickness	Protruding area of the grease fitting N
RA15	Standard	AN, AL, EM	70	79	4.5	(3)
	Long	BN, BL, GM	85.4	94.4		
RA20	Standard	AN, EM	86.5	95.5	4.5	(3)
	Long	BN, GM	106.3	115.3		
RA25	Standard	AN, AL,EM	97.5	107.5	5	(11)
	Long	BN, BL, GM	115.5	125.5		
RA30	Standard	AN, AL, EM	110.8	122.8	6	(11)
	Long	BN, BL, GM	135.4	147.4		
RA35	Standard	AN, AL, EM	123.8	136.8	6.5	(11)
	Long	BN, BL, GM	152	165		
RA45	Standard	AN, AL, EM	154	168	7	(14)
	Long	BN, BL, GM	190	204		
RA55	Standard	AN, AL, EM	184	198	7	(14)
	Long	BN, BL, GM	234	248		
RA65	Standard	AN, EM	228.4	243.4	7.5	(14)
	Long	BN, GM	317.5	317.5		

Roller slide length equipped with NSK K1 case unit=
(Standard roller slide length) + (Thickness of NSK K1 case unit × Number of NSK K1 case unit)

3. Double seal and protector

For RA Series, double seal and protector can be installed only before shipping from the factory. Table 13 shows the increased thickness when end seal and protector are installed.

Table 13

Model No.	Thickness of end seal	Thickness of protector
RA15	3	2.7
RA20	3	3.3
RA25	3.2	3.3
RA30	3.4	3.6
RA35	3.4	3.6
RA45	4	4.2
RA55	4	4.2
RA65	5	5.5

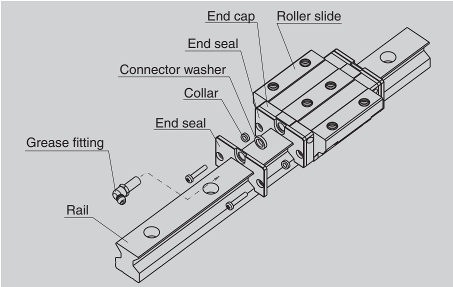


Fig. 17 Double seal

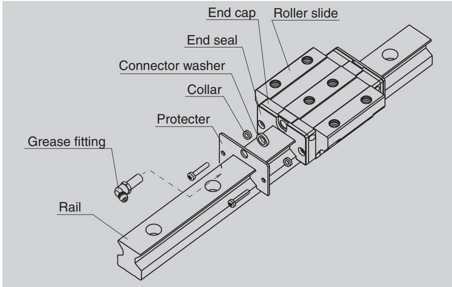


Fig. 18 Protector

4. Rail cover

When the rail cover is used, use the cover bracket to secure the rail cover. Fig.19 shows the dimensions for the cover bracket. The required room at the end of the rail is:

- Inside: 10.5 mm or less
- Outside: 4 mm or less (Common to the models of RA25 to 65)
  Please confirm the interference with your machine at the stroke end.
- Machine stroke
- Room for the end of the rail

The height of the rail with the rail cover is shown in Table 14.

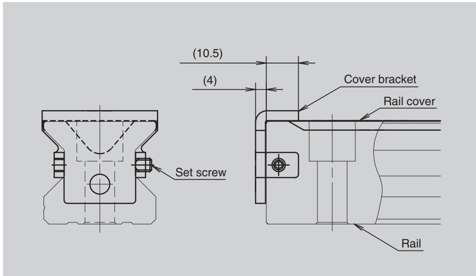


Fig. 19 End configuration of rail equipped with the rail cover

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

5. Cap to cover the bolt hole for rail mounting

Table 15 Caps to cover rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
RA15	M4	LG-CAP/M4	20
RA20	M5	LG-CAP/M5	20
RA25	M6	LG-CAP/M6	20
RA30, RA35	M8	LG-CAP/M8	20
RA45	M12	LG-CAP/M12	20
RA55	M14	LG-CAP/M14	20
RA65	M16	LG-CAP/M16	20

(8) Reference number

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

1. Reference number for preloaded assembly

RA 35 1000 AN C 2 - P6 3**

- RA — Series name
- 35 — Size
- 1000 — Rail length (mm)
- AN — Roller slide shape code (See page A252)
- C — Material/surface treatment code (See Table 16)
- 2 — Number of roller slides per rail
- -** — Design serial number
  Added to the reference number.
- P6 — Accuracy code (See Table 17)
- 3 — Preload code (See page A254)

2. Reference number for random-matching type

Roller slide

RAA 35 AN C - P6 Z**

- RAA — Random-matching roller slide series code
  RAA: RA Series random-matching roller slide
- 35 — Size
- AN — Roller slide shape code (See page A252)
- C — Material/surface treatment code (See Table 16)
- -** — Design serial number
  Added to the reference number.
- P6 — Accuracy code
  P6 and K6: Precision grade is only available
- Z — Preload code : Z
  Z: Medium preload is only available

Rail

R1A 30 1000 L C N - P6 Z**

- R1A — Random-matching rail series code
  R1A : RA Series random-matching rail
- 30 — Size
- 1000 — Rail length (mm)
- L — Rail shape code: L
  L : Standard
- C — Material/surface treatment code (See Table 16)
- N — *Butting rail specification
  N: Non-butting. L: Butting specification
- -** — Design serial number
  Added to the reference number.
- P6 — Accuracy code
  P6 and K6: Precision grade is only available.
- Z — Preload code : Z
  Z: Medium preload is only available

*Please consult with NSK for butting rail specification.

Reference number for assembly of random-matching roller slide and rail is the same as the coding of preloaded assembly. However, preload code is medium preload "Z".

Table 16 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
Z	Other, special

Table 17 Accuracy code

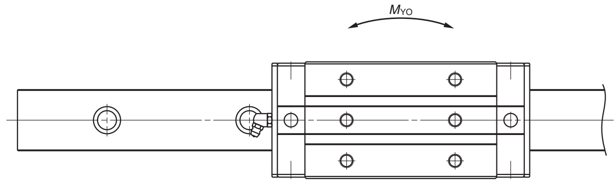
Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5
Precision grade	P6	K6

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

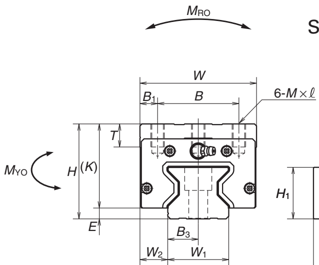
(9) Dimensions
RA-AN (High-load type)
RA-BN (Super-high-load type)

RA 35 1000 AN C 2 - ** **P6 3**

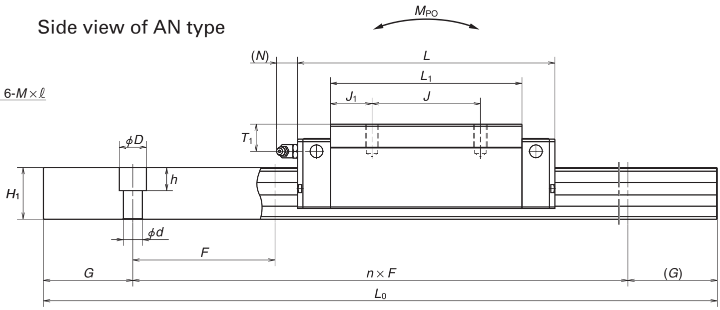
- RA: Series name
- 35: Size
- 1000: Rail length (mm)
- AN: Roller slide shape code (See page A252)
- C: Material/surface treatment code (See Table 16)
- 2: Number of roller slides per rail
- **: Design serial number (Added to the reference number.)
- P6: Accuracy code (See Table 17)
- 3: Preload code (See page A254)



Front view of AN and BN types



Side view of AN type



Model No.	Assembly			Roller 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
RA15AN RA15BN	28	4	9.5	34	70 85.4	26	26	M4×0.7×6	4	44.8 60.2	9.4 17.1	24	8	ϕ3	8	3
RA20AN RA20BN	30	5	12	44	86.5 106.3	32	36 50	M5×0.8×6	6	57.5 77.3	10.75 13.65	25	12	ϕ3	4	3
RA25AN RA25BN	40	5	12.5	48	97.5 115.5	35	35 50	M6×1×9	6.5	65.5 83.5	15.25 16.75	35	12	M6×0.75	10	11
RA30AN RA30BN	45	6.5	16	60	110.8 135.4	40	40 60	M8×1.25×11	10	74 98.6	17 19.3	38.5	14	M6×0.75	10	11
RA35AN RA35BN	55	6.5	18	70	123.8 152	50	50 72	M8×1.25×12	10	83.2 111.4	16.6 19.7	48.5	15	M6×0.75	15	11
RA45AN RA45BN	70	8	20.5	86	154 190	60	60 80	M10×1.5×17	13	105.4 141.4	22.7 30.7	62	17	Rc1/8	20	14
RA55AN RA55BN	80	9	23.5	100	184 234	75	75 95	M12×1.75×18	12.5	128 178	26.5 41.5	71	18	Rc1/8	21	14
RA65AN RA65BN	90	13	31.5	126	228.4 302.5	76	70 120	M16×2×20	25	155.4 229.5	42.7 54.75	77	22	Rc1/8	19	14

Remarks: 1) Select either one of dimensions for pitch of holes for rail fixing F without parenthesis for standard dimension and with parenthesis for semi-standard dimension.

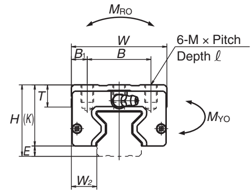
Reference number for roller slide of random-matching type

Roller slide **RAA 35 AN C -✻✻P6 Z**

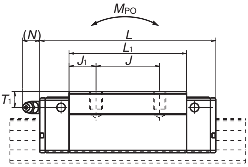
Random-matching roller slide series code
RAA: RA Series random-matching roller slide
Size
Roller slide shape code (See page A252)
Material/surface treatment code (See Table 16)

Preload code : Z
Z: Medium preload is only available
Accuracy code
P6 and K6: Precision grade is only available
Design serial number
Added to the reference number.

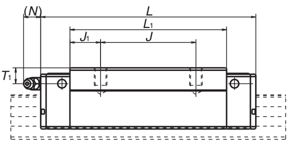
AN and BN types



AN type



BN type



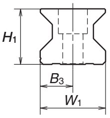
Reference number for rail of random-matching type

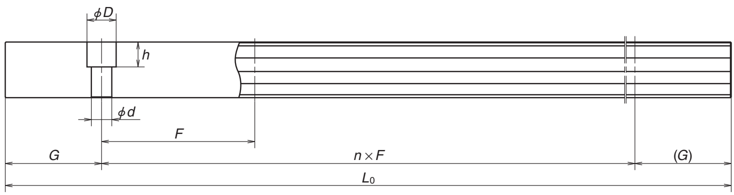
Rail **R1A 30 1000 L C N -✻✻ P6 Z**

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
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.





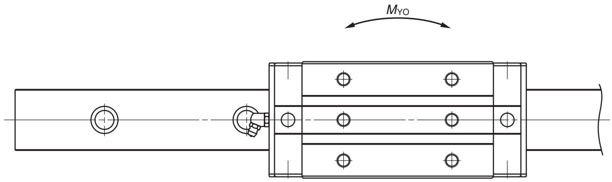
Rail							Basic load rating					Weight	
Width W_1	Height H_1	Pitch F	Mounting bolt hole $d \times D \times h$	B_3	G (Reference)	Maximum length L_{0max}	Dynamic C (N)	Static C_0 (N)	Static moment M_{RO} (N·m)	Static moment M_{PO} (N·m)	Static moment M_{YO} (N·m)	Roller slide (kg)	Rail (kg/m)
15	16.3	60 (30)	4.5×7.5×5.3	7.5	20	2 000	10 300 13 000	27 500 37 000	260 350	210 375	210 375	0.21 0.30	1.6
20	20.8	60 (30)	6×9.5×8.5	10	20	3 000	19 200 24 000	52 500 70 000	665 890	505 900	505 900	0.38 0.50	2.6
23	24	30	7×11×9	11.5	20	3 000	29 200 35 400	72 700 92 900	970 1 240	760 1 240	760 1 240	0.60 0.91	3.4
28	28	40	9×14×12	14	20	3 500	38 900 47 600	93 500 121 000	1 670 2 170	1 140 1 950	1 140 1 950	1.0 1.3	4.9
34	31	40	9×14×12	17	20	3 500	53 300 67 400	129 000 175 000	2 810 3 810	1 800 3 250	1 800 3 250	1.6 2.1	6.8
45	38	52.5	14×20×17	22.5	22.5	3 500	92 800 116 000	229 000 305 000	6 180 8 240	4 080 7 150	4 080 7 150	3.0 4.1	10.9
53	43.5	60	16×23×20	26.5	30	3 500	129 000 168 000	330 000 462 000	10 200 14 300	7 060 13 600	7 060 13 600	4.9 6.7	14.6
63	55	75	18×26×22	31.5	35	3 500	210 000 288 000	504 000 756 000	19 200 28 700	12 700 28 600	12 700 28 600	9.3 12.2	22.0

2) RA25 to RA65 are available in random matching.
3) The basic load rating complies with ISO standards (ISO14728-1, ISO14728-2).
If the basic dynamic load rating (100 km rating) is converted into 50 km rating, use the following formula:
$C_{50\,km} = 1.23 \times C_{100\,km}$

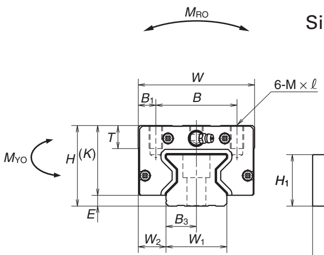
RA-AL (High-load type)
RA-BL (Super-high-load type)

RA 35 1000 AL C 2 -＊＊ P6 3

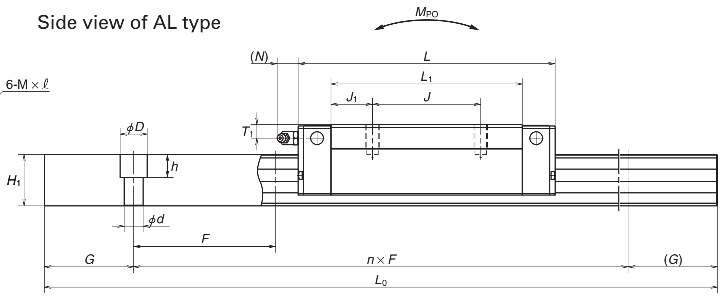
- RA: Series name
- 35: Size
- 1000: Rail length (mm)
- AL: Roller slide shape code (See page A252)
- C: Material/surface treatment code (See Table 16)
- 2: Number of roller slides per rail
- -＊＊: Design serial number (Added to the reference number.)
- P6: Accuracy code (See Table 17)
- 3: Preload code (See page A254)



Front view of AL and BL types



Side view of AL type



Model No.	Assembly			Roller 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
RA15AL **RA15BL**	24	4	9.5	34	70 85.4	26	26	M4×0.7×5.5	4	44.8 60.2	9.4 17.1	20	8	ϕ3	4	3
RA25AL **RA25BL**	36	5	12.5	48	97.5 115.5	35	35 50	M6×1×8	6.5	65.5 83.5	15.25 16.75	31	12	M6×0.75	6	11
RA30AL **RA30BL**	42	6.5	16	60	110.8 135.4	40	40 60	M8×1.25×11	10	74 98.6	17 19.3	35.5	14	M6×0.75	7	11
RA35AL **RA35BL**	48	6.5	18	70	123.8 152	50	50 72	M8×1.25×12	10	83.2 111.4	16.6 19.7	41.5	15	M6×0.75	8	11
RA45AL **RA45BL**	60	8	20.5	86	154 190	60	60 80	M10×1.5×16	13	105.4 141.4	22.7 30.7	52	17	Rc1/8	10	14
RA55AL **RA55BL**	70	9	23.5	100	184 234	75	75 95	M12×1.75×18	12.5	128 178	26.5 41.5	61	18	Rc1/8	11	14

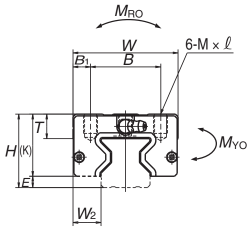
Remarks: 1) Select either one of dimensions for pitch of holes for rail fixing F without parenthesis for standard dimension and with parenthesis for semi-standard dimension.

Reference number for roller slide of random-matching type

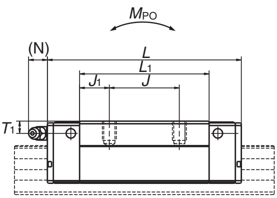
Roller slide **RAA 35 AL C -**P6 Z**

- Random-matching roller slide series code
  RAA: RA Series random-matching roller slide
- Size
- Roller slide shape code (See page A252)
- Material/surface treatment code (See Table 16)
- Preload code : Z
  Z: Medium preload is only available
- Accuracy code
  P6 and K6: Precision grade is only available
- Design serial number
  Added to the reference number.

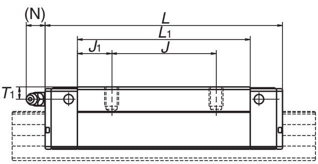
AL and BL types



AL type



BL type

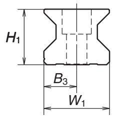


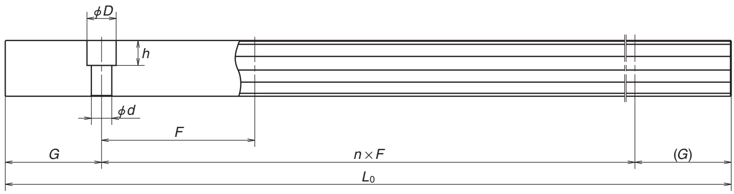
Reference number for rail of random-matching type

Rail **R1A 30 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
  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.





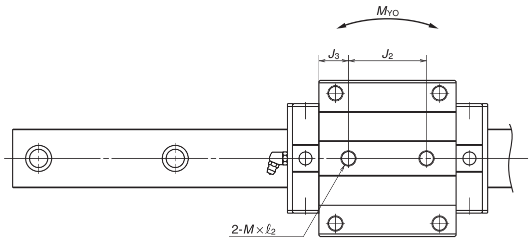
Rail							Basic load rating					Weight	
Width	Height	Pitch	Mounting bolt hole		G	Maximum length	Dynamic	Static	Static moment			Roller slide	Rail
W_1	H_1	F	$d \times D \times h$	B_3	(Reference)	L_{0max}	C (N)	C_0 (N)	M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	(kg)	(kg/m)
15	16.3	60 (30)	4.5×7.5×5.3	7.5	20	2 000	10 300 13 000	27 500 37 000	260 350	210 375	210 375	0.17 0.25	1.6
23	24	30	7×11×9	11.5	20	3 000	29 200 35 400	72 700 92 900	970 1 240	760 1 240	760 1 240	0.45 0.80	3.4
28	28	40	9×14×12	14	20	3 500	38 900 47 600	93 500 121 000	1 670 2 170	1 140 1 950	1 140 1 950	0.85 1.1	4.9
34	31	40	9×14×12	17	20	3 500	53 300 67 400	129 000 175 000	2 810 3 810	1 800 3 250	1 800 3 250	1.2 1.7	6.8
45	38	52.5	14×20×17	22.5	22.5	3 500	92 800 116 000	229 000 305 000	6 180 8 240	4 080 7 150	4 080 7 150	2.5 3.4	10.9
53	43.5	60	16×23×20	26.5	30	3 500	129 000 168 000	330 000 462 000	10 200 14 300	7 060 13 600	7 060 13 600	4.1 5.7	14.6

2) RA25 to RA55 are available in random matching.
3) The basic load rating complies with ISO standards (ISO14728-1, ISO14728-2).
If the basic dynamic load rating (100 km rating) is converted into 50 km rating, use the following formula:
$C_{50\,km} = 1.23 \times C_{100\,km}$

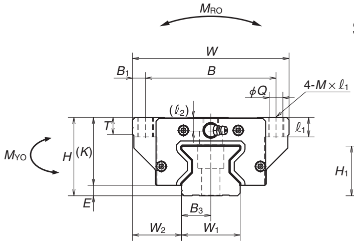
RA-EM (High-load type)
RA-GM (Super-high-load type)

RA 35 1000 EM C 2 - **P6 3**

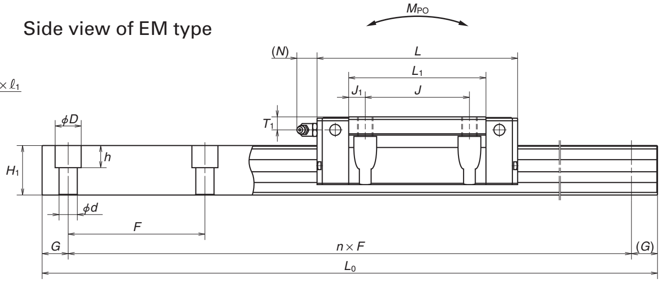
- Series name
- Size
- Rail length (mm)
- Roller slide shape code (See page A252)
- Material/surface treatment code (See Table 16)
- Number of roller slides per rail
- Design serial number (Added to the reference number.)
- Accuracy code (See Table 17)
- Preload code (See page A254)



Front view of Em and GM types



Side view of EM type



Model No.	Assembly: Height H	Assembly: E	Assembly: W_2	Roller slide: Width W	Roller slide: Length L	Mounting hole: B	Mounting hole: J	Mounting hole: J_2	Mounting hole: M × pitch × ℓ_1(ℓ_2)	Q_2	B_1	L_1	J_1	J_3	K	T
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
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
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
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
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
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
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
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

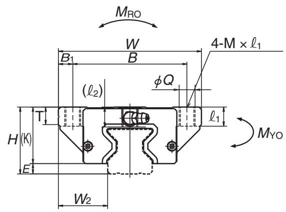
Remarks: 1) Select either one of dimensions for pitch of holes for rail fixing F without parenthesis for standard dimension and with parenthesis for semi-standard dimension.

Reference number for roller slide of random-matching type

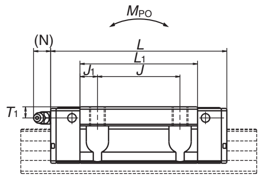
Roller slide **RAA 35 EM C -** ** **P6 Z**

- Random-matching roller slide series code
  - RAA: RA Series random-matching roller slide
- Size
- Roller slide shape code (See page A252)
- Material/surface treatment code (See Table 16)
- Preload code : Z
  - Z: Medium preload is only available
- Accuracy code
  - P6 and K6: Precision grade is only available
- Design serial number
  - Added to the reference number.

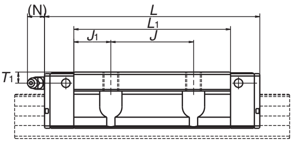
EM and GM types



EM type



GM type

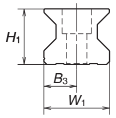


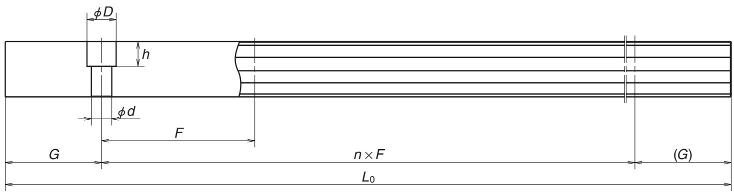
Reference number for rail of random-matching type

Rail **R1A 30 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
  - 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.

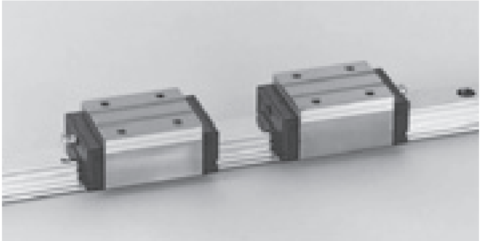




Grease fitting			Rail							Basic load rating					Weight	
			Width	Height	Pitch	Mounting		G	Maximum	Dynamic	Static	Static moment			Roller	Rail
Hole size	T_1	N	W_1	H_1	F	bolt hole $d \times D \times h$	B_3	(Reference)	length L_{0max}	C (N)	C_0 (N)	M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	slide (kg)	(kg/m)
ϕ3	4	3	15	16.3	60 (30)	4.5×7.5×5.3	7.5	20	2 000	10 300 13 000	27 500 37 000	260 350	210 375	210 375	0.21 0.28	1.6
ϕ3	4	3	20	20.8	60 (30)	6×9.5×8.5	10	20	3 000	19 200 24 000	52 500 70 000	665 890	505 900	505 900	0.45 0.65	2.6
M6×0.75	6	11	23	24	30	7×11×9	11.5	20	3 000	29 200 35 400	72 700 92 900	970 1 240	760 1 240	760 1 240	0.80 1.1	3.4
M6×0.75	7	11	28	28	40	9×14×12	14	20	3 500	38 900 47 600	93 500 121 000	1 670 2 170	1 140 1 950	1 140 1 950	1.3 1.7	4.9
M6×0.75	8	11	34	31	40	9×14×12	17	20	3 500	53 300 67 400	129 000 175 000	2 810 3 810	1 800 3 250	1 800 3 250	1.7 2.3	6.8
Rc1/8	10	14	45	38	52.5	14×20×17	22.5	22.5	3 500	92 800 116 000	229 000 305 000	6 180 8 240	4 080 7 150	4 080 7 150	3.2 4.3	10.9
Rc1/8	11	14	53	43.5	60	16×23×20	26.5	30	3 500	129 000 168 000	330 000 462 000	10 200 14 300	7 060 13 600	7 060 13 600	5.4 7.5	14.6
Rc1/8	19	14	63	55	75	18×26×22	31.5	35	3 500	210 000 288 000	504 000 756 000	19 200 28 700	12 700 28 600	12 700 28 600	12.2 16.5	22.0

2) RA25 to RA65 are available in random matching.
3) The basic load rating complies with ISO standards (ISO14728-1, ISO14728-2).
If the basic dynamic load rating (100 km rating) is converted into 50 km rating, use the following formula:
$C_{50\,km} = 1.23 \times C_{100\,km}$

A-5-2.2 LA Series



(1) Features

1. High rigidity and high load carrying capacity

A set of three ball grooves is made on both sides. This contributes to the increased rigidity and load carrying capacity. The top and bottom groove are formed in the circular arc with a closer radius of ball, which ensures great rigidity and load carrying capacity. With the Gothic arch center groove, rigidity and load carrying capacity are further increased.

2. Moderate friction

A well-balanced combination of 2-point contacts at the top and bottom grooves and 4 points contact at the center groove provides moderate friction while ensuring rigidity by appropriate preload.

3. Load distribution four directions

Contact angle is set at 45 degrees in all grooves, dispersing the load to four rows irrespective of load direction. This realizes equal rigidity and load carrying capacity in vertical and lateral directions and provides well-balanced design.

4. Strong against shock load

Load from any direction, vertical and lateral, is received by four rows at all times. The number of rows which receive the load is larger than in other linear guides, making this series stronger against shock load.

5. High accuracy

Fixing the measuring rollers is easy thanks to the Gothic arch groove. Ball-groove measuring is accurate and simple. This benefits a highly precise and stable manufacturing.

6. The dust protection design

The rail's cross section is designed as simple as possible. Furthermore, the improved seal enhances the sealing function. Inner seal is available as an option.

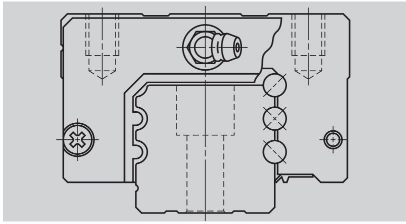


Fig. 1 LA Series

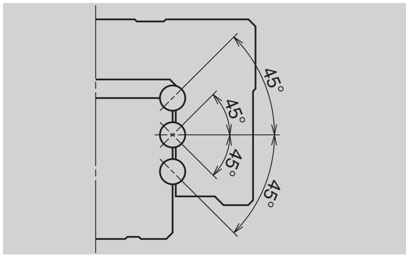


Fig. 2 Super rigidity design

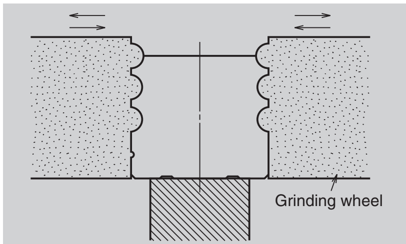


Fig. 3 Rail grinding

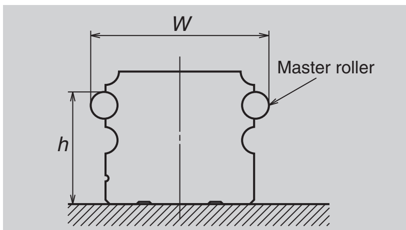
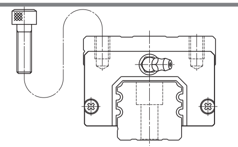
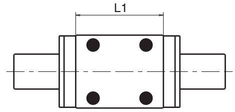
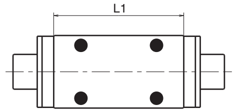
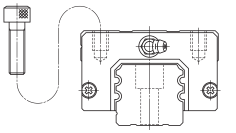
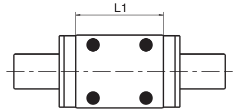
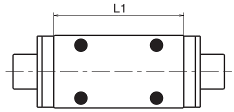
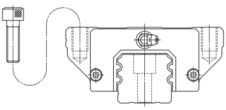
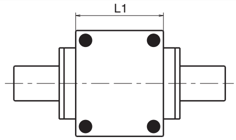
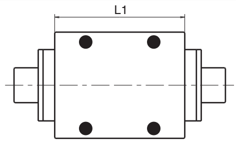
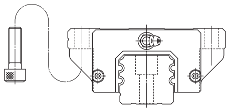
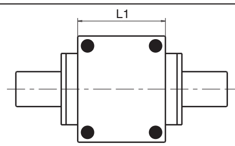
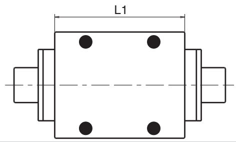


Fig. 4 Measuring groove accuracy

(2) Ball slide shape

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

(3) Accuracy and preload

1. Running parallelism of ball slide

Table 1

Unit: µm

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

2. Accuracy standard

LA series have four degrees such as ultra precision P3, super precision P4, high precision P5, and precision grade P6.

Table 2

Unit: μm

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

3. Assembled accuracy

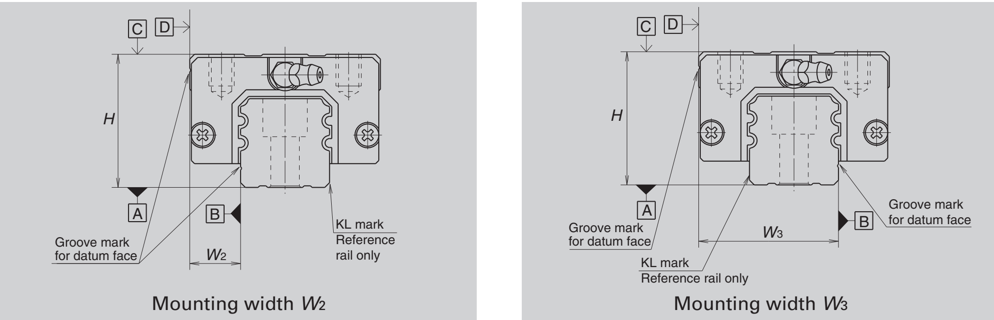


Fig. 5

4. Preload and rigidity

Table 3 shows preload and rigidity of LA Series.

LA Series has two types of preload Z3 (medium preload) and Z4 (heavy preload).

Table 3

	Model No.	Preload (N)		Rigidity (N/μm)	
		Medium preload Z3	Heavy preload Z4	Medium preload Z3	Heavy preload Z4
High-load type	LA25 AL, AN, EL, FL	1670	2110	475	550
	LA30 AL, AN, EL, FL	2450	3140	705	835
	LA35 AL, AN, EL, FL	3450	4300	825	970
	LA45 AL, AN, EL, FL	5050	6350	1100	1240
	LA55 AL, AN, EL, FL	8100	10200	1400	1540
	LA65 AN, EL, FL	13800	18800	1730	2030
Super-high-load type	LA25 BL, BN, GL, HL	2260	2840	700	820
	LA30 BL, BN, GL, HL	3250	4050	1000	1180
	LA35 BL, BN, GL, HL	4450	5650	1200	1400
	LA45 BL, BN, GL, HL	6150	7750	1450	1640
	LA55 BL, BN, GL, HL	9550	12100	1840	2020
	LA65 BN, GL, HL	18000	24400	2450	2840

(4) Available length of rail

Show the limitations of rail length (maximum length). However, the limitations vary by accuracy grade.

Table 4

Unit: mm

Series \ Size	25	30	35	45	55	65
LA	3960	4000	4000	3990	3960	3900

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

(5) Installation

1. Permissible values of mounting error

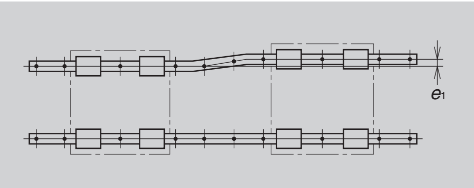


Fig. 6

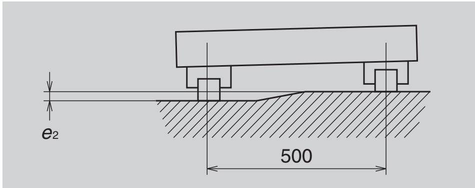


Fig. 7

Table 5

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 face and corner radius r

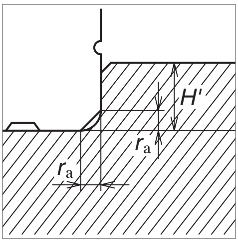


Fig. 8 Shoulder for the rail datum face

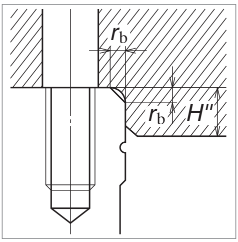


Fig. 9 Shoulder for the ball slide datum face

Table 6

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
LA25	0.5	0.5	5	5
LA30	0.5	0.5	6	6
LA35	0.5	0.5	6	6
LA45	0.7	0.7	8	8
LA55	0.7	0.7	10	10
LA65	1	1	11	11

(6) Lubrication components

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

1. Types of lubrication accessories

Figure 10 and Table 7 show grease fittings and tube fittings.

2. Mounting position of lubrication accessories

The standard position of grease fittings is the end face of ball slide. We mount them on a side of end cap for an option. (Fig. 11) .

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

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

Table 7 Unit: mm

Model No.	Dust proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
LA25	Standard	5	6*
	With NSK K1	14	13*
	Double seal	10	9*
	Protector	10	9*
LA30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
LA35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
LA45	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
LA55	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
LA65	Standard	8	17
	With NSK K1	22	25.5
	Double seal	16	19
	Protector	16	17

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

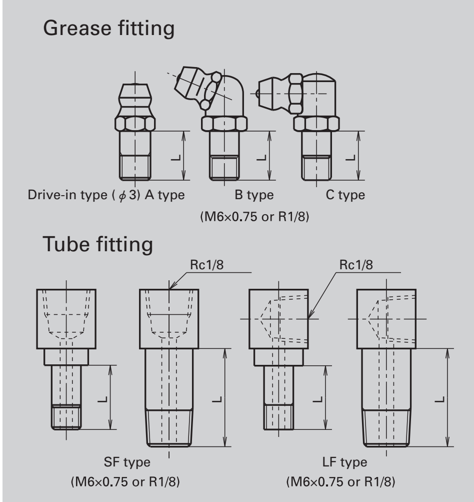


Fig. 10 Grease fitting and tube fitting

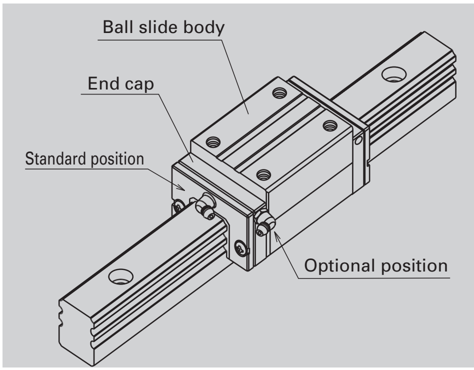


Fig. 11 Mounting position of lubrication accessories

(7) Dust proof components

1. Standard Specification

To keep foreign matters from entering inside the ball slide, LA Series has an end seal on both ends, and bottom seals at the bottom.
Inner seal is available as an option.

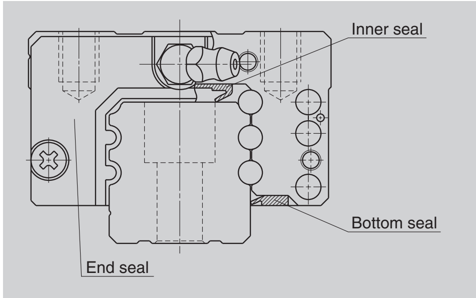


Fig. 12

Table 8 Seal friction per ball slide (maximum value)

Unit: N

Series \ Size	25	30	35	45	55	65
LA	11	11	12	17	17	23

2. NSK K1™

Table 9 shows the dimension of linear guides equipped with the NSK K1.

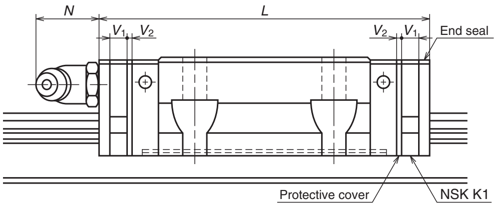


Table 9

Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_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 NSK K1 = (Standard ball slide length) + (Thickness of NSK K1, $V_1 \times$ Number of NSK K1) + (Thickness of the protective cover $V_2 \times 2$)

3. Double seal and protector

For LA series, double seal and protector can be installed only before shipping from the factory. Please consult with NSK.

Table 10 shows the increased thickness of V_1 and V_2 when end seals and protectors are installed (Fig. 15).

Table 10

Unit: mm

Model No.	Thickness of end seal: V_1	Thickness of protector: V_2
LA25	3.2	3.6
LA30	4.4	4.2
LA35	4.4	4.2
LA45	5.5	4.9
LA55	5.5	4.9
LA65	6.5	5.5

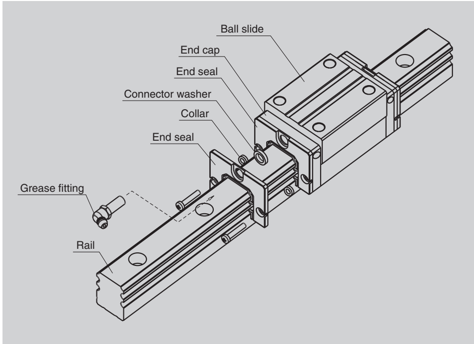


Fig. 13 Double seal

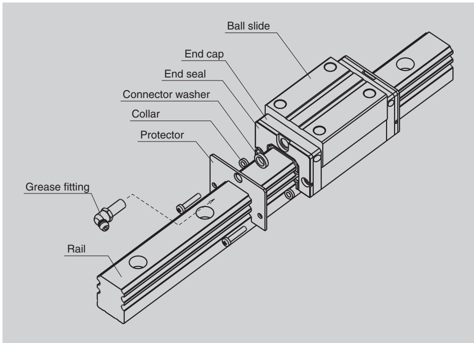


Fig. 14 Protector

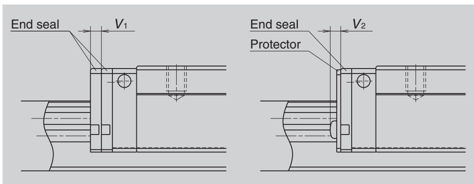


Fig. 15

4. Cap to cover the bolt hole for rail mounting

Table 11 Caps to cover rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
LA25	M6	LG-CAP/M6	20
LA30, LA35	M8	LG-CAP/M8	20
LA45	M12	LG-CAP/M12	20
LA55	M14	LG-CAP/M14	20
LA65	M16	LG-CAP/M16	20

5. Bellows

Make tap holes to the rail end face to fix the bellows mounting plate.

NSK processes tap holes to the rail end face when ordered with a linear guide.

Dimension tables of bellows
LA Series

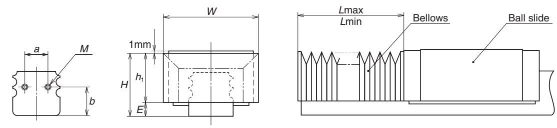


Fig. 16 An installed bellows

Bellows reference number

J A A 30 L 08

Bellows

A: Bellows for the ends
B: Middle bellows

Bellows for LA series

Number of BL (fold number)

N: High type L: Low type

Size number of linear guide

Table. 12 Dimensions of bellow

Unit: mm

Model No.	H	h_1	E	W	P	a	b	Length of BL	Tap (M) xdepth
JAA25L	35	29.5	5.5	55	12	12	13.8	17	M3×5
JAA25N	39	33.5	5.5	61	15	12	13.8	17	M3×5
JAA30L	41	33.5	7.5	60	12	14	17.5	17	M4×6
JAA30N	44	36.5	7.5	66	15	14	17.5	17	M4×6
JAA35L	47	39.5	7.5	72	15	15	18.8	17	M4×6
JAA35N	54	46.5	7.5	82	20	15	18.8	17	M4×6
JAA45L	59	49	10	93	20	25	22.5	17	M5×8
JAA45N	69	59	10	113	30	25	22.5	17	M5×8
JAA55L	69	57	12	101	20	35	27.1	17	M5×8
JAA55N	79	67	12	121	30	35	27.1	17	M5×8
JAA65N	89	75	14	131	30	40	33.3	17	M6×12

Table. 13 Numbers of folds (BL) and length of bellows

Unit: mm

Type	Model No.	Length of BL	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	1072	1206	1340
		L_{max}	168	336	504	672	840	1008	1176	1344	1512	1680
High type	JAA25N	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
		L_{max}	210	420	630	840	1050	1260	1470	1680	1890	2100
Low type	JAA30L	Stroke	134	268	402	536	670	804	938	1072	1206	1340
		L_{max}	168	336	504	672	840	1008	1176	1344	1512	1680
High type	JAA30N	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
		L_{max}	210	420	630	840	1050	1260	1470	1680	1890	2100
Low type	JAA35L	Stroke	176	352	528	704	880	1056	1232	1408	1584	1760
		L_{max}	210	420	630	840	1050	1260	1470	1680	1890	2100
High type	JAA35N	Stroke	246	492	738	984	1230	1476	1722	1968	2214	2460
		L_{max}	280	560	840	1120	1400	1680	1960	2240	2520	2800
Low type	JAA45L	Stroke	246	492	738	984	1230	1476	1722	1968	2214	2460
		L_{max}	280	560	840	1120	1400	1680	1960	2240	2520	2800
High type	JAA45N	Stroke	386	772	1158	1544	1930	2316	2702	3088	3474	3860
		L_{max}	420	840	1260	1680	2100	2520	2940	3360	3780	4200
Low type	JAA55L	Stroke	246	492	738	984	1230	1476	1722	1968	2214	2460
		L_{max}	280	560	840	1120	1400	1680	1960	2240	2520	2800
High type	JAA55N	Stroke	386	772	1158	1544	1930	2316	2702	3088	3474	3860
		L_{max}	420	840	1260	1680	2100	2520	2940	3360	3780	4200
Low/high type	JAA65N	Stroke	386	772	1158	1544	1930	2316	2702	3088	3474	3860
		L_{max}	420	840	1260	1680	2100	2520	2940	3360	3780	4200

Note (1) Bellows for LA65 is for both low and high types.

Remarks : Values of odd number BLs are obtained by adding values of the even number BLs on both sides, then dividing the sum by two.

(8) Reference number

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

LA 35 0840 AL C 2 - P6 3**

- LA: Series name
- 35: Size
- 0840: Rail length (mm)
- AL: Ball slide shape code (See page A270)
- C: Material/surface treatment (See Table 14)
- 2: Number of ball slides per rail
- -**: Design serial number (Added to the reference number.)
- P6: Accuracy code (See Table 15)
- 3: Preload code (See page A271)

Table 14 Material/surface treatment code

Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
Z	Other, special

Table 15 Accuracy code

Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5
Precision grade	P6	K6

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

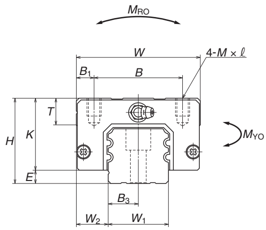
(9) Dimensions

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

LA 35 0840 AL C 2 -∗∗ P6 3

- Series name — LA
- Size — 35
- Rail length (mm) — 0840
- Ball slide shape code (See page A270) — AL
- 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 A271) — 3

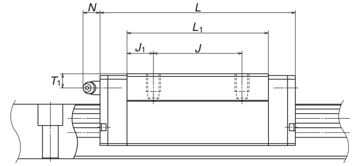
Front view of AL and BL types



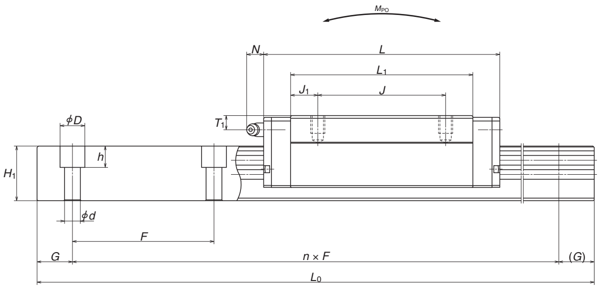
Model No.	Assembly Height H	Assembly E	Assembly W_2	Ball slide Width W	Ball slide Length L	Mounting hole B	Mounting hole J	Mounting hole M×pitch×ℓ	B_1	L_1	J_1	K	T	Grease fitting Hole size	Grease fitting T_1	Grease fitting N
LA25AL	36	5.5	12.5	48	79.8	35	35	M6×1×7	6.5	58	11.5	30.5	8	M6×0.75	6	11
LA25BL					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					

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

Side view of AL type



Side view of BL type



Unit: mm

Rail							Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole		G	Max. length	Dynamic	Static	Static moment				Ball slide	Rail
							C	C_0	M_{RO}	M_{PO}	M_{YO}	D_W		
W_1	H_1	F	$d \times D \times h$	B_3	(Reference)	L_{0max}	(N)	(N)	(N·m)	(N·m)	(N·m)		(kg)	(kg/m)
23	22	60	7×11×9	11.5	20	3960	30000	50000	290	410	410	3.968	0.5	3.7
							40500	77000	445	935	935		0.8	
28	28	80	9×14×12	14	20	4000	47000	77500	535	820	820	4.762	0.8	5.8
							58000	105000	725	1470	1470		1.2	
34	30.8	80	9×14×12	17	20	4000	61500	98000	845	1130	1130	5.556	1.3	7.7
							80500	143000	1240	2330	2330		1.6	
45	36	105	14×20×17	22.5	22.5	3990	91000	148000	1840	2210	2210	6.350	2.5	12.0
							111000	197000	2460	3850	3850		3.2	
53	43.2	120	16×23×20	26.5	30	3960	139000	215000	3150	3800	3800	7.937	3.9	17.2
							172000	292000	4250	6800	6800		5.1	

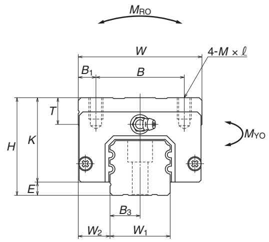
2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface.
When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

LA-AN (High-load type)
LA-BN (Super-high-load type)

LA 35 0840 AN C 2 -** P6 3

- LA: Series name
- 35: Size
- 0840: Rail length (mm)
- AN: Ball slide shape code (See page A270)
- C: Material/surface treatment (See Table 14)
- 2: Number of ball slides per rail
- -**: Design serial number (Added to the reference number.)
- P6: Accuracy code (See Table 15)
- 3: Preload code (See page A271)

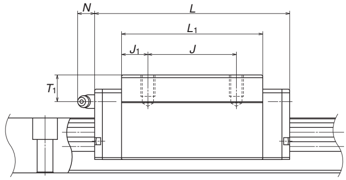
Front view of AN and BN types



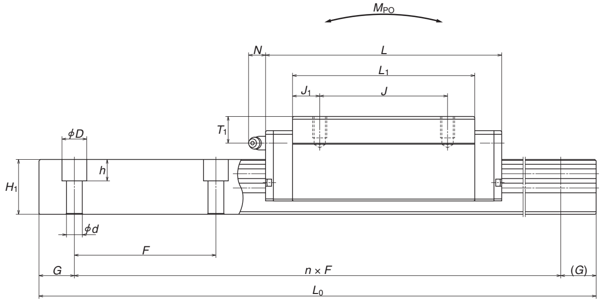
Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	M×pitch×ℓ	B_1	L_1	J_1	K	T	Grease fitting Hole size	T_1	N
LA25AN **LA25BN**	40	5.5	12.5	48	79.8 107.8	35	35 50	M6×1×10	6.5	58 86	11.5 18	34.5	12	M6×0.75	10	11
LA30AN **LA30BN**	45	7.5	16	60	100.2 126.2	40	40 60	M8×1.25×11	10	72 98	16 19	37.5	14	M6×0.75	9.5	11
LA35AN **LA35BN**	55	7.5	18	70	110.6 144.6	50	50 72	M8×1.25×12	10	80 114	15 21	47.5	15	M6×0.75	15	11
LA45AN **LA45BN**	70	10	20.5	86	141.4 173.4	60	60 80	M10×1.5×16	13	105 137	22.5 28.5	60	17	Rc1/8	20	13
LA55AN **LA55BN**	80	12	23.5	100	165.4 203.4	75	75 95	M12×1.75×18	12.5	126 164	25.5 34.5	68	18	Rc1/8	21	13
LA65AN **LA65BN**	90	14	31.5	126	196.2 256.2	76	70 120	M16×2×19	25	147 207	38.5 43.5	76	22	Rc1/8	19	13

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

Side view of AN type



Side view of BN type



Unit: mm

Rail							Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole		G	Max. length	Dynamic	Static	Static moment				Ball slide	Rail
							C	C_0	M_{RO}	M_{PO}	M_{YO}	D_W		
W_1	H_1	F	$d \times D \times h$	B_3	(Reference)	L_{0max}	(N)	(N)	(N·m)	(N·m)	(N·m)		(kg)	(kg/m)
23	22	60	7×11×9	11.5	20	3960	30000	50000	290	410	410	3.968	0.6	3.7
							40500	77000	445	935	935		0.9	
28	28	80	9×14×12	14	20	4000	47000	77500	535	820	820	4.762	0.9	5.8
							58000	105000	725	1470	1470		1.3	
34	30.8	80	9×14×12	17	20	4000	61500	98000	845	1130	1130	5.556	1.5	7.7
							80500	143000	1240	2330	2330		2.1	
45	36	105	14×20×17	22.5	22.5	3990	91000	148000	1840	2210	2210	6.350	3.0	12.0
							111000	197000	2460	3850	3850		3.9	
53	43.2	120	16×23×20	26.5	30	3960	139000	215000	3150	3800	3800	7.937	4.7	17.2
							172000	292000	4250	6800	6800		6.1	
63	55	150	18×26×22	31.5	35	3900	260000	420000	7300	9050	9050	10.318	7.7	25.9
							340000	615000	10700	18700	18700		10.8	

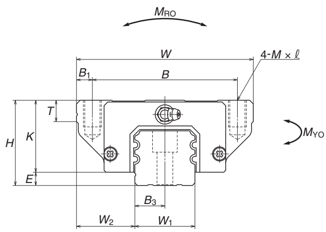
2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface.
When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

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

LA 35 0840 EL C 2 - P6 3**

- LA — Series name
- 35 — Size
- 0840 — Rail length (mm)
- EL — Ball slide shape code (See page A270)
- C — Material/surface treatment (See Table 14)
- 2 — Number of ball slides per rail
- ** — Design serial number (Added to the reference number.)
- P6 — Accuracy code (See Table 15)
- 3 — Preload code (See page A271)

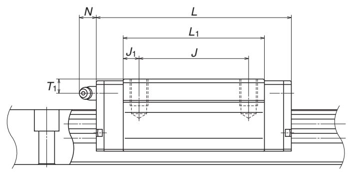
Front view of EL and GL types



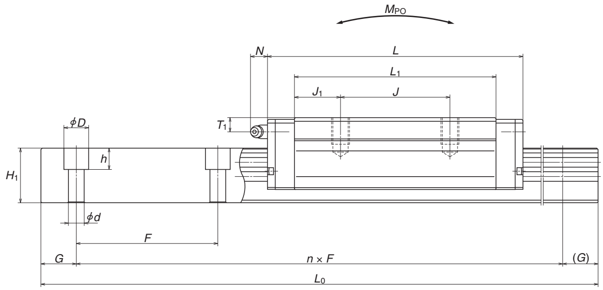
Model No.	Assembly Height H	E	W_2	Ball slide Width W	Length L	Mounting hole B	J	M×pitch×ℓ	B_1	L_1	J_1	K	T	Grease fitting Hole size	T_1	N
LA25EL **LA25GL**	36	5.5	23.5	70	79.8 107.8	57	45	M8×1.25×12	6.5	58 86	6.5 20.5	30.5	11	M6×0.75	6	11
LA30EL **LA30GL**	42	7.5	31	90	100.2 126.2	72	52	M10×1.5×16	9	72 98	10 23	34.5	11	M6×0.75	6.5	11
LA35EL **LA35GL**	48	7.5	33	100	110.6 144.6	82	62	M10×1.5×15	9	80 114	9 26	40.5	12	M6×0.75	8	11
LA45EL **LA45GL**	60	10	37.5	120	141.4 173.4	100	80	M12×1.75×18	10	105 137	12.5 28.5	50	13	Rc1/8	10	13
LA55EL **LA55GL**	70	12	43.5	140	165.4 203.4	116	95	M14×2×21	12	126 164	15.5 34.5	58	15	Rc1/8	11	13
LA65EL **LA65GL**	90	14	53.5	170	196.2 256.2	142	110	M16×2×24	14	147 207	18.5 48.5	76	22	Rc1/8	19	13

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

Side view of EL type



Side view of GL type



Unit: mm

Rail							Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole		G	Max. length	Dynamic	Static	Static moment				Ball slide	Rail
							C	C_0	M_{RO}	M_{PO}	M_{YO}	D_W		
W_1	H_1	F	$d \times D \times h$	B_3	(Reference)	L_{0max}	(N)	(N)	(N·m)	(N·m)	(N·m)		(kg)	(kg/m)
23	22	60	7×11×9	11.5	20	3960	30000	50000	290	410	410	3.968	0.8	3.7
							40500	77000	445	935	935		1.1	
28	28	80	9×14×12	14	20	4000	47000	77500	535	820	820	4.762	1.3	5.8
							58000	105000	725	1470	1470		1.8	
34	30.8	80	9×14×12	17	20	4000	61500	98000	845	1130	1130	5.556	1.9	7.7
							80500	143000	1240	2330	2330		2.6	
45	36	105	14×20×17	22.5	22.5	3990	91000	148000	1840	2210	2210	6.350	3.3	12.0
							111000	197000	2460	3850	3850		4.3	
53	43.2	120	16×23×20	26.5	30	3960	139000	215000	3150	3800	3800	7.937	5.5	17.2
							172000	292000	4250	6800	6800		7.2	
63	55	150	18×26×22	31.5	35	3900	260000	420000	7300	9050	9050	10.318	11.0	25.9
							340000	615000	10700	18700	18700		15.5	

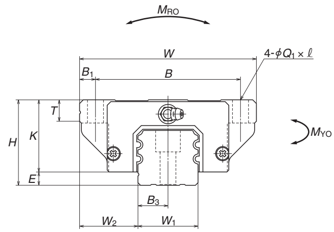
2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface.
When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

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

LA 35 0840 FL C 2 - P6 3**

- LA — Series name
- 35 — Size
- 0840 — Rail length (mm)
- FL — Ball slide shape code (See page A270)
- C — Material/surface treatment (See Table 14)
- 2 — Number of ball slides per rail
- -** — Design serial number (Added to the reference number.)
- P6 — Accuracy code (See Table 15)
- 3 — Preload code (See page A271)

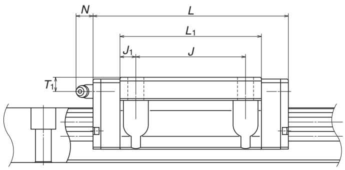
Front view of FL and HL types



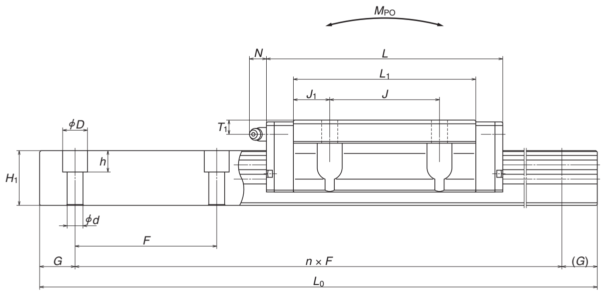
Model No.	Assembly			Ball slide												
	Height			Width	Length	Mounting hole								Grease fitting		
	H	E	W_2	W	L	B	J	$Q_1 \times \ell$	B_1	L_1	J_1	K	T	Hole size	T_1	N
LA25FL	36	5.5	23.5	70	79.8	57	45	7×10	6.5	58	6.5	30.5	11	M6×0.75	6	11
LA25HL					107.8					86	20.5					
LA30FL	42	7.5	31	90	100.2	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					

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

Side view of FL type



Side view of HL type



Unit: mm

Rail							Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole		G	Max. length	Dynamic	Static	Static moment				Ball slide	Rail
							C	C_0	M_{RO}	M_{PO}	M_{YO}	D_W		
W_1	H_1	F	$d \times D \times h$	B_3	(Reference)	L_{0max}	(N)	(N)	(N·m)	(N·m)	(N·m)		(kg)	(kg/m)
23	22	60	7×11×9	11.5	20	3960	30000	50000	290	410	410	3.968	0.8	3.7
							40500	77000	445	935	935		11	
28	28	80	9×14×12	14	20	4000	47000	77500	535	820	820	4.762	1.3	5.8
							58000	105000	725	1470	1470		1.8	
34	30.8	80	9×14×12	17	20	4000	61500	98000	845	1130	1130	5.556	1.9	7.7
							80500	143000	1240	2330	2330		2.6	
45	36	105	14×20×17	22.5	22.5	3990	91000	148000	1840	2210	2210	6.350	3.3	12.0
							111000	197000	2460	3850	3850		4.3	
53	43.2	120	16×23×20	26.5	30	3960	139000	215000	3150	3800	3800	7.937	5.5	17.2
							172000	292000	4250	6800	6800		7.2	
63	55	150	18×26×22	31.5	35	3900	260000	420000	7300	9050	9050	10.318	11.0	25.9
							340000	615000	10700	18700	18700		15.5	

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

A-5-3 Liquid Crystal Display and Semiconductor

A-5-3.1 PU Series (Miniature type)

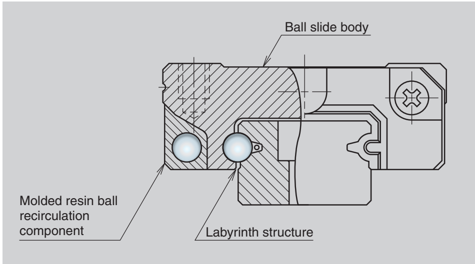


Fig. 1

(1) Features

1. Motion performance

Newly designed recirculation component facilitates smooth circulation of steel balls.

2. Lightweight

The ball slide is fabricated to be approximately 20% lighter than LU Series by the application of resin to a part of its body.

3. Reduced noise intensity

Resin components applied in ball circulating circuits reduce collision noise between steel balls and the inner wall of circulating circuits.

4. Low dust generation

The structure of the ball slide is designed to prevent dust generation.

5. Excellent dust-proofing

The labyrinth structure adopted for the side of the rails and the inner walls of the ball slide allows effects equivalent to a bottom seal.

6. High corrosion resistance

High corrosion-resistant martensite stainless steel incorporated as a standard feature provides excellent resistance to corrosion.

7. Easy to handle

Safety design includes a retainer that prevents steel balls from dropping out of the ball slide even when the slide is removed from the rail.

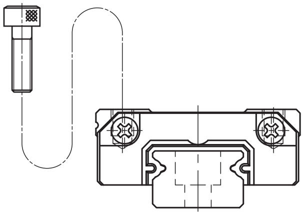
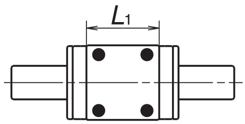
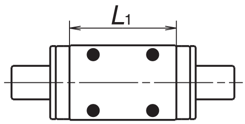
8. Long-term maintenance-free

Equipped with NSK K1 Lubrication unit realizes long-term, maintenance-free use.

9. Fast delivery

Lineup of random-matching rails and ball slides in the series supports random matching and facilitates fast delivery. (PU09 to PU15)

(2) Ball slide shape

Ball slide Model	Shape/installation method	Type	
		Standard type	High-load type
AR TR AL UR BL		TR, AR, AL 	UR, BL 

(3) Accuracy and preload

1. Runing parallelism tolerance

Table 1

Unit: 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	1000	5	9	16	18	18
1000	1250	6	10	17	20	20

2. Accuracy standard

The preloaded assembly types products have four accuracy grades; Super precision P4, High precision P5, Precision grade P6, and normal grade PN, while the random-matching type has a normal grade PC.
Table 2 shows the accuracy standard for the preloaded assembly type while Table 3 shows the accuracy standard for the random-matching types.

• Tolerance of preloaded assembly

Table 2

Unit: 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 face C to face A Running parallelism of face D to face B	Shown in Table 1 and Fig. 2			

• Tolerance of random-matching type: Normal grade PC

Table 3

Unit: μm

Characteristics \ Accuracy grade	Normal grade PC
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 face C to face A Running parallelism of face D to face B	Shown in Table 1 and Fig. 2

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

3. Assembled accuracy

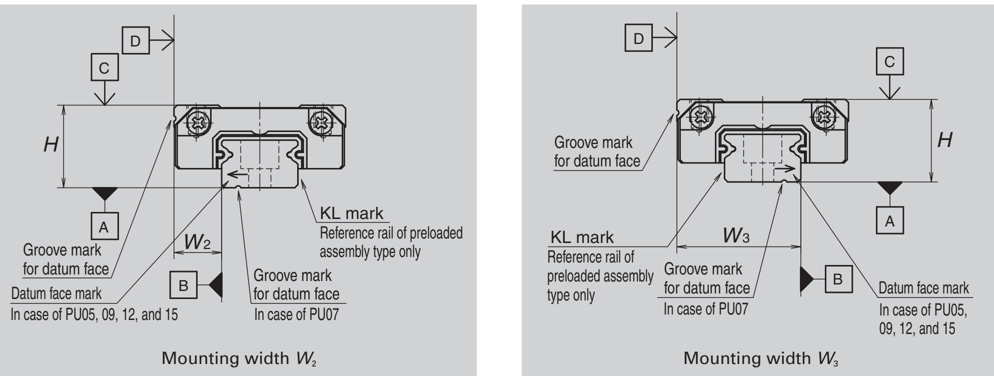


Fig. 2

Note: Please refer to page A67 for marks on the datum faces.

4. Preload and rigidity

We offer three levels of preload: Slight preload Z1 and Fine clearance Z0, along with random-matching type of Fine clearance ZT. Values for preload and rigidity of the preloaded assembly type are shown in Tables 4. Rigidities are for the median of the preload range.

• Preload and rigidity of preloaded assembly

Table 4

Model No.		Preload (N)	Rigidity (N/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.
However, Z0 of PN grade is 3 to 10 μm.
Clearance values of the random-matching type are shown in Tables 5.

• Clearance of random-matching type

Table 5 Unit: μm

Model No.	Fine clearance ZT
PU09TR	3 or less
PU12TR	
PU15AL	

(4) Available length of rail

Table 6 shows the limitations of rail length (maximum length). However, the limitations vary by accuracy grade.

Table 6 Length limitations of rails

Unit: mm

Series	Material \ Size	05	07	09	12	15
PU	Stainless steel	210	375	600	800	1000

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

(5) Installation

1. Permissible values of mounting error

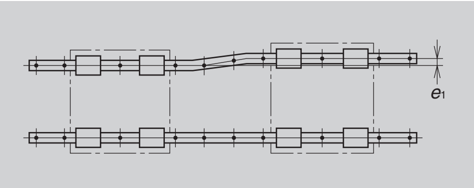


Fig. 3

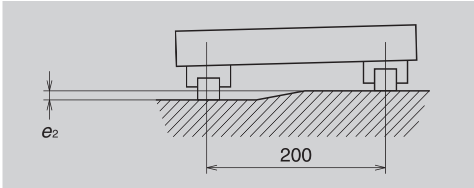


Fig. 4

Table 7

Unit: 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 face and corner radius r

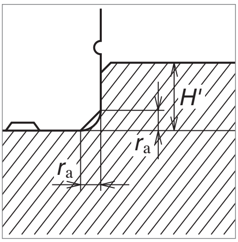


Fig. 5 Shoulder for the rail datum face

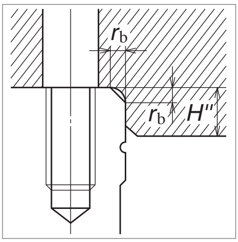


Fig. 6 Shoulder for the ball slide datum face

Table 8

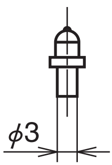
Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H′	H″*
PU05	0.2	0.2	0.7	2.3
PU07	0.2	0.3	1.2	2.5
PU09	0.3	0.3	1.9	2.6
PU12	0.3	0.3	2.5	3.4
PU15	0.3	0.5	3.5	4.4

*) H″ is the minimum recommended value based on the dimension T in dimension table.

(6) Lubrication accessory

PU15 can select drive-in type grease fitting as an option.
For PU05 to PU12, apply grease directly to the ball grooves of rail using a point nozzle.



Drive-in type

(7) Dust proof components

1. Standard specification

End seal: Provided to both ends of the ball slide as a standard feature.
Bottom seal function: A labyrinth structure of the ball slide bottom face functions as sealing effect.

Seal friction per standard ball slide is shown in Table 9.

Table 9 Seal friction per ball slide (maximum value)

Unit: N

Series \ Size	05	07	09	12	15
PU	0.3	0.3	0.5	0.5	0.5

2. NSK K1™

Table 10 shows the dimension of linear guides equipped with the NSK K1.

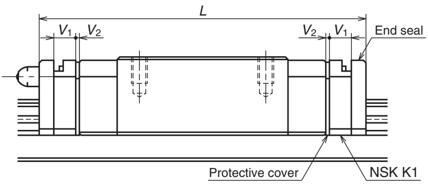


Table 10

Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length equipped with two NSK K1 L	Thickness of NSK K1, V_1	Thickness of protective cover, V_2
PU05	Standard	TR	19.4	24.4	2	0.5
PU07	Standard	AR	23.4	29.4	2.5	0.5
PU09	Standard	TR	30	36.4	2.7	0.5
	Long	UR	41	47.4		
PU12	Standard	TR	35	42	3	0.5
	Long	UR	48.7	55.7		
PU15	Standard	AL	43	51.2	3.5	0.6
	Long	BL	61	69..2		

Note: Ball slide length equipped with NSK K1 =
(Standard ball slide length) + (Thickness of NSK K1, V_1 × 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

PU 15 0470 AL K 2 - ** **P5 1**

- PU: Series name
- 15: Size
- 0470: Rail length (mm)
- AL: Ball slide shape code (See page A290)
- K: Material/surface treatment code (See Table 11)
- 2: Number of ball slides per rail
- -**: Design serial number
  Added to the reference number.
- P5: Accuracy code (See Table 12)
- 1: Preload code (See page A292)

2. Reference number for random-matching type

Ball slide

PAU 15 AL K - **PC T**

- PAU: Random-matching ball slide series code
  PAU : PU Series random-matching ball slide
- 15: Size
- AL: Ball slide shape code (See page A290)
- K: Material/surface treatment code (See Table 11)
- -**: Design serial number
  Added to the reference number.
- PC: Accuracy code : PC
  PC: Normal grade is only available
- T: Preload code
  T: Fine clearance (See page A292)

Rail

P1U 15 0470 R K N - ** **PC T**

- P1U: Random-matching rail series code
  P1U : PU Series random-matching rail
- 15: Size
- 0470: Rail length (mm)
- R: Rail shape code
  S: PU09, 12. R: PU15
- 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
  T: Fine clearance (See page A292)

*Please consult with NSK for butting rail specification.

Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is fine clearance "T" (Refer to page A292).

Table 11 Material/surface treatment code

Code	Description
K	Stainless steel
H	Stainless steel with surface treatment
Z	Other, special

Table 12 Accuracy code

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

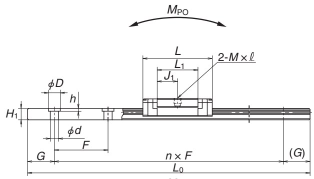
Note: Refer to Page A38 and A61 for NSK K1 lubrication unit.

(9) Dimensions

PU 15 0470 AL K 2 -∗∗ P5 1

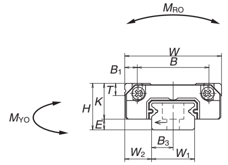
- Series name (PU)
- Size (15)
- Rail length (mm) (0470)
- Ball slide shape code (See page A290) (AL)
- Material/surface treatment code (See Table 11) (K)
- Number of ball slides per rail (2)
- Design serial number (∗∗) — Added to the reference number.
- Accuracy code (See Table 12) (P5)
- Preload code (See page A292) (1)

Side view

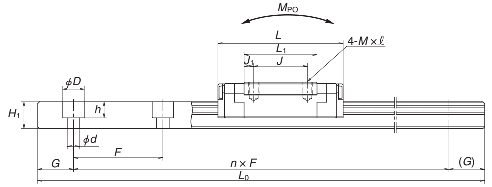


PU05

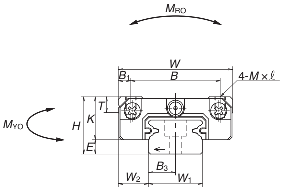
Front view



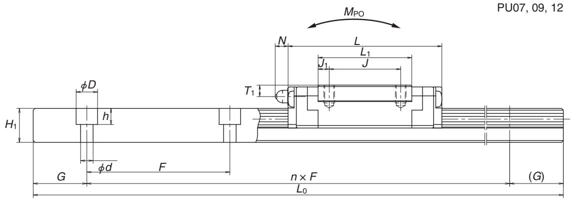
PU05, 07, 09, 12



PU07, 09, 12



PU15



PU15

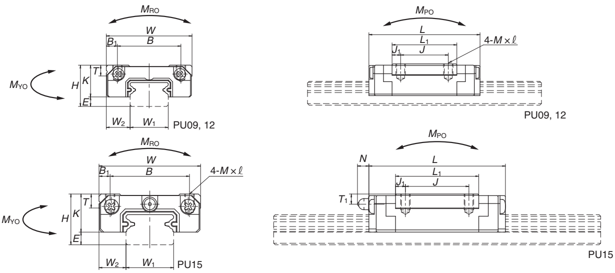
Model No.	Assembly			Ball slide										Grease fitting		
	Height			Width	Length	Mounting hole								Hole size		
	H	E	W_2	W	L	B	J	M×Pitch×ℓ	B_1	L_1	J_1	K	T		T_1	N
PU05TR	6	1	3.5	12	19.4	8	—	M2×0.4×1.5	2	11.4	5.7	5	2.3	—	—	—
PU07AR	8	1.5	5	17	23.4	12	8	M2×0.4×2.4	2.5	13.3	2.65	6.5	2.45	—	—	—
PU09TR PU09UR	10	2.2	5.5	20	30 41	15	10 16	M3×0.5×3	2.5	19.6 30.6	4.8 7.3	7.8	2.6	—	—	—
PU12TR PU12UR	13	3	7.5	27	35 48.7	20	15 20	M3×0.5×3.5	3.5	20.4 34.1	2.7 7.05	10	3.4	—	—	—
PU15AL PU15BL	16	4	8.5	32	43 61	25	20 25	M3×0.5×5	3.5	26.2 44.2	3.1 9.6	12	4.4	φ3	3.2	(3.6)

Remarks: 1) Ball slide of PU05TR has only two mounting tap holes in the center.

Reference number for ball slide of random-matching type

Ball slide **PAU 15 AL K -✱✱PC T**

- Random-matching ball slide series code
  PAU : PU Series random-matching ball slide
- Size
- Ball slide shape code (See page A290)
- Material/surface treatment code (See Table 11)
- Preload code
  T: Fine clearance (See page A292)
- Accuracy code : PC
  PC: Normal grade is only available
- Design serial number
  Added to the reference number.

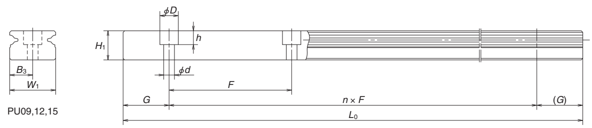


Reference number for rail of random-matching type

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
  T: Fine clearance (See page A292)
- 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					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole		G	Maximum length	Dynamic	Static	Static moment				Ball slide	Rail
W_1	H_1	F	d×D×h	B_3	(Reference)	L_{0max}	C (N)	C_0 (N)	M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	(g)	(g/100mm)
5	3.2	15	2.3×3.3×0.8	2.5	5	210	520	775	2.06	1.28	1.28	1	4	11
7	4.7	15	2.4×4.2×2.3	3.5	5	375	1 090	1 370	5.20	2.70	2.70	1.5875	8	23
9	5.5	20	3.5×6×4.5	4.5	7.5	600	1 490 2100	2 150 3 500	9.90 16.2	6.10 15.6	6.10 15.6	1.5875	16 25	35
12	7.5	25	3.5×6×4.5	6	10	800	2 830 4 000	3 500 5 700	21.1 34.5	11.4 28.3	11.4 28.3	2.3812	32 53	65
15	9.5	40	3.5×6×4.5	7.5	15	1 000	5 550 8 100	6 600 11 300	49.5 84.5	25.6 69.5	25.6 69.5	3.175	59 100	105

2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.
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-5-3.2 PE Series (Miniature type)

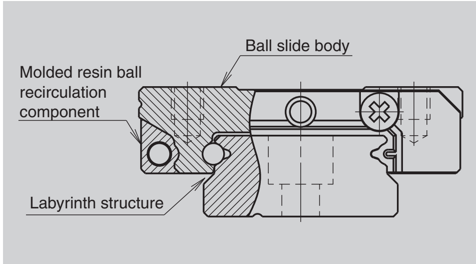


Fig. 1

(1) Features

1. Motion performance

Newly designed recirculation component facilitates smooth circulation of steel balls.

2. Lightweight

The ball slide is fabricated to be approximately 20% lighter than LE Series by the application of resin to a part of its body.

3. Reduced noise intensity

Resin components applied in ball circulating circuits reduce collision noise between steel balls and the inner wall of circulating circuits.

4. Low dust generation

The structure of the ball slide is designed to prevent dust generation.

5. Excellent dust-proofing

The labyrinth structure adopted for the side of the rails and the inner walls of the ball slide allows effects equivalent to a bottom seal.

6. High corrosion resistance

High corrosion-resistant martensite stainless steel incorporated as a standard feature provides excellent resistance to corrosion.

7. Easy to handle

Safety design includes a retainer that prevents steel balls from dropping out of the ball slide even when the slide is removed from the rail.

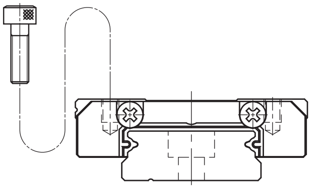
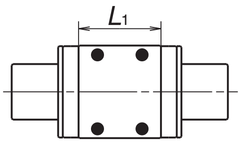
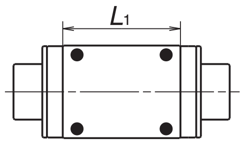
8. Long-term maintenance-free

Equipped with NSK K1 Lubrication unit realizes long-term, maintenance-free use.

9. Fast delivery

Lineup of random-matching rails and ball slides in the series supports random matching and facilitates fast delivery. (PE09 to PE15)

(2) Ball slide shape

Ball slide Model	Shape/installation method	Type	
		Standard type	High-load type
AR TR UR BR		AR, TR 	UR, BL 

(3) Accuracy and preload

1. Runing parallelism tolerance

Table 1

Unit: 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	1000	5	9	16	18	18
1000	1250	6	10	17	20	20

2. Accuracy standard

The preloaded assembly types products have four accuracy grades; Super precision P4, High precision P5, Precision P6, and Normal PN grades, while the random-matching type has Normal PC grade.

Table 2 shows the accuracy standard for the preloaded assembly type while Table 3 shows the accuracy standard for the random-matching types.

• Tolerance of preloaded assembly

Table 2

Unit: 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 face C to face A Running parallelism of face D to face B	Shown in Table 1 and Fig. 2			

• Tolerance of random-matching type: Normal grade PC

Table 3

Unit: μm

Characteristics \ Accuracy grade	Normal grade PC
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 face C to face A Running parallelism of face D to face B	Shown in Table 1 and Fig. 2

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

3. Assembled accuracy

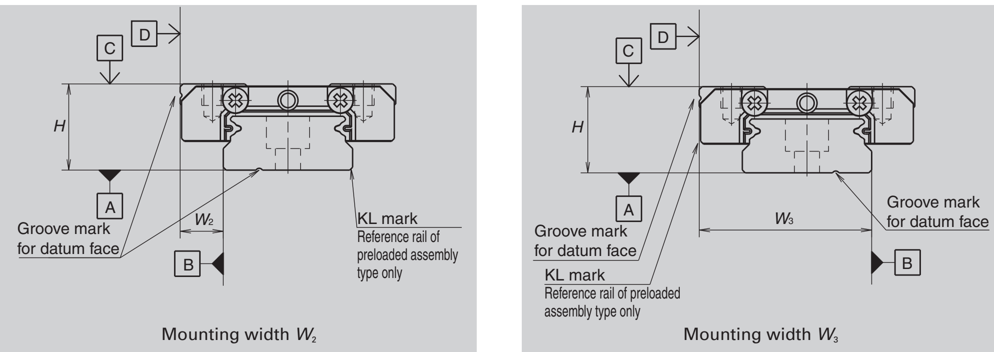


Fig. 2

4. Preload and rigidity

We offer three levels of preload: Slight preload Z1 and Fine clearance Z0, along with random-matching type of Fine clearance ZT. Values for preload and rigidity of the preloaded assembly types are shown in Tables 4. Rigidities are for the median of the preload range.

Table 4 Preload and rigidity of preloaded assembly

Model No.		Preload (N)	Rigidity (N/μm)
		Slight preload (Z1)	Slight preload (Z1)
Standard type	PE05AR	0 – 28	45
	PE07TR	0 – 29	46
	PE09TR	0 – 37	61
	PE12AR	0 – 40	63
	PE15AR	0 – 49	66
High-load type	PE09UR	0 – 54	86
	PE12BR	0 – 59	97
	PE15BR	0 – 75	114

Note: Clearance of fine clearance Z0 is 0 to 3 μm. Therefore, preload is zero.
However, Z0 of PN grade is 3 to 10 μm.
Clearance values of the random-matching types are shown in Tables 5.

• Clearance of random matching type

Table 5 Unit: μm

Model No.	Fine clearance ZT
PE09TR	3 or less
PE12AR	
PE15AR	

(4) Available length of rail

Table 6 shows the limitations of rail length (maximum length).

However, the limitations vary by accuracy grade.

Table 6 Length limitations of rails

Unit: mm

Series	Size / Material	05	07	09	12	15
PE	Stainless steel	150	600	800	1000	1200

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

(5) Installation

1. Permissible values of mounting error

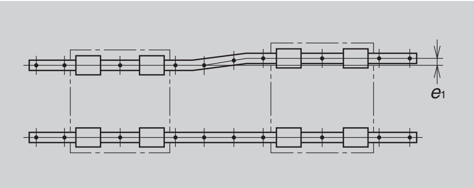


Fig. 3

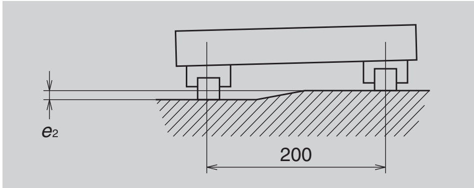


Fig. 4

Table 7

Unit: 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 face and corner radius r

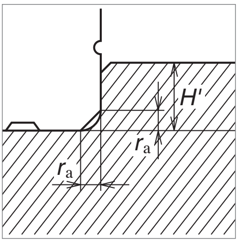


Fig. 5 Shoulder for the rail datum face

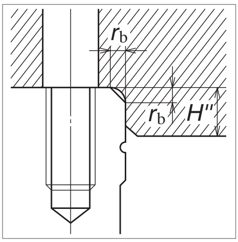


Fig. 6 Shoulder for the ball slide datum face

Table 8

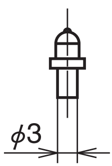
Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H′	H″*
PE05	0.2	0.2	1.1	2.5
PE07	0.2	0.3	1.7	3
PE09	0.3	0.3	3.5	2.8
PE12	0.3	0.3	3.5	3.2
PE15	0.3	0.5	3.5	4.1

*) H″ is the minimum recommended value based on the dimension T in dimension table.

(6) Lubrication accessory

PE15 can select drive-in type grease fitting as an option.
For PE05 to PE12, apply grease directly to the ball grooves of rail using a point nozzle.



Drive-in type

(7) Dust proof components

1. Standard specification

End seal: Provided to both ends of the ball slide as a standard feature.
Bottom seal function: A labyrinth structure of the ball slide bottom face functions as sealing effect.

Seal friction per standard ball slide is shown in Table 9.

Table 9 Seal friction per ball slide (maximum value)

Unit: N

Series \ Size	05	07	09	12	15
PE	0.4	0.4	0.8	1	1.2

2. NSK K1™

Table 10 shows the dimension of linear guides equipped with the NSK K1.

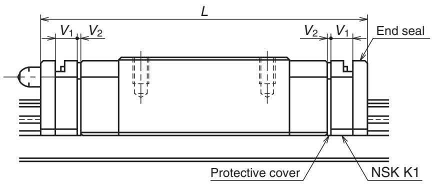


Table 10

Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length equipped with two NSK K1 L	Thickness of NSK K1, V_1	Thickness of protective cover, V_2
PE05	Standard	AR	24.1	28.9	2	0.4
PE07	Standard	TR	31.1	37.1	2.5	0.5
PE09	Standard	TR	39.8	46.8	3	0.5
	Long	UR	51.2	58.2		
PE12	Standard	AR	45	53	3.5	0..5
	Long	BR	60	68		
PE15	Standard	AR	56.6	66.2	4	0.8
	Long	BR	76	85.6		

Note: Ball slide length equipped with NSK K1 =
(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

PE 15 0470 AR K 2 - ** P5 1**

- PE: Series name
- 15: Size
- 0470: Rail length (mm)
- AR: Ball slide shape code (See page A300)
- K: Material/surface treatment code (See Table 11)
- 2: Number of ball slides per rail
- -**: Design serial number
  Added to the reference number.
- P5: Accuracy code (See Table 12)
- 1: Preload code (See page A302)

2. Reference number for random-matching type

Ball slide

PAE 15 AR K - PC T**

- PAE: Random-matching ball slide series code
  PAE : PE Series random-matching ball slide
- 15: Size
- AR: Ball slide shape code (See page A300)
- K: Material/surface treatment code (See Table 11)
- -**: Design serial number
  Added to the reference number.
- PC: Accuracy code : PC
  PC: Normal grade is only available
- T: Preload code
  T: Fine clearance (See page A302)

Rail

P1E 15 0470 R K N - PC T**

- P1E: Random-matching rail series code
  P1E : PE Series random-matching rail
- 15: Size
- 0470: Rail length (mm)
- R: Rail shape code
  R: PE09, 12. P: PE15
- 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
  T: Fine clearance (See page A302)

*Please consult with NSK for butting rail specification.

Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is fine clearance "T" (Refer to page A302).

Table 11 Material/surface treatment code

Code	Description
K	Stainless steel
H	Stainless steel with surface treatment
Z	Other, special

Table 12 Accuracy code

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

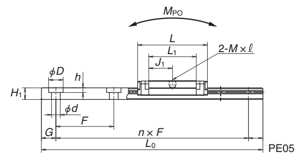
Note: Refer to Page A125 for NSK K1 lubrication unit.

(9) Dimensions

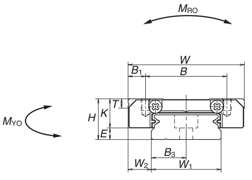
PE 15 0470 AR K 2 -＊＊ P5 1

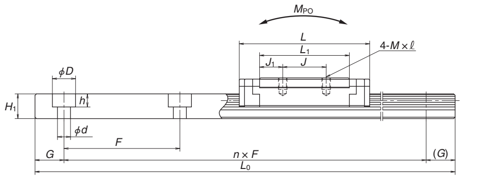
- PE — Series name
- 15 — Size
- 0470 — Rail length (mm)
- AR — Ball slide shape code (See page A300)
- K — Material/surface treatment code (See Table 11)
- 2 — Number of ball slides per rail
- ＊＊ — Design serial number (Added to the reference number.)
- P5 — Accuracy code (See Table 12)
- 1 — Preload code (See page A302)

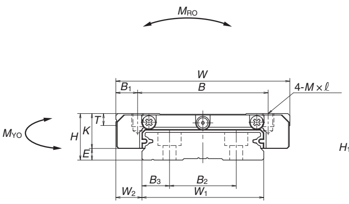
Side view

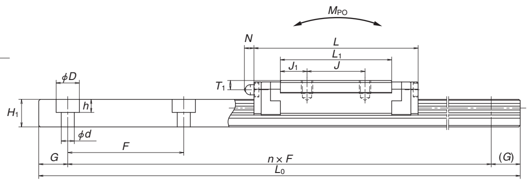


Front view









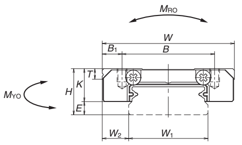
Model No.	Assembly			Ball slide										Grease fitting		
	Height			Width	Length	Mounting hole										
	H	E	W_2	W	L	B	J	M×Pitch×ℓ	B_1	L_1	J_1	K	T	Hole size	T_1	N
PE05AR	6.5	1.4	3.5	17	24.1	13	—	M2.5×0.45×1.5	2	16.4	8.2	5.1	2.5	—	—	—
PE07TR	9	2	5.5	25	31.1	19	10	M3×0.5×2.8	3	20.8	5.4	7	3	—	—	—
PE09TR 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	—	—	—
PE12AR PE12BR	14	4	8	40	45 60	28	15 28	M3×0.5×4	6	31 46	8 9	10	3.2	—	—	—
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)

Remarks: 1) Ball slide of PE05AR has only two mounting tap holes in the center.

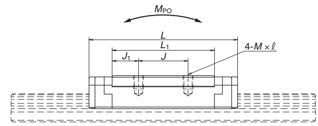
Reference number for ball slide of random-matching type

PAE 15 AR K -✱✱PC T

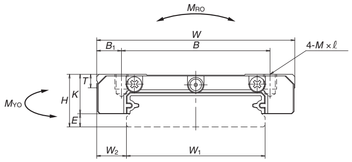
- Random-matching ball slide series code
  PAE : PE Series random-matching ball slide
- Size
- Ball slide shape code (See page A300)
- Material/surface treatment code (See Table 11)
- Design serial number
  Added to the reference number.
- Accuracy code : PC
  PC: Normal grade is only available
- Preload code
  T: Fine clearance (See page A302)



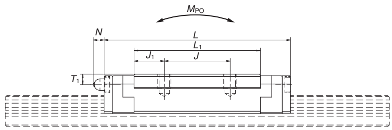
PE09, 12



PE09, 12



PE15



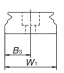
PE15

Reference number for rail of random-matching type

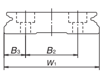
P1E 15 0470 R K N -✱✱ PC T

- 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)
- *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
  T: Fine clearance (See page A302)

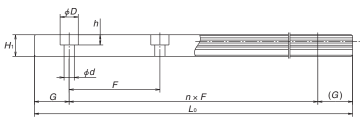
*Please consult with NSK for butting rail specification.



PE09,12



PE15

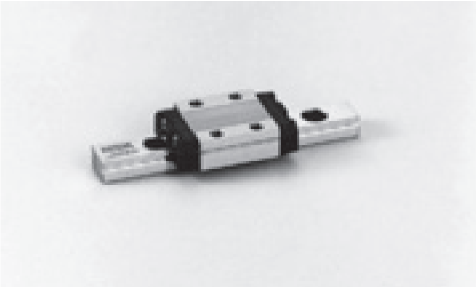


Unit: mm

Rail								Basic load rating					Ball dia.	Weight	
Width	Height		Pitch	Mounting bolt hole		G	Maximum length	Dynamic	Static	Static moment				Ball slide	Rail
								C	C_0	M_{RO}	M_{PO}	M_{YO}	D_W		
W_1	H_1	B_2	F	d×D×h	B_3	(Reference)	L_{0max}	(N)	(N)	(N·m)	(N·m)	(N·m)		(g)	(g/100mm)
10	4	—	20	3×5×1.6	5	7.5	150	690	1 160	6.00	2.75	2.75	1	7	34
14	5.2	—	30	3.5×6×3.2	7	10	600	1 580	2 350	16.7	7.20	7.20	1.5875	19	55
18	7.5	—	30	3.5×6×4.5	9	10	800	3 000 4 000	4 500 6 700	36.5 54.5	17.3 37.5	17.3 37.5	2.000	35 50	95
24	8.5	—	40	4.5×8×4.5	12	15	1 000	4 350 5 800	6 350 9 550	70.5 106	29.3 63.5	29.3 63.5	2.3812	66 98	140
42	9.5	23	40	4.5×8×4.5	9.5	15	1 200	7 600 10 300	10 400 16 000	207 320	59.0 135	59.0 135	3.175	140 211	275

2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface.
When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.
3) To fix rail of PE05AR, use M2.5 x 0.45 cross-recessed pan head machine screw for precision instrument.
(JCIS 10-70 No. 0 pan head machine screw No.3.)
(JCIS : Japanese Camera Industrial Standard.)

A-5-3.3 LU Series (Miniature type)



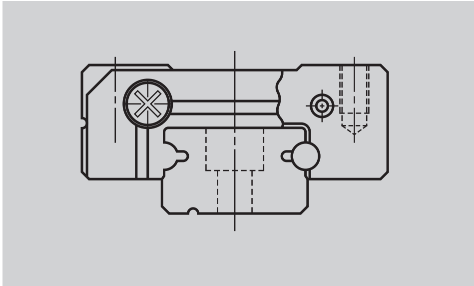


Fig. 1 LU Series

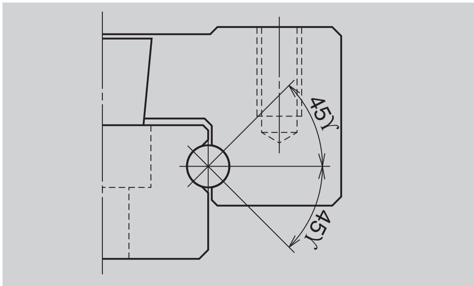


Fig. 2 Balls are in contact.

(1) Features

1. Super-small type

This compact guide owes its design to the single ball groove on both right and left sides (Gothic arch) .

2. Equal load carrying capacity in vertical and lateral directions

Contact angle is set at 45 degrees, equally load carrying capacity in vertical and lateral directions. This also provides equal rigidity in both directions.

3. Stainless steel is also standardized

Items made of the martensitic stainless steel are available as standard.

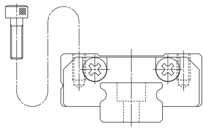
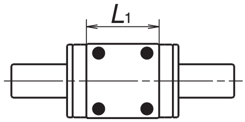
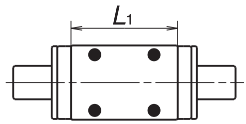
4. Some series have a ball retainer

Ball slide types AR and TR come with a ball retainer. Balls are retained in the retainer and do not fall out when the bearing is withdrawn from the rail. (Ball slides of random-matching parts as well as LU15 come with ball retainer.)

5. Fast delivery

The series enables random matching of rails and ball slides for prompt delivery. (LU09 to LU15)

(2) Ball slide shape

Ball slide Model	Shape/installation method	Type: Standard type	Type: High-load type
AL TL AR TR BL UL		AL, TL, AR, TR 	BL, UL 

(3) Accuracy and preload

1. Runing parallelism tolerance

Table 1

Unit: µm

Rail length (mm) over – or less	Preloaded assembly type (not random matching): Super precision P4	High precision P5	Precision grade P6	Normal grade PN	Random-matching type: Normal grade PC
– 50	2	2	4.5	6	6
50 – 80	2	3	5	6	6
80 – 125	2	3.5	5.5	6.5	6.5
125 – 200	2	4	6	7	7
200 – 250	2.5	5	7	8	8
250 – 315	2.5	5	8	9	9
315 – 400	3	6	9	11	11
400 – 500	3	6	10	12	12
500 – 630	3.5	7	12	14	14
630 – 800	4.5	8	14	16	16
800 – 1000	5	9	16	18	18
1000 – 1250	6	10	17	20	20

2. Accuracy standard

The preloaded assembly types products have four accuracy grades; Super precision P4, High precision P5, Precision P6, and Normal PN grades, while the random-matching type has Normal PC grade.
Table 2 shows the accuracy standard for the preloaded assembly type while Table 3 shows the accuracy standard for the random-matching types.

• Tolerance of preloaded assembly

Table 2

Unit: 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 face C to face A Running parallelism of face D to face B	Refer to Table 1 and Fig. 3			

• Tolerance of random-matching type: Normal grade PC

Table 3

Unit: μm

Characteristics \ Accuracy grade	Normal grade PC
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 face C to face A Running parallelism of face D to face B	Refer to Table 1 and Fig. 3

3. Assembled accuracy

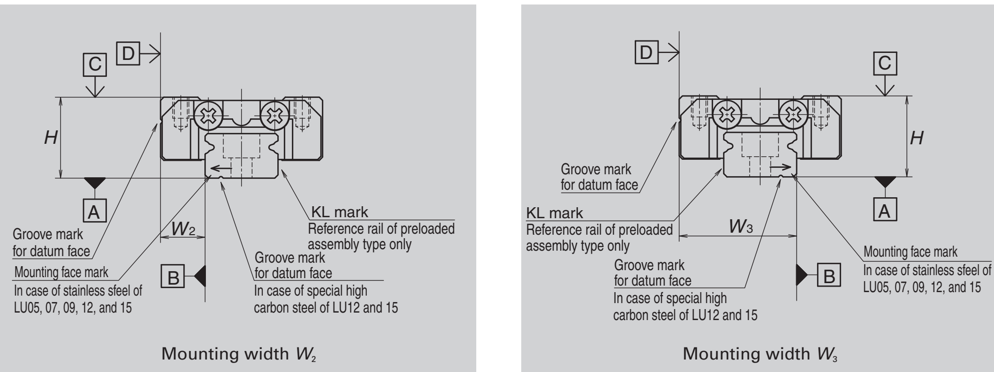


Fig. 3

Note: Please refer to page A67 for marks on the datum faces.

4. Preload and rigidity

We offer three levels of preload: Slight preload (Z1) and Fine clearance (Z0), along with random-matching type of Fine clearance (ZT). Values for preloaded and rigidity of the preloaded assembly type are shown in Table 4. Rigidities are for the median of the preload range.

• Preload and rigidity of preloaded assembly

Table 4

Model No.		Preload (N) Slight preload (Z1)	Rigidity (N/μm) Slight preload (Z1)
Standard type	LU05 TL	0 – 3	15
	LU07 AL	0 – 8	22
	LU09 AL, TL	0 – 12	26
	LU09 AR, TR	0 – 10	30
	LU12 AL, TL	0 – 17	33
	LU12 AR, TR	0 – 17	33
	LU15 AL	0 – 33	45
High-load type	LU09 BL, UL	0 – 17	43
	LU12 BL, UL	0 – 25	52
	LU15 BL	0 – 51	75

Note: Clearance of fine clearance Z0 is 0 to 3 μm. Therefore, preload is zero.
However, Z0 of PN grade is 3 to 10 μm.
Clearance values of the random-matching type are shown in Table 5.

• Clearance of random-matching type

Table 5

Unit: μm

Model No.	Fine clearance ZT
LU09	0 – 15
LU12	
LU15	

(4) Available length of rail

Table 6 shows the limitations of rail length (maximum length).

However, the limitations vary by accuracy grade.

Table 6 Length limitation of rails

Unit: mm

Series	Size / Material	05	07	09	12	15
LU	Special high carbon steel	–	–	1200	1800	2000
	Stainless steel	210	375	600	800	1000

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

(5) Installation

1. Permissible values of mounting error

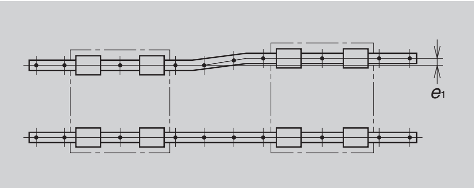


Fig. 4

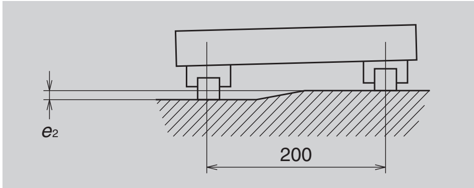


Fig. 5

Table 7

Unit: 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 face and corner radius r

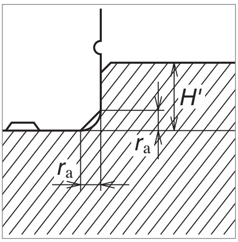


Fig. 6 Shoulder for the rail datum face

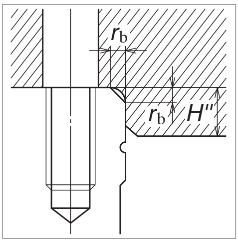


Fig. 7 Shoulder for the ball slide datum face

Table 8

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
LU05	0.2	0.2	0.7	2
LU07	0.2	0.3	1.2	3
LU09	0.3	0.3	1.9	3
LU12	0.3	0.3	2.5	4
LU15	0.3	0.5	3.5	5

(6) Lubrication accessories

There is no standard grease fitting for LU05 to LU15.
For LU Series, apply grease directly to ball groove, etc. using a point nozzle.

(7) Dust proof components

1. Standard specification

End seal: Provided to both ends of the ball slide as a standard feature.
LU05TL, LU07AL, LU09AL, and LU09TL can install as an option.

• Seal friction per standard ball slide is shown in Table 9.

Table 9 Seal friction per ball slide (maximum value)

Unit: N

Series \ Size	05	07	09	12	15
LU	0.3	0.3	0.5	0.5	0.5

2. NSK K1™

Dimension of installing NSK K1 shown in Table 10.

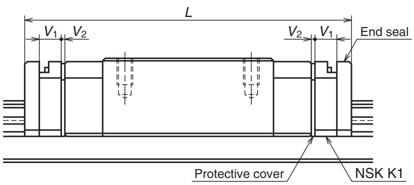


Table 10

Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_1	Protective cover thickness V_2
LU05	Standard	TL	18*	24.4	2.0	0.5
LU07	Standard	AL	20.4*	29.4	2.5	0.5
	Standard	AR, TR	30	36.4		
LU09	Standard	AL, TL	26.8*	34.2	2.7	0.5
	Long	BL, UL	41	47.4		
	Standard	AR	35.2	42.2		
LU12	Standard	AL, TL	34	41	3.0	0.5
	Long	BL, UL	47.5	54.5		
LU15	Standard	AL	43.6	51.8	3.5	0.6
	Long	BL	61	69.2		

*) Standard ball slide length of LU05TL, LU07AL, LU09AL and LU09TL does not include thickness of the end seal thickness (1.5 mm). However, it includes the height of the screw head for end cap installation (Included length – LU05, 0.8 mm; LU07, no projection; LU09, 1 mm)

Note: Ball slide length equipped with NSK K1 =
(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**

- LU: Series name
- 12: Size
- 0270: Rail length (mm)
- AR: Ball slide shape code (See page A310)
- K: Material/surface treatment code (See Table 11)
- 2: Number of ball slides per rail
- -**: Design serial number
  Added to the reference number.
- P5: Accuracy code (See Table 12)
- 1: Preload code (See page A312)

2. Reference number for random-matching type

Ball slide

LAU 12 AR K - **PC T**

- LAU: Random-matching ball slide series code
  LAU : LU Series random-matching ball slide
- 12: Size
- AR: Ball slide shape code (See page A310)
- K: Material/surface treatment code (See Table 11)
- -**: Design serial number
  Added to the reference number.
- PC: Accuracy code : PC
  PC: Normal grade is only available
- T: Preload code
  T: Fine clearance (See page A312)

Rail

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
  T: Fine clearance (See page A312)

*Please consult with NSK for butting rail specification.

Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is fine clearance "T" (Refer to page A312).

Table 11 Material/surface treatment code

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

Table 12 Accuracy code

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

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

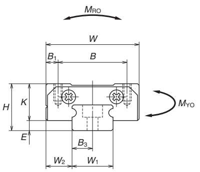
(9) Dimensions

LU-AL (LU15 is equipped with ball retainer)
LU-TL (Large mounting hole)
LU-AR (With ball retainer)
LU-TR (Large mounting hole, with ball retainer)

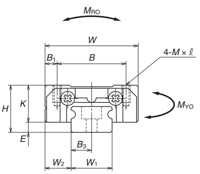
LU 12 0270 AR K 2 -∗∗ P5 1

- Series name
- Size
- Rail length (mm)
- Ball slide shape code (See page A310)
- Material/surface treatment code (See Table 11)
- Number of ball slides per rail
- Design serial number
  Added to the reference number.
- Accuracy code (See Table 12)
- Preload code (See page A312)

Front view

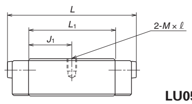


LU05TL, LU07AL
LU09AL, TL

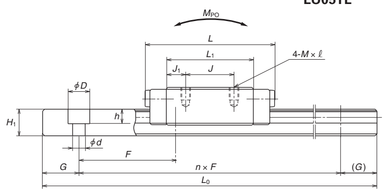


LU09AR, TR
LU12AL, TL, AR, TR
LU15AL

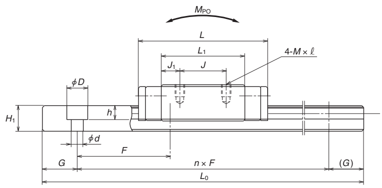
Side view



LU05TL



LU07AL
LU09AL, LU09TL



LU09AR, TR
LU12AL, TL, AR, TR
LU15AL

Model No.	Assembly			Ball slide										
	Height			Width	Length	Mounting hole							Width	Height
	H	E	W_2	W	L	B	J	M×pitch×ℓ	B_1	L_1	J_1	K	W_1	H_1
LU05TL	6	1	3.5	12	18	8	—	M2×0.4×1.5	2	12	6	5	5	3.2
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
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
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
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
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
LU15AL	16	4	8.5	32	43.6	25	20	M3×0.5×4	3.5	27	3.5	12	15	9.5

Remarks 1) LU05TL, LU07AL, LU09TL, LU09AR, LU09TR, LU12AR and LU12TR come in stainless steel only.
2) Ball slide of LU05TL has only two mounting tap holes in the center.
3) End seals of LU05TL, LU07AL, LU09AL and LU09TL are available on request.

Random matching with retainer: LU09 - 12 are AR/TR, LU15 is AL.
Reference number for ball slide of random-matching type

LAU-AR (With ball retainer)
LAU-TR (Large mounting hole, with ball retainer)
LAU-AL (LU15 is equipped with ball retainer)

LAU 12 AR K - PC T**

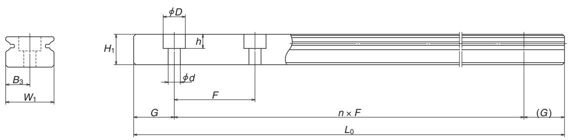
- LAU: Random-matching ball slide series code
  - LAU : LU Series random-matching ball slide
- 12: Size
- AR: Ball slide shape code (See page A310)
- K: Material/surface treatment code (See Table 11)
- **: Design serial number
  - Added to the reference number.
- PC: Accuracy code : PC
  - PC: Normal grade is only available
- T: Preload code
  - T: Fine clearance (See page A312)

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 (See page A315)
- 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
  - T: Fine clearance (See page A312)

*Please consult with NSK for butting rail specification.



Unit: mm

Rail					Basic load rating					Ball dia.	Weight	
Pitch F	Mounting bolt hole d×D×h	B_3	G (Reference)	Max. length L_{0MAX}. ( ) for stainless	Dynamic C (N)	Static C_0 (N)	Static moment M_{RO} (N · m)	Static moment M_{PO} (N · m)	Static moment M_{YO} (N · m)	D_W	Ball slide (g)	Rail (g/100mm)
15	2.3×3.3×1.5	2.5	5	— (210)	545	740	1.93	1.22	1.22	1.2	4	11
15	2.4×4.2×2.3	3.5	5	— (375)	1090	1370	4.90	2.66	2.66	1.587	10	23
20	2.6×4.5×3 3.5×6×4.5	4.5	7.5	1200 (600)	1760	2220	10.2	6.10	6.10	2	17	35
20	2.6×4.5×3 3.5×6×4.5	4.5	7.5	— (600)	1490	2150	9.9	6.10	6.10	1.587	19	35
25	3×5.5×3.5 3.5×6×4.5	6	10	1800 (800)	2830	3500	21.1	11.4	11.4	2.381	38	65
25	3×5.5×3.5 3.5×6×4.5	6	10	— (800)	2830	3500	21.1	11.4	11.4	2.381	38	65
40	3.5×6×4.5	7.5	15	2000 (1000)	5550	6600	49.5	25.6	25.6	3.175	70	105

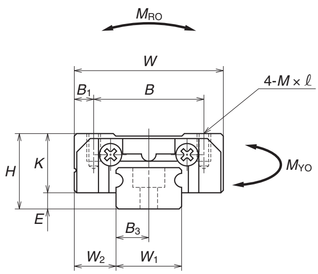
4) To fix rail of LU05TL, use M2 x 0.4 cross-recessed pan head machine screw for precision instrument.
(JCIS 10-70 No. 0 pan head machine screw No.1.)
(JCIS : Japanese Camera Industrial Standard.)
5) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

LU-BL (High-load type)
LU-UL (High-load type, large mounting hole)

LU 12 0270 BL K 2 -∗∗ P5 1

- Series name (LU)
- Size (12)
- Rail length (mm) (0270)
- Ball slide shape code (See page A310) (BL)
- Material/surface treatment code (See Table 11) (K)
- 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 A312) (1)

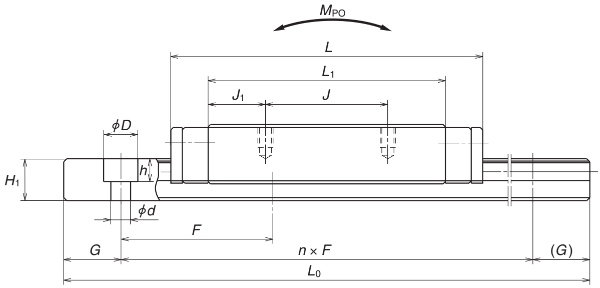
Front view



Model No.	Assembly			Ball slide										
	Height			Width	Length	Mounting hole							Width	Height
	H	E	W_2	W	L	B	J	M×pitch×ℓ	B_1	L_1	J_1	K	W_1	H_1
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
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
LU15BL	16	4	8.5	32	61	25	25	M3×0.5×4	3.5	44.4	9.7	12	15	9.5

Remarks 1) LU09UL is available only in stainless steel.
2) LU15BL is equipped with ball retainer.

Side view

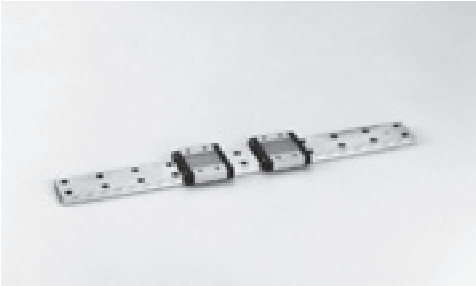


Unit: mm

Rail					Basic load rating					Ball dia.	Weight	
Pitch F	Mounting bolt hole $d \times D \times h$	B_3	G (Reference)	Max. length $L_{0MAX.}$ ( ) for stainless	Dynamic C (N)	Static C_0 (N)	Static moment M_{RO} (N · m)	 M_{PO} (N · m)	 M_{YO} (N · m)	D_W	Ball slide (g)	Rail (g/100mm)
20	2.6×4.5×3 3.5×6×4.5	4.5	7.5	1200 (600)	2600	3900	17.9	17.2	17.2	2	29	35
25	3×5.5×3.5 3.5×6×4.5	6	10	1800 (800)	4000	5700	34.5	28.3	28.3	2.381	59	65
40	3.5×6×4.5	7.5	15	2000 (1000)	8100	11300	84.5	69.5	69.5	3.175	107	105

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

A-5-3.4 LE Series
(Miniature type)



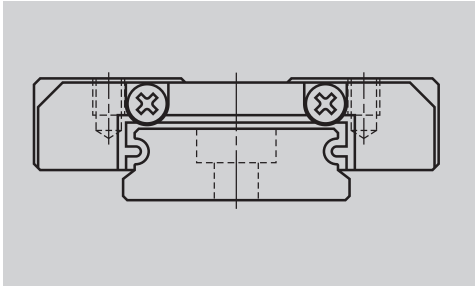


Fig. 1 LE Series

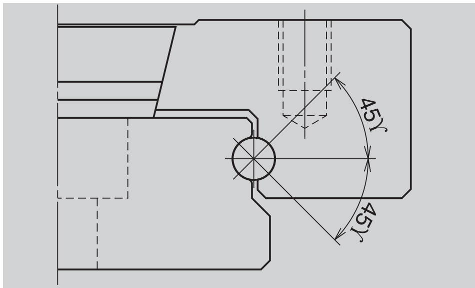


Fig. 2 Balls in contact

(1) Features

1. Ideal for use of single rail

LE Series linear guides are miniature and wide rail type. Thanks to the wide rail, load carrying capacity is high against moment load from rolling direction.

2. Equal load carrying capacity in vertical and lateral directions

Contact angle is set at 45 degrees, equally dispersing the load from vertical and lateral directions. This also provides equal rigidity in the two directions.

3. Guides are super-thin.

Super-thin guides owe their design to the single ball groove on right and left sides (Gothic arch).

4. High accuracy

Fixing the master rollers is easy thanks to the Gothic arch groove. Groove measuring is accurate and easy.

5. Stainless steel is standard.

Rails and ball slides are made of martensitic stainless steel.

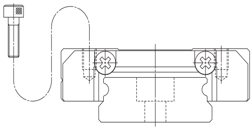
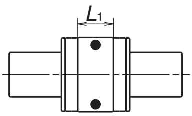
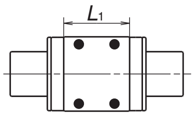
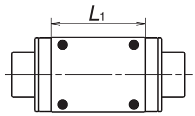
6. Ball retainer is available in some series.

Some series come with a ball retainer (ball slide model: AR and TR). Balls are retained in the retainer and do not fall out when a ball slide is withdrawn from the rail (random-maching ball slides come with a ball retainer).

7. Fast delivery

The series enables random matching of rails and ball slides (interchangeability) for prompt delivery. (LE09 to LE15)

(2) Ball slide shape

Ball slide Model	Shape/installation method	Type		
		Medium-load type	Standard type	High-load type
AL TL AR TR BL UL CL SL		CL, SL 	AL, TL, AR, TR 	BL, UL 

Specification	Detail	Type		
Mounting hole	Normal	CL*	AL, AR	BL*
	Large	SL*	TL, TR	UL*
Ball retainer	Without	CL, SL	AL, TL	BL, UL
	With	—	AR, TR	—

* Only applicable to LE09

(3) Accuracy and preload

1. Runing parallelism tolerance

Table 1

Unit: μm

Rail length (mm)		Preloaded assembly type (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	1000	9	16	18	18
1000	1250	10	17	20	20

2. Accuracy standard

The preloaded assembly types products have three accuracy grades; High precision P5, Precision P6, and Normal PN grades, while the random-matching type has Normal PC grade.
Table 2 shows the accuracy standard for the preloaded assembly type while Table 3 shows the accuracy standard for the random-matching types.

• Tolerance of preloaded assembly

Table 2

Unit: µm

Characteristics \ Accuracy grade	High precision P5	Precision grade P6	Normal grade PN
Mounting height H Variation of H (All ball slides on a set of rails)	±15 7	±20 15	±40 25
Mounting width W_2 or W_3 Variation of W_2 or W_3 (All ball slides on reference rail)	±20 10	±30 20	±50 30
Running parallelism of face C to face A Running parallelism of face D to face B	Refer to Table 1 and Fig. 3		

• Tolerance of random-matching type: Normal grade, PC

Table 3

Unit: µm

Characteristics \ Accuracy grade	Normal grade PC
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 face C to face A Running parallelism of face D to face B	Refer to Table 1 and Fig. 3

3. Assembled accuracy

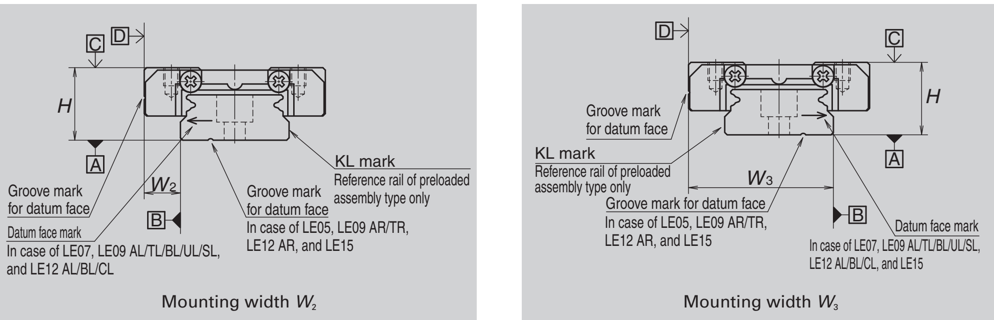


Fig. 3

4. Preload and rigidity

We offer three levels of preload: Slight preload (Z1) and Fine clearance (Z0), along with random-matching type of Fine clearance (ZT). Values for preloaded and rigidity of the preloaded assembly type are shown in Table 4. Rigidities are for the median of the preload range.

• Preload and rigidity of preloaded assembly

Table 4

Model No.		Preload (N)	Rigidity (N/μm)
		Slight preload (Z1)	Slight preload (Z1)
Sutandard type	LE05 AL	0 – 23	36
	LE07 TL	0 – 29	46
	LE09 AL, TL, AR, TR	0 – 37	61
	LE12 AL, AR	0 – 40	63
	LE15 AL, AR	0 – 49	66
Medium-load type	LE05 CL	0 – 18	29
	LE07 SL	0 – 16	28
	LE09 CL, SL	0 – 21	33
	LE12 CL	0 – 23	36
	LE15 CL	0 – 29	44
High-load type	LE07 UL	0 – 43	71
	LE09 BL, UL	0 – 54	86
	LE12 BL	0 – 59	97
	LE15 BL	0 – 75	114

Note: Clearance of fine clearance Z0 is 0 to 3 μm. Therefore, preload is zero.
However, Z0 of PN grade is 3 to 10 μm.
Clearance values of the random-matching type are shown in Table 5.

• Clearance of random-matching type

Table 5

Unit: μm

Model No.	Fine clearance ZT
LE09	0 – 15
LE12	
LE15	

(4) Available length of rail

Table 6 shows the limitations of rail length (maximum length).
However, the limitations vary by accuracy grade.

Table 6 limitations of rail length (single rail)

Unit: mm

Series	Size / Material	05	07	09	12	15
LE	Stainless steel	150	600	800	1000	1200

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

(5) Installation

1. Permissible values of mounting error

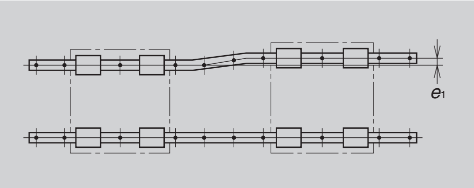


Fig. 4

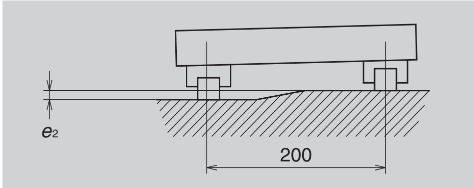


Fig. 5

Table 7

Unit: 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 face and corner radius r

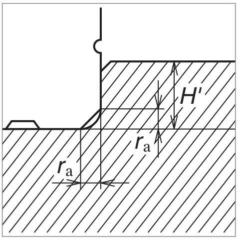


Fig. 6 Shoulder for the rail datum face

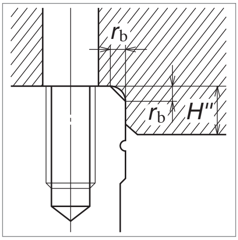


Fig. 7 Shoulder for the ball slide datum face

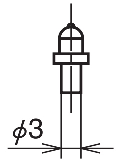
Table 8

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
LE05	0.2	0.2	1.1	2
LE07	0.2	0.3	1.7	3
LE09	0.3	0.3	3.5	3
LE12	0.3	0.3	3.5	4
LE15	0.3	0.5	3.5	5

(6) Lubrication accessories

LE15 AR can select drive-in type grease fitting as option.
There is no standard grease fitting for LE05 to 12.
For LE05 to 15, apply grease directly to ball groove, etc. using a point nozzle.



Drive-in type

(7) Dust proof components

1. Standard specification

End seal: Provided to both ends of the ball slide as a standard feature.

• Seal friction per standard ball slide is shown in Table 9.

Table 9 Seal friction per ball slide (maximum value)

Unit: N

Series \ Size	05	07	09	12	15
LE	0.4	0.4	0.8	1.0	1.2

2. NSK K1™

The dimension of linear guides equipped with NSK K1 are shown in Table 10.

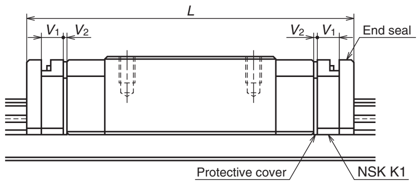


Table 10

Unit: mm

Model No.	Ball slide length	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_1	Protective cover thickness V_2
LE07	Standard	TL	31	37	2.5	0.5
	Long	UL	42	48		
	Short	SL	22.4	28.4		
LE09	Standard	AL, TL	39	46	3.0	0.5
	Standard	AR, TR	39.8	46.8		
	Long	BL, UL	50.4	57.4		
	Short	CL, SL	26.4	33.4		
LE12	Standard	AL	44	52	3.5	0.5
	Standard	AR	45	53		
	Long	BL	59	67		
	Short	CL	30.5	38.5		
LE15	Standard	AL	55.0	64.6	4.0	0.8
	Standard	AR	56.6	66.2		
	Long	BL	74.4	84		
	Short	CL	41.4	51		

Note: Ball slide length equipped with NSK K1 =
(Standard ball slide length) + (Thickness of NSK K1, V_1 × 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**

- LE: Series name
- 15: Size
- 0310: Rail length (mm)
- AR: Ball slide shape code (See page A322)
- K: Material/surface treatment code (See Table 11)
- 2: Number of ball slides per rail
- -**: Design serial number
  Added to the reference number.
- P5: Accuracy code (See Table 12)
- 1: Preload code (See page A324)

2. Reference number for random-matching type

Ball slide

LAE 15 AR K - **PC T**

- LAE: Random-matching ball slide series code
  LAE : LE Series random-matching ball slide
- 15: Size
- AR: Ball slide shape code (See page A322)
- K: Material/surface treatment code (See Table 11)
- -**: Design serial number
  Added to the reference number.
- PC: Accuracy code : PC
  PC: Normal grade is only available
- T: Preload code
  T: Fine clearance (See page A324)

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: LU09 and LU12 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
  T: Fine clearance (See page A324)

*Please consult with NSK for butting rail specification.

Reference number for assembly of random-matching ball slide and rail is the same as the coding of preloaded assembly. However, preload code is fine clearance "T" (Refer to page A324).

Table 11 Material/surface treatment code

Code	Description
K	Stainless steel
H	Stainless steel with surface treatment
Z	Other, special

Table 12 Accuracy code

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

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

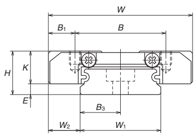
(9) Dimensions

LE-AL
LE-TL (Large mounting hole)
LE-AR (With ball retainer)
LE-TR (Large mounting hole, with ball retainer)

LE 15 0310 AR K 2 -∗∗ P5 1

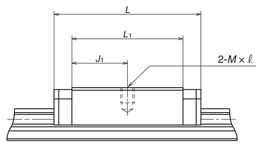
- Series name (LE)
- Size (15)
- Rail length (mm) (0310)
- Ball slide shape code (See page A322) (AR)
- Material/surface treatment code (See Table 11) (K)
- Number of ball slides per rail (2)
- Design serial number (-∗∗) Added to the reference number.
- Accuracy code (See Table 12) (P5)
- Preload code (See page A324) (1)

Front view

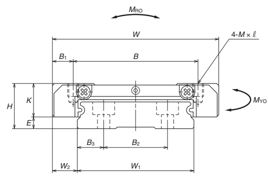


LE05, 07, 09, 12

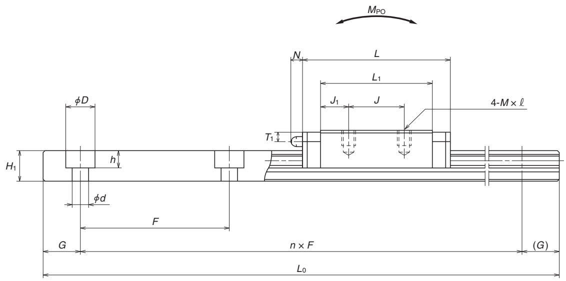
Side view



LE05



LE15



LE07, 09, 12, 15

Model No.	Assembly			Ball slide									Grease fitting				
	Height			Width	Length	Mounting hole							Hole size			Width	Height
	H	E	W_2	W	L	B	J	M × pitch × ℓ	B_1	L_1	J_1	K		T_1	N	W_1	H_1
LE05AL	6.5	1.4	3.5	17	24	13	—	M2.5×0.45×2	2	17	8.5	5.1	—	—	—	10	4
LE07TL	9	2	5.5	25	31	19	10	M3×0.5×3	3	21.2	5.6	7	—	—	—	14	5.2
LE09AL **LE09TL**	12	4	6	30	39	21	12	M2.6×0.45×3 M3×0.5×3	4.5	27.6	7.8	8	—	—	—	18	7.5
LE09AR **LE09TR**	12	4	6	30	39.8	21	12	M2.6×0.45×3 M3×0.5×3	4.5	27.6	7.8	8	—	—	—	18	7.5
LE12AL **LE12AR**	14	4	8	40	44 45	28	15	M3×0.5×4	6	31	8	10	—	—	—	24	8.5
LE15AL **LE15AR**	16	4	9	60	55 56.6	45	20	M4×0.7×4.5	7.5	38.4	9.2	12	— φ3	— 3.2	— 3	42	9.5

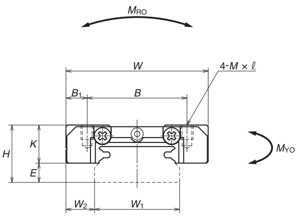
Remarks: 1) Ball slide of LE05 has only two mounting tap holes.

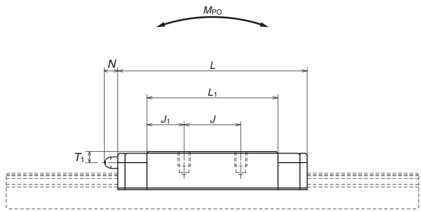
Random matching with retainer: AR, TR.
Reference number for ball slide of random-matching type

LAE-AR (With ball retainer)
LAE-TR (Large mounting hole with ball retainer)

Ball slide **LAE 15 AR K -∗∗PC T**

- Random-matching ball slide series code
  LAE : LE Series random-matching ball slide
- Size
- Ball slide shape code (See page A322)
- Material/surface treatment code (See Table 11)
- Preload code
  T: Fine clearance (See page A324)
- Accuracy code : PC
  PC: Normal grade is only available
- Design serial number
  Added to the reference number.



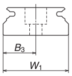


Reference number for rail of random-matching type

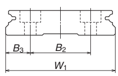
Rail **L1E 15 0310 R K N -∗∗ PC T**

- Random-matching rail series code
  L1E : LE Series random-matching rail
- Size
- Rail length (mm)
- Rail shape code
  R: LU09 and LU12 standard equipped with ball retainer
- Material/surface treatment code (See Table 11)
- Preload code
  T: Fine clearance (See page A324)
- 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

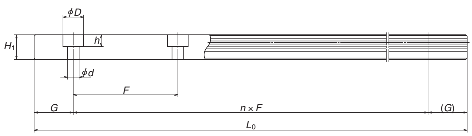
*Please consult with NSK for butting rail specification.



LE09, 12



LE15



Unit: mm

Rail						Basic load rating					Ball dia.	Weight	
	Pitch	Mounting bolt hole		G	Max. length	Dynamic	Static	Static moment				Ball slide	Rail
						C	C_0	M_{RO}	M_{PO}	M_{YO}	D_W		
B_2	F	$d \times D \times h$	B_3	(Reference)	L_{0max}	(N)	(N)	(N·m)	(N·m)	(N·m)		(g)	(g/100mm)
—	20	3×5×1.6	5	7.5	150	725	1110	5.65	2.58	2.58	1.200	11	34
—	30	3.5×6×3.2	7	10	600	1580	2350	16.7	7.20	7.20	1.587	25	55
—	30	3.5×6×4.5	9	10	800	3000	4500	36.5	17.3	17.3	2.000	40	95
—	30	3.5×6×4.5	9	10	800	3000	4500	36.5	17.3	17.3	2.000	40	95
—	40	4.5×8×4.5	12	15	1000	4350	6350	70.5	29.3	29.3	2.381	75	140
23	40	4.5×8×4.5	9.5	15	1200	7600	10400	207	59.0	59.0	3.175	150	275

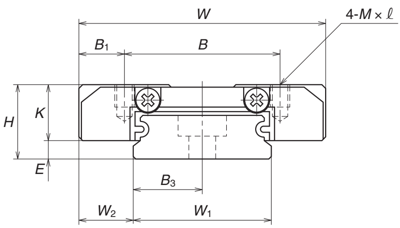
2) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface.
3) When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.
For fixing a rail of LE05AL, use M2.5x0.45 cross-recessed pan head machine screw for precision instruments.
(JCIS 10-70 : No.0 pan head machine screw No.3) (JCIS : Japanese Camera Industrial Standard)

LE-BL (High-load type)
LE-UL (High-load type, large mounting hole)

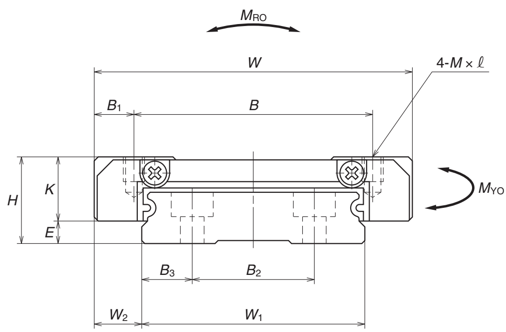
LE 15 0310 AR K 2 -∗∗ P5 1

- Series name: LE
- Size: 15
- Rail length (mm): 0310
- Ball slide shape code (See page A322): AR
- Material/surface treatment code (See Table 11): K
- 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 A324): 1

Front view



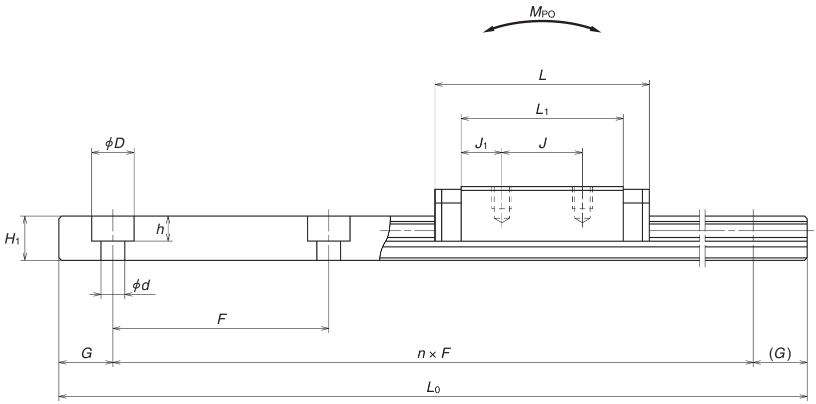
LE07, 09, 12



LE15

Model No.	Assembly			Ball slide										
	Height			Width	Length	Mounting hole							Width	Height
	H	E	W_2	W	L	B	J	M × pitch × ℓ	B_1	L_1	J_1	K	W_1	H_1
LE07UL	9	2	5.5	25	42	19	19	M3×0.5×3	3	32.2	6.6	7	14	5.2
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
LE12BL	14	4	8	40	59	28	28	M3×0.5×4	6	46	9	10	24	8.5
LE15BL	16	4	9	60	74.4	45	35	M4×0.7×4.5	7.5	57.8	11.4	12	42	9.5

Side view



Unit: mm

Rail						Basic load rating					Ball dia.	Weight	
	Pitch	Mounting bolt hole		G	Max. length	Dynamic	Static	Static moment				Ball slide	Rail
						C	C_0	M_{RO}	M_{PO}	M_{YO}	D_W		
B_2	F	$d \times D \times h$	B_3	(Reference)	L_{0max}	(N)	(N)	(N·m)	(N·m)	(N·m)		(g)	(g/100mm)
—	30	3.5×6×3.2	7	10	600	2180	3700	26.4	17.3	17.3	1.587	39	55
—	30	3.5×6×4.5	9	10	800	4000	6700	54.5	37.5	37.5	2.000	58	95
—	40	4.5×8×4.5	12	15	1000	5800	9550	106	63.5	63.5	2.381	115	140
23	40	4.5×8×4.5	9.5	15	1200	10300	16000	320	135	135	3.175	235	275

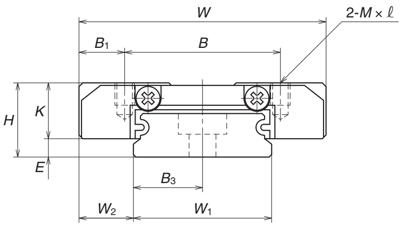
Remark: The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface.
When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

LE-CL (Medium-load type)
LE-SL (Medium-load type, large mounting hole)

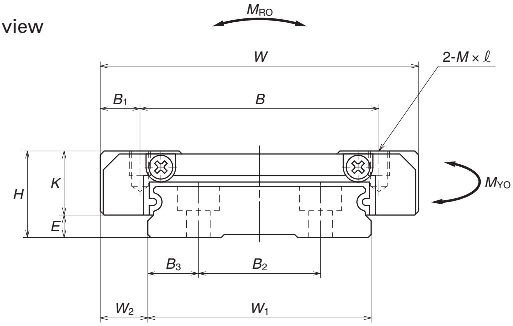
LE 15 0310 AR K 2 - P5 1**

- Series name (LE)
- Size (15)
- Rail length (mm) (0310)
- Ball slide shape code (See page A322) (AR)
- Material/surface treatment code (See Table 11) (K)
- 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 A324) (1)

Front view



LE05, 07, 09, 12

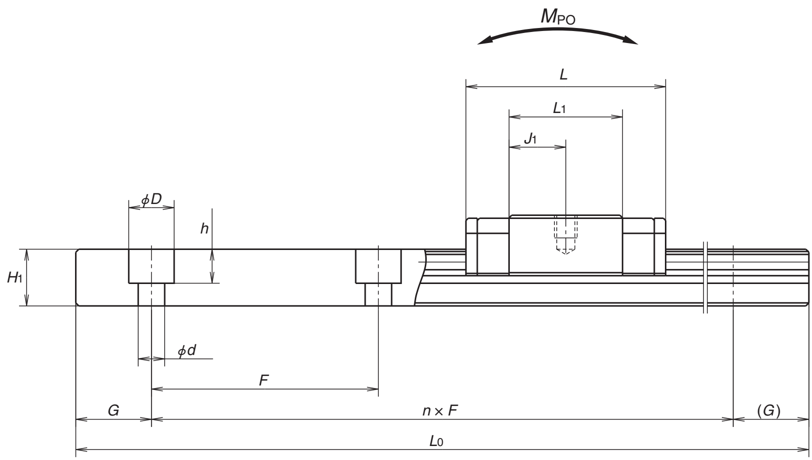


LE15

Model No.	Assembly			Ball slide										
	Height			Width	Length	Mounting hole							Width	Height
	H	E	W_2	W	L	B	J	M × pitch × ℓ	B_1	L_1	J_1	K	W_1	H_1
LE05CL	6.5	1.4	3.5	17	20	13	—	M2.5×0.45×2	2	13	6.5	5.1	10	4
LE07SL	9	2	5.5	25	22.4	19	—	M3×0.5×3	3	12.6	6.3	7	14	5.2
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
LE12CL	14	4	8	40	30.5	28	—	M3×0.5×4	6	17.5	8.75	10	24	8.5
LE15CL	16	4	9	60	41.4	45	—	M4×0.7×4.5	7.5	24.8	12.4	12	42	9.5

Remarks: 1) Ball slide of CL and SL types have only two mounting tap holes in the center.

Side view



Unit: mm

Rail						Basic load rating					Ball dia.	Weight	
	Pitch	Mounting bolt hole		G	Max. length	Dynamic	Static	Static moment				Ball slide	Rail
						C	C_0	M_{RO}	M_{PO}	M_{YO}	D_W		
B_2	F	$d \times D \times h$	B_3	(Reference)	L_{0max}	(N)	(N)	(N·m)	(N·m)	(N·m)		(g)	(g/100mm)
—	20	3×5×1.6	5	7.5	150	595	835	4.25	1.51	1.51	1.200	8	34
—	30	3.5×6×3.2	7	10	600	980	1170	8.35	2.01	2.01	1.587	17	55
—	30	3.5×6×4.5	9	10	800	1860	2240	18.2	4.85	4.85	2.000	25	95
—	40	4.5×8×4.5	12	15	1000	2700	3150	35.0	8.15	8.15	2.381	50	140
23	40	4.5×8×4.5	9.5	15	1200	5000	5650	113	19.4	19.4	3.175	110	275

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

3) For fixing a rail of LE05CL, use cross-recessed pan head machine screw for precision instruments M2.5x0.45 (JCIS 10-70 : Japan Camera Industry Association, No.0, class 3).

A-5-3.5 LL Series

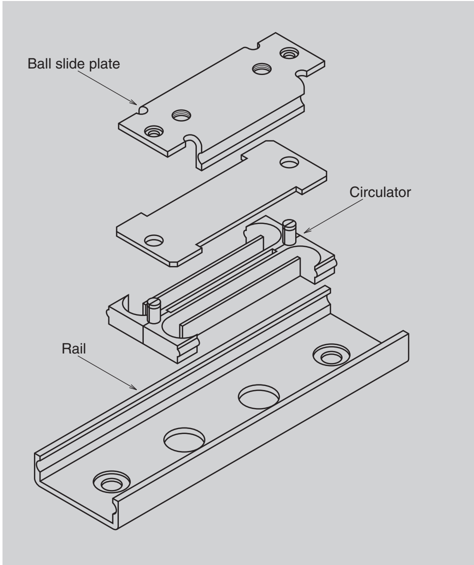


Fig. 1 LL Series structure

(1) Features

1. Super light-weight

This compact guide has a single ball groove on both right and left sides (Gothic arch). Rails and ball slides are made of stainless steel plate, therefore they are lightweight.

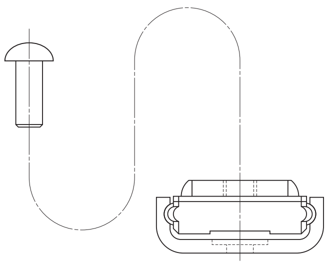
2. Compact

The ball groove is made outside the ball slide to reduce overall size and to obtain high speed.

3. High corrosion resistance

High corrosion resistant martensitic stainless steel is used as standard material.

(2) Ball slide model

Ball slide model	Shape/installation method
PL	

(3) Accuracy and preload

1. Accuracy standard

LL Series has a normal grade PN as accuracy.
Table 1 shows tolerance.

Table 1 Tolerance of LL Series Normal grade (PN)

Unit: μm

Characteristic \ Model No.	LL15
Mounting height	±20
Running parallelism of face C to face A Running parallelism of face D to face B	20 (See Fig. 2)

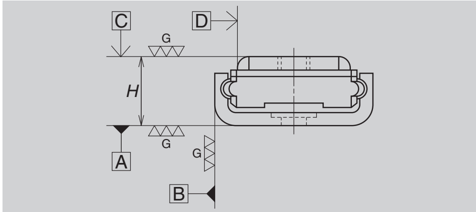


Fig. 2 Standard LL

2. Preload

We offer clearance for LL Series.
Table 2 shows clearance.

Table 2 Radial clearance

Unit: μm

Model No.	Clearance
LL15	0 – 10

(4) Available length of rail

Table 3 Length limitation

Unit: mm

Series	Material \ Size	15				
LL	Stainless steel	40	60	75	90	120

(5) Reference number

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

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

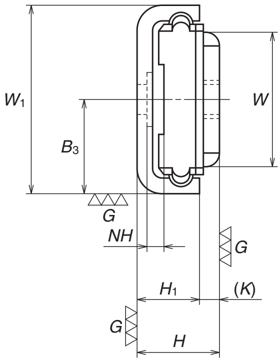
LL 15 0060 PL K 1 -∗∗ PN 0

- LL: Series name
- 15: Size
- 0060: Rail length (mm)
- PL: Ball slide shape code (See page A335)
- K: Material code : K
  - K: Stainless steel
- 1: Number of ball slides per rail
- -∗∗: Design serial number
  - Added to the reference number.
- PN: Accuracy code : PN
  - (PN: Normal grade is only available.)
- 0: Preload code : 0
  - 0 : Clearance

(6) Dimensions

LL 15 0060 PL K 1 -∗∗ PN 0

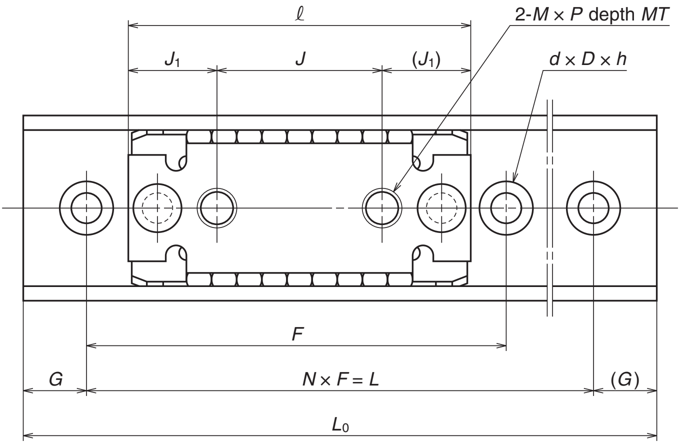
- LL — Series name
- 15 — Size
- 0060 — Rail length (mm)
- PL — Ball slide shape code (See page A335)
- K — Material code : K
  K: Stainless steel
- 1 — Number of ball slides per rail
- ∗∗ — Design serial number
  Added to the reference number.
- PN — Accuracy code : PN
  (PN: Normal grade is only available.)
- 0 — Preload code : 0
  0 : Clearance



Model No.	Assembly Height H	W_1	Ball slide Width W	Length ℓ	Mounting hole J	M × pitch	MT	J_1	K	Height H_1	Pitch F	N
LL15	6.5	15	10.6	27	13	M3×0.5	1.2	7	1.5	5	30	1
											40	1
											30	2
											40	2
											50	2

Remarks:

1) LL Series does not have a ball retainer. Be aware that the balls fall out when a bearing is withdrawn from the rail.
2) Seal Is not available. Please provide the dust-prevention measures on the equipment.
3) Do not use an installation screw on the ball slide which exceeds MT (maximum screw depth allowance) in the dimension table.
4) To fix of LL15PL, use M2 × 0.4 cross recessed machine screw for precision instrument.
   (JCIS10-70 No.0 pan head machine screw No.1)
   (JCIS: Japanese Camera Industrial Standard)



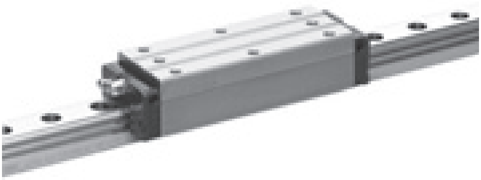
Unit: mm

Rail					Basic load rating					Ball dia.	Weight	
Mounting bolt hole				Length	Dynamic	Static	Static moment				Ball slide	Rail
					C	C_0	M_{RO}	M_{PO}	M_{YO}	D_W		
$d \times D \times h$	NH	B_3	G	L_0	(N)	(N)	(N·m)	(N·m)	(N·m)		(g)	(g)
2.4×5×0.4	1.2	7.5	5 10 7.5 5 10	40 60 75 90 120	880	785	7	3	3	2	6	9 11 13 16 21

5) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the 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 adopting ultra-long ball slides and optimum design features for the ball recirculation component.

2. Ball passage vibration reduced to one-third of our conventional models
Tests show ball passage vibration has been reduced to one-third of our conventional models, dramatically improving straightness in table unit.

3. Installation of rail with greater accuracy
Increased counterbore depth of the rail mounting hole reduces rail deflection, which is caused by bolt tightening when fixing the rail to the base component, to 50% or less. This feature restrains the pitching motion of ball slide whose frequency matches to the mounting hole pitch.
In addition, the length of mounting hole pitch has been reduced by one-half of the conventional models, so the rail can be more accurately installed in position.

4. High rigidity and load capacity with lower friction
High rigidity, high load capacity and low friction are achieved by increasing the number of balls.

5. Compact design
Reduced body size enables more compact machinery.

6. Load distribution four directions
Contact angle is set at 45 degrees in all grooves, dispersing the load to four rows irrespective of load direction. This realizes equal rigidity and load carrying capacity in vertical and lateral directions and provides well-balanced design.

7. Strong against shock load
Load from any direction, vertical and lateral, is received by four rows at all times. The number of the row which receives the load is larger than in other linear guides, making this series stronger against shock load.

8. High accuracy at manufacturing
Fixing the measuring rollers is easy thanks to the Gothic arch groove. Ball-groove measuring is accurate and simple. This benefits a highly precise and stable manufacturing.

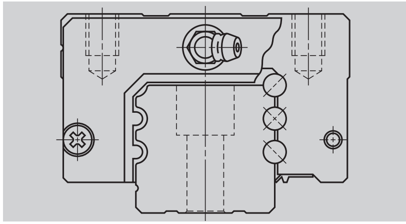


Fig. 1 HA Series

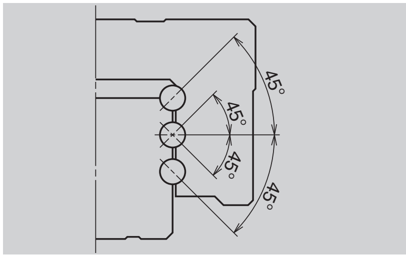


Fig. 2 Super rigidity design

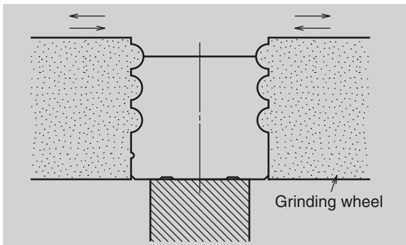


Fig. 3 Rail grinding

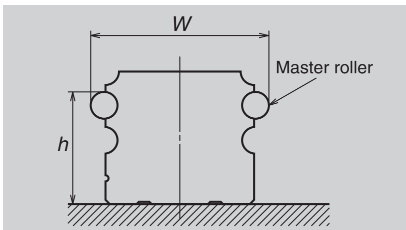


Fig. 4 Measuring groove accuracy

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.

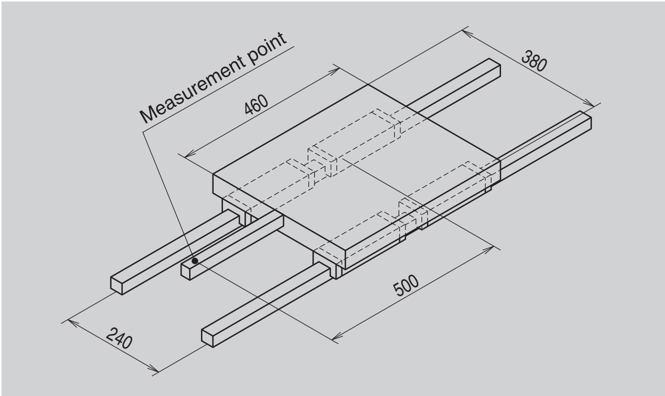


Fig. 5 Schematic view of measurement of ball passage vibration

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

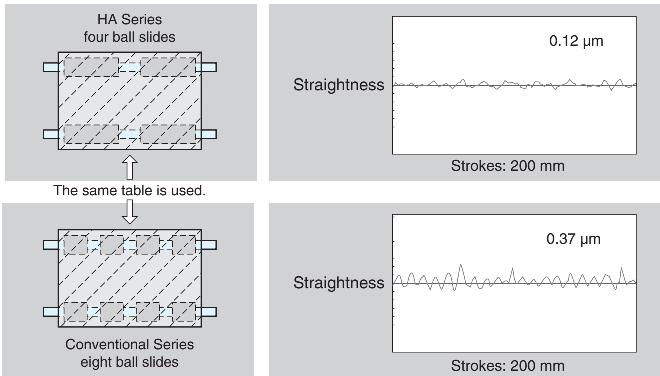
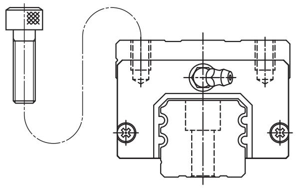
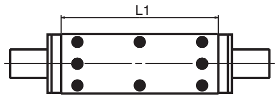
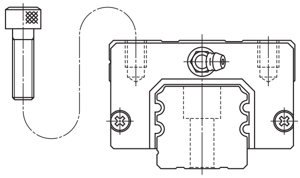
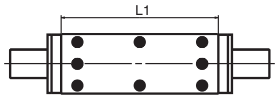
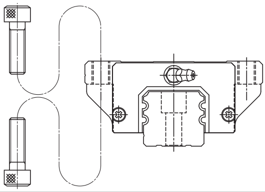
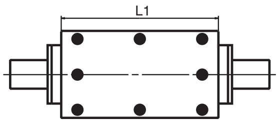


Fig. 6 Measurement results of HA Series and conventional Series

(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 over all length (mm) over | or less	Preloaded assembly Ultra precision P3	Super precision P4	High precision P5
– 200	2	2	4
200 – 250	2	2.5	5
250 – 315	2	2.5	5
315 – 400	2	3	6
400 – 500	2	3	6
500 – 630	2	3.5	7
630 – 800	2	4.5	8
800 – 1 000	2.5	5	9
1 000 – 1 250	3	6	10
1 250 – 1 600	4	7	11
1 600 – 2 000	4.5	8	13
2 000 – 2 500	5	10	15
2 500 – 3 150	6	11	17
3 150 – 4 000	9	16	23

2. Accuracy standard

Three accuracy grades are available: Ultra precision P3, Super precision P4 and High precision P5.

Table 2

Unit: 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 face C to face A Running parallelism of face D to face B	Refer to Table 1 and Fig. 7		

3. Assembled accuracy

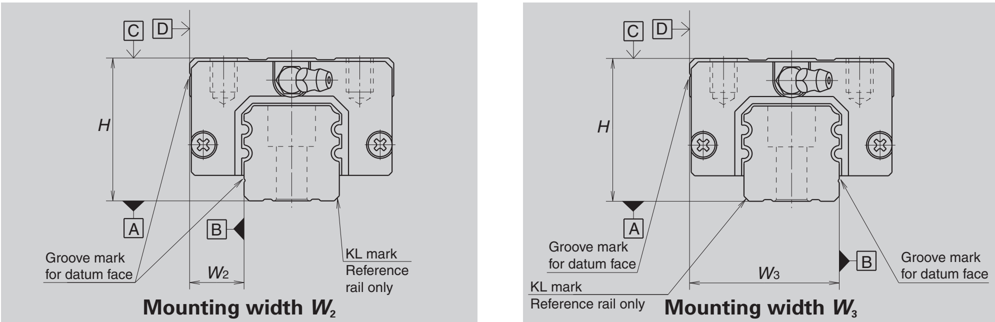


Fig. 7

4. Preload and rigidity

Slight preload Z1 and medium preload Z3 are available for preload, which can be selected for specific applications.

Table 3

Model No	Preload (N)		Rigidity (N/µm)	
	Slight preload (Z1)	Medium preload (Z3)	Slight preload (Z1)	Medium preload (Z3)
HA25	735	2 990	635	1 030
HA30	1 030	4 400	880	1 270
HA35	1 470	6 100	1 030	1 620
HA45	1 960	8 150	1 230	2 060
HA55	3 150	13 100	1 520	2 450

(4) Available length of rail

Table 4 shows the limitations of rail length (maximum length).
However, the limitations vary by accuracy grade.

Table 4

Unit: mm

Series \ Size	25	30	35	45	55
HA	3960	4000	4000	3990	3960

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

(5) Installation

1. Permissible values of mounting error

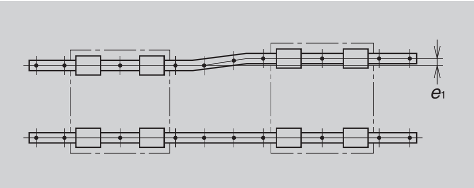


Fig. 8

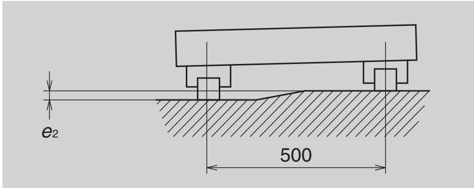


Fig. 9

Table 5

Unit: 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 face and corner radius r

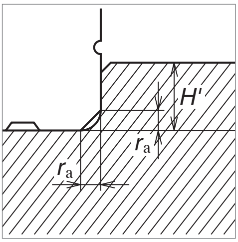


Fig. 10 Shoulder for the rail datum face

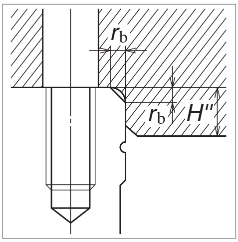


Fig. 11 Shoulder for the ball slide datum face

Table 6

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
HA25	0.5	0.5	5	5
HA30	0.5	0.5	6	6
HA35	0.5	0.5	6	6
HA45	0.7	0.7	8	8
HA55	0.7	0.7	10	10

(6) Lubrication components

Refer to Page A38 and D13 for linear guide lubrication.

1. Types of lubrication accessories

Figure 12 and Table 7 show grease fittings and tube fittings.
We provide lubrication accessories with extended thread body length (L) for the addition of dust proof accessories such as NSK K1 lubrication unit, double seal and protector.
We provide a suitable lubrication accessory for the special requirement on dust proof accessories.
Consult NSK for a lubrication accessory with extended length of thread body for your convenience of replenishing lubricant.
Please ask NSK for stainless lubrication accessories.

2. Mounting position of lubrication accessories

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

Table 7 Unit: mm

Model No.	Dust-proof specification	Grease fitting	Tube fitting
		Thread body length L	Thread body length L
HA25	Standard	5	6*
	With NSK K1	14	13*
	Double seal	10	9*
	Protector	10	9*
HA30	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
HA35	Standard	5	6
	With NSK K1	14	13
	Double seal	12	11
	Protector	12	11
HA45	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17
HA55	Standard	8	17
	With NSK K1	18	21.5
	Double seal	14	17
	Protector	14	17

*) The ball slide shape is only for AN.

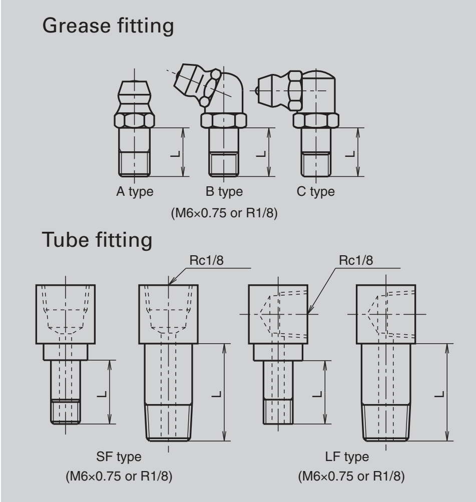


Fig. 12 Grease fitting and tube fitting

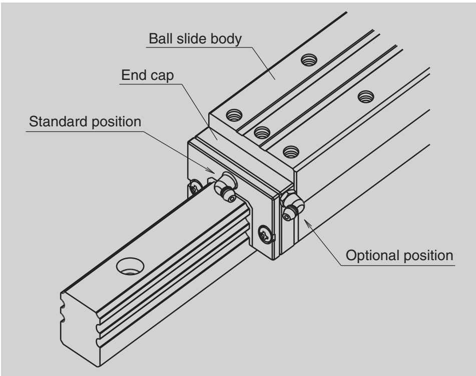


Fig. 13 Mounting position of lubrication accessories

(7) Dust proof components

1. Standard Specification

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

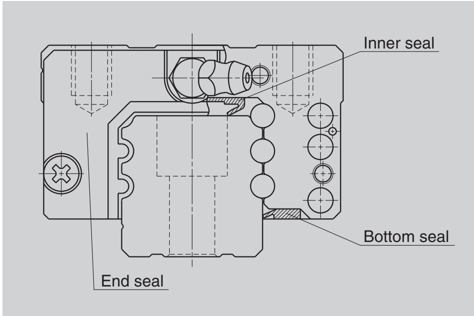


Fig. 14

Table 8 Seal friction per ball slide (maximum value)

Unit: N

Series \ Size	25	30	35	45	55
HA	17	17	19	21	22

2. NSK K1™

• Table 9 shows the dimensions of linear guides equipped with the NSK K1.

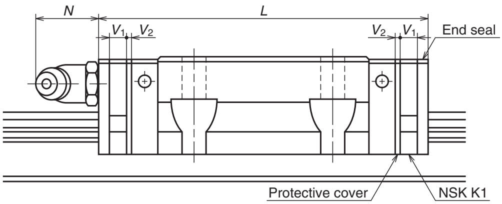


Table 9

Unit: mm

Model No.	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_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 HA series, double seal and protector can be installed only before shipping from the factory. Please consult with NSK.

Table 10 shows the increased thickness of V_1, and V_2 when end seal and protector are installed.

Table 10

Unit: mm

Model No.	Thickness of end seal: V_1	Thickness of protector: V_2
HA25	3.2	3.6
HA30	4.4	4.2
HA35	4.4	4.2
HA45	5.5	4.9
HA55	5.5	4.9

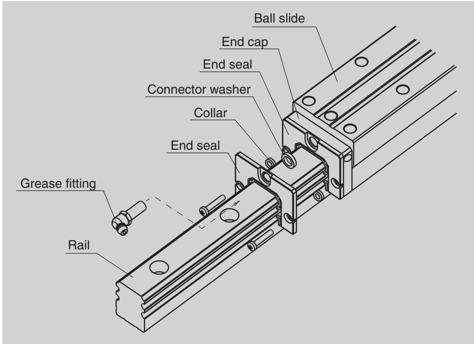


Fig. 15 Double seal

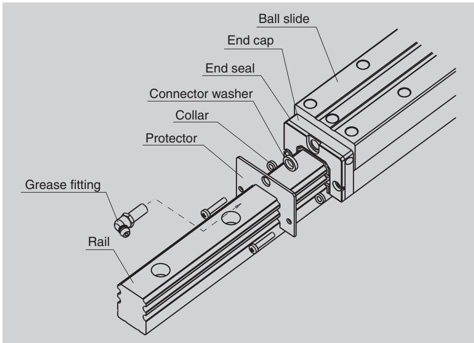


Fig. 16 Protector

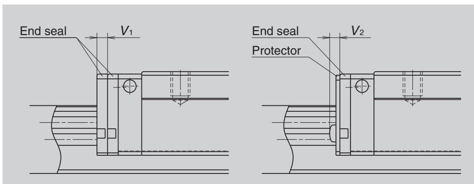


Fig. 17

4. Caps to cover the bolt hole for rail mounting

Table 12 shows size of the bolts for the each model number as well as reference number of the cap.

Table 12 Caps to cover rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
HA25	M6	LG-CAP/M6	20
HA30, HA35	M8	LG-CAP/M8	20
HA45	M12	LG-CAP/M12	20
HA55	M14	LG-CAP/M14	20

(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.

HA 30 0850 AN C 2 - ** **P5 1**

- HA: Series name
- 30: Size
- 0850: Rail length (mm)
- AN: Ball slide shape code (See page A343)
- 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 A344)

Table 12 Material/surface treatment code

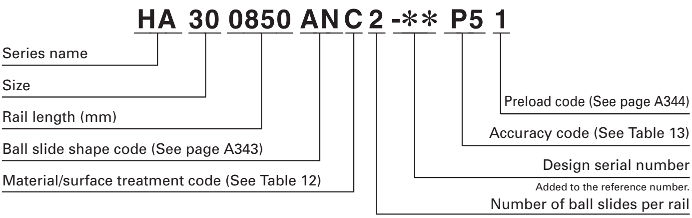
Code	Description
C	Special high carbon steel (NSK standard)
D	Special high carbon steel with surface treatment
Z	Other, special

Table 13 Accuracy code

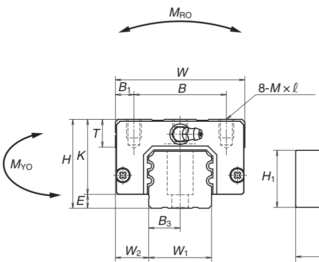
Accuracy	Standard (Without NSK K1)	With NSK K1
Ultra precision grade	P3	K3
Super precision grade	P4	K4
High precision grade	P5	K5

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

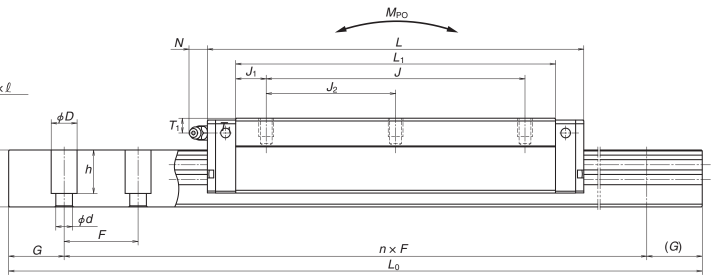
(9) Dimensions



Front view of AL type



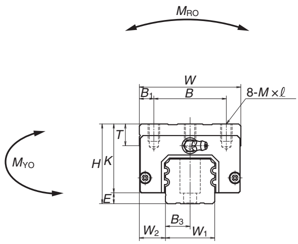
Side view of AL type



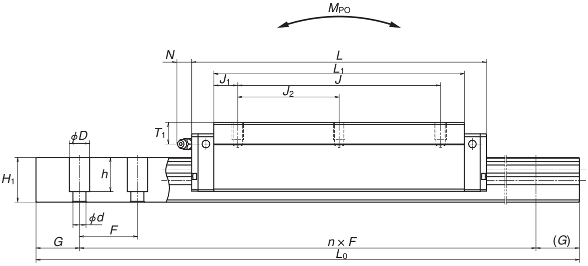
Model No.	Assembly			Ball slide													
	Height			Width	Length	Mounting hole									Grease fitting		
	H	E	W_2	W	L	B	J	J_2	$M \times$ pitch $\times \ell$	B_1	L_1	J_1	K	T	Hole size	T_1	N
HA25AN	40	5.5	12.5	48	147.8	35	100	50	M6×1.0×10	6.5	126	13	34.5	12	M6×0.75	10	11
HA30AN	45	7.5	16	60	177.2	40	120	60	M8×1.25×11	10	149	14.5	37.5	14	M6×0.75	9.5	11
HA35AN	55	7.5	18	70	203.6	50	140	70	M8×1.25×12	10	173	16.5	47.5	15	M6×0.75	15	11
HA35AL	48								M8×1.25×10				40.5			8	
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
HA45AL	60												50			10	
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
HA55AL	70												58			11	

Remarks: 1) HA Series does not have a ball retainer. Be aware that the balls fall out when a bearing is withdrawn from the rail.

Front view of AN type



Side view of AN type



Unit: mm

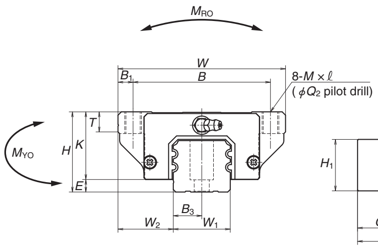
Rail							Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole		G	Maximum length	Dynamic	Static	Static moment				Ball slide	Rail
							C	C_0	M_{RO}	M_{PO}	M_{YO}	D_W		
W_1	H_1	F	$d \times D \times h$	B_3	(Reference)	L_{0max}	(N)	(N)	(N·m)	(N·m)	(N·m)		(kg)	(kg/m)
23	22	30	7×11×16.5	11.5	20	3 960	54 000	115 000	670	2 060	2 060	3.968	1.2	3.7
28	28	40	9×14×21	14	20	4 000	79 500	166 000	1 140	3 550	3 550	4.762	1.8	5.8
34	30.8	40	9×14×23.5	17	20	4 000	111 000	226 000	1 950	5 650	5 650	5.556	3.0 2.6	7.7
45	36	52.5	14×20×27	22.5	22.5	3 990	147 000	295 000	3 700	8 450	8 450	6.350	6.0 5.0	12.0
53	43.2	60	16×23×32.5	26.5	30	3 960	232 000	445 000	6 500	15 400	15 400	7.937	9.4 7.8	17.2

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

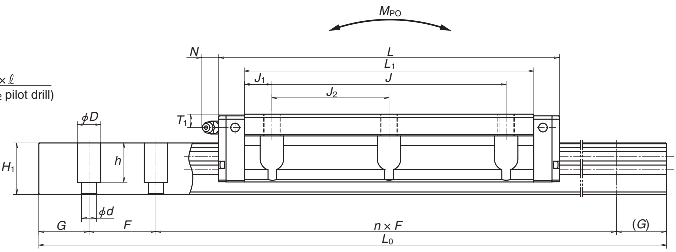
HA 30 0850 EM C 2 -＊＊ P5 1

- Series name — HA
- Size — 30
- Rail length (mm) — 0850
- Ball slide shape code (See page A343) — EM
- Material/surface treatment code (See Table 12) — C
- Number of ball slides per rail — 2
- Design serial number — -＊＊ (Added to the reference number.)
- Accuracy code (See Table 13) — P5
- Preload code (See page A344) — 1

Front view of EM type



Side view of EM type



Model No.	Assembly			Ball slide														
	Height			Width	Length	Mounting hole										Grease fitting		
	H	E	W_2	W	L	B	J	J_2	$M \times$ pitch $\times \ell$	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

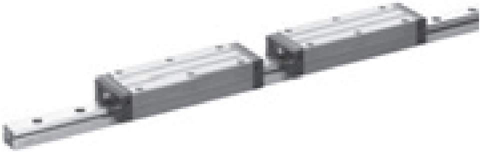
Remarks: 1) HA Series does not have a ball retainer. Be aware that the balls fall out when a bearing is withdrawn from the rail.

Unit: mm

Rail							Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting bolt hole		G	Maximum length	Dynamic	Static	Static moment				Ball slide	Rail
W_1	H_1	F	$d \times D \times h$	B_3	(Reference)	L_{0max}	C (N)	C_0 (N)	M_{RO} (N·m)	M_{PO} (N·m)	M_{YO} (N·m)	D_W	(kg)	(kg/m)
23	22	30	7×11×16.5	11.5	20	3 960	54 000	115 000	670	2 060	2 060	3.968	1.6	3.7
28	28	40	9×14×21	14	20	4 000	79 500	166 000	1 140	3 550	3 550	4.762	2.6	5.8
34	30.8	40	9×14×23.5	17	20	4 000	111 000	226 000	1 950	5 650	5 650	5.556	3.8	7.7
45	36	52.5	14×20×27	22.5	22.5	3 990	147 000	295 000	3 700	8 450	8 450	6.350	6.6	12.0
53	43.2	60	16×23×32.5	26.5	30	3 960	232 000	445 000	6 500	15 400	15 400	7.937	11	17.2

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

A-5-4.2 HS Series



(1) Features

1. High motion accuracy
High motion accuracy is achieved in both narrow and wide ranges by adopting ultra-long ball slides and optimum design features for the ball recirculation component.

2. Ball passage vibration reduced to one-third of our conventional models
Tests show ball passage vibration has been reduced to one-third of our conventional models, dramatically improving straightness in table unit.

3. Installation of rail with greater accuracy
Increased counterbore depth of the rail mounting hole reduces rail deflection, which is caused by bolt tightening when fixing the rail to the base component, to 50% or less. This feature restrains the pitching motion of ball slide whose frequency matches to the mounting hole pitch.
In addition, the length of mounting hole pitch has been reduced by one-half of the conventional models, so the rail can be more accurately installed in position.

4. High rigidity and load capacity with lower friction
High rigidity, high load capacity and low friction are achieved by increasing the number of balls.

5. Compact design
Reduced body size enables more compact machinery.

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

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

8. High accuracy at manufacturing
As showing in Fig. 4, fixing the measuring rollers is simple thanks to the Gothic arch groove. This makes easy and accurate measuring of ball grooves.

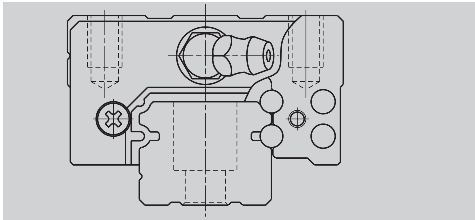


Fig. 1 HS Series

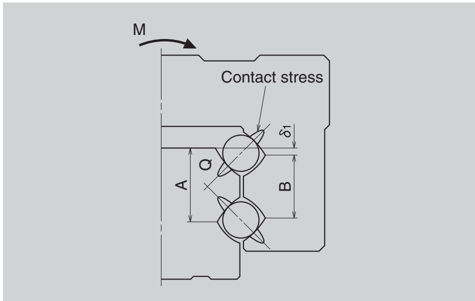


Fig. 2 Enlarged illustration: Offset Gothic arch

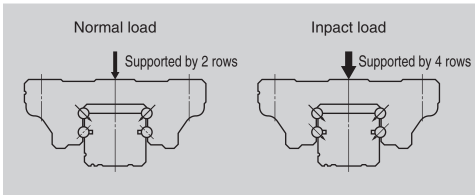


Fig. 3 When load is applied

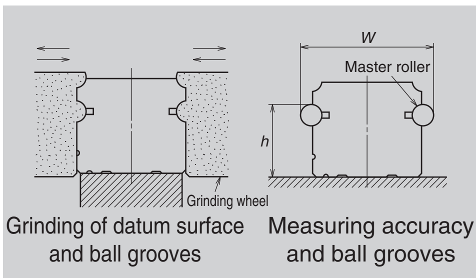


Fig. 4 Rail-grinding and measuring

Measurement results of ball passage vibration

Ball passage vibration can translate into posture changes in the ball slide which result from ball passage (circulation). In the HS Series, this vibration has been substantially reduced to one-third of conventional models.

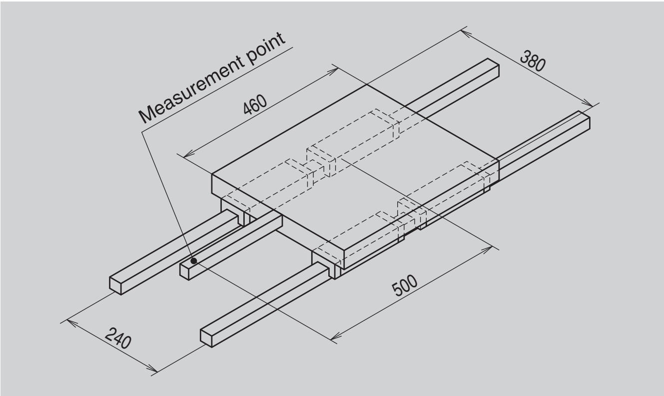


Fig. 5 Schematic view of measurement of ball passage vibration

HS Series

Model No.: HS30
Preload: Z1
Table dimensions: 460 mm × 380 mm

Conventional Series

Model No.: LS30
Preload: Z1
Table dimensions: 460 mm × 380 mm

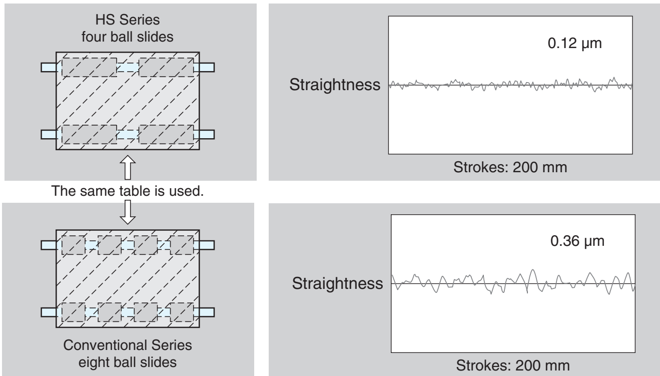
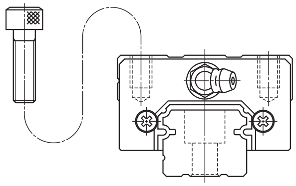
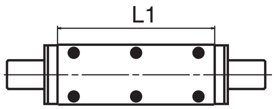
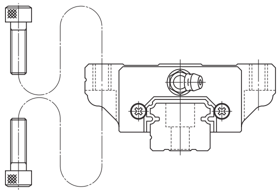
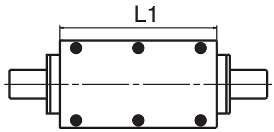


Fig. 6 Measurement results of HS Series and conventional Series

(2) Ball slide shape

Ball slide Model	Shape/installation method	Type
AL		AL 
EM		EM 

(3) Accuracy and preload

1. Running parallelism of ball slide

Table 1

Unit: μm

Rail over all length (mm) over – or less	Preloaded assembly Ultra precision P3	Super precision P4	High precision P5
– 200	2	2	4
200 – 250	2	2.5	5
250 – 315	2	2.5	5
315 – 400	2	3	6
400 – 500	2	3	6
500 – 630	2	3.5	7
630 – 800	2	4.5	8
800 – 1 000	2.5	5	9
1 000 – 1 250	3	6	10
1 250 – 1 600	4	7	11
1 600 – 2 000	4.5	8	13
2 000 – 2 500	5	10	15
2 500 – 3 150	6	11	17
3 150 – 4 000	9	16	23

2. Accuracy Standard

Three accuracy grades are available: ultra precision P3, super precision P4 and high precision P5.

Table 2

Unit: 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 face C to face A Running parallelism of face D to face B	Refer to Table 1 and Fig. 7		

3. Assembled accuracy

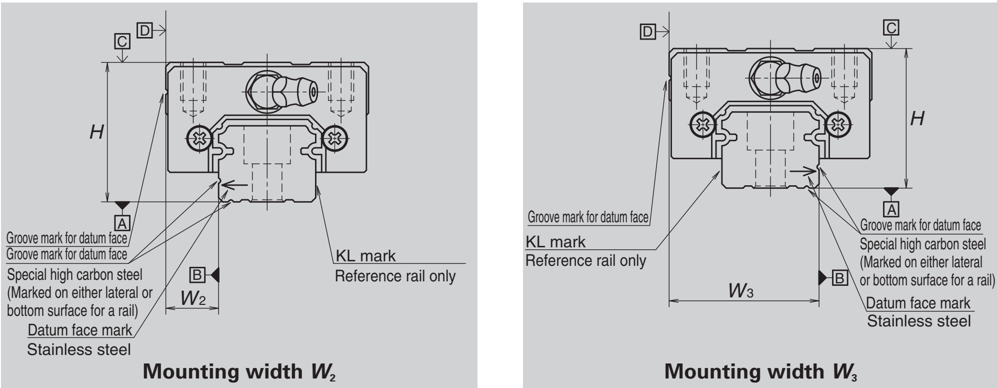


Fig. 7

4. Preload and rigidity

Slight preload Z1 and medium preload Z3 are available for preload, which can be selected for specific applications.

Table 3

Model No.	Preload (N)		Rigidity (N/μm)	
	Slight preload (Z1)	Medium preload (Z3)	Slight preload (Z1)	Medium preload (Z3)
HS15	98	785	260	530
HS20	147	1 030	305	600
HS25	245	1 620	385	735
HS30	390	2 550	505	965
HS35	590	3 550	610	1 140

(4) Available length of rail

Table 4 shows the limitation of rail length (maximum length). The dimension in parenthesis is for stainless. However, the limitations vary by accuracy grade.

Table 4

Unit: mm

Series \ Size	15	20	25	30	35
HS	2000 (1700)	3960 (3500)	3960 (3500)	4000 (3500)	4000 (3500)

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

(5) Installation

1. Permissible values of mounting error

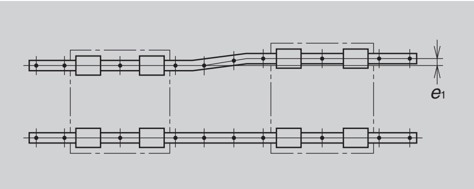


Fig. 8

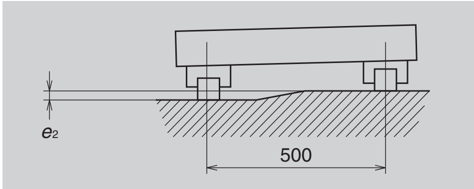


Fig. 9

Table 5

Unit: 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 face and corner radius r

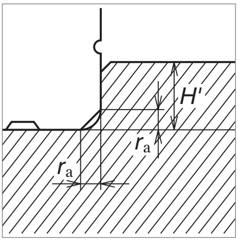


Fig. 10 Shoulder for the rail datum face

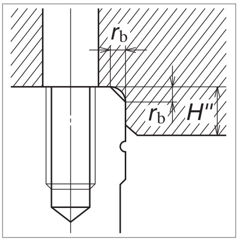


Fig. 11 Shoulder for the ball slide datum face

Table 6 Height of the shoulder and corner radius of the mounting face

Unit: mm

Model No.	Corner radius (maximum)		Shoulder height	
	r_a	r_b	H'	H''
HS15	0.5	0.5	4	4
HS20	0.5	0.5	4.5	5
HS25	0.5	0.5	5	5
HS30	0.5	0.5	6	6
HS35	0.5	0.5	6	6

(6) Lubrication components

Refer to Page A38 and D13 for linear guide lubrication.

1. Types of lubrication accessories

Figure 12 and Table 7 show grease fittings and tube fittings.
We provide lubrication accessories with extended thread body length (L) for the addition of dust proof accessories such as NSK K1 lubrication unit, double seal and protector.
We provide a suitable lubrication accessory for the special requirement on dust proof accessories.
Consult NSK for a lubrication accessory with extended length of thread body for your convenience of replenishing lubricant.
Please ask NSK for stainless lubrication accessories.

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.

Table 7 Unit: mm

Model No.	Dust-proof specification	Grease fitting Drive-in Thread body length L	Tube fitting 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

*) Please contact NSK as a connector is required.

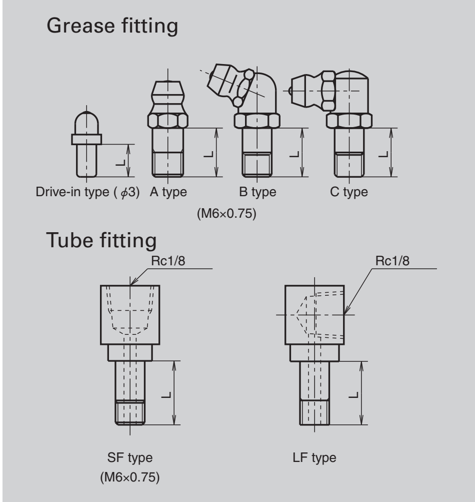


Fig. 12 Grease fitting and tube fitting

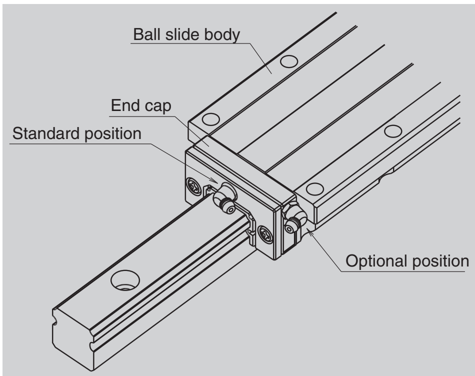


Fig. 13 Mounting position of lubrication accessories

(7) Dust-proof components

1. Standard Specification

To keep foreign matters from entering inside the ball slide, HS Series has an end seal on both ends.

Bottom seal is equipped on bottom as an option.

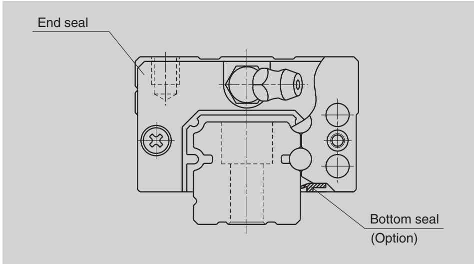


Fig. 14

Table 8 Seal friction per ball slide (maximum): end seal only

Unit: N

Series \ Size	15	20	25	30	35
HS	3	3	3	3	4

2. NSK K1™

Refer to Table 9 for dimension of linear guides equipped with the NSK K1.

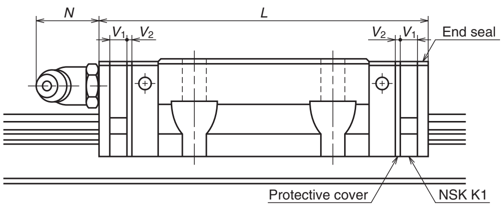


Table 9

Unit: mm

Model No.	Ball slide model	Standard ball slide length	Ball slide length installed with two NSK K1 L	Per NSK K1 thickness V_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 HS series, double seal and protector can be installed only before shipping from the factory. Please consult with NSK.

Table 10 shows the increased thickness of V_1, and V_2 when end seal and protector are installed.

Table 10

Unit: mm

Model No.	Thickness of end seal: V_1	Thickness of protector: V_2
HS15	2.8	3
HS20	2.5	2.7
HS25	2.8	3.2
HS30	3.6	4.2
HS35	3.6	4.2

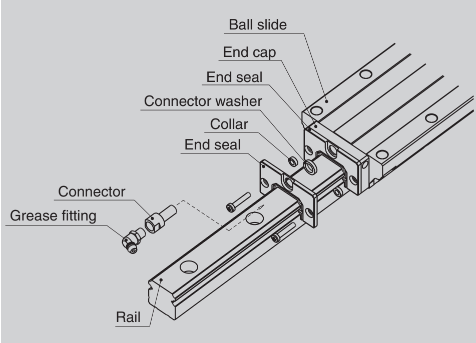


Fig. 15 Double seal

4. Caps to cover the bolt hole for rail mounting

Table 12 shows size of the bolts for the each model number as well as reference number of the cap.

Table 11 Caps to cover rail bolt hole

Model No.	Bolt to secure rail	Cap reference No.	Quantity /case
HS15	M3	LG-CAP/M3	20
HS15	M4	LG-CAP/M4	20
HS20	M5	LG-CAP/M5	20
HS25, HS30	M6	LG-CAP/M6	20
HS35	M8	LG-CAP/M8	20

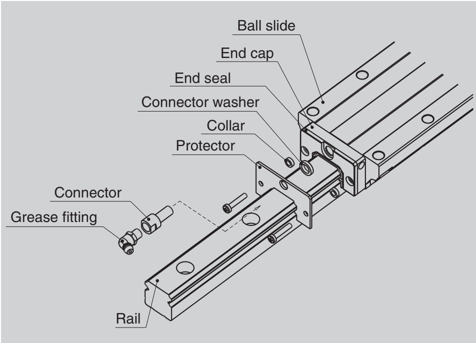


Fig. 16 Protector

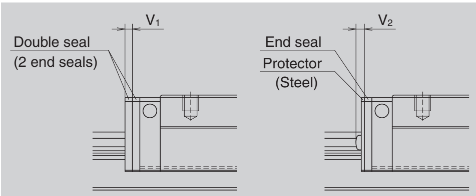


Fig. 17

(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 - ** **K5 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.)
- K5: Accuracy code (See Table 13)
- 1: Preload code (See page A358)

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

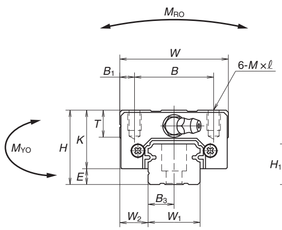
Note: Refer to Page A38 for NSK K1 lubrication unit.

(9) Dimensions

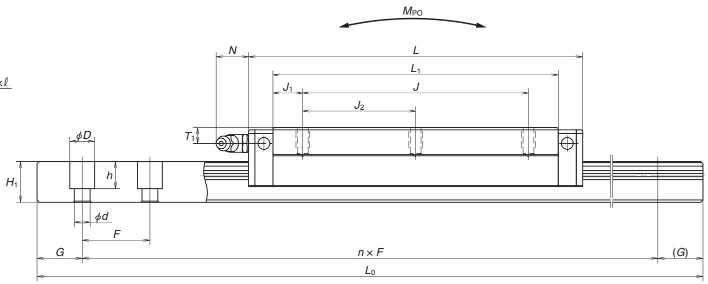
HS 30 1000 AL C 2 - K5 1**

- Series name (HS)
- Size (30)
- Rail length (mm) (1000)
- Ball slide shape code (See page A357) (AL)
- Material/surface treatment code (See Table 12) (C)
- Number of ball slides per rail (2)
- Design serial number (-**) Added to the reference number.
- Accuracy code (See Table 13) (K5)
- Preload code (See page A358) (1)

Front view of AL types



Side view of AL type



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	B_1	L_1	J_1	K	T	Hole size	T_1	N
HS15AL	24	4.6	9.5	34	106	26	60	30	M4×0.7×6	4	89.2	14.6	19.4	10	ϕ3	6	3
HS20AL	28	6	11	42	119.7	32	80	40	M5×0.8×7	5	102.5	11.25	22	12	M6×0.75	5.5	11
HS25AL	33	7	12.5	48	148	35	100	50	M6×1×9	6.5	126.4	13.2	26	12	M6×0.75	7	11
HS30AL	42	9	16	60	176.1	40	120	60	M8×1.25×12	10	150.7	15.35	33	13	M6×0.75	8	11
HS35AL	48	10.5	18	70	203.6	50	140	70	M8×1.25×12	10	175.6	17.8	37.5	14	M6×0.75	8.5	11

Remarks: 1) HS Series does not have a ball retainer. Be aware that balls fall out when the ball slider is withdrawn from the rail.
2) The external appearance of stainless steel ball slides differ from those of standard material ball slide.

Unit: mm

Rail							Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting Bolt hole		G	Maximum length	Dynamic	Static	Static moment				Ball slide	Rail
						L_{0max}	C	C_0	M_{RO}	M_{PO}	M_{YO}	D_W		
W_1	H_1	F	$d \times D \times h$	B_3	(Reference)	( ) for stainless	(N)	(N)	(N·m)	(N·m)	(N·m)		(g)	(kg/m)
15	12.5	30	*3.5×6×8.5 4.5×7.5×8.5	7.5	20	2 000 (1 700)	15 300	40 000	199	395	335	2.778	0.34	1.4
20	15.5	30	6×9.5×10.5	10	20	3 960 (3 500)	20 400	52 000	350	590	495	3.175	0.52	2.3
23	18	30	7×11×12	11.5	20	3 960 (3 500)	32 000	78 000	605	1 090	910	3.968	0.85	3.1
28	23	40	7×11×16	14	20	4 000 (3 500)	51 500	127 000	1 190	2 120	1 780	4.762	1.7	4.8
34	27.5	40	9×14×20	17	20	4 000 (3 500)	71 500	172 000	1 980	3 350	2 820	5.556	2.5	7.0

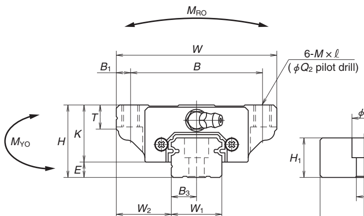
3) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

*) The standard rail mounting bolt hole for HS15 is specified as the hole for M3 (3.5×6×8.5). Please contact us to request a different hole for M4 (4.5×7.5×8.5).
Parenthesized dimensions are applicable to stainless steel products.

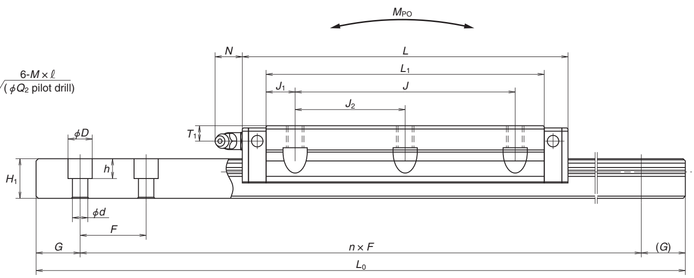
HS 30 1000 EM C 2 -＊＊ K5 1

- HS — Series name
- 30 — Size
- 1000 — Rail length (mm)
- EM — 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.)
- K5 — Accuracy code (See Table 13)
- 1 — Preload code (See page A358)

Front view of EM type



Side view of EM type



Model No.	Assembly: Height H	E	W_2	Ball slide: Width W	Length L	Mounting hole: B	J	J_2	M × pitch × ℓ	Q_2	B_1	L_1	J_1	K	T	Grease fitting: Hole size	T_1	N
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	ϕ3	6	3
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
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
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
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

Remarks: 1) HS Series does not have a ball retainer. Be aware that balls fall out when the ball slider is withdrawn from the rail.
2) The external appearance of stainless steel ball slides differ from those of standard material ball slide.
3) Parenthesized dimensions are applicable to stainless steel products.

Unit: mm

Rail							Basic load rating					Ball dia.	Weight	
Width	Height	Pitch	Mounting Bolt hole		G	Maximum length	Dynamic	Static	Static moment				Ball slide	Rail
						L_{0max}	C	C_0	M_{RO}	M_{PO}	M_{YO}	D_W		
W_1	H_1	F	$d \times D \times h$	B_3	(Reference)	( ) for stainless	(N)	(N)	(N·m)	(N·m)	(N·m)		(kg)	(kg/m)
15	12.5	30	*3.5×6×8.5 4.5×7.5×8.5	7.5	20	2 000 (1 700)	15 300	40 000	199	395	335	2.778	0.45	1.4
20	15.5	30	6×9.5×10.5	10	20	3 960 (3 500)	20 400	52 000	350	590	495	3.175	0.67	2.3
23	18	30	7×11×12	11.5	20	3 960 (3 500)	32 000	78 000	605	1 090	910	3.968	1.3	3.1
28	23	40	7×11×16	14	20	4 000 (3 500)	51 500	127 000	1 190	2 120	1 780	4.762	2.4	4.8
34	27.5	40	9×14×20	17	20	4 000 (3 500)	71 500	172 000	1 980	3 350	2 820	5.556	3.4	7.0

4) The basic dynamic load rating is a load that furnishes 50 km rating fatigue life; it is a vertical and constant load to the ball slide mounting surface. When converting the basic dynamic load rating C to the dynamic load rating C_{100} for 100 km rating fatigue life, divide the C by 1.26.

*) The standard rail mounting bolt hole for HS15 is specified as the hole for M3 (3.5×6×8.5). Please contact us to request a different hole for M4 (4.5×7.5×8.5).
Parenthesized dimensions are applicable to stainless steel products.

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									-6	-14	-4	-9
6	10	0	-8	0	-5					-6	-15	-4	-10
10	18					0	-120	+240	-240	-6	-17	-4	-12
18	30	0	-10	0	-6					-6	-19	-4	-13
30	50	0	-12	0	-8					-7	-23	-5	-16

Table 2 Tolerance of linear rolling bush outside diameter, and housing inside diameter

Unit: μm

Nominal dimension/ outside diameter/housing inside diameter (mm)		Tolerance/outside diameter D[1]				ccentricity[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						+12	0	+8	0
6	10	0	-10	0	-7	8	+15	0	+9	0
10	18						+18	0	+11	0
18	30	0	-12	0	-8	9	+21	0	+13	0
30	50	0	-14	0	-9	10	+25	0	+16	0

Note: 1) For adjustable clearance type and open type, figures indicate tolerances before the cut is made.
2) Eccentricity means the run-out of offset between the centers of outer sleeve diameter and inscribed circle diameter.

(4) Composition of Reference Number

Example LB 35 N K Y S __

- LB: Linear rolling bushing
- 35: Nominal inscribed circle diameter (linear shaft nominal diameter)
- N: N···············With retaining ring groove / No code·····Without retaining ring groove
- K: No code·····Standard type LB / T···············Adjustable clearance type LB-T / K ···············Open type LB-K
- Y: Plastic retainer
- S: Accuracy grade / S········ High precision grade / SP···· Super precision grade
- __: No code·················No seal / D················Single-side seal / DD··········· Double-side seal

(5) Lubrication and Friction

1. Grease lubrication

① Supply at initial stage

At time of delivery, the linear rolling bushing has a coat of rust preventive agent. Wipe it off with clean kerosene or organic solvent. Dry with an air blower, etc., then apply grease.

Lithium soap based greases with consistency level of 2 are generally used (e.g. NSK Grease LR3, PS2, and AS2).

② Replenishment

- Sealed linear rolling bushing is designed to be a disposal item. Therefore, a replenishing grease is considered to be not required. However, if replenishment becomes necessary due to dirty environment or wear of the seal, remove the linear bushing from the shaft and replenish lubricant in the same manner as the initial lubricating.
- For items without seal, wipe off old grease from the linear shaft, and apply new grease.
- Intervals of replenishments are every 100 km in a dirty environment, 500 km in a slightly dirty environment, 1000 km or no replenishing for a normal environment.

2. Oil lubrication

It is not necessary to wash off the rust preventive agent applied before delivery.

Use an oil of ISO viscosity grade VG15-100. Drip the oil on the linear shaft by an oil supply system.

Temperature to use

–30°C to 50°C Viscosity VG15 – 46

50°C to 80°C Viscosity VG46 – 100

Lubricant is removed by the seal if the linear ball bearing has a seal. Therefore, the drip method cannot be used except for single-seal types.

3. Friction coefficient

The linear rolling bushing has a small dynamic friction coefficient. This contributes to low power loss and temperature rise.

Fig. 4 indicates dynamic friction coefficient is merely 0.001-0.004. Also, at the speed of under 60 m/min, there is no danger of the temperature rising.

Friction force can be obtained by the following formula.

$$F = \mu \cdot P \quad \cdots\cdots (1)$$

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.

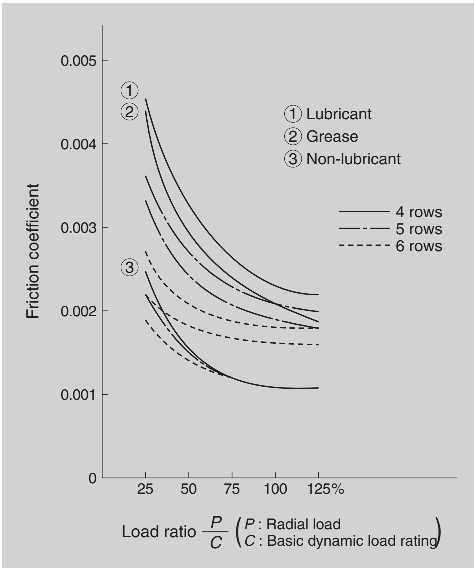


Fig. 4 Dynamic friction coefficient of linear rolling bushing

(6) Range of Conditions to Use

Generally, use under the following conditions.
Please consult NSK when values exceed the ranges given below.
Temperature········Minus 30°C to plus 80°C
Speed·················Up to 120 m/min
(excluding oscillation and short strokes)

(7) Preload and Rigidity

The linear rolling bushing is normally used without applying preload. If high positioning accuracy is required, set the clearance between the linear rolling bush and the shaft at the range of 0 to 5 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 0.1 C, is obtained by the following formula.

$$K_N = K\,(P/0.1C)^{1/3} \quad (2)$$

In this formula:

K : Rigidity value in the dimension table (N/μ m)
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

$$L = 50\,f_L^{\,3} \quad (3)$$

$$f_L = C/P \quad (4)$$

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.

$$f_L = C \cdot f_H/P \quad (5)$$

Or

$$C = P \cdot f_L/f_H \quad (6)$$

Life in time can be obtained by the following formula, substituting for given stroke length, cycle numbers, and running distance:

$$L_h = (L/1.2 \cdot S \cdot n) \times 10^4 \quad (7)$$

In this formula:

L_h : Life hours (h)
L : Rated life (km)
S : Stroke (mm)
n : Cycles per minute (cpm)

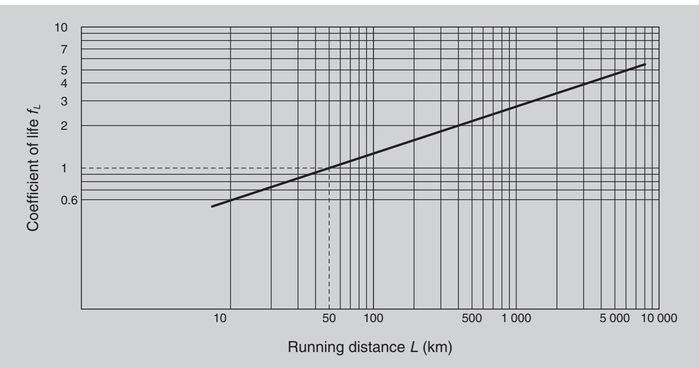


Fig. 5 Relationship between life factor and running distance

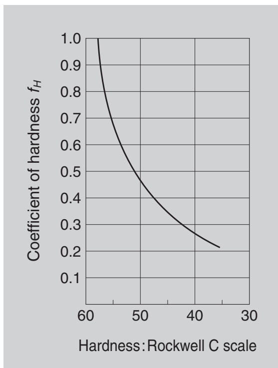


Fig. 6 Hardness factor

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 5000 hours?

Conditions are:

- Three linear rolling bushings are installed in two parallel shafts, and support a reciprocating table.
- Load 450 N is equally distributed to the three bushings.
- The table is required to reciprocate on the shafts at 200 times per minute, at a stroke of 70 mm.
- Hardness of the shaft: HRC 55

$$450/3 = 150 \text{ (N)}$$

- Load per linear rolling bushing is:

From Formula (7), the required life, when indicated in distance, is:

$$L = 5 \times 10^3 \times 1.2 \times 70 \times 200/10^4 = 8.4 \times 10^3 \text{ (km)}$$

From Fig. 5 and Fig. 6,
Life factor $f_L = 5.6$
Hardness factor $f_H = 0.65$
Therefore, from Formula (6),

$$C = P \times f_L / f_H$$
$$= 150 \times 5.6/0.65 = 1292 \text{ (N)}$$

Based on the above, select linear rolling bushing LB30NY with shaft diameter of 30 mm, basic dynamic load rating of 1400 N.

4. Compensating load rating by ball row position

Load rating of the linear rolling bushing changes by the position of the ball circuit rows.
Permissible load is larger when it is applied to the middle of the ball circuit rows than when it is applied directly above the ball row (Fig. 7).
(Radial clearance set at zero in this case.)
Load ratings in the dimension table are in case "A" when it is applied directly above the ball circuit row. If used as in case "B," the load rating becomes larger (Refer to Fig. 7).

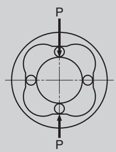
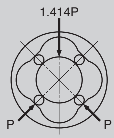
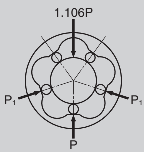
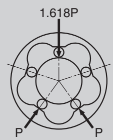
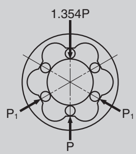
	A Load is directly above the ball rows	B Load is applied at the middle between the ball rows	Increase rate of load rating ($\frac{B}{A}$) Dynamic load rating	 Static load rating
4 rows			1.15	1.41
5 rows			1.19	1.46
6 rows			1.06	1.28

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/1000 mm

An appropriate clearance for normal use conditions can be obtained when the tolerance in shaft diameter remains within the recommended range (refer to Table 1 in Page A366). For operations which require particular accuracy, select the shaft diameter which creates a clearance in the range of 0 to 0.005 (mm) for example, when assembled with the rolling bushing.

(10) Dust Proof

Select a linear rolling bushing with seals to prevent moisture or foreign matters, which are floating in the air, from entering.

(11) Installation

1. Combination of shaft and linear rolling bushing

When the linear rolling bushing is installed in a linear motion table for its reciprocating movement, it is necessary to prevent the table from rotating.
In general, for this reason, two shafts, installed with two linear rolling bushings on each, are used.
Fig. 8 is an installation example.

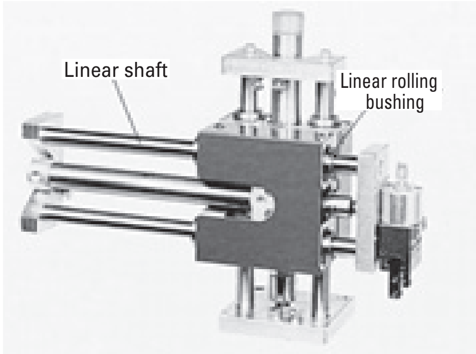


Fig. 8 Installation example

2. Installation of linear rolling bushing

① Standard type installation

Fig. 9 shows a method using a retainer ring. Linear rolling bushing can also be secured to the housing using a stop plate and/or screw.

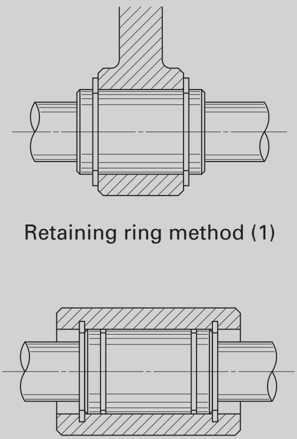


Fig. 9 Installation using retaining rings

ⓐ Housing inside diameter should be of a recommended value (Table 2, Page A366). The entire rolling bushing contracts and gives excessive preload if: the inside diameter is small ; the roundness or cylindricity is excessive. This may result in an unexpected failure.

ⓑ To install linear rolling bushing, use a tool (Fig. 10) and squeeze it in, or use a holder and lightly pound it.

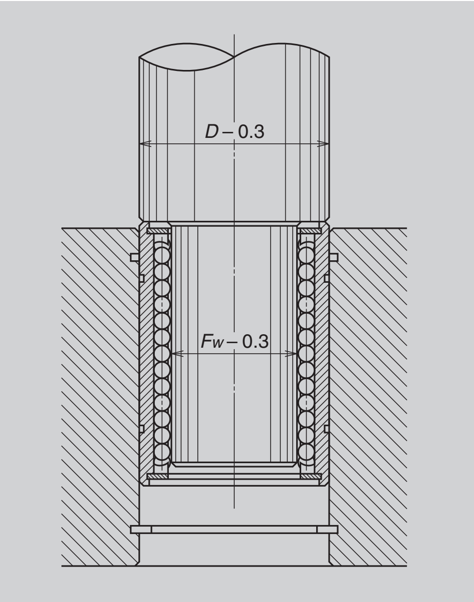


Fig. 10 Tool to install a linear rolling bushing

② **Installation of adjustable clearance type**

Use a housing which can adjust the inside diameter of the rolling bushing. This way, the clearance between the rolling bushing and the linear shaft can be easily adjusted. Arrange the cut-open section of the rolling bushing at a 90-degree angle to the housing's cut-open section. This is the most effective way to evenly distribute deformation toward circumferential direction.

The tolerance of shaft diameter of the adjustable clearance type should be within the recommended range (Refer to Table 1 in Page A366). As a general rule, set the preload at slight or light volume. (Do not provide excessive preload.) Use a dial gauge to measure and adjust clearance. However, here is an easy method to adjust .

First, loosen the housing until shaft turns freely. Then narrow the clearance gradually. Stop at the point when the shaft rotation becomes heavy. This creates a clearance zero or light preload.

③ **Installation of open type**

Use with clearance or with light preload.

Keep the tolerance in shaft diameter within the recommended range (Refer to Table 1 in Page A366), so the preload shall not become excessive.

(Unlike the adjustable clearance type, clearance cannot be narrowed by rotating the shaft because the state of shaft rotation does not indicate how narrow the space has become. Narrowing clearance requires caution for open type.)

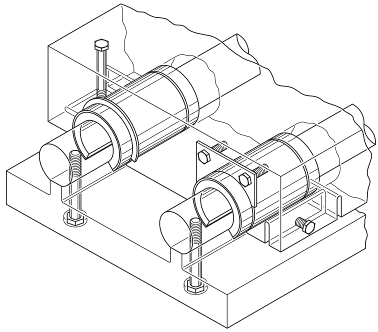


Fig. 11 Installation example of an open type

3. Precaution for installing a shaft in the linear rolling bushing

ⓐ 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.

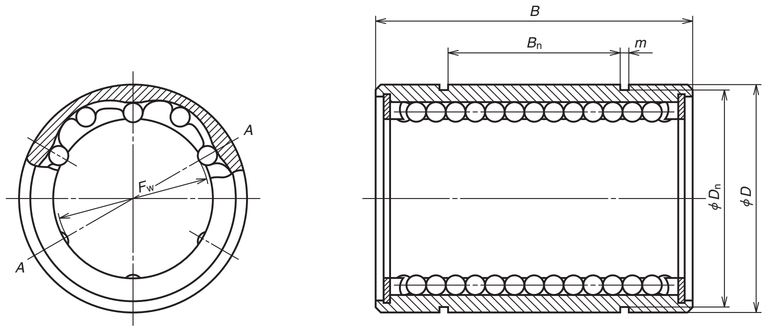
ⓑ Do not incline the shaft when inserting it into the linear rolling bushing. Do not force it to enter by twisting. This deforms the retainer, and causes the balls to fall out.

ⓒ Do not use the shaft for rotating movement after the shaft is in the linear rolling bushing. The balls slip and damage the shaft.

ⓓ Do not twist the shaft after it is in the linear rolling bushing. The pressure scars the shaft.

(12) Dimension tables

Model LB (standard type), no seal



Section A-A

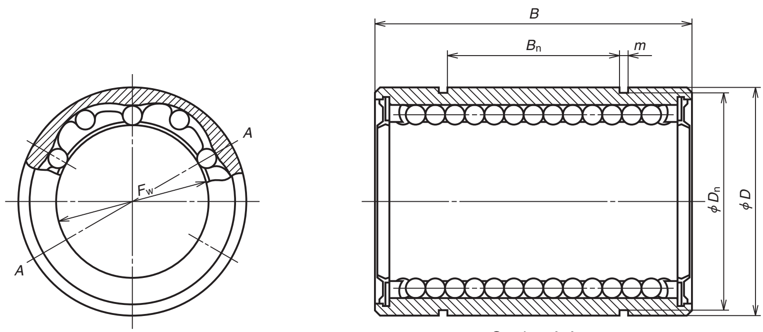
Unit: mm

Model No.	Inscribed circle diameter F_w	Outside diameter D	Length B	Retaining ring groove Distance B_n	Retaining ring groove Width m	Retaining ring groove Bottom diameter D_n	Stiffness[1] (N/μm)	Number of ball circuit	Weight (kg) (Reference only)	Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
LB3Y	3	7	10	—	—	—	3	4	0.0016	20	39
LB4Y	4	8	12	—	—	—	4.5	4	0.0022	29	59
LB6NY	6	12	19	11	1.15	11.5	7	4	0.0074	74	147
[2]**LB8ANY**	8	15	17	9	1.15	14.3	5.5	4	0.0094	78	118
LB8NY	8	15	24	15	1.15	14.3	9.5	4	0.014	118	226
LB10NY	10	19	29	19	1.35	18	12	4	0.025	206	355
LB12NY	12	21	30	20	1.35	20	13	4	0.028	265	500
LB13NY	13	23	32	20	1.35	22	13	4	0.040	294	510
LB16NY	16	28	37	23	1.65	26.6	14	4	0.063	440	635
LB20NY	20	32	42	27	1.65	30.3	19	5	0.088	610	1010
LB25NY	25	40	59	37	1.9	38	35	6	0.267	1000	1960
LB30NY	30	45	64	40	1.9	42.5	41	6	0.305	1400	2500
LB35NY	35	52	70	45	2.2	49	48	6	0.440	1510	2800
LB40NY	40	60	80	56	2.2	57	54	6	0.520	2230	4000
LB50NY	50	80	100	68	2.7	76.5	69	6	1.770	4100	7100

Note (1): Refer to Section (7).

(2): Semi-standard item of which length B is shorter than standard.

Model LB (standard type), with seal



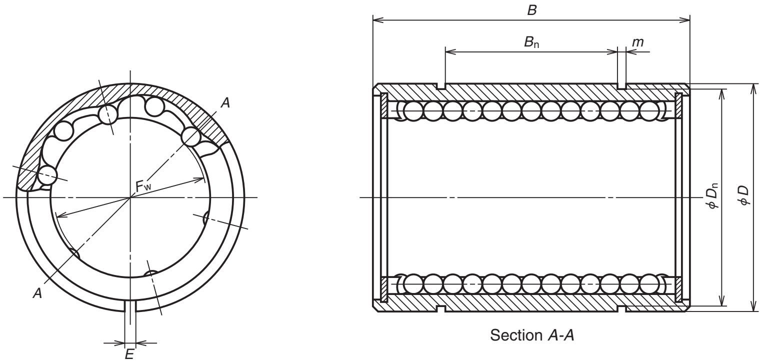
Section *A-A*

Unit: mm

[1]Model No.	Inscribed circle diameter F_w	Outside diameter D	Length B	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)
LB6NYDD	6	12	19	11	1.15	11.5	4	0.0074	74	147
LB8ANYDD	8	15	17	9	1.15	14.3	4	0.0094	78	118
LB8NYDD	8	15	24	15	1.15	14.3	4	0.014	118	226
LB10NYDD	10	19	29	19	1.35	18	4	0.025	206	355
LB12NYDD	12	21	30	20	1.35	20	4	0.028	265	500
LB13NYDD	13	23	32	20	1.35	22	4	0.040	294	510
LB16NYDD	16	28	37	23	1.65	26.6	4	0.063	440	635
LB20NYDD	20	32	42	27	1.65	30.3	5	0.088	610	1010
LB25NYDD	25	40	59	37	1.9	38	6	0.267	1000	1960
LB30NYDD	30	45	64	40	1.9	42.5	6	0.305	1400	2500
LB35NYDD	35	52	70	45	2.2	49	6	0.440	1510	2800
LB40NYDD	40	60	80	56	2.2	57	6	0.520	2230	4000
LB50NYDD	50	80	100	68	2.7	76.5	6	1.770	4100	7100

Note (1) Single-seal type is indicated as LB-D.

Model LB-T (Adjustable clearance type)

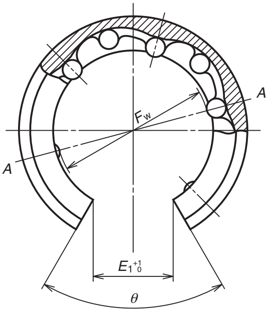


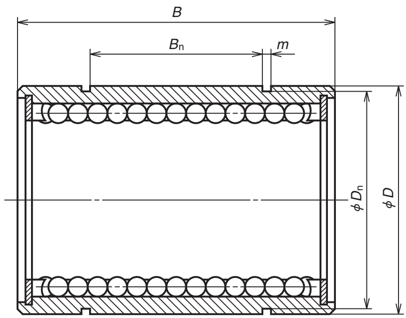
Section A-A

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	1010
LB25NTY	25	40	59	2	37	1.9	38	6	0.265	1000	1960
LB30NTY	30	45	64	2	40	1.9	42.5	6	0.302	1400	2500
LB35NTY	35	52	70	3	45	2.2	49	6	0.44	1510	2800
LB40NTY	40	60	80	3	56	2.2	57	6	0.52	2230	4000
LB50NTY	50	80	100	3	68	2.7	76.5	6	1.75	4100	7100

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	Retaining ring groove: Width m	Retaining ring groove: Bottom diameter D_n	Number of ball circuit	Weight (kg) (Reference only)	Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
LB20NKY	20	32	42	11	60°	27	1.65	30.3	4	0.072	610	1010
LB25NKY	25	40	59	13	50°	37	1.9	38	5	0.220	1000	1960
LB30NKY	30	45	64	15	50°	40	1.9	42.5	5	0.260	1400	2500
LB35NKY	35	52	70	17	50°	45	2.2	49	5	0.370	1510	2800
LB40NKY	40	60	80	20	50°	56	2.2	57	5	0.440	2230	4000
LB50NKY	50	80	100	25	50°	68	2.7	76.5	5	1.480	4100	7100

A-6-2 Crossed Roller Guide

(1) Structure

Rollers with a retainer (hereinafter referred to as "retainer") are assembled in a pair of rails which have a V-shape groove. (the grooves form a 90-degree angle. Refer to Fig. 1, 2). Rollers are placed crisscrossed, and are able to support load in all directions, including moment loads.

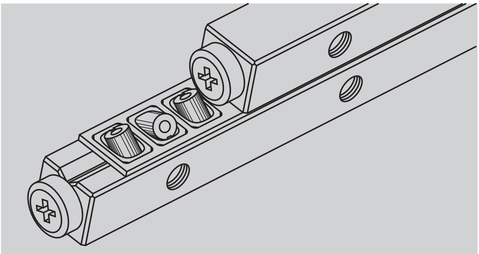


Fig. 1 Structure of crossed roller guide

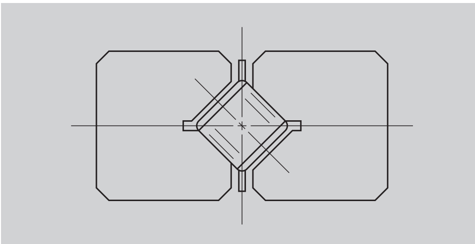


Fig. 2 Cross section of a crossed roller guide

(2) Features

1. High rigidity
This is attributable to the long contact area between the rollers and their accurately ground rolling surface.

2. Superbly smooth movement, low noise
The window which directly embraces the roller is made of plastic for smooth and quiet operation, lowering clatter when the retainer and the rollers come into contact.

3. Less micro-slip
Occasionally, a minute continuous slippage of the retainer to one direction, called "micro-slip," is caused due to installation error of the rail. After years of testing and research, NSK has developed technology to minimize this.

4. Easy installation
Installation is easy because the rail bending is minimal, and the bolt hole pitch for installation is precise.

5. Long durability
The material is vacuum-degassed and highly pure, and is hardened by carburized heat treatment for superb resistance to wear and fatigue.

(3) Accuracy

Accuracy grade P5 super precision and high precision grade P6 are available.
Fig. 3 shows parallelism of the roller's rolling surface to the mounting datum face.

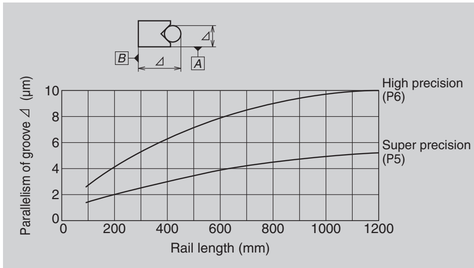


Fig. 3 Parallelism of the roller rolling surface

(4) Rigidity

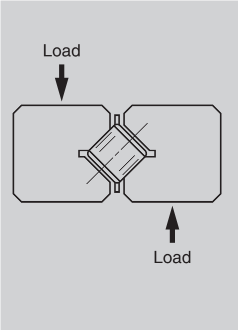
The number of the load rollers changes by the direction of the load. This is because the rollers are positioned crisscross.
That is, in case of Fig. 4:

The number of load rollers =1/2 x 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.



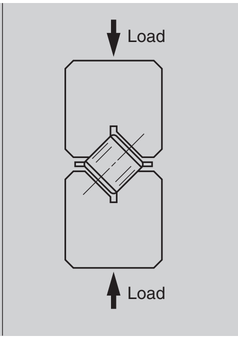


Fig. 4 **Fig. 5**

[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

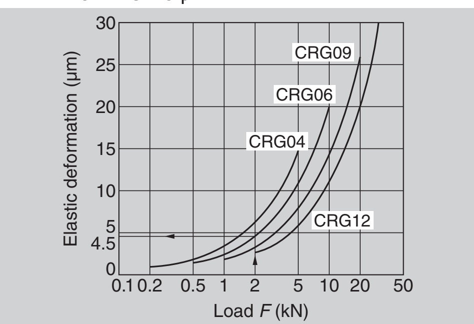


Fig. 6 Elastic deformation with 20 rollers

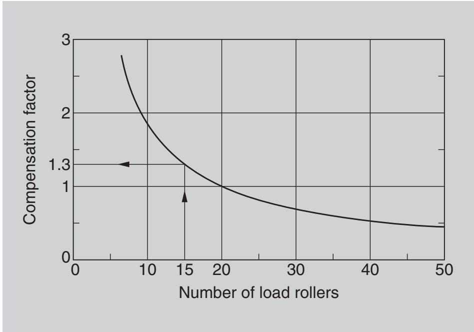


Fig. 7 Compensation factor to obtain elastic deformation

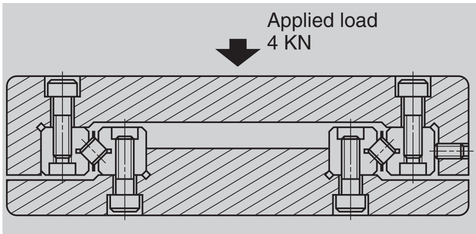


Fig. 8 Example calculation of elastic deformation (illustration)

(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:

$K < L - \frac{S}{2}$ ···································· (5)

The retainer does not detach from the rail when condition in Formula (5) is satisfied (Refer to Fig. 9).

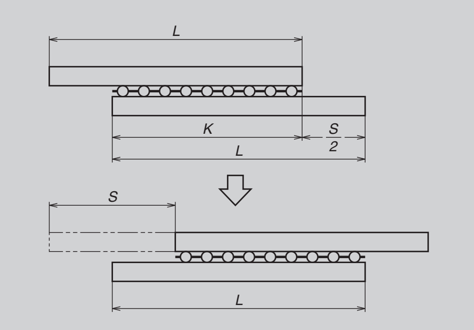


Fig. 9 Relationship of rail and retainer

(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.

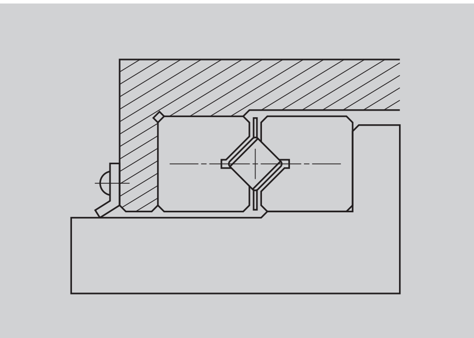


Fig. 10 Dust prevention (example)

(8) Installation

Fig. 11 shows the standard installation procedures.

ⓐ Secure Rail 1 and 2 to the bed using the fixing bolts. . Secure Rail 3 to the table with the bolts. Temporarily secure Rail 4 and loosen the side bolt.

ⓑ 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.

ⓒ 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.

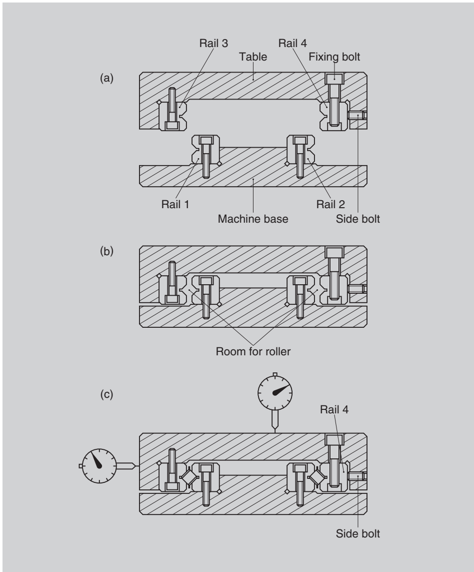


Fig. 11 Standard installation procedures

[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.

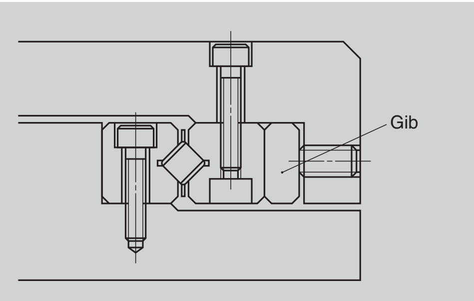


Fig. 12 Tightening using a gib

(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 numbers of rollers is n can be obtained as follows.

$$C_{0n} = n \times C_{01} \quad \cdots\cdots (6)$$

Values of C_{01} are shown in the dimension table.

(10) Basic Dynamic Load Rating and Rated Life

Basic static load rating is based on a rated traveled distance of 50 km. The dimension table shows the value with 20 load rollers. When the number of load rollers is other than 20, a basic dynamic load rating C_n can be obtained by multiplying a compensation factor (obtained from Fig. 13.) by C in the dimension table.

(Suffix 'n' is to refer the number of load rollers.)

As an example; Number of load rollers: n = 15.

The compensation factor from Fig. 13 is 0.8.

$$C_{15} = 0.8 \times C$$

Therefore, C_{15} is obtained from the following formula.

Rated life (km) is shown in the formula below.

In this formula:

$$L = 50 \left(\frac{C_n}{f_w \cdot F_c} \right)^{\frac{10}{3}} \quad \cdots\cdots (7)$$

f_w: Load factor. 1.0 to 1.2 under smooth operation

F_c: Computed load which applies to the guide (kN)

Please refer to NSK Linear Guide Technical Description for details.

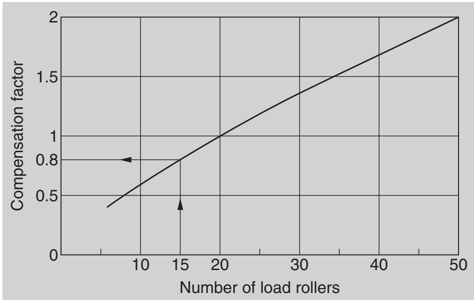


Fig. 13 Compensation factor for basic dynamic load rating

(11) Reference Number and Standard Set for "One-Axis"

Specifications are indicated as a reference number as shown below.

CRG06-380 A P5 N

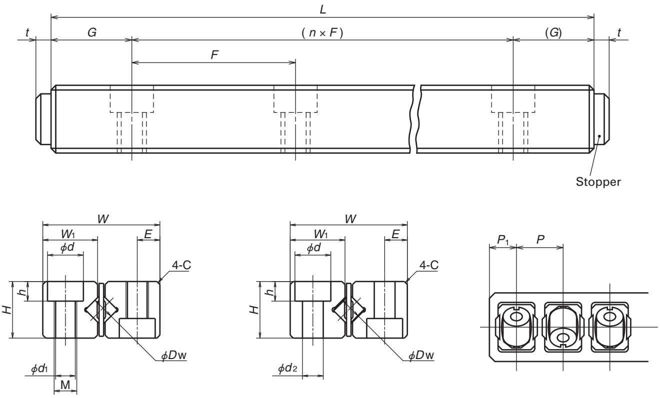
- Model number: CRG06
- Rail length (mm): 380
- Shape of the rail cross section: Standard: A Semi-standard: T
- Accuracy grade: P5··· Super precision grade; P6··· High precision grade
- Holes for mounting: Tap hole: N; Drill hole: D

Note (1) : Semi-standard T, a shape of rail cross section, is available only for CRG04. It is lower in H dimension, and wider in W dimension compared with A.

Remarks : Standard set for "one axis" of the guide refers to 4 rails and 2 retainers which usually comprise the guide way for a one axis.

(12) Dimension Table

Crossed roller guide: Model CRG



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	L Max length Saper high pre cision 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	9800	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	9800	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	26700	1510	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	72500	3400	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	130000	6050	900	1200

Remarks: The area which embraces the roller is plastic for the standard retainer. A solid type made of steel plate is available for high temperature resistance.

A-6-3 Roller Pack

(1) Structure

A roller pack comprises a main body which supports load from the guide way block via two rows of rollers; an end cap which changes the direction of the 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.

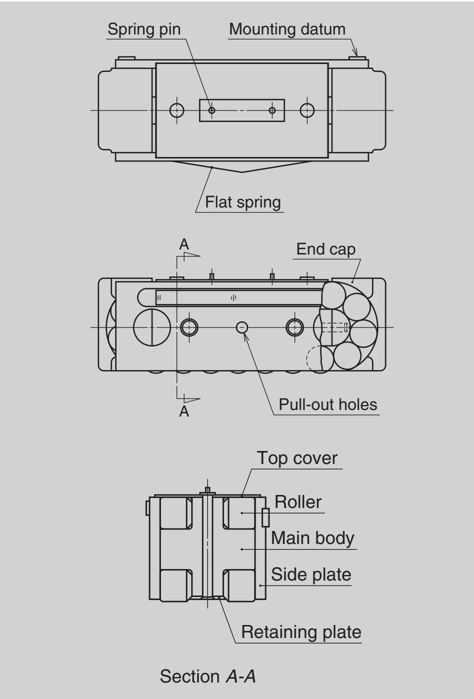


Fig. 1 Roller pack

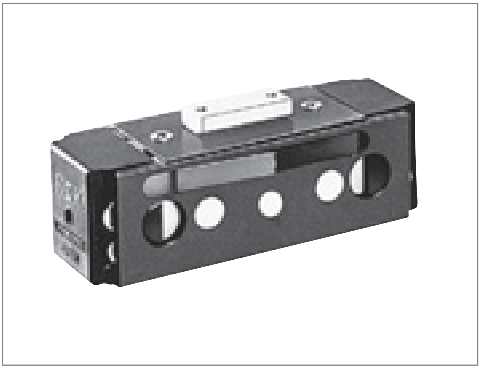


Photo 1 Roller pack

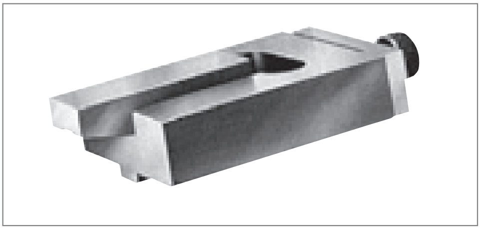


Photo 2 Wedge block

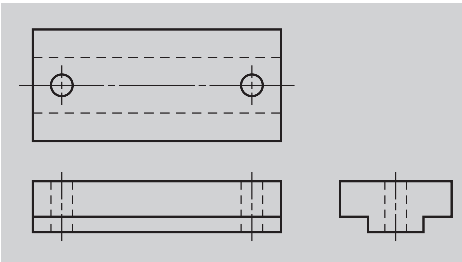


Fig. 2 Fitting plate

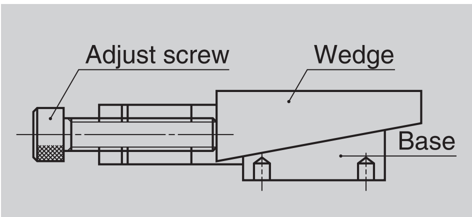


Fig. 3 Wedge block

(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.

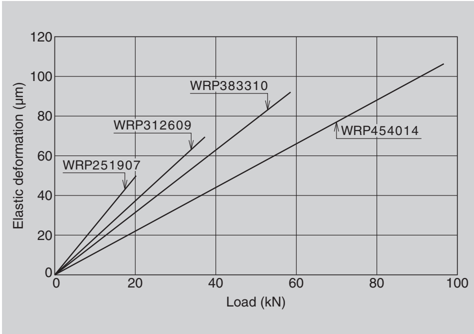


Fig. 4 Elastic deformation of the roller pack

(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.

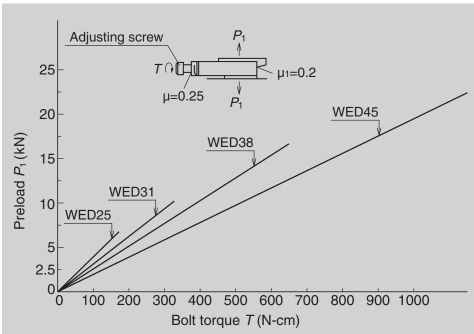


Fig. 5 Tightening torque of the adjust screw, and preload volume

(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.

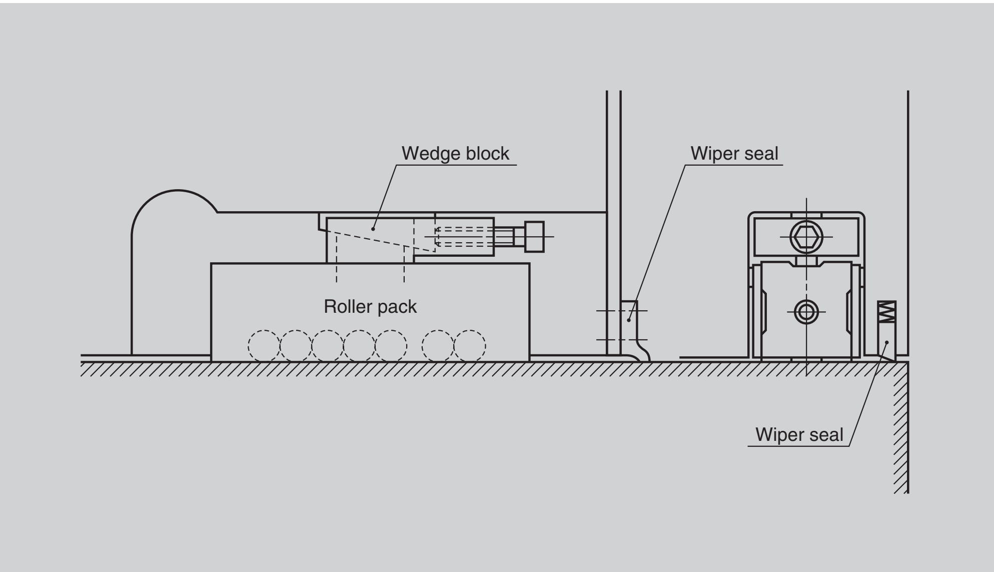


Fig. 6 Installation of seal

(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 life in (8) in determining preload volume.)

2. Accuracy of way block

The following is the ideal accuracy specification and installation accuracy of way block as a guide face.

Hardness by heat treatment
: More than HRC58 hardened depth 2 mm or more

Surface roughness
: Less than 1.6 S
Parallelism as a single unit: Less than 0.010 mm per meter

Parallelism after installation
: Less than 0.020 mm per meter

Please consult NSK when using cast iron or cast steel guide face.

3. Pocket accuracy

Accuracy of the pocket in which the roller pack is mounted should satisfy the following conditions.

Pocket width
: Roller pack width + 0.10 mm to 0.20 mm

Parallelism of the pocket side faces to the guide way face
: Less than 0.010 mm per 100 mm.

Parallelism of the fitting plate (pocket bottom) mounting face to the guide way face and parallelism of the wedge block mounting face to the guide way face :
: Less than 0.040 mm per 100 mm.

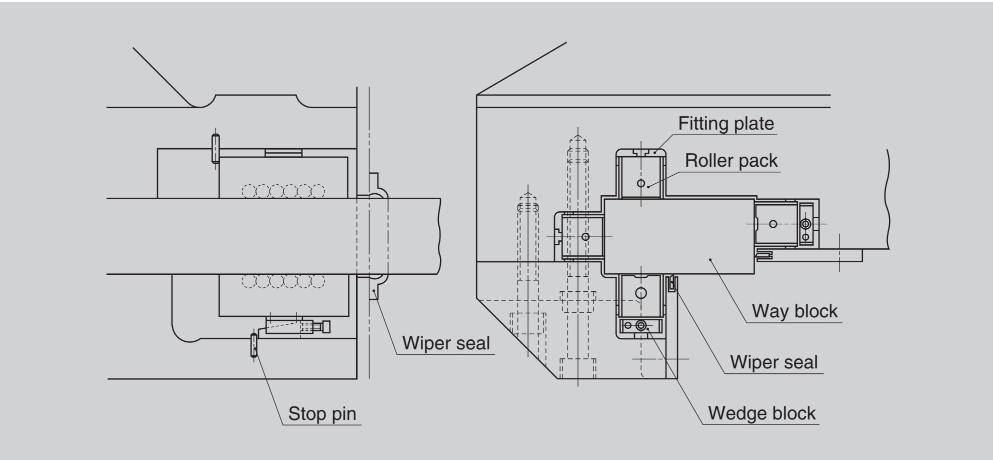


Fig. 7 Design of the roller pack pocket (example)

(8) Rated life

Rated life L (km) is shown in the following formula.
In this formula:

$$L = 50 \left(\frac{C}{f_w \cdot F_c} \right)^{\frac{10}{3}} \cdots\cdots (2)$$

C : Basic dynamic load rating (kN)

f_w : Load factors. 1.0 to 1.2 at time of smooth operation

F_c : Calculated load (kN) applied to the roller pack

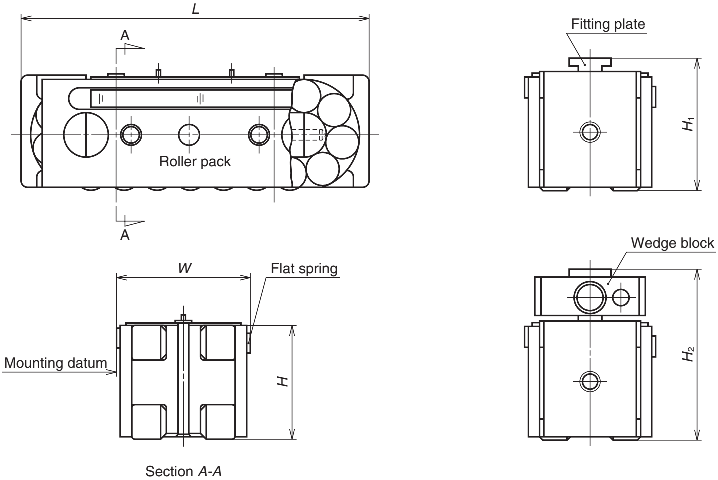
(9) Disassembly

Remove the roller pack preloaded by the wedge block in the following manner.

- Loosen the adjust screw of the wedge block. Lightly tap the wedge. In case of light preload, the wedge loosens, and the roller pack can be pulled out.
- When pulling, put the bolt in the tap hole at the end of the end cap, and tug the bolt.
- In case of heavy load, the roller pack could not be pulled out by the above method. Hook a tool to the pull-out hole (Fig. 1) on the side plate of the roller pack, and pull out the roller pack.

(10) Dimension Table

Roller pack: Model WRP

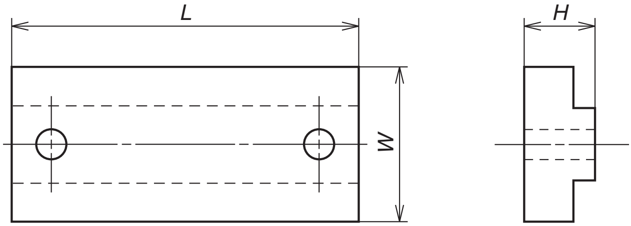


Unit: mm

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)	31000	40500
WRP 312609	31	26	85	WFT 31	31	WED 31	40 (39.4 – 40.6)	57000	73000
WRP 383310	38.1	33.31	104	WFT 38	38.91	WED 38	50.8 (50 – 51.5)	91000	113000
WRP 454014	45	40	138	WFT 45	45	WED 45	60 (59.2 – 60.8)	151000	191000

Remarks : Numbers in the parentheses in column H_2 show the adjustable height range of the wedge block.

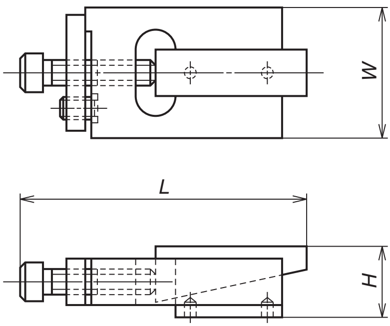
Fitting plate: Model WFT



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

Remarks : 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.

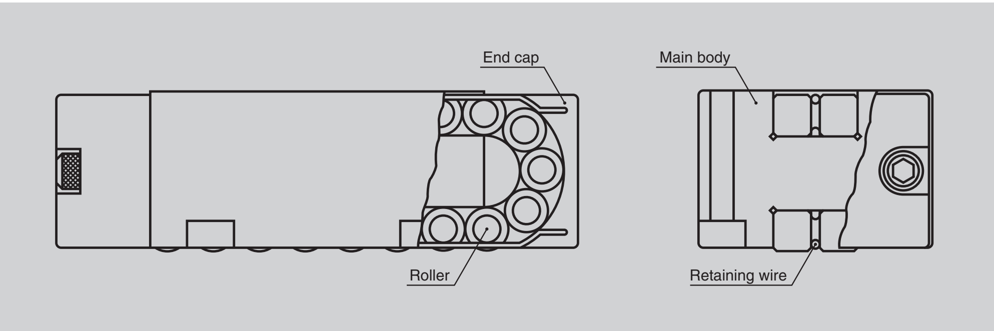


Fig. 1 Linear roller bearing

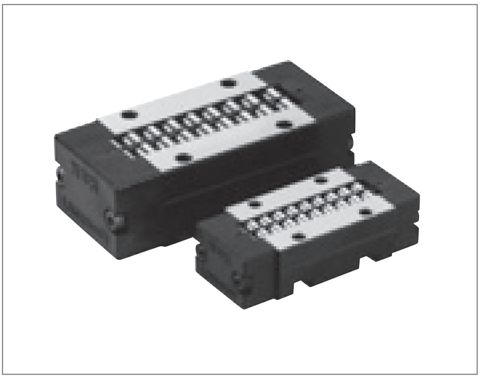


Photo 1 Linear roller bearing

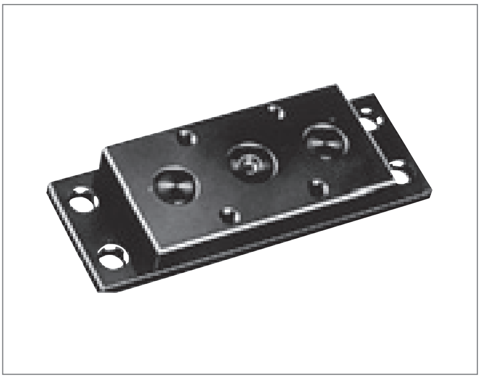


Photo 2 Preload pad

(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 over		Category or less	Code
0	–	–2	A
–2	–	–4	B
–4	–	–6	C
–6	–	–8	D
–8	–	–10	E

(4) Rigidity

Fig. 2 shows elastic deformation.

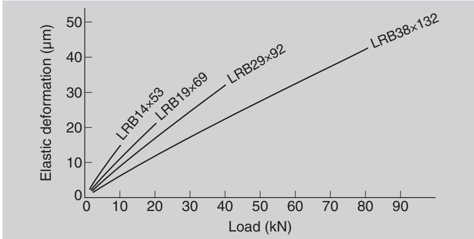


Fig. 2 Elastic deformation

(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 1m, the volume of lubricant per roller bearing is more than 0.25 (cc/h). It is recommended to supply a small amount of oil at short intervals rather than supplying a large amount at one time. In case of grease lubrication, a grease of consistency degree 2, such as Albania EP2, is generally used.

2. Friction coefficient

Starting friction coefficient is significantly small at under 0.005.

3. Seal

Install a wiper seal on the way block surface to prevent foreign matters (cutting chip and other contaminant from entering) to realize a full life of the linear roller bearing. The material of the seal should have strong resistance against oil and wear. Felt and synthetic rubber (acrylonitril-butadien rubber) are some of the suitable materials.

(6) Installation

Secure the linear roller bearing using four bolts. The bearing main body has four holes for mounting.

Accuracy of way block
The ideal accuracy specification and mounting accuracy of a way block as a guide way surface are as follows.

Hardness by heat treatment
: More than HRC58 hardened depth 2 mm or more

Surface roughness
: Less than 1.6S

Parallelism as a single unit
: Less than 0.010 mm per 1 m

Parallelism after installation
: Less than 0.020 mm per 1 m

Please consult NSK when using cast iron or cast steel guide way.

(7) Rated life

Rated life L (km) is shown in the following formula.
In this formula:

$$L = 50\left(\frac{C}{f_w \cdot F_c}\right)^{\frac{10}{3}} \cdots\cdots(2)$$

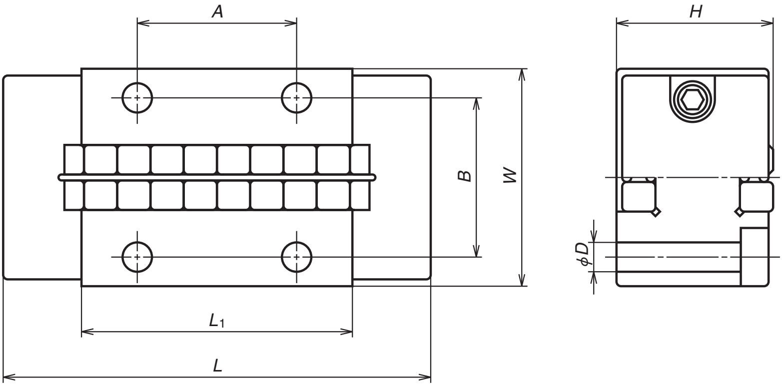
C : Basic dynamic load rating (N)

f_w : Load factor. 1.0 to 1.2 at time of smooth operation

F_c : Calculated load applied on the bearing (N)

(8) Dimension Table

Linear roller bearing   Model: LRB

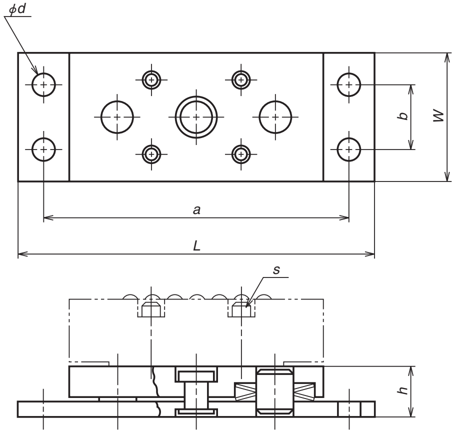


Unit: mm

Model No.	Width W	Height $H^{0}_{-0.010}$	Length L	L_1	Roller Diameter × length	Mounting bolt hole D	Bolt hole distance A	Bolt hole distance B	Basic dynamic load rating C (N)	Basic static load rating C_0 (N)
LRB 14×53	26.5	14.29	52.8	32.8	ϕ 4×8	3.4	19	19.3	15400	21900
LRB 19×69	30.5	19.05	68.6	44.6	ϕ 5×10	3.4	25.4	23.3	27000	39000
LRB 29×92	41.5	28.58	92.0	59	ϕ 7.5×15	4.5	38.1	32.7	57500	76500
LRB 38×132	51.4	38.10	132.0	88	ϕ 10×20	5.5	50.8	41.5	119000	159000

Remarks: 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	1570	26	72	4.5	62	14	M3×16
PRP 19×69	LRB 19×69	11.53	11.10	2650	30	96	4.5	86	18	M3×19
PRP 29×92	LRB 29×92	13.13	12.70	6450	41	120	4.5	110	27	M3×25
PRP 38×132	LRB 38×132	16.28	15.88	12000	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 Screw

B-3 Ball Screw Dimension Table

B-1 Selection Guide to NSK Ball Screw

B-1-1 Features of NSK Ball Screws

① Quick delivery

Standard ball screws are in stock for short lead time.

- Precision ball screws with finished shaft end
  PSS Type, MA Type, FA Type, SA Type, KA Type
- Precision ball screws with blank shaft end
  MS Type, FS Type, SS Type

Ball screws for transfer equipment are also available in stock.

- Finished shaft end
  VFA Type, RMA Type
- Blank shaft end
  RMS Type, R Series

② Competitive prices

NSK reduces cost by well-planned mass production of standardized items. We rank the best in the world production of ordered items. We are able to offer our products at competitive prices by producing similar items in the same production group.

③ Unparalleled accuracy

NSK utilizes its unique grinding technique and measuring equipment for topnotch precision.

④ Superb durability

NSK uses thoroughly purified alloy steel for superb durability.

⑤ No backlash, and unparalleled rigidity

NSK ball screws use Gothic arch grooves as shown in Fig. 1.1. The Gothic arch has no clearance between the balls and grooves with applying preload, and no backlash can be obtained. As providing controlled rigidity is easy, appropriate rigidity is obtained.
As the Gothic arch also minimizes the clearance between the balls and the grooves, the backlash is minimized without applying preload.

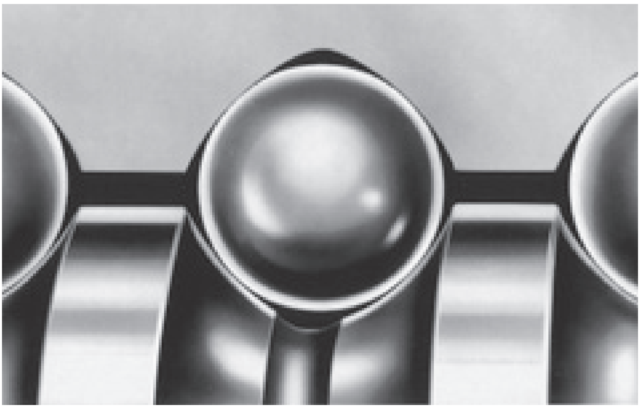


Fig. 1.1 Ball groove profile of NSK ball screw

⑥ Smooth movement assures high efficiency

NSK uses the Gothic arc design for the ball grooves. This design prevents the balls from slightly wedding into the groove of the ball nut and screw shaft and causing minute vibration. This phenomenon is common with the circular-arc design used by other manufacturers. The Gothic arc, along with the low friction inherent in a ball screw, results in a smooth and highly efficient conversion of motion as shown in Fig. 1.2.

⑦ Optimal units available

Utilizing bearing technology, NSK produces high quality support units (for light load type to be used for small equipment and heavy load type to be used for machine tools) which are exclusive for ball screws. These units are standardized and always in stock.

NSK also offers quality-assured accessories such as lock nuts to tighten bearings, travel stoppers to prevent overrun, and sealing units to cool hollow shaft ball screws.

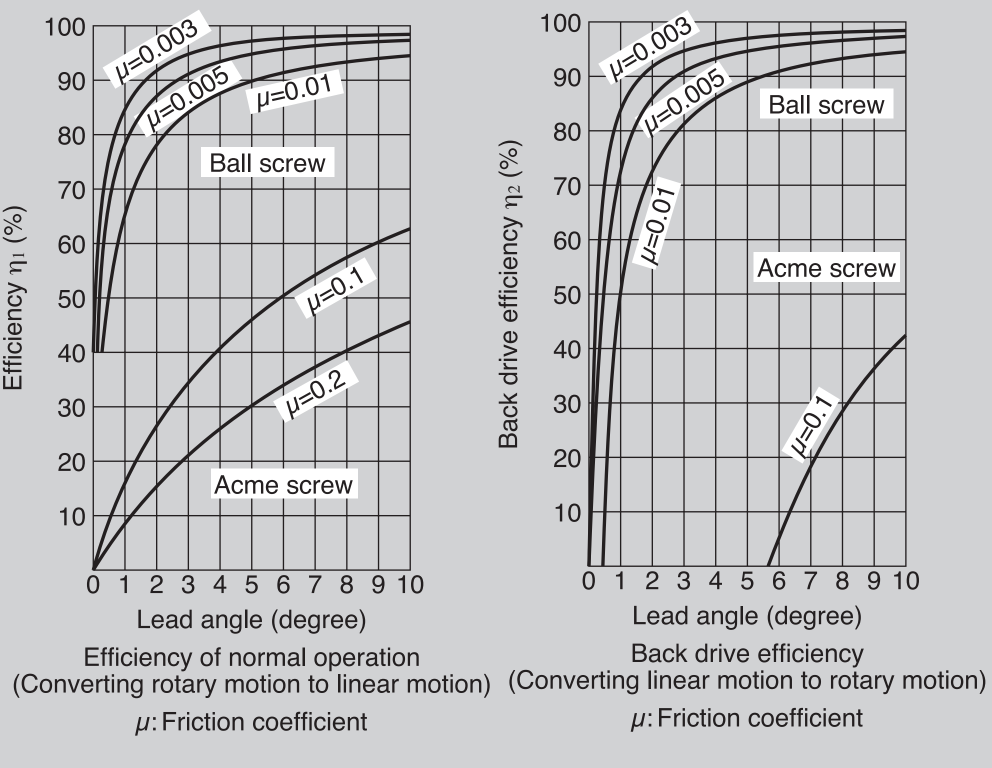


Fig. 1.2 Mechanical efficiency of ball screws

B-1-2 Structure of a Ball Screw

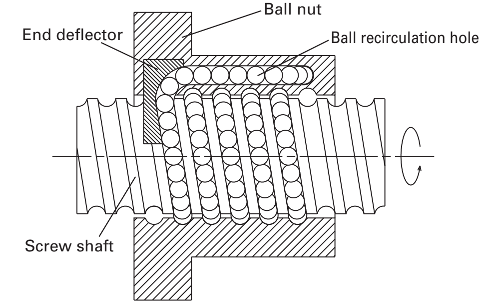
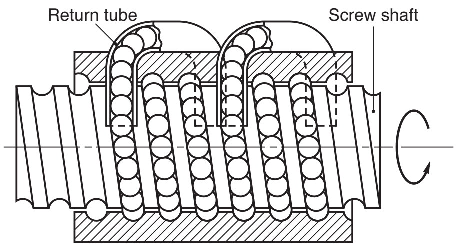
Balls are placed between the screw shaft and nut, and roll. This system is called a "ball screw." To keep the balls recirculating continually, this system requires a screw shaft, a nut, balls, and recirculation components as basic items. A ball screw has the following functions.

① Converting motion: Changing rotary motion to linear motion (normal operation); Changing linear motion to rotary motion efficiently (back-drive operation).

② Increasing power: A small torque is converted to a large thrust force.

③ Positioning: Sets accurate position in linear motion.

Table 2.1 Ball screw recirculation system

<table>
<tr><th>End deflector type</th><th>Ball return tube type</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>[Structure]
Balls are smoothly picked up in tangential direction at the end of nut, and recirculated via hole in the nut.
If the ball is picked up at the middle of the nut, it is called middle deflector type.

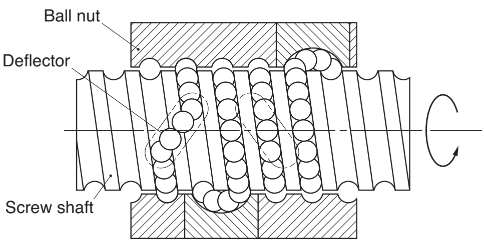
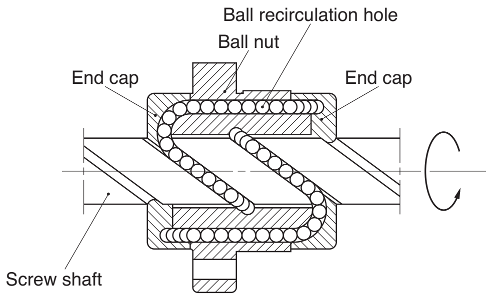
[Features]
· Small nut O.D., allows compact design.
· Low noise, High speed.</td><td>[Structure]
Balls are recalculated through pipe of optimized size, bridging the start and end of recirculation.

[Features]
· Adapt to various specifications. (screw shaft diameter, lead)</td></tr>
</table>

B-1-2.1 Ball Recirculation System

A ball recirculation system is categorically most important, as well as the preload system, to classify the structure of ball screw.

As shown in Table 2.1, four types of ball recirculation system are used for NSK ball screw.

<table>
<tr><th>Deflector type</th><th>End cap type</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>[Structure]
Balls are recirculated by horseshoe shaped deflector bridging the pitch groove.

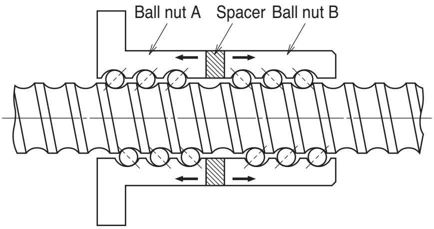
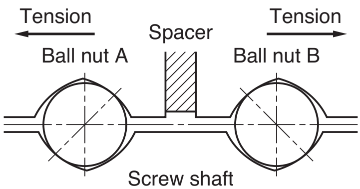
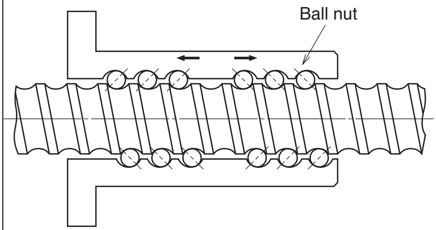
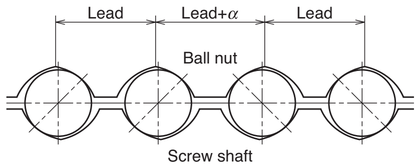
[Features]
· Suitable for fine lead ball screws.
· Small nut O.D., allows compact design.</td><td>[Structure]
Balls are picked up by cap placed at both ends of the nut, and recirculated via hole in the nut.

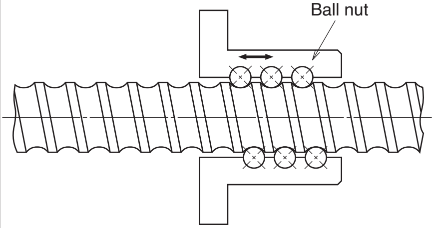
[Features]
· Suitable for large lead ball screws.
· Not universal due to complex recirculation structure.</td></tr>
</table>

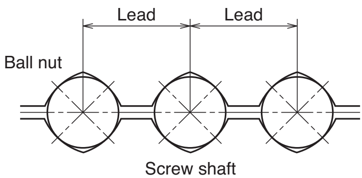
B-1-2.2 Preload system

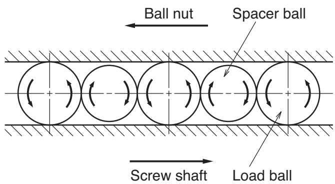
There are four systems to apply preload to NSK ball screws depending on the application.

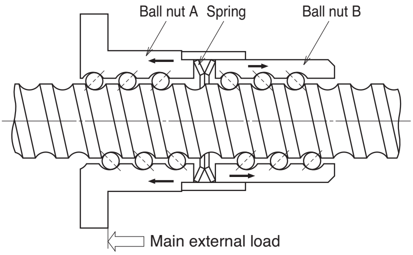
Table 2.2 Preload system for ball screw

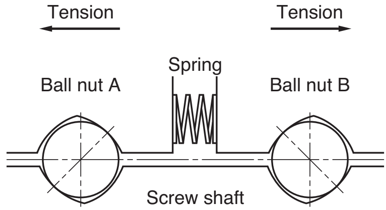
Preload system	Double nut preload (D Preload)	Offset preload (Z Preload)
Structure	 	 
Description	Uses two nuts, and inserts a spacer between them to apply preload. In general, a spacer is thicker (by the deformation equivalent to the preload) than the actual space between two nuts. On the contrary, a thin spacer is inserted in some cases.	To apply preload, the lead near the center of the nut is enlarged by the volume equivalent to preload (α). Uses a single nut to create a preload similar to D preload. Not using spacer enables compact nut design.
Nut length	Long	Medium
Torque characteristics	Fair	Fair
Rigidity	Excellent	Excellent

<table>
<tr><th>Oversize ball preload (P Preload)</th><th>Spring preloaded double nut (J Preload)</th></tr>
<tr><td>






</td><td>




</td></tr>
<tr><td>Balls slightly larger than the space of the ball groove (over-size balls) are inserted to apply preload by balls' four-point contact.
Provide better torque characteristics in the low torque range.</td><td>A spring is used as a spacer of D Preload. Must be used with discretion in its varied rigidity by load direction.</td></tr>
<tr><td>Short</td><td>Long</td></tr>
<tr><td>Fair</td><td>Excellent</td></tr>
<tr><td>Fair</td><td>Poor</td></tr>
</table>

B 6

B-1-3 Ball Screw Series

B-1-3.1 Ball Screw Classification

- Ball screws
  - Application-oriented ball screws
    Features and application examples are shown in page B107.
    - For high-speed machine tools
      - HMD Type — Page B109
      - HMC Type — Page B113
    - BSL™ Type for miniature lathe — Page B119
    - For high load drive
      - HTF-SRC Type — Page B123
      - HTF-SRD Type — Page B127
      - HTF Type — Page B131
    - VSS Type for contaminated environment — Page B139
    - TW Series for twin drive — Page B143
    - Hollow shaft ball screw for high precision machine tools — Page B144
    - ND Series for nut rotatable drive — Page B149
    - • Series for robot — Page B157
    - R Series ball screw for transfer equipment — Page B169
    - Ball screw equipped with NSK K1 Lubrication Unit — Page B209
  - Standard ball screws
    - Finished shaft end
      - Compact FA PSS Type — Page B219
      - MA Type, Miniature, fine lead ball screws — Page B243
      - FA Type for small equipment — Page B265
      - SA Type for machine tools — Page B301
      - KA Type, Stainless steel product — Page B357
    - Blank shaft end
      - MS Type, Miniature, fine lead ball screws — Page B385
      - FS Type for small equipment — Page B393
      - SS Type for machine tools — Page B405
  - Standard nut ball screws
    - End deflector type — Page B467
      High speed and low noise operation, and compact nut outside diameter
      A wide range of screw diameter and lead combinations
    - Tube type — Page B473
      Standard ball recirculation system for ball screws
      A wide range of screw diameter and lead combinations
    - Deflector type — Page B507
      Most compact nut outside diameter recirculation system
      Suitable for fine lead operation
    - End cap type — Page B521
      Ball screws with high helix lead and multiple start threads
      High speed, High load capacity

- Ball screw accessories
  - Support units (Support bearing units for ball screw)
    - For small equipment, light load — **Page B439**
    - For machine tools, high load — **Page B449**
  - Lock nut — **Page B453**
  - Grease unit — **Page B455**
  - Travel stopper (by order) — **Page B456**
  - Ball screw support bearing, thrust angular contact ball bearings — **Page B457**

Lead classification

Classification	Lead ratio K = lead l / shaft diameter$d$
Fine	$K < 0.5$
Medium	$0.5 \leq K < 1$
High helix	$1 \leq K < 2$
Ultra high helix	$2 \leq K$

B-1-3.2 Product externals

(1) Ball screws

●Application-oriented ball screws

Fig. 3.1 HMD type for high-speed machine tools Page B109

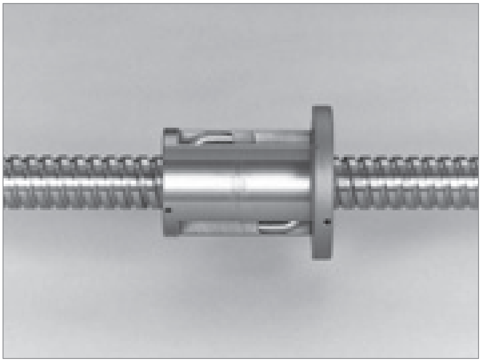


Fig. 3.2 HMC type for high-speed machine tools Page B113

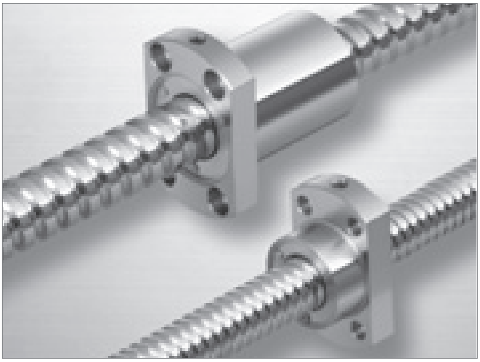


Fig. 3.3 BSL type for miniature lathe Page B119

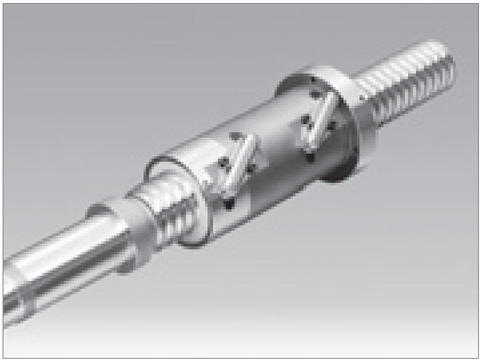


Fig. 3.4 HTF-SRC type for high-load drive Page B123

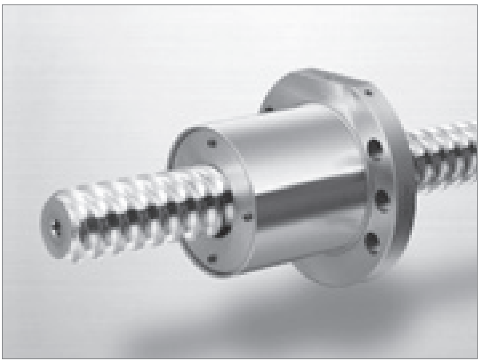


Fig. 3.5 HTF-SRD type for high-load drive Page B127

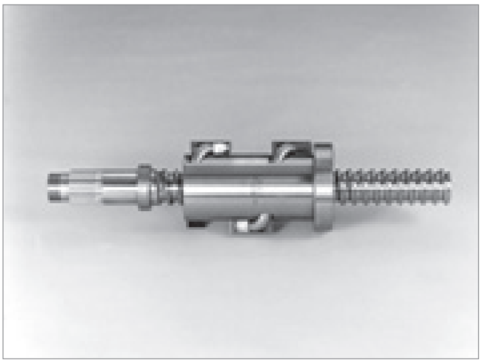


Fig. 3.6 HTF type for high-load drive Page B131

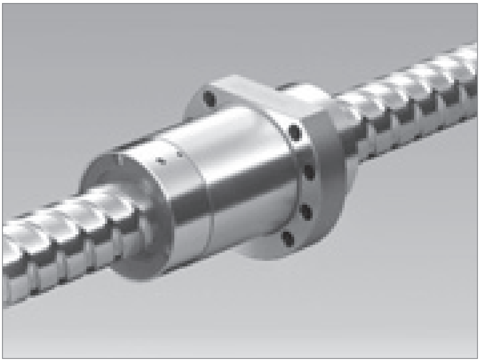


Fig. 3.7 VSS type for contaminated environment Page B139

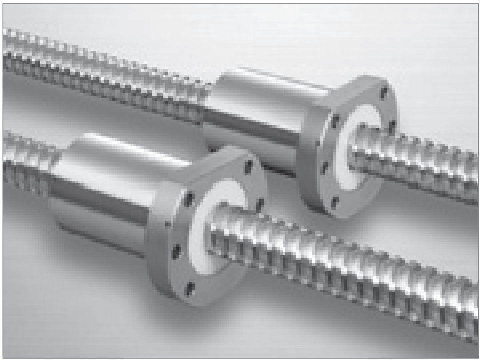


Fig. 3.8 TW series for twin-drive system Page B143

Fig. 3.9 Hollow shaft ball screw for high-precision machine tools Page B144

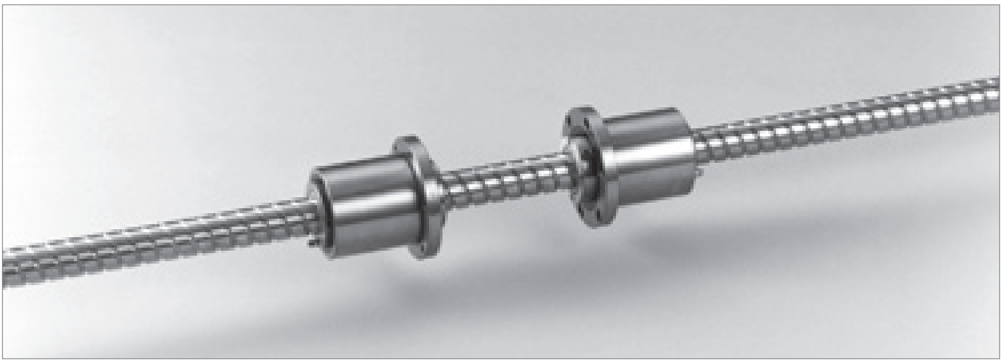


Fig. 3.10 ND series for nut-rotatable drive Page B149

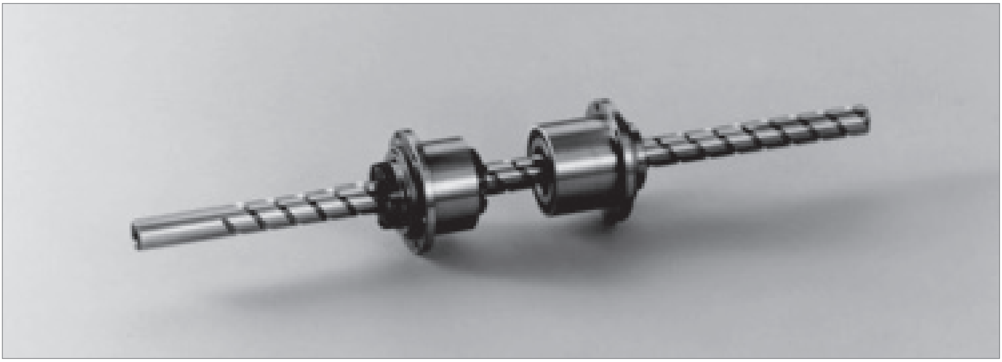


Fig. 3.11 $\sum$ series for robot **Page B157**

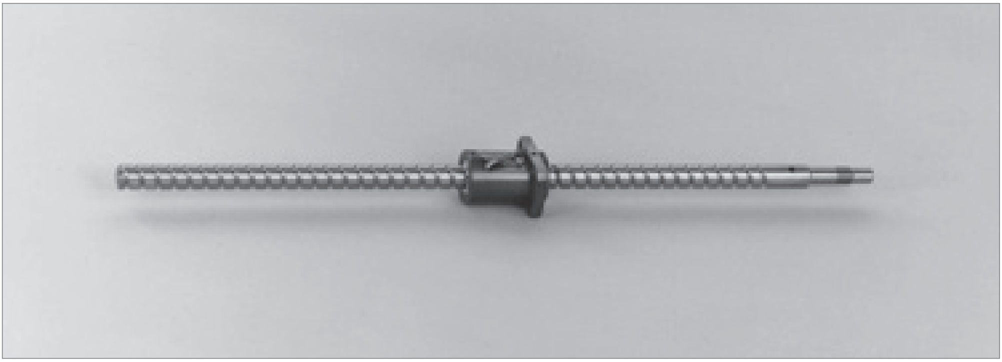


Fig. 3.12 Finished shaft end VFA type for transfer equipment **Page B169**

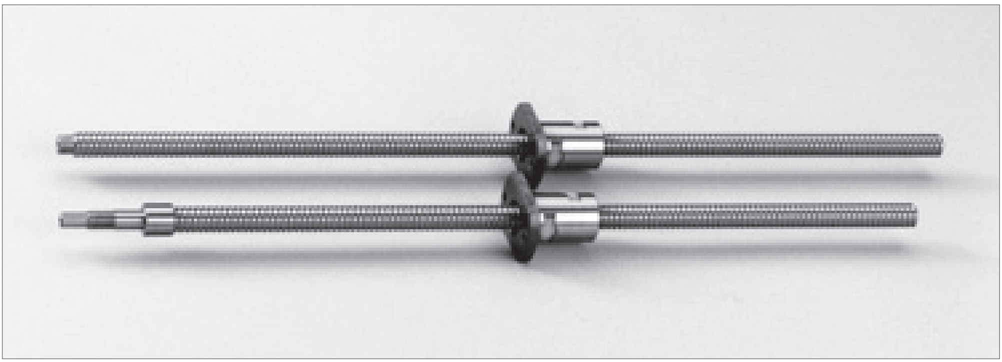


Fig. 3.13 Finished shaft end RMA type and blank shaft end RMS type for transfer equipment **Page B169**

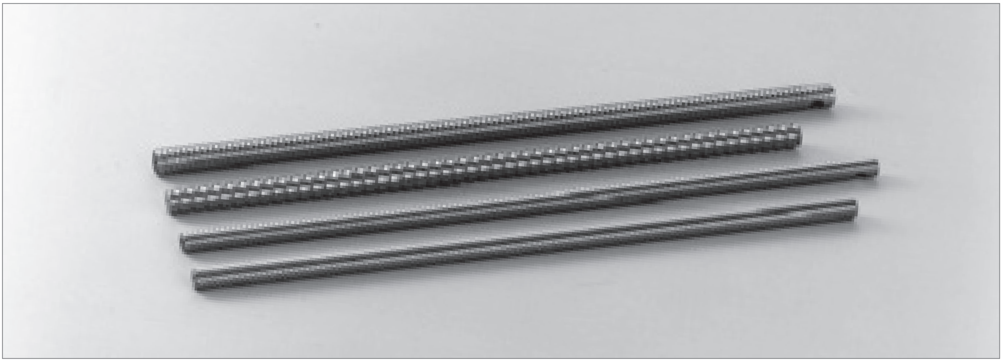


Fig. 3.14 Blank shaft end R series for transfer equipment Page B169

Fig. 3.15 R series nut assembly for transfer equipment

●Standard ball screws

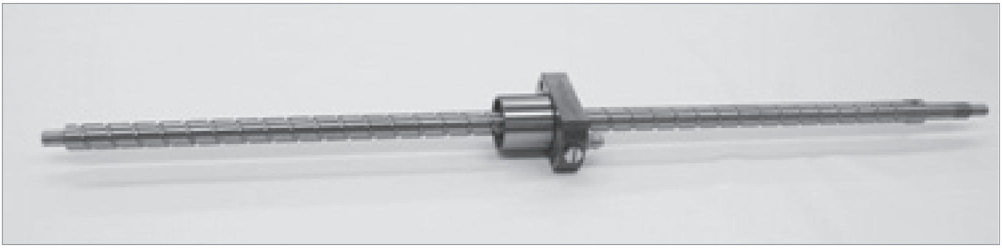


Fig. 3.16 Finished shaft end compact FA PSS type Page B219

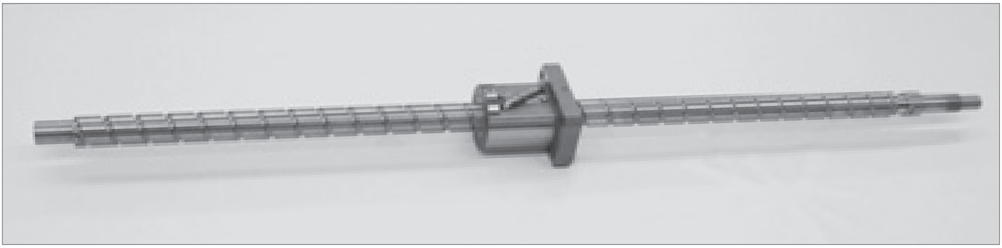


Fig. 3.17 Finished shaft end MA type, FA type, SA type Page B241

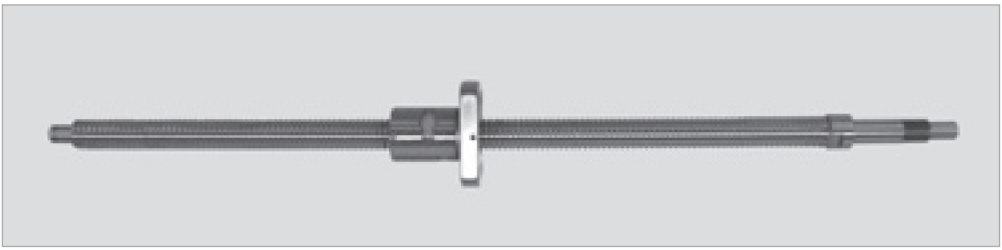


Fig. 3.18 Finished shaft end KA type Page B357

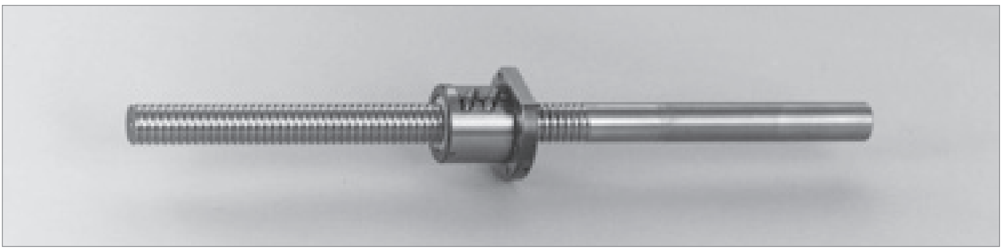


Fig. 3.19 Blank shaft end MS type, FS type, SS type Page B383

●**Standard nut ball screws**

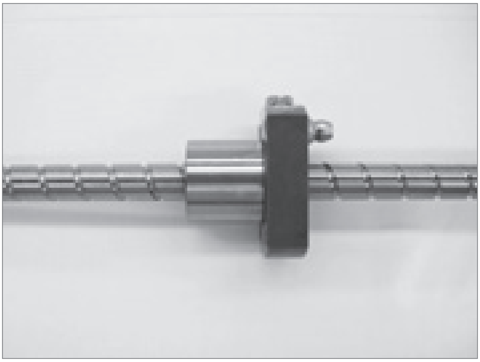


Fig. 3.20 End deflector type **Page B467**

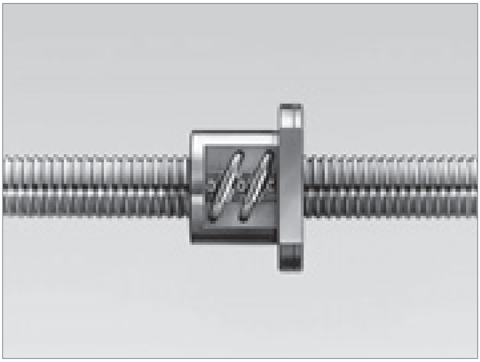


Fig. 3.21 Tube type **Page B473**

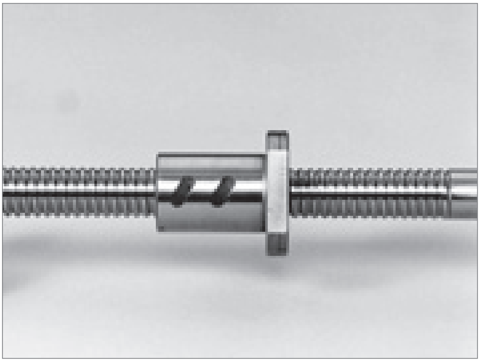


Fig. 3.22 Deflector type **Page B507**

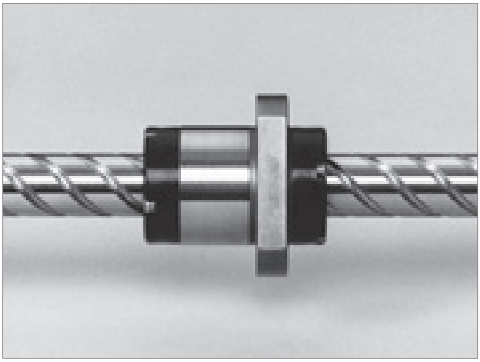


Fig. 3.23 End cap type **Page B521**

(2) Standard accessories

Fig. 3.24 Support unit **Page B439**
(For small equipment, light load)

Fig. 3.25 Low-profile support unit **Page B439**
(For small equipment, light load)

Fig. 3.26 Support unit **Page B449**
(For machine tools, heavy load)

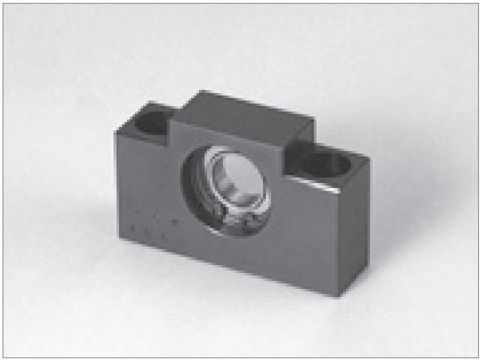


Fig. 3.27 Support unit for VFA type **Page B446**
(simple support side)

Fig. 3.28 Support kit for RMA and RMS types
Page B445

Fig. 3.29 Lock nuts A type **Page B453**

Fig. 3.30 Lock nuts S type **Page B454**

Fig. 3.31 NSK hand grease pump unit **Page D20**

Fig. 3.32 NSK grease **Page B455, D20**

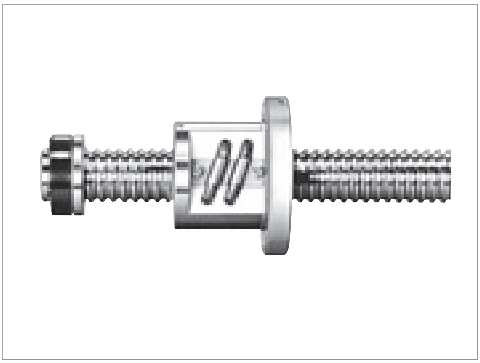


Fig. 3.33 Travel stopper **Page B456**
(by order)

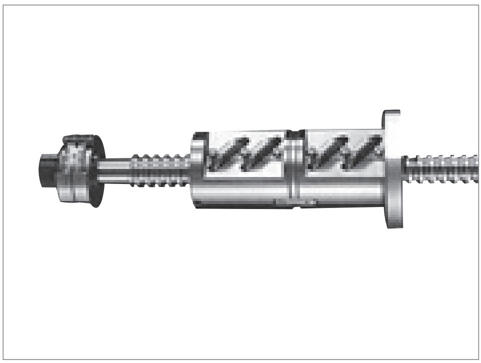


Fig. 3.34 Ball screw support bearing, thrust angular contact ball bearings **Page B457**

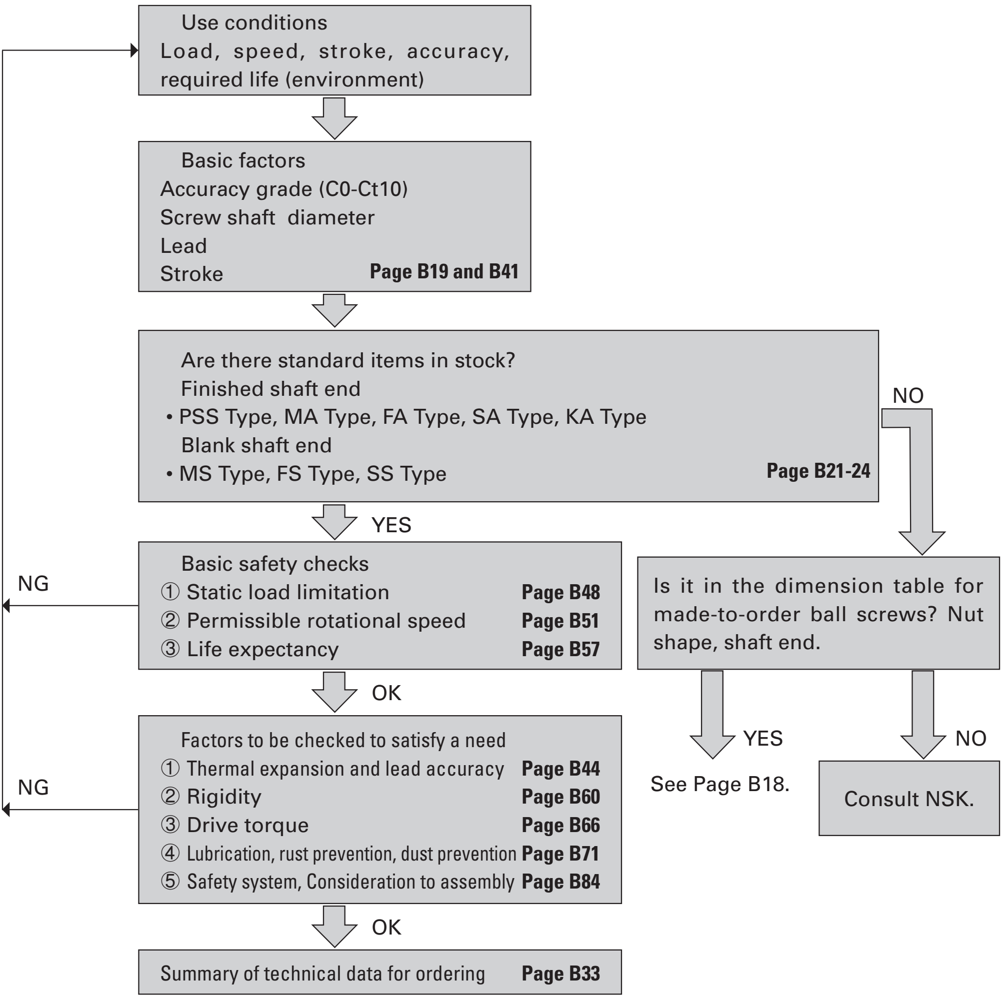
B-1-4 Procedures to Select Ball Screw

B-1-4.1 Flow Chart for Selection

When selecting a ball screw, you have to review a variety of use conditions and requirements such as applied loads, speeds, motion strokes, positioning accuracy, required life and operating environment.
You require a multiple inspection because some of these conditions force a ball screw to have conflicting characteristics.

(1) Standard ball screw

The chart below is one of the selection methods. To take advantage of prompt delivery and reasonable prices, this method focuses on the standardized ball screws that are available in stock.
NSK offers a ball screw selection program, and also has a service to select appropriate items using data file compiled by our knowledge and experience.



(2) Made-to-order ball screws

Dimensions and specifications can be decided individually for the application-oriented ball screws and standard nut ball screws. Procedures are as follows. Refer to the selection exercises on Page B87.

Table 4.4 is "Combinations of screw shaft diameter and leads for basic type ball screw." Please consult NSK if you require the types that are not listed in the Table.

Select screw shaft diameter, lead, nut. **Page B21, B105, B465**

↓

Select setting stroke, screw shaft length. **Page B25**

↓

Select the ball nut type **Page B26, B465**

↓

Select the shaft end shape. **Page B27, B29**

↓

Basic safety checks (NG → return to first step)

① Static load limitation **Page B48**

② Permissible rotational speed **Page B51**

③ Life expectancy **Page B57**

↓ OK

Factors to be checked to satisfy a need (NG → return to first step)

① Thermal expansion and lead accuracy **Page B44**

② Rigidity **Page B60**

③ Drive torque **Page B66**

④ Lubrication, rust prevention, dust prevention **Page B71**

⑤ Safety system, Consideration to assembly **Page B84**

↓ OK

Summary of technical data for ordering **Page B31**

B-1-4.2 Accuracy Grades

Table 4.1 shows examples of how to select accuracy grade for a specific use. These practical cases are based on NSK's experience. Circle indicates the range of the accuracy grade in actual use. A double circle indicates accuracy grades most frequently used among cases marked with a single circle. These symbols help to select the accuracy grade of ball screws temporarily. To confirm whether a specific ball screw accuracy grade satisfies requirements in positioning accuracy in actual use, refer to "Technical Description" and "Mean travel deviation and travel variation." (Page B42)

Table 4.1 Accuracy grades of ball screw and their application

Application		NC machine tools																			
		Lathe		Milling machine Boring machine		Machining center		Drilling machine		Jig boring machine		Grinder		Electric discharge machine		Wire cutting Electric discharge machine		Punch press	Laser cutting machine		Woodworking machine
Name of axis		X	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	Z	XY	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 machine	Three-dimensional coordinate measuring machine	Office machine	Image processing equipment	Nuclear power		Aircraft
			Lithographic machine	Chemical processing equipment	Wire bonder	Prober	Electric component mounted device	Printed circuit board drilling machine	Cartesian type		Articulate type		SCARA type						Fuel rod control	Mechanical snubber	
									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 combinations of NSK ball screw accuracy grades and axial play. Select an axial play which satisfies the required accuracy in backlash, positioning and repeatability. Ranges of available ball thread effective length in relation to accuracy grade and axial play are shown in Table 4.3. Please note that if the effective length exceeds the range, the axial play may become partially negative (preloaded condition).

For axial play of Ct10 grade (ball screws for transfer equipment), refer to the R series dimension tables.

Table 4.2 Combinations of accuracy grades and axial play

Axial play / Accuracy grade	*Z* 0 mm (Preload)	*T* 0.005 mm or less	*S* 0.020 mm or less	*N* 0.050 mm or less	*L* 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	1000	1000	1000
32 – 40	1000	800	2000	1500	1500
50 – 63	1200	1000	2500	2000	2000
80 – 125	—	—	4000	3000	3000

Remarks: Refer to Table 4.8 (Page B25) for the available length of screw shaft (maximum length). Also, axial play of code N does not become partial negative play if it is within the available range of effective ball thread length.

B-1-4.4 Screw Shaft Diameter, Lead, and Stroke

Choose a screw shaft diameter and stroke based on the allowable space for ball screw installation. Lead should be set based on the required running speed, and should give some allowance to the maximum rotational speed of the motor.

(1) Made-to-order ball screws

Table 4.4 shows the combinations of screw shaft diameter and leads for made-to-order ball screws. For details, refer to the dimension tables from Page B105 and B465.

Table 4.4 Combinations of screw shaft diameter and leads for typical ball screw Unit: mm

Screw shaft diameter \ Lead	0.5	1	1.5	2	2.5	3	4	5	6	8	10	12	14	16	20	25	30	32	36	40	50	60	64	80	100
4	D	D																							
6	D	D		D																					
8	D	D	D	D																					
10		D		D	D		T	S			S														
12		D		D	D	D	T	S,T			S,T				S,C		S								
14				D		D		T		T															
15								S			S,T				S,C		S			C					
16				D	D		T	T	T					T,C				C			C				
20				D			T	S,T D,B	T,D B	T	S,T			T	S,T C		S			S,C		S,C			
25				D			T	S,T D,B	T,D B	T,B	S,T D,B			T	S,T	S,T C	S				S,C			C	
28								T	T		T														
32				D			T	S,T D	T,D	T,D	S,T D,B V,F	S,T B		S,V	S,T V,N	T,N		S,T C,V N					S,C		
36								S,T	T		S,T F	S,F		S,H	S,H										
40				D				T,D	T,D	T,D	S,T D,F	S,T F		S,T H	S,H	S,T H,N	S,H	T,H N	H	S,T C,V N				S	
45											S,T F	S,T F		S,H	S,H	S,H	S,H	H	H						
50								T,D	T,D	T,D	S,T D,F	S,T D,F	F	S,T F	S,T D,H	S,T H,N	S,H	T,H N		T,N F	S,T C,V N				S
55											T,F	F	F	F	H	H	H	H							
63									D	D	T,D	D,F	F	F	T,D F	F		F		T,F	T				
80											T,D	T,D	F	T,F	T,D F	F					F				
100											D	T,D		T,F	T,D F	F									
120														F	F	F									
125														T	T										
140															F	F	F	F							
160																F	F	F							
200																	F	F							

T: Tube type
D: Deflector type
C: End cap type
S: End deflector type
H: HMC type, HMD type
F: HTF-SRC, HTF-SRD, HTF type
N: ND Series
B: BSL type
V: VSS type

Table 4.5 Screw shaft diameter, lead and standard screw shaft length of R Series Unit: mm

Screw shaft diameter	Lead	Standard screw shaft length									
		400	500	800	1000	1500	2000	2500	3000	4000	5000
10	3	●		●							
	6	●		●							
12	8	●		●							
	12	●		●							
14	4		●		●						
	5		●		●						
15	20		●		●	●					
16	10		●		●	●					
	16		●		●	●					
	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) Standard ball screw

Table 4.6 and 4.7 show combinations of ball screw shaft diameter and leads, and range of stroke.
From these tables, select closest values to the shaft diameter, lead, and stroke which had been selected previously. Also, confirm detailed specifications and sizes in "Dimensional table of standard ball screw" (Page B217).

Table 4.6 Screw shaft diameter, lead and stroke of standard ball screw

Shaft dia.	Lead	Stroke												
		– 50	– 100	– 150	– 200	– 250	– 300	– 350	– 400	– 450	– 500	– 550	– 600	– 650
4	1	○	○△											
6	1	○	○	○△										
8	1		○△	○	○△									
	1.5		○△	○	○△									
	2		○△	○	○△									
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									○	○		△	○

See Table 4.7 for KA Type in stainless steel product

Table 4.7 Screw shaft diameter, lead and stroke of KA type in stainless steel product Unit: mm

Shaft dia.	Lead	Stroke – 150	– 200	– 250	– 300	– 350	– 450	– 500	– 650	– 1050
6	1	●								
8	1		●							
	2		●							
10	2			●						
	4	●				●				
12	2	●			●					
	5			●				●		
	10				●			●		
15	10						●		●	●
	20						●		●	●
16	2	●				●				
20	20						●		●	●

●mark; PSS type: ○mark; MA type, FA type, SA type: △mark; MS type, FS type, SS type

Unit: mm

	Stroke – 700	– 750	– 800	– 850	– 900	– 950	– 1100	– 1200	– 1300	– 1400	– 1500	– 1700	– 2100	– 3000
		○	△											
	●													
		●○		●○△			●○△							
		●○		●○	△		●○△							
	●		●		●		●							
				○	△									
		○		○			○△							
				○	△				○△					
			△											
		●○		●		△								
		●○		●○△		○	●○	○	●○△					
	●	○	●	○	●	○△	●○	○	●		○△	●		
		●		●			●		●					
	●○		●		●○		●○△		●○			●○△	●	
	●		●				●		●			●	●	
		○					△							
		●○△		●△		○	●	○△						
		○△					△	○△			△			
	●○	△	●		●○	△	●○			○	△	●		
	○	●		●	○		●○		●○△		○	●○	●○△	
	●○		●		●○		●○		●○△		○	●○	●○△	
	●		●		●		●		●			●	●	
	●		●○		●		●○		●		△	●○	●○△	
	○	○△			○	○	○	○△						
	○	△			○		○	△						
	○	△	○	△	○	○	○	○△		○	○△	△		
	○	○			○	○△	○	○		○	○△			
	○				○	△				○	△			
	○		○	△	○△		○		○△	○		○△		
							○					○△	○	○△
							○					○△	○	○△
			○		○		△	○	○			○△	△	
	○				○	△	○				○	△		
				○			○△				○	△		
	○		○△	△	○△		○	○	○△	○	○	○△		○△
			○△	△	○			○	○	△	△	○		○△
					○△				○		△	○		○△
	○			○△	○△		○			○△			○△	○△

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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

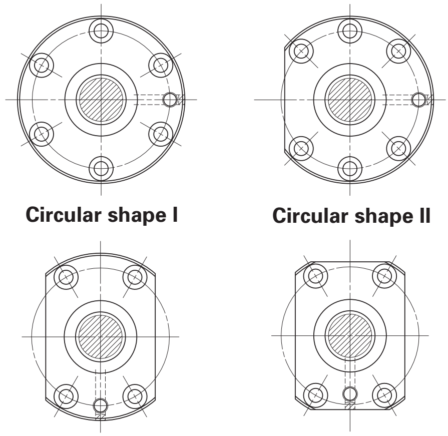
Screw shaft diameter \ Accuracy grade	C0	C1	C2	C3	C5	Ct7	Ct10
4	90	110	120	140	140	140	—
6	150	180	200	250	250	250	—
8	240	280	340	340	340	340	—
10	350	400	500	500	500	550	800
12	450	500	650	700	750	800	800
14	600	650	750	800	1000	1000	1000
15	600	700	800	900	1250	1250	1500
16	600	750	900	1000	1500	1500	1500
18	—	—	—	—	—	—	1500
20	850	1000	1200	1400	1900	1900	2000
25	1100	1400	1600	1900	2500	2500	2500
28	1100	1400	1600	1900	2500	2500	2500
32	1500	1750	2250	2500	3200	3200	3000(4000)
36	1500	1750	2250	2500	3200	3500	3000
40	2000	2400	3000	3400	3800	4300	4000(5000)
45	2000	2400	3000	3400	4000	4500	4000
50	2000	3200	4000	4500	5000	5750	4000
63	2000	4000	5000	6000	6800	7700	—
80	—	4000	6300	8200	9200	10000	—
*100	—	4000	6300	10000	12500	13500	—
*120	—	—	—	—	—	13500	—
*125	—	—	—	10000	13500	13500	—
*140	—	—	—	—	—	10000	—
*160	—	—	—	—	—	8000	—
*200	—	—	—	—	—	5000	—

Remarks: 1. Values in parentheses of Ct10 are applicable to the ultra high helix lead (l/d≥2). Refer to dimension tables in B203 and following pages for details.
2. Please note that the range for small leads (3 mm or under) are also limited by the screw length.

B-1-4.6 Outside Shapes of Ball Nut

(1) Flange shape

Fig. 4.1 shows the available flange shape. Select the appropriate shape according to the nut installation condition. (Fig. 4.2)



Circular shape I | Circular shape II

Circular shape III | Rectangular shape

Fig. 4.1 Flange shape

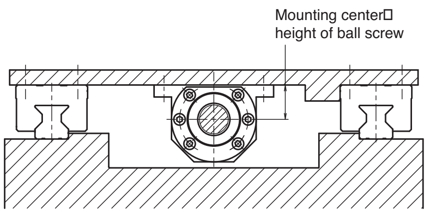


Fig. 4.2 Installation example

(2) Shapes of nut cross section

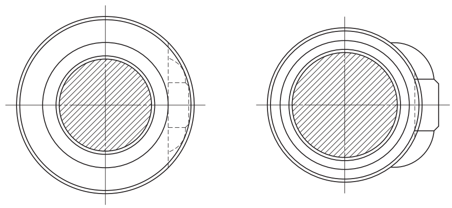
Cross-section of nuts are shown in Fig. 4.3. For detailed dimensions, refer to "Dimension table of nut."

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.



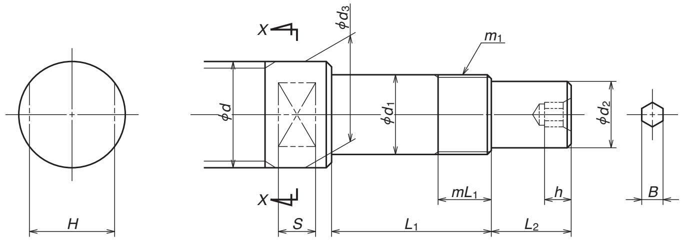
Circular (round) | Tube-projecting type

Fig. 4.3 Shape of the cross section of nut

B-1-4.7 Shaft End Configuration

(1) Standard shaft end dimensions

Table 4.9 and 4.10 show shaft end types for NSK standard support units.
Refer to the dimension tables below when designing shaft ends of standard ball screw.



Section *X-X*

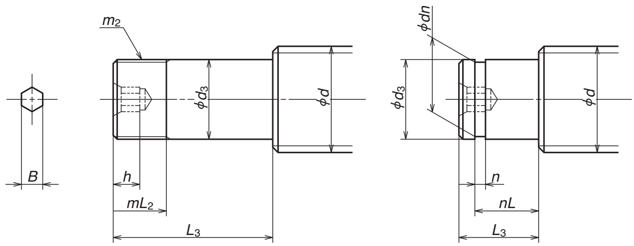
Fig. 4.4 Configuration of standard shaft end (drive side)

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	Outside diameter	Width across flats	Depth	Width across flats	Length		
d	d_1	L_1	m_1	mL_1	d_2	L_2	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	15	4	6	12	6.5	WBK12-01A	WBK12-11
15	12	30	M12×1	10	10	15	15	4	6	12	6.5	WBK12-01A	WBK12-11
16	12	30	M12×1	10	10	15	15	4	6	12	6.5	WBK12-01A	WBK12-11
20	15	40	M15×1	15	12	20	19.5	5	7	17	8.5	WBK15-01A	WBK15-11
	17	81	M17×1	23	12	29	20	5	7	22	10	WBK17DF-31	
25	20	53	M20×1	16	15	27	25	6	8	22	10	WBK20-01	WBK20-11
	20	81	M20×1	23	15	39	25	6	8	22	10	WBK20DF-31	
28	20	53	M20×1	16	15	27	25	6	8	22	10	WBK20-01	WBK20-11
	20	81	M20×1	23	15	39	28	6	8	24	12	WBK20DF-31	
32	25	62	M25×1.5	20	20	33	32	8	10	27	12	WBK25-01	WBK25-11
	25	89	M25×1.5	26	20	51	32	8	10	27	12	WBK25DF-31	
	25	104	M25×1.5	26	20	51	32	8	10	27	12	WBK25DFD-31	
36	30	89	M30×1.5	26	25	61	36	10	12	30	13	WBK30DF-31	
	30	104	M30×1.5	26	25	61	36	10	12	30	13	WBK30DFD-31	
40	30	89	M30×1.5	26	25	61	40	10	12	—	—	WBK30DF-31	
	30	104	M30×1.5	26	25	61	40	10	12	—	—	WBK30DFD-31	
45	35	92	M35×1.5	30	30	63	45	12	14	—	—	WBK35DF-31	
	35	107	M35×1.5	30	30	63	45	12	14	—	—	WBK35DFD-31	
50	40	92	M40×1.5	30	35	78	50	14	18	—	—	WBK40DF-31	
	40	107	M40×1.5	30	35	78	50	14	18	—	—	WBK40DFD-31	

Low-profile support unit is available for compact FA PSS type.



Shape Ⅰ **Shape Ⅱ**

Fig. 4.5 Standard shaft end configuration (opposite to the drive side)

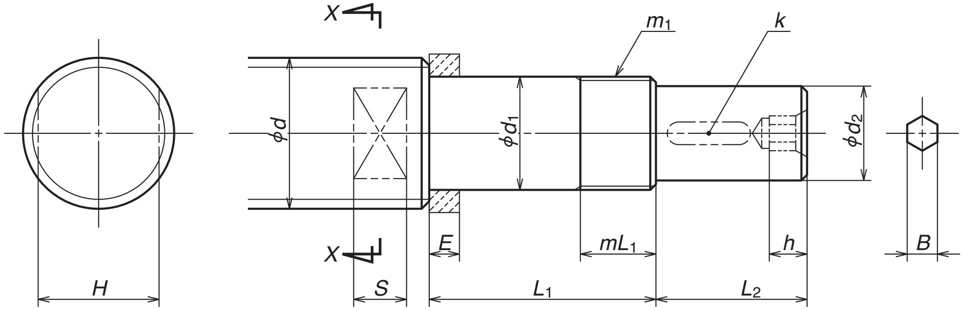
Table 4.10 Dimensions of shaft ends (opposite to the drive side)

Unit: mm

Screw shaft diameter d	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 d_3	Length L_3	Nominal spec. m_2	Length mL_2	Width n	Groove diameter dn	Groove position nL	Width across flats B	Depth 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-01	
	Ⅰ	25	62	M25×1.5	20	—	—	—	8	10	WBK25-01	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

Table 4.11 and 4.12 show shaft end types for R Series.



Section *X-X*

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	WBK25-01	WBK25-11
36	25	76	M25×1.5	20	14	20	33	6	8	10	27	12	WBK25-01	WBK25-11
40	30	89	M30×1.5	26	—	25	61	8	10	12	—	—	WBK30DF-31	
45	35	92	M35×1.5	30	—	30	63	8	12	14	—	—	WBK35DF-31	
50	35	92	M35×1.5	30	—	30	63	8	12	14	—	—	WBK35DF-31	

Note : The dimension d_1 shall be smaller enough than the minor diameter of the ball screw thread to provide sufficient shoulder surface for the spacer.
Refer to "B-Ⅱ-14 Precautions for Designing Ball Screw (B84 page)".

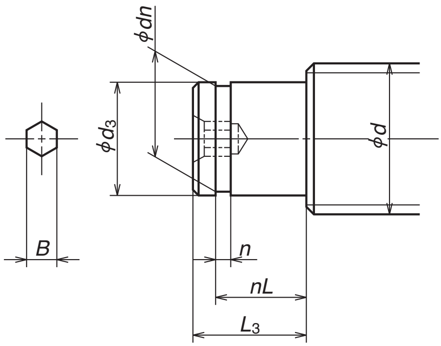


Fig. 4.7 Shaft end configuration of R Series (opposite to the drive side)

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-01(6205)
36	25	20	1.35	23.9	16.35	8	10	WBK25S-01(6205)
40	30	22	1.75	28.6	17.75	10	12	(6206)
45	35	23	1.75	33	18.75	12	14	(6207)
50	35	23	1.75	33	18.75	12	14	(6207)

B-1-5 When Placing Orders

To avoid confusion, please use "reference number" or "specification number" when inquiring about desired ball screw specifications.

◇ **Reference number**:

Alpha-numeric codes are assigned to each ball screw. When placing order, please use this reference number.

◇ **Specification number**:

Specification factors are identified by alpha-numeric codes. Codes are for easy explanation of your requirements. (If you do not use these numbers, please itemize your requirements.)

B-1-5.1 When Ordering Made-to-Order Ball Screws

If you would like to discuss technical points regarding specifications, use the NSK ball screw technical data sheet as an aid (Page B36). For high-load drive ball screws, use the technical sheet for NSK high-load drive ball screw.

(1) Specification number of made-to-order ball screw

DFT 5010-5 L C 3 Z-850/1230

- DFT: Nut model
- 50: Screw shaft diameter (mm)
- 10: Lead (mm)
- 5: Effective turns of balls (number of turns of balls x number of circuit)
- L: Direction of turn : No code, Right; L, Left
- C3: Accuracy grade
- Z: Axial play
- 850: Threaded length (mm)
- 1230: Screw shaft length (mm)

(2) Reference number of made-to-order ball screw

W 50 12 - 26 L D - C1 Z 10

- W: Product code (Ball Screw)
- 50: Screw shaft diameter (mm)
- 12: Effective threaded length (by the unit of 100 mm)
- 26: Design serial number
- L: Direction of turn : No code, Right; L, Left
- D: Ball screw specification/appearance
- C1: Accuracy grade
- Z: Axial play
- 10: Lead (mm)

(3) Reference number of ball screws for transfer equipment with finished shaft end and blank shaft end

VFA 15 10 C7 S - 500

- VFA: Ball screws for transfer equipment: VFA, RMA, RMS
- 15: Screw shaft diameter (mm)
- 10: Lead (mm)
- C7: Accuracy grade
- S: Axial play
- 500: Screw shaft length (mm)

(4) Reference number of R series ball screws for transfer equipment

Nut assembly

RN FTL 25 10 A 5 S

- RN: Product code (nut assembly)
- FTL: Nut model: RNFTL, RNFBL, RNSTL RNCT, RNFCL
- 25: Screw shaft diameter (mm)
- 10: Lead (mm)
- A: Internal design specification code
- 5: Effective turns of balls(number of turns of balls × number of circuit)
- S: Seal code S: With seal No code: Without seal

Screw shaft

RS 25 10 A 20

- RS: Product code (screw shaft)
- 25: Screw shaft diameter (mm)
- 10: Lead (mm)
- A: Internal design specification code
- 20: Screw shaft length (× 100)

B-1-5.2 When Ordering Standard Ball Screw

Find the reference number from the dimension table. Enter the reference number in the "Order Form by Fax" (Page B34). Send the fax to a NSK agency (branch office, sales office, or your local representative.).

(1) Example of reference number of Compact FA PSS Type

PSS 15 20 N1D - 0561

- PSS: Compact FA PSS
- 15: Screw shaft diameter (mm)
- 20: Lead (mm)
- N1D: NSK control No.
- 0561: Ball screw shaft length (mm)

(2) Example of reference number of Standard ball screw

W 16 03 FA - 7 P G X - C5 Z 32

- W: Product code (ball screw)
- 16: Screw shaft diameter (mm)
- 03: Effective threaded length (by the unit of 100 mm)
- FA: Standard ball screw: MA, FA, SA, KA MS, FS, SS
- 7: Design serial number
- P: Preload code
- G: Recirculation code
- X: Appearance/specification code
- C5: Accuracy grade
- Z: Axial play
- 32: Lead (mm)

Fax Order Form

(Make copies for future orders)

(1) Standard ball screw

Company name :

Date: Day Month Year

Address :

Telephone :

Name of person in charge :

Section :

Product name	Specification number	Quantity	Desired delivery date
Precision ball screw			
R Series ball screw Nut			
R Series ball screw Screw shaft			
Support unit			
Lock nut			
Grease unit			

Describe the shaft end configuration if processing is required (blank shaft end ball screw). In this case, specify which ball screw in the above list the shaft end shall be processed.

Refer to Page B27 to 30 for shaft end configuration. These pages also show the reference number for support units.

Drive side
Opposite of drive side

NSK Ball Screw Technical Data Sheet (example)

(2) Made-to-order ball screw

Company name ______________________ Date: Day Month Year

Address ______________________ Telephone

Person in charge ______________________ Section

Machine which uses the ball screw *Machining center Model MC-* Application *Table left/right movement (X axis)*

Drawing/rough sketch attached? Yes No

Use conditions

	Axial load	Rotational speed	Operating hours		
Maximum load	*9000* N	*20* min^{-1}	*15* %	Operating conditions	Shaft rotation - Moving nut; Normal operation; Shaft rotation - Moving shaft; Back drive operation; Nut rotation - Moving nut; Nut rotation - Moving shaft; Oscillation
Load in normal use	*4000* N	*360* min^{-1}	*60* %		
Minimum load	*2000* N	*1000* min^{-1}	*25* %	Degree of vibration shock	*Normal*
Maximum rotational speed	*1000* min^{-1}			Required life	*20000h*
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	*1335 mm*	Required torque	
Nut model	ZFT5010-10		Flange type	*Circular I*	Nut orientation	Same as shown in the dimension table		Opposite	

Supplemental explanation/requests

NSK Ball Screw Technical Data Sheet (example)

(2) Made-to-order ball screw

Company name ______ Date: Day Month Year

Address ______ Telephone ______

Person in charge ______ Section ______

Machine which uses the ball screw ______ Application ______

Drawing/rough sketch attached? Yes No

Use conditions

	Axial load	Rotational speed	Operating hours		
Maximum load	N	min^{-1}	%	Operating conditions	Shaft rotation - Moving nut; Normal operation; Shaft rotation - Moving shaft; Back drive operation; Nut rotation - Moving nut; Nut rotation - Moving shaft; Oscillation
Load in normal use	N	min^{-1}	%		
Minimum load	N	min^{-1}	%	Degree of vibration shock	
Maximum rotational speed	min^{-1}			Required life	
Lubricant	Grease/oil (Brand name: Maker:)			Motor in use	
Seal	Yes No			Control system	(resolution:)
Support bearing	Drive side			Opposite 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

NSK Technical Data Sheet for NSK High-Load Drive Ball Screw

Made-to-order ball screw

Company name:	Date:	NSK sales office
Section:	Person in charge:	
Address:		

Name of machine*1 : *Electric injection molding machine; 30-ton capacity* Application*2 : *Clamping axis*

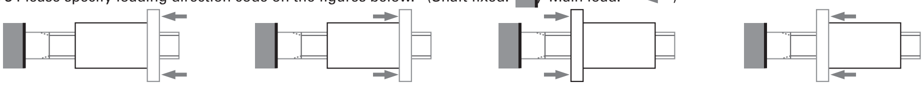
Drawing/rough sketch attached?: ☐ Yes ☑ No

*1 Please specify capacity of the machine in case of injection molding machine or press.
*2 If the application is injection molding machine, please indicate the axis. (Examples: injection axis and clamping axis)

1. Use conditions

Operating conditions	☑ 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

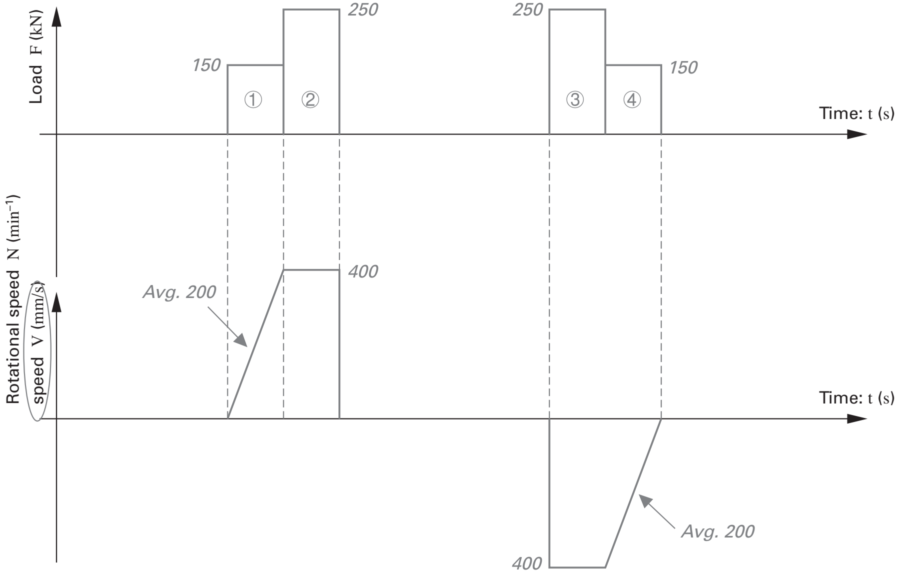
Shaft diameter	*ϕ140* mm	Lead	*32* mm	Accuracy grade	*Ct7*	Axial play	*0.050 or less* mm max.
Nut model No.	*HTF 14032-7.5-S1*	Effective turns of balls	*2.5 × 2*	Direction of turn	*right*	Thread length /Overall shaft length	*1000* / *1500*

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 Screw

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 Screw

Made-to-order ball screw

Company name:	Date:
Section:	Person in charge:
Address:	

NSK sales office

Name of machine*1 : ______________________ Application*2 : ______________

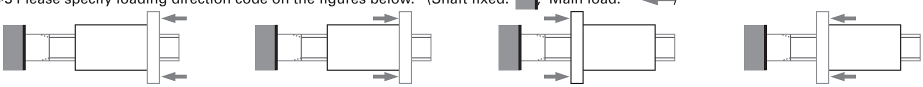
Drawing/rough sketch attached?: ☐ Yes ☐ No

∗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

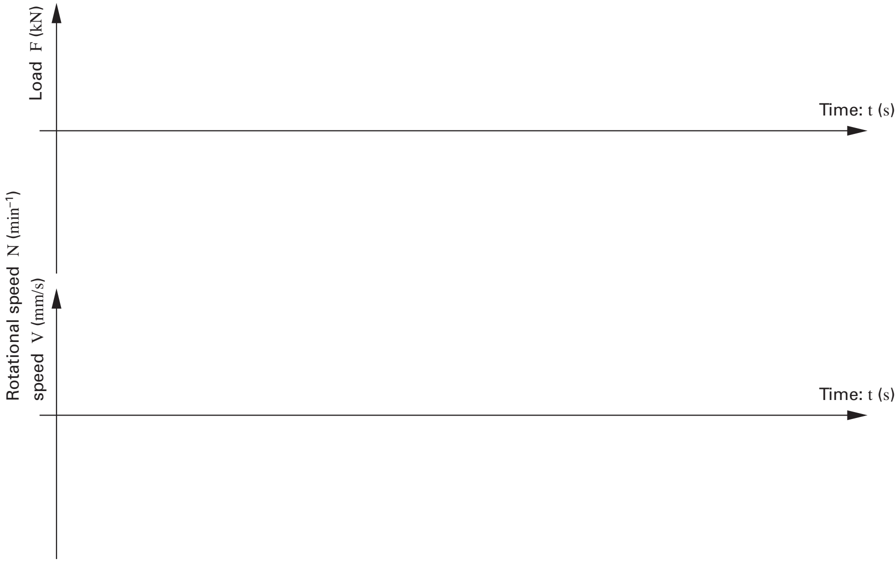
2. Specifications

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 Screw

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-2 Technical Description of Ball Screws

B-2-1 Accuracy

B-2-1.1 Lead Accuracy

The lead accuracy of NSK precision ball screws (C0-C5 grades) conforms to the four characteristics specified in JIS Standards. These characteristics are expressed by codes *ep*, 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. Table 1.2, 1.3 and 1.4 show tolerance of each characteristic.

JIS B1192 sets C type and Cp type standards for positioning ball screws. NSK uses the specification of C type only. JIS B1192 specifies Ct1, 3, and 5 grade. NSK standards are integrated by C type only. Refer to Table 1.2 for C type standard tolerance.

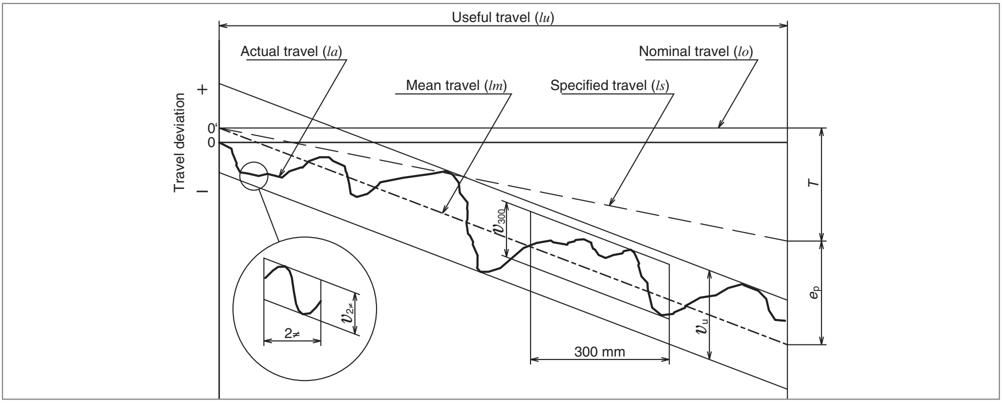


Fig. 1.1 Definition of lead accuracy

Table 1.1 Terminology in lead accuracy

Term	Code	Description	Tolerance
Specified travel	*ls*	The travel compensates the nominal travel for an elongation caused by an increase of temperature or load.	
Travel compensation	*T*	Value obtained by subtracting the specified travel from the nominal travel based on the useful travel. The value is to compensate for the errors caused by thermal deformation or deformation by load.This value is determined by tests and experience (See Page B43).	
Actual travel	*la*	Actually measured travel	
Actual mean travel	*lm*	A straight line that demonstrates the direction of actual travel. This straight line is obtained from the curve that shows actual travel volume by least-squares method or by resembling approximation.	
Tolerance on specified travel	*ep*	Obtained by subtracting the specified travel from the actual mean travel.	Table 1.2
Travel variation	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

Effective thread length mm		C0		C1		C2		C3		C5	
over	or less	±*ep*	υ_u	±*ep*	υ_u	±*ep*	υ_u	±*ep*	υ_u	±*ep*	υ_u
–	100	3	3	3.5	5	5	7	8	8	18	18
100	200	3.5	3	4.5	5	7	7	10	8	20	18
200	315	4	3.5	6	5	8	7	12	8	23	18
315	400	5	3.5	7	5	9	7	13	10	25	20
400	500	6	4	8	5	10	7	15	10	27	20
500	630	6	4	9	6	11	8	16	12	30	23
630	800	7	5	10	7	13	9	18	13	35	25
800	1000	8	6	11	8	15	10	21	15	40	27
1000	1250	9	6	13	9	18	11	24	16	46	30
1250	1600	11	7	15	10	21	13	29	18	54	35
1600	2000			18	11	25	15	35	21	65	40
2000	2500			22	13	30	18	41	24	77	46
2500	3150			26	15	36	21	50	29	93	54
3150	4000			30	18	44	25	60	35	115	65
4000	5000					52	30	72	41	140	77
5000	6300					65	36	90	50	170	93
6300	8000							110	60	210	115
8000	10000									260	140
10000	12500									320	170

Table 1.3 Tolerance of travel variation relative to 300 mm (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

Remark ▭ 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 (*C*t type) ball screws

Unit: μm

Accuracy grade	Ct7	Ct10
υ_{300}	5	210

Remark Tolerance on specified travel (*ep*) of the transportation (*C*t 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: 1000 mm

Positioning accuracy: ±0.035 mm/1000 mm

<Calculation>

Obtain required lead accuracy of a ball screw under these conditions.

①Calculate the length of the thread

Stroke + nut length + margin =1000 + 193 + 100

=1293 (mm)···→1300 mm

②Calculate lead accuracy

From Table 1.2, obtain the tolerance on specified travel relative to the length of thread (1300 mm).

C5 ··· ±0.054/1250 – 1600

C3 ··· ±0.029/1250 – 1600

③Determine lead accuracy

Positioning accuracy is: ±ep ＜±0.035/1000 mm

Accuracy grade: C3 grade $\pm ep$ = 0.029/length of thread (1300 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.

$\Delta L_\theta = \rho \cdot \theta \cdot L$(mm) -- (Ⅱ-1)

In this formula:

ΔL_θ : Thermal expansion (mm)

ρ : Thermal expansion coefficient (12.0×10^{-6} ℃$^{-1}$)

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.

① Suppress heat generation
- Do not apply excessive preload to the ball screw and support bearing.
- Select correct lubricant and use it appropriately.
- Use higher helix ball screw lead to lower rotational speed.

② Use forced cooling.
- Use hollow screw shaft, and flow liquid coolant through it. - Refer to hollow ball screws in the section for application-oriented ball screws (Page B144).
- Cool screw shaft surface with lubricant oil or air.

③ Avoid effects of temperature rise on positioning
- Warm up the machine by high speed until temperature rise saturate, then maintain a stable temperature of ball screw shaft.
- Set pre-tension. (Fig. 1.2)
- Set the negative (minus) target value of specified travel.
- Employ the closed loop control system.

(3) How to determine specified travel

In general, the specified travel of ball screw is the same as the nominal travel . However, the specified lead of ball screw is sometimes set to negative (minus) or positive (plus) to adjust expansion by temperature rise during operation, or the elongation/contraction of the screw shaft by external load. For such occasion, specify travel compensation (T) when ordering the ball screw.

As an example, Table 1.5 shows the travel compensation (T) for typical NC machine tools.

Table 1.5 Travel compensation (T) of specified travel for typical NC machine tools

Unit: mm

Type of machine	Axis	Travel compensation (per 1 m)
NC lathe	X	– 0.02 — – 0.05
	Z	– 0.02 — – 0.03
Machining center	X, Y	– 0.03 — – 0.04
	Z	Differs by structure

(4) How to determine pre-tension force

In order to absorb thermal expansion, pre-tension can be provided to the screw shaft at the time of installation. In this case, the pre-tension is usually equivalent to the expansion brought about by the temperature rise of 2 to 3°C.

Fig. 1.2 shows the bearing support structure in such occasion.

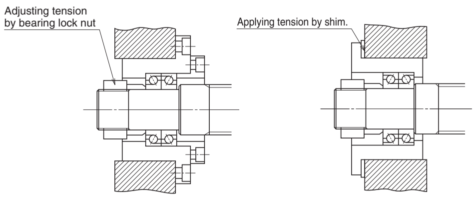


Fig. 1.2 Bearing structure to provide pre-tension

B-2-1.3 Mounting Accuracy and Tolerance of Ball Screws

The accuracy related to mount the ball screws is specified in the following seven characteristics (Fig. 1.3).

The tolerance is indicated in the specification drawing.

Detailed tolerances are specified by JIS B1192. For reference, Table 1.6 shows standard values of "(7) Total run-out of the screw shaft axis (straightness of the screw shaft)". NSK sets stricter tolerance standards than JIS standards. For accuracy of the ball screw installation, refer to "Installation of Ball Screw (1) Centering of the units" (Page B77).

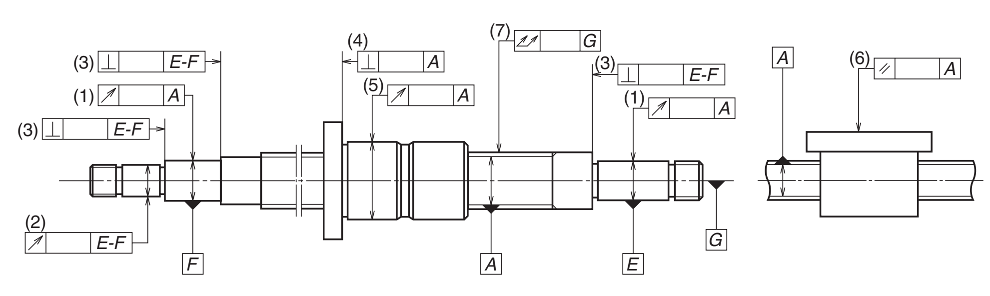


Fig. 1.3 Mounting accuracy of ball screw

(1) Radial run-out of the support bearing seat relative to the axis of the ball thread of screw shaft.
(2) Radial run-out of the other shaft ends section relative to the axis of the support bearing seat.
(3) Perpendicularity of the shoulder of support bearing seat relative to the axis of support bearing seat.
(4) Perpendicularity of the nut flange face, or of the nut end datum face, relative to the axis of screw shaft.
(5) Eccentricity of the nut outside surface (cylindrical shape) to the axis of screw shaft.
(6) Parallelism of the nut mounting surface to the screw shaft axis. (in case of flat mounting surface)
(7) Total run-out of the screw shaft axis.

Table 1.6 Total run-out of the screw shaft axis

Unit: μm

Accuracy grade		C0						C1						
Nominal diameter (mm)	over	–	8	12	20	32	50	–	8	12	20	32	50	80
	or less	8	12	20	32	50	80	8	12	20	32	50	80	125
Overall length of screw shaft (mm) over	or less													
–	125	15	15	15				20	20	15				
125	200	25	20	20	15			30	25	20				
200	315	35	25	20	20			40	30	25	20			
315	400		35	25	20	15		45	40	30	25	20		
400	500		45	35	25	20			50	40	30	25		
500	630		50	40	30	20	15		60	45	35	25	20	
630	800			50	35	25	20			60	40	30	25	
800	1000			65	45	30	25			75	55	40	30	25
1000	1250			85	55	40	30			95	65	45	35	30
1250	1600			110	70	50	40			130	85	60	45	35
1600	2000				95	65	45				120	80	55	40
2000	2500											100	70	50
2500	3150												130	90
3150	4000													120

Unit: μm

Accuracy grade		C3							C5						
Nominal diameter (mm)	over	–	8	12	20	32	50	80	–	8	12	20	32	50	80
	or less	8	12	20	32	50	80	125	8	12	20	32	50	80	125
Overall length of screw shaft (mm) over	or less														
–	125	25	25	20					35	35	35				
125	200	35	35	25	20				50	40	40	35			
200	315	50	40	30	30				65	55	45	40			
315	400	60	50	40	35	25			75	65	55	45	35		
400	500		65	50	40	30				80	60	50	45		
500	630		70	55	45	35	30			90	75	60	50	40	
630	800			70	55	40	35				90	70	55	45	
800	1000			95	65	50	40	30			120	85	65	50	45
1000	1250			120	85	60	45	35			150	100	75	60	50
1250	1600			160	110	75	55	40			190	130	95	70	55
1600	2000				140	95	70	50				170	120	85	65
2000	2500					120	85	60					150	110	80
2500	3150					160	110	75					200	140	95
3150	4000					220	150	100					260	180	120
4000	5000						200	130						240	160
5000	6300													310	210
6300	8000														280
8000	10000														370

B-2-1.4 Automatic lead accuracy measuring system of NSK

In response to the demand for high precision in production technology, NSK is the first in the world that developed and uses "Lead Accuracy Measuring System (LAMS)." Lead accuracy is measured by the system that employs a laser interferometer measuring instrument and a personal computer.

Fig. 1.4 shows the lead accuracy measuring system. The inspection date of the ball screw is shown in Fig. 1.5. The laser interferometer measures either ball nut travel accuracy or lead accuracy of the ball thread. The data which are input into a computer are processed into four characteristics readings regarding lead accuracy. (See Page B41.)

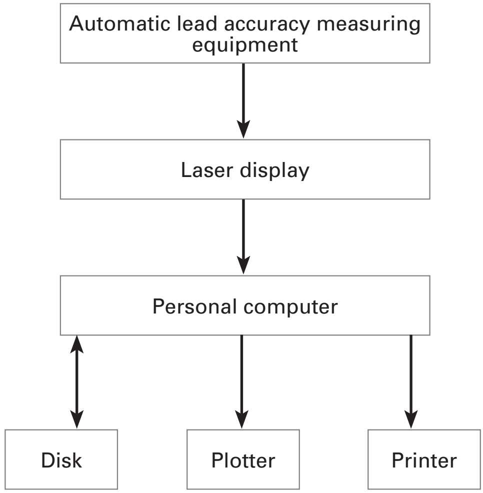


Fig. 1.4 Lead accuracy measuring system

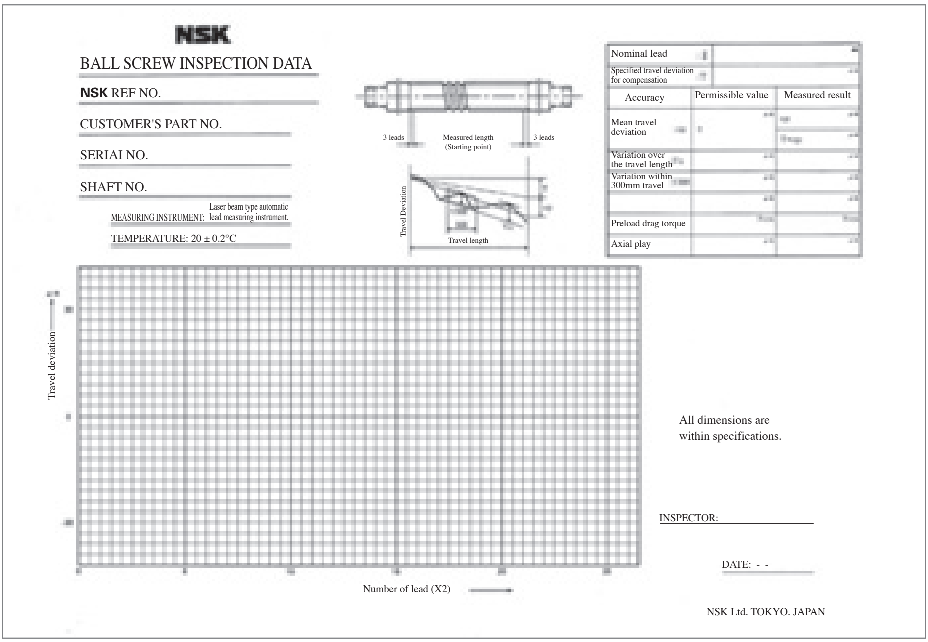


Fig. 1.5 Ball screw Inspection data

B-2-2 Static Load Limitation

Ball screw, based on its function, will generally receive axial load only. Ball screw shaft in general is long, so it is necessary to consider 3 items below:

- Buckling load of the screw shaft
- Yielding of the screw shaft by tensional or compressive stress
- Permanent deformation at the ball contact points

B-2-2.1 Buckling Load

It is necessary to calculate whether the ball screw shaft is safe against buckling.

Buckling load, i.e. permissible compressive load "P" to axial direction, is calculated as follows.

$$P = \alpha = \frac{N \cdot \pi^2 \cdot E \cdot I}{L^2} = m\frac{d_r^{\,4}}{L^2} \times 10^4 \quad (\mathrm{N}) \cdots\cdots (\text{Ⅱ-2})$$

In this formula:

α : Safety factor (α = 0.5)

E : Elastic modulus (E = 2.06 x 10^5 MPa)

I : Moment of inertia

$$I = \frac{\pi}{64} d_r^{\,4} \quad (\mathrm{mm}^4) \cdots\cdots (\text{Ⅱ-3})$$

d_r : Screw shaft root diameter (mm) [See the dimension table.]

L : Unsupported length (mm) [See Fig. 4.1 and 4.2 'Supporting conditions of screw shaft and nut' in Page B55.)

m, N : Factors determined by the supporting condition of the ball screw shaft

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

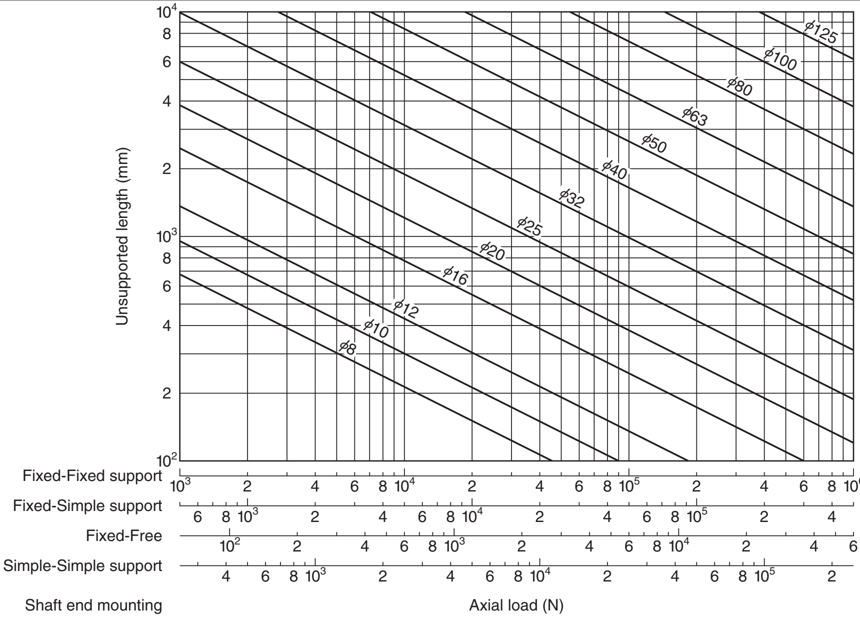


Fig. 2.1 Buckling load

<<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' in Page B55.)

Unsupported length L = 2000 mm

Screw shaft root diameter d_r = 34.4 mm (From the dimension table)

<Calculation>

Support condition is Fixed - Fixed support, From Table 2.1 in Page B48

N = 4

m =19.9

By Formula (Ⅱ-2) in Page B48

$$P = m\frac{d_r^4}{L^2} \cdot 10^4 = 19.9 \times \frac{34.4^4}{2000^2} \times 10^4 = 69667\ (\mathrm{N})$$

Therefore,

Permissible buckling load P = 69600 N

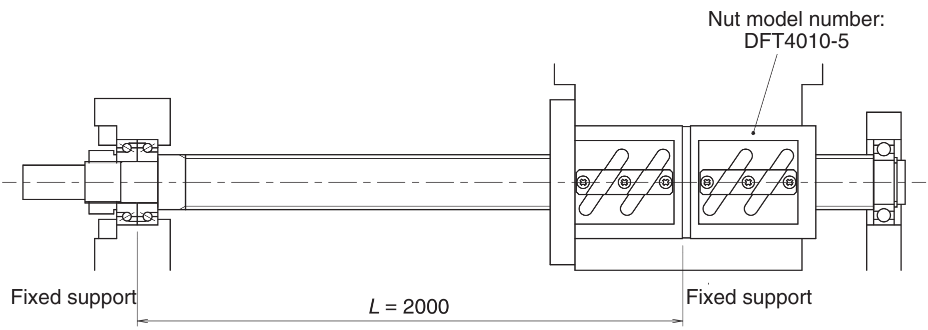


Fig. 2.2 Calculation example of buckling load

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

$$P = \sigma \cdot A = 1.15 d_r^2 \times 10^2 \ \text{(N)} \qquad (\text{II-4})$$

In this formula:

σ : Allowable stress (= 147 MPa)

A : Cross section area of a screw shaft using root diameter (mm^2)

$$A = \frac{\pi}{4} \cdot d_r^2 \ (\text{mm}^2) \qquad (\text{II-5})$$

d_r : Screw shaft root diameter (mm)

<<Calculation example of yield load>>

Obtain load in respect to the allowable stress under the conditions in Fig. 2.2.

<Use conditions>

Nut model: DFT4010-5

Screw shaft root diameter d_r = 34.4 (mm)

(From the dimension table)

<Calculation>

By Formula II-4

$P = 1.15 d_r^2 \times 10^2 = 1.15 \times 34.4^2 \times 10^2$

$= 136086$ (N)

Therefore,

Permissible load P = 136000 N

B-2-2.3 Permanent Deformation of the Ball Contact Point

Exposed to an excessively heavy load in axial direction, the balls are squashed, and the ball rolling surface is dented. The deformations on these points do not perfectly restore to original shape after the load is removed. They are permanently disfigured. It is necessary to determine the limitation of this disfigurement to containing it within a certain range.

(1) Basic static load rating C_{0a}

Basic static load rating C_{0a} is a load to axial direction that results in the combined permanent deformation equal to 0.01% of the ball diameter at the contact points of ball and ball grooves of the screw shaft and nut.

(2) Calculation of permissible load by C_{0a}

P_o (allowable axial direction load to limit the permanent deformation) is calculated using C_{0a}.

$$P_0 = \frac{C_{0a}}{f_s} \ \text{(N)} \qquad (\text{II-6})$$

In this formula, f_s: Static permissible load factor

Table 2.2 Static permissible load factor

At time of normal operation	1 – 2
With vibration impact	1.5 – 3

<<Calculation example of maximum allowable load>>

Obtain maximum allowable load to the ball groove section under conditions in Fig. 2.2

<Use conditions>

Nut model: DFT4010-5

Basic static load rating C_{0a} = 137000 (N)

(From the dimension table)

Static permissible load factor f_s = 2

(normal operation, no vibration impact)

<Calculation>

By Formula II-6, maximum allowable load of the ball groove section

$$P_0 = \frac{C_{0a}}{f_s} = \frac{137000}{2} = 68500 \ \text{(N)}$$

B-2-3 Permissible Rotational Speed

Permissible rotational speed is determined by the feeding speed and ball screw lead. When selecting ball screw, it is important to know the permissible rotational speed.
It is necessary to calculate two items below, and whichever smaller is the permissible rotational speed.
The lower of the following two factors, d·n and Critical Speed, will determine the overall Permissible Rotational Speed of the ball screw.

- Critical speed which is the resonance vibration of the shaft.
- d·n value which is involved in damaging the ball recirculation components.

* Please consult NSK if the maximum rotational speed exceeds the criteria of maximum rotational speed on page B54, even both the critical speed of screw shaft rotation and the d·n value are in range of the allowable limit.

B-2-3.1 Critical Speed of the Screw Shaft

Calculate the critical speed which is the matching value of the ball screw rotational speed and the natural frequency of the screw shaft. The permissible rotational speed is up to the 80% range of the critical speed.
Calculate the critical speed of the screw shaft whether you use shaft rotation or nut rotation. Critical speed varies by the nut traveling position. Please consult NSK for detailed calculation.
If using a ball screw exceeding the critical speed, it is necessary to increase the natural frequency by using an intermediate support, etc. If using with nut rotation, it is possible to operate exceeding critical speed by installing a vibration energy absorbing system (optional, vibration control damper: patented by NSK) to the screw shaft. (Refer to "Nut rotatable drive ND Series" in Page B149.)

Calculate the permissible rotational speed based on critical speed n_c as follows, taking in account "supporting conditions for calculation of buckling load and critical speed" on Page B55.
Fig. 3.1 shows the permissible rotational speeds against critical speed for each shaft diameter.

$$n_c = \alpha \times \frac{60\lambda^2}{2\pi L^2}\sqrt{\frac{E \cdot I \cdot g}{\gamma \cdot A}}$$

$$= f\frac{d_r}{L^2} \times 10^7 \ (\text{min}^{-1}) \qquad (\text{II-}7)$$

In this formula:

α : Safety factor (α = 0.8)

E : Elastic modulus (E = 2.06 × 10^5 MPa)

I : Moment of inertia of area of screw shaft

$$I = \frac{\pi}{64} d_r^4 \ (\text{mm}^4) \qquad (\text{II-}3)$$

d_r : Screw shaft root diameter (mm) [See the dimension table.]

g : Acceleration of gravity (= 9.8 × 10^3 mm/s^2)

γ : Specific weight (γ = 7.65 × 10^{-5} N/mm^3)

A : Cross section area of the screw shaft root diameter (mm^2)

$$A = \frac{\pi}{4} d_r^2 \ (\text{mm}^2) \qquad (\text{II-}5)$$

L : Unsupported length (mm) [See Fig. 4.1, 4.2 'Supporting conditions of screw shaft and ball nut' on Page B55]

f, 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

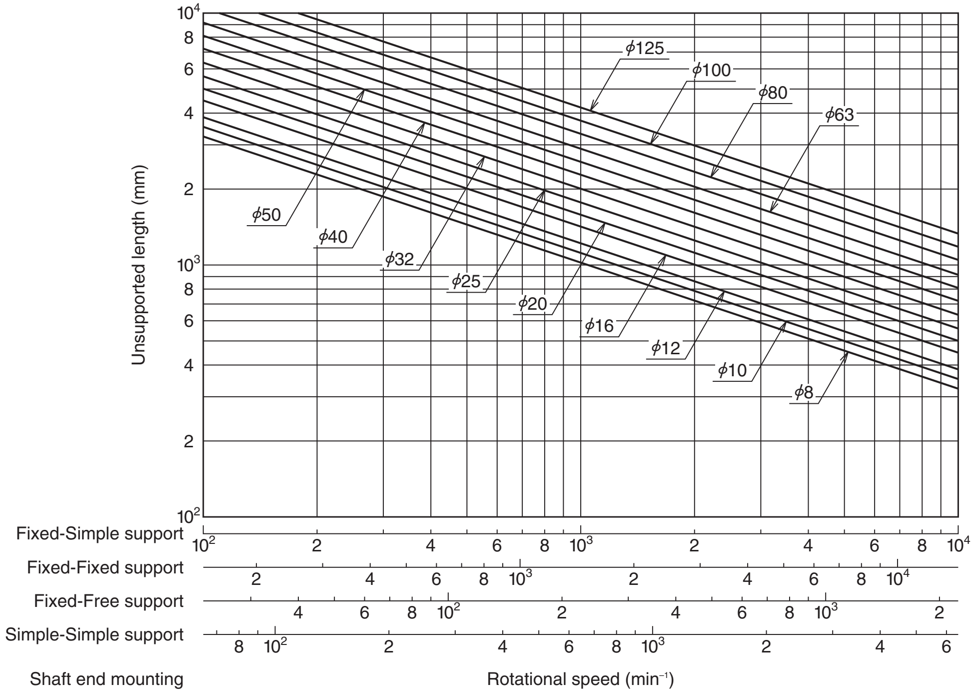


Fig. 3.1 Permissible rotational speeds vs. critical speeds

<<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.')

Unsupported length $L = 2000$ mm

Screw shaft root diameter $d_r = 34.4$ mm (From the dimension table)

<Calculation>

Supporting condition is Fixed-Simple support, from Table 3.1 in Page B51

$\lambda = 3.927$

$f = 15.1$

By Formula Ⅱ-7 in Page B51, permissible rotational speed to critical speed is

$$n_c = f\frac{d_r}{L^2} \times 10^7 = 15.1 \times \frac{34.4}{2000^2} \times 10^7 = 1298.6\ (\mathrm{min}^{-1})$$

$n_c = 1290\ \mathrm{min}^{-1}$ or under

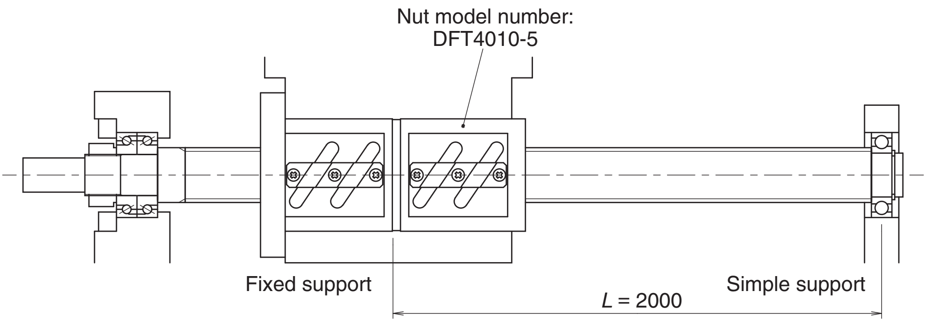


Fig. 3.2 Calculation example of permissible rotational speed to the critical speed

B-2-3.2 d·n value

An increase of ball orbital speed will increase the collision impact of balls to ball recirculation parts, and thus resulting in damage to them. For this reason, Permissible rotational speed is also limited by the d·n value (d: shaft diameter in millimeters; n: rotational speed per minutes). Table 3.2 shows the allowable d·n value and maximum rotational speed of ball screws.

*Special measure must be taken for high-speed specification products. Please consult NSK.

*Please consult NSK if the maximum rotational speed or the d·n value exceed the values on the table below, even both the critical speed of screw shaft and the d·n value are in ranges of the allowable limit.

Table 3.2 Criteria of allowable d·n value and maximum rotational speed

Ball screw recirculation system, Series/Type		Allowable d·n value		Criterion of permissible rotational speed [min^{-1}]
		Standard	High-speed	
Application-oriented ball screws	HMD type for high-speed machine tools	160000 or less	–	4000
	HMC type for high-speed machine tools	100000 or less, 135000 or less*1	–	3750
	BSL type for miniature lathe	(180000 or less)	–	4000
	HTF-SRC type for high-load drive	140000 or less, 160000 or less*1	–	3225
	HTF-SRD type for high-load drive	120000 or less	–	2400
	HTF type for high-load drive	50000 or less, 70000 or less*1	100000 or less	3125
	VSS type for contaminated environment	150000 or less	–	3000
	ND series nut-rotatable ball screws	70000 or less	100000 or less	3000
	$\sum$ series for robot	70000 or less	–	3000
	R series for transfer equipment	50000 or less	–	3000
Standard nut ball screws	End-deflector type	180000 or less	–	5000
	Return tube type	70000 or less	100000 or less	3000
	Deflector type	84000 or less	100000 or less	3000
	End cap type	80000 or less	100000 or less	3000

*1 Please refer to the explanation of each ball screw for which two allowable d·n values are listed

· HMC type for high-speed machine tools: page B113
· HTF-SRC type for high-load drive: page B123
· HTF type for high-load drive: page B131

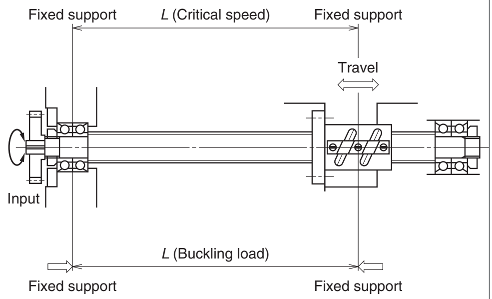
B-2-4 Supporting Conditions for Calculation of Buckling Load and Critical Speed

Fig. 4.1 and 4.2 are typical conditions in supporting ball screw. Use them as reference to calculate buckling load and critical speed.
Please consult NSK if it is necessary to scrutinize calculation due to use conditions, or if boundary conditions are not clear due to special installation.

[How to read the tables]
Example ii: Buckling load generates between the nut and the left bearings, indicating that the critical speed appears between the nut and the right bearing. Therefore, set L at maximum stroke for each side. Calculate by applying support bearing conditions.

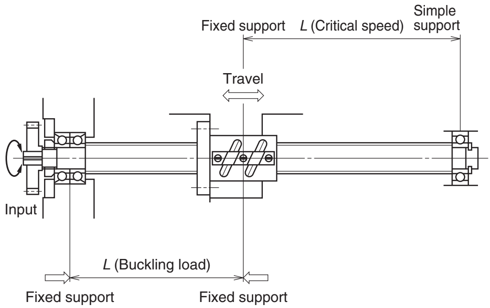
i

Buckling load: Fixed - Fixed support
Critical speed: Fixed - Fixed support



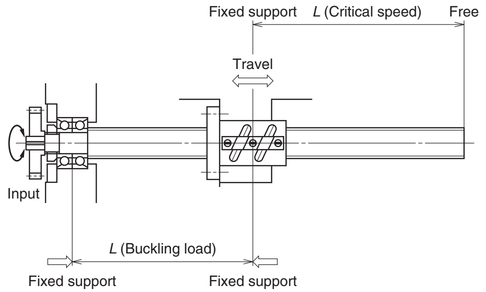
ii

Buckling load: Fixed - Fixed support
Critical speed: Fixed - Simple support



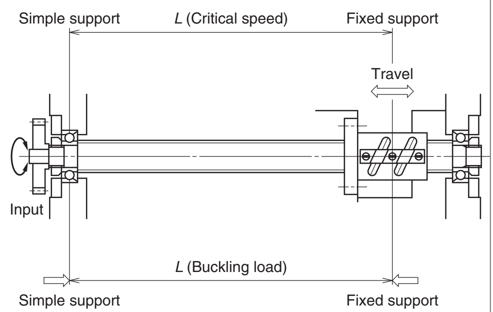
iii

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

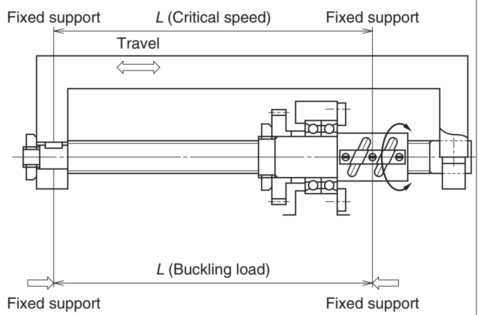
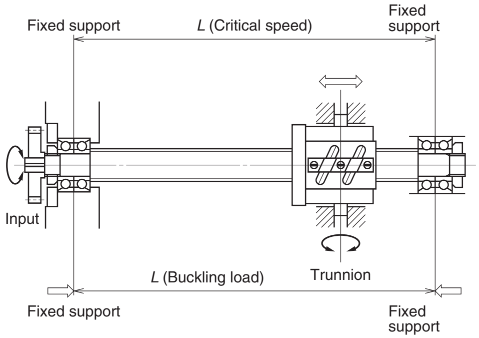


Fig. 4.1 Supporting conditions for screw shaft and ball nut

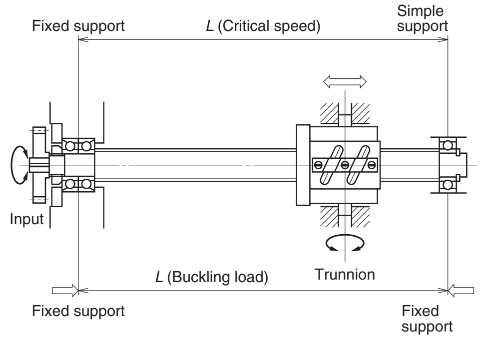
vi

Buckling load: Fixed - Fixed support
Critical speed: Fixed - Fixed support
} Minimum value (estimate) is obtained in the state as shown in the figure.



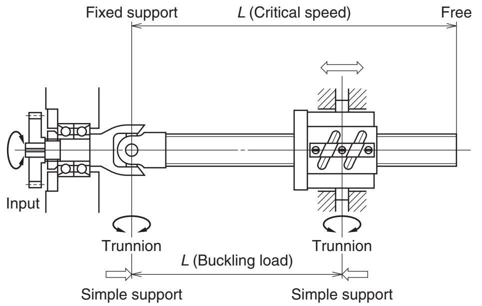
vii

Buckling load: Fixed - Fixed support
Critical speed: Fixed - Simple support
} Minimum value (estimate) is obtained in the state as shown in the figure.



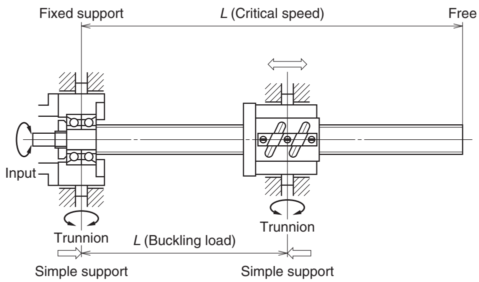
viii

Buckling load: Simple support - Simple support
Critical speed: Fixed - Free Support→ Minimum value (estimate) is obtained in the state as shown in the figure.



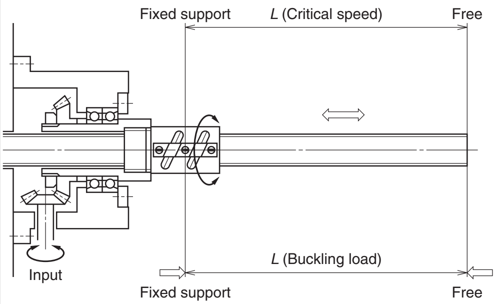
ix

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

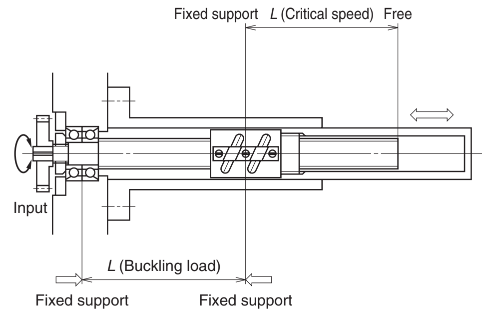


Fig. 4.2 Supporting conditions of screw shaft and ball nut w

B-2-5 Life (dynamic load limitation)

B-2-5.1 Life of Ball Screw

Although used in appropriate conditions and is ideally designed, the ball screw deteriorates after a certain operation period, and eventually becomes unusable. The period in this situation is the life of the ball screw. There are two life categories, "fatigue life" caused by flaking, and "life of accuracy" caused by deterioration in precision because of wear.

B-2-5.2 Fatigue Life

Fatigue life of the ball screw can be estimated by basic dynamic load rating (C_a) as is for the rolling bearing.

(1) Basic dynamic load rating C_a

Basic dynamic load rating is the axial load which allows a 90% of the group of the same ball screws to rotate 1 million times (10^6rev) under the same condition without causing flaking by rolling contact fatigue.

Please note:

Due to the implementation of the ISO 3408-5, NSK are also changing their ratings accordingly. All values for load ratings are now based on this valid formulas.

(2) Fatigue life calculation

Fatigue life is defined as a total rotation number in general. It is sometimes indicated by total rolling hours or total running distance. Fatigue life is obtained by the following formula.

$$L = \left(\frac{C_a}{F_a \cdot f_w}\right)^3 \cdot 10^6 \qquad \cdots (\text{II-8})$$

$$L_t = \frac{L}{60n} \qquad \cdots (\text{II-9})$$

$$L_s = \frac{L \cdot l}{10^6} \qquad \cdots (\text{II-10})$$

In this formula:

- L : Rating fatigue life (rev)
- L_t : Life in hours (h)
- L_s : Life by running distance (km)
- C_a : Basic dynamic load rating (N)
- F_a : Axial load (N)
- n : Rotational speed (min^{-1})
- l : Lead (mm)
- f_w : Load factor (Coefficient by operating condition)

Load coefficients f_w in operation condition are shown in Table 5.1.

Table 5.1 Load coefficient f_w

Smooth operation without impact	1.0 – 1.2
Normal operation	1.2 – 1.5
Operation associated with impact or vibration	1.5 – 3.0

Setting too long fatigue life requires larger ball screw, and is not economical. Below are the general target values of operating life for machines. (reference)

Table 5.2 General target values of fatigue life

Machine tools	20000 hours
Industrial machines	10000 hours
Automatic control system	15000 hours
Measuring equipment	15000 hours

(3) Mean load

If the axial load varies often, to calculate a life, obtain a mean load which gives equivalent fatigue life under this varying load conditions.

①When load and rotational speed shift stepwise

Obtain the mean load F_m by the formula below.

Obtain mean rotational speed N_m by the formula below as Table 5.3, Fig. 5.1.

$$F_m = \left(\frac{F_1^3 \cdot n_1 \cdot t_1 + F_2^3 \cdot n_2 \cdot t_2 + \cdots F_n^3 \cdot n_n \cdot t_n}{n_1 \cdot t_1 + n_2 \cdot t_2 + \cdots + n_n \cdot t_n}\right)^{\frac{1}{3}} \qquad \cdots (\text{II-11})$$

$$N_m = \frac{n_1 \cdot t_1 + n_2 \cdot t_2 + \cdots + n_n \cdot t_n}{t_1 + t_2 + \cdots + t_n} \qquad \cdots (\text{II-12})$$

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

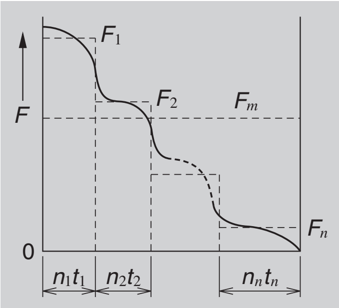


Fig. 5.1 Stepwise load variation

②When the rotational speed is constant, and the load changes linearly, obtain approximate value of the mean load F_m by the formula below.

$$F_m = \frac{1}{3}(F_{min} + 2F_{max}) \quad \cdots (\text{II-13})$$

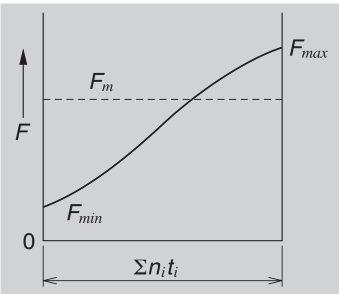


Fig. 5.2 Linear load change

③When rotational speed is constant, and the load changes in sinusoidal pattern, obtain approximate value of the mean load F_m by the formula below.

When the sine curve is Fig. (a)

$$F_m \fallingdotseq 0.65\,F_{max} \quad \cdots (\text{II-14})$$

When the sine curve is Fig. (b)

$$F_m \fallingdotseq 0.75\,F_{max} \quad \cdots (\text{II-15})$$

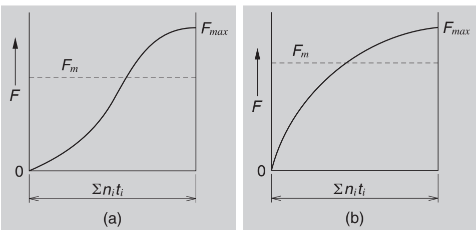


Fig. 5.3 Load changes in sinusoidal pattern

(4) Affect of mounting misalignment

If moment load or radial load is applied to the ball screw, it adversely affects ball screw function, and shortens life. Watch for eccentric load that induces moment or radial load.

Fig. 5.4 shows a calculation example of fatigue life when moment load is applied to the ball screw. In this figure, the value of the rigidity of mounting ball screw sections (screw shaft, support bearing, guide, etc.) is set at infinity. In actual use, deformation is absorbing the moment load in various areas, and the moment load that generates between the screw shaft and nut is abated.

In general, the following values are recommended as control values for precision grade.

Misalignment in inclination	··1/2000 or less
Eccentricity	························20 μm or less

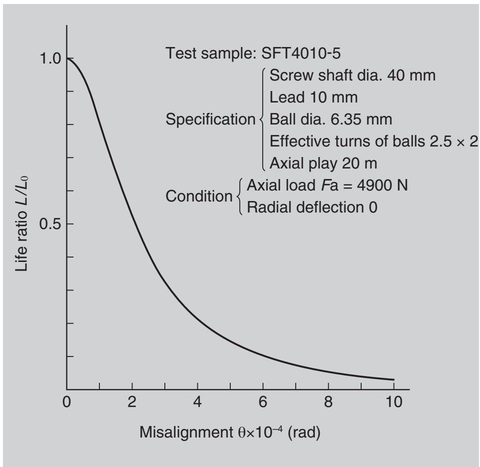


Fig. 5.4 Affects of misalignment

B 58

(5) Effects of heavy load and short stroke

If the ball screw is used under heavy load and short strokes, such as for drive of plastic injection molding machine and of press machines, the fatigue life may become significantly shorter than the rated fatigue life which is calculated in B-2-5.2.

This decreased life occurs because the heavy load generates large stress (surface pressure) in the contact point of balls and ball grooves of the screw shaft and the nut, adversely affecting the life. In such case, the life calculation should take into account the size of the surface pressure as well as the size of the stroke.

The axial load F_{amax}*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.

$$F_{amax} \geq 0.10C_{0a} \qquad \cdots (\text{II-16})$$
$$S \leq 4$$

In this formula:

F_{amax} : Maximum load to axial direction during drive (N)

C_{0a} : Basic static load rating (N)

S : Stroke (rev)

$$S = \frac{L_S}{l}$$

L_s : Stroke distance (mm)

l : Lead (mm)

* Axial load : The load is applied to the axial direction when screw shaft and the nut of ball screw are rotating relatively each other. The rotational speed is irrelevant.

B-2-5.3 Ball screw and Hardness

Table 5.4 indicates NSK standard ball screw and their hardness.

Table 5.4 Ball screw materials and their hardness

Component	Heat treatment method	Hardness (HRC)
Screw shaft	Carburizing	58 or over
	Induction hardening	58 or over
Nut	Carburizing	58 or over

* NSK manufactures special material ball screws for special environments (stainless steel: SUS440C, SUS630). NSK also furnishes surface treatment (Refer to Page D5). Please consult NSK for such request.

B-2-5.4 Wear Life

Wear of materials, as is the case for other mechanical components, is significantly affected by use conditions, lubrication conditions and other factors. It is difficult to estimate its volume, and measuring requires various tests and field data.

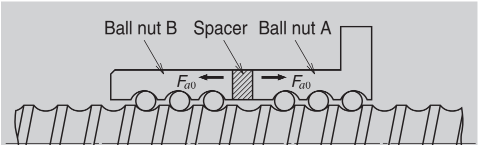
NSK has data of wear accumulated through abundant experience. Please contact NSK for inquiry pertaining to the wear.

B-2-6 Preload and Rigidity

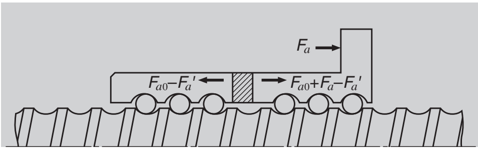
B-2-6.1 Elastic Deformation of the Preloaded Ball Screw

(1) Position preload (D, Z, P preloads)

Double nut preload ball screw shown in Fig. 6.1.



(a) Extemal load : 0



(b) Extemal load : F_a

Fig. 6.1 Position preload (double-nut)

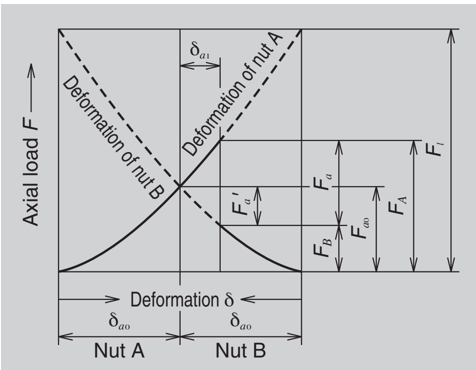


Fig. 6.2 Deformation of A and B nut (position preload)

Elastic deformation of Nut A and B is already given at time of assembly by the amount of δ_{ao} 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,

$$\delta_a = \delta_{ao} + \delta_{a1} \qquad \delta_b = \delta_{ao} - \delta_{a1}$$

At this time, the load to each Nut A and B are:

$$F_A = F_{ao} + F_a - F_a'$$

$$F_B = F_{ao} - F_a'$$

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. (Fig. 6.2)

$$\delta_{ao} = K \cdot F_{ao}^{2/3} \qquad 2\delta_{ao} = K \cdot F_l^{2/3}$$

(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. Please note that the preload of about 1/3 of the maximum axial load increases heat, and shortens life if it exceeds 10% of C_a. The criterion for the maximum preload is 0.1 C_a.

Fig. 6.3 shows two types of elastic deformation curves: one is by the ball screw with preload, the other without preload. When an axial load which is about three times as large as the preload is applied, the deformation of the preloaded ball screw is 1/2 of the deformation of the ball screw without preload.

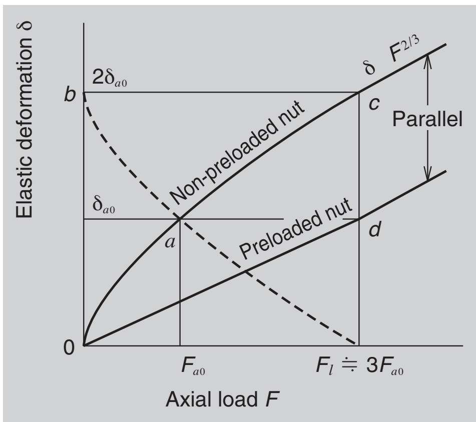


Fig. 6.3 Deformation of preloaded ball nut (position preload)

(2) Constant pressure preload (J preload: preloaded by spring)

Fig. 6.5 shows an elastic deformation of the ball screw which is preloaded with "constant pressure." The rigidity of the preload spring is sufficiently smaller than the nut rigidity. Therefore, the deformation of the spring becomes nearly parallel to the axis of abscissa. For this reason, the elastic deformation by the preload with constant pressure changes along the deformation curve by Nut A.

In order to take advantage of the characteristics of the preload with constant pressure, the major external load should be applied in the directions shown by arrows (Fig. 6.4.).

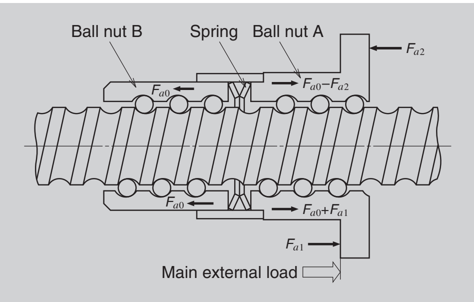


Fig. 6.4 Constant pressure preload (double nut)

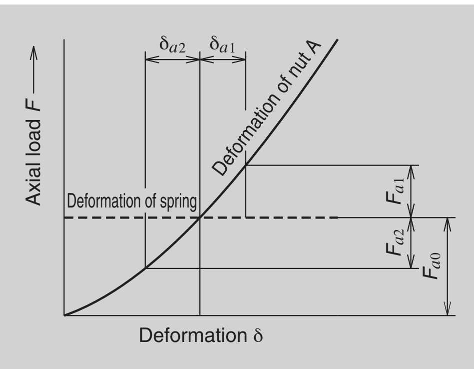


Fig. 6.5 Deformation curve of constant pressure preloaded nut

B-2-6.2 Rigidity of the Feed Screw System

A low rigidity around the feed screw mounting area causes lost motion. To improve the positioning accuracy of precision machines such as NC machine tools, it requires a good balance in axial rigidities of composing parts of the feed screw system.

Also should examine torsional rigidities of the feed screw system.

(1) Axial rigidity of the feed screw system K_T

Elastic deformation and rigidity of the feed screw system can be obtained by the following formula.

$$\delta = \frac{F_a}{K_T} \quad \cdots\cdots (\text{II-17})$$

$$\frac{1}{K_T} = \frac{1}{K_S} + \frac{1}{K_N} + \frac{1}{K_B} + \frac{1}{K_H} \quad \cdots\cdots (\text{II-18})$$

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)

$$K_S = \frac{A \cdot E}{x} \times 10^{-3} \quad \cdots\cdots (\text{II-19})$$

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)

$$K_S = \frac{A \cdot E \cdot L}{x\,(L - x)} \times 10^{-3} \cdots\cdots\cdots\cdots (\text{II-20})$$

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.

$$K_S = \frac{4A \cdot E}{L} \times 10^{-3} \cdots\cdots\cdots\cdots (\text{II-21})$$

<<Axial rigidity example of calculation (1)>>

Obtain axial rigidity of the screw shaft under the condition in Fig. 6.6.

<Use conditions>

Nut model: DFT 4010-5
From Fig. 6.6: Supporting condition ;
Fixed support --Free (axial direction)
Distance between points of load application
x = 1200 mm
Screw shaft root diameter (From the dimension table)
d_r = 34.4 mm

<Calculation>

By Formula II-19, axial rigidity K_S is :

$$A = \frac{\pi}{4} d_r^2 = \frac{3.14}{4} \times 34.4^2 = 929.4 \text{ (mm}^2\text{)}$$

$$K_S = \frac{A \cdot E}{x} \times 10^{-3} = \frac{929.4 \times 2.06 \times 10^5}{1200} \times 10^{-3} = 159 \text{ (N/μm)}$$

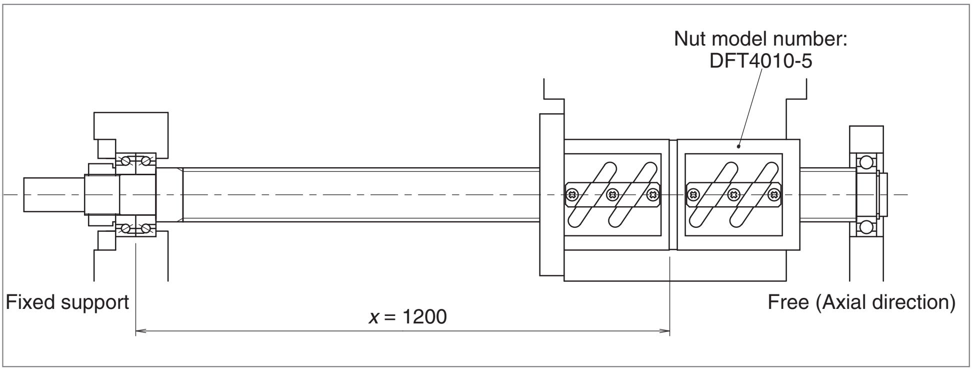


Fig. 6.6 Axial rigidity of the screw shaft calculation example (1)

<<Axial rigidity example of calculation (2)>>

Obtain axial rigidity of the screw shaft under the conditions in Fig. 6.7.

<Use conditions>

Nut model: DFT 4010-5

From Fig. 6.7: Supporting condition:

Fixed - Fixed support (axial direction)

L = 1200 mm

Distance between points of load application:

Screw shaft root diameter (From the dimension table)

dr = 34.4 mm

<Calculation>

By Formula Ⅱ-21, axial rigidity K_s is :

$$A = \frac{\pi}{4} dr^2 = \frac{3.14}{4} \times 34.4^2 = 929.4 \ (\mathrm{mm}^2)$$

$$K_s = \frac{4A \cdot E}{L} \times 10^{-3} = \frac{4 \times 929.4 \times 2.06 \times 10^5}{1200} \times 10^{-3} = 638 \ (\mathrm{N/\mu m})$$

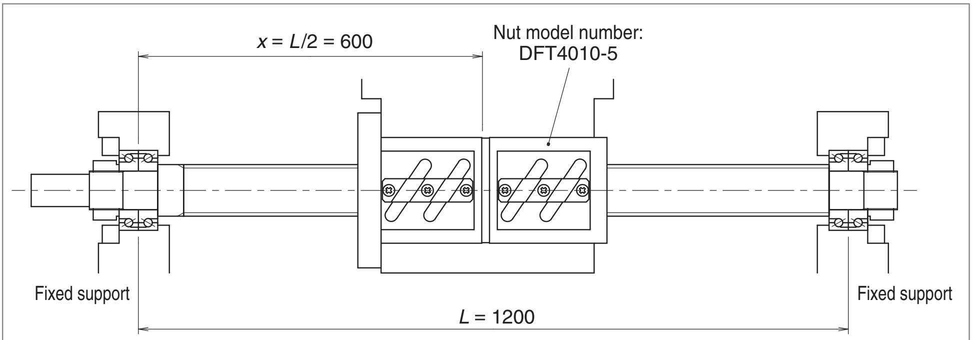


Fig. 6.7 Axial rigidity of the screw shaft calculation example (2)

(3) Axial rigidity of the ball nut : K_N

(a) Rigidity of the nut with axial play

Theoretical rigidity value K is shown in the dimension table. K is obtained from the elastic deformation between screw grooves and balls when an axial load which is equivalent to 30% of the basic dynamic load rating C_a is applied. The criterion for calculation of ball nut rigidity is 80% of the value listed in the table taking into consideration of deformation of the ball nut, etc. Rigidity value K_N is obtained by the following formula when the axial load "F_a" is not 30% of "C_a."

$$K_N = 0.8 \times K \left(\frac{F_a}{0.3\ C_a} \right)^{1/3} \ (\text{N/μm}) \qquad (\text{II-22})$$

In this formula:

K : Rigidity value in dimension tables (N/μm)
F_a : Axial load (N)
C_a : Basic dynamic load rating (N)

<<Axial rigidity example of calculation (3)>>

Obtain axial rigidity of the nut under the following conditions.

<Use conditions>

Nut model: SFT 4010-5
Axial load: $F_a = 6000$ N
F_a = Rigidity at 0.3 C_a $K = 706$ N/μm
(From the dimension table)

<Calculation>

By Formula II-22, axial rigidity K_N is :

$$K_N = 0.8 \times K \left(\frac{F_a}{0.3 \cdot C_a} \right)^{1/3}$$

$$= 0.8 \times 706 \times \left(\frac{6000}{0.3 \times 52000} \right)^{1/3}$$

$$= 410 \ (\text{N/μm})$$

(b) Rigidity of preloaded ball nut

Theoretical rigidity K is shown in each dimension table. K is obtained from the elastic deformation of the ball rolling surface and the balls when: a preload which is equivalent to 10% of the basic dynamic load rating C_a (P Preload. 5% for single-nut oversize ball pre-load system) is applied, followed by an axial load. The criterion for calculation of nut rigidity is 80% of the value listed in the table taking into consideration of deformation of the ball nut, etc. Rigidity K_N is obtained by the following formula when preload "F_{a0}" is not 10% (or 5%) of "C_a".

$$K_N = 0.8 \times K \left(\frac{F_{a0}}{\varepsilon \cdot C_a} \right)^{1/3} \ (\text{N/μm}) \qquad (\text{II-23})$$

In this formula:

K : Rigidity in the dimension tables (N/μm)
F_{a0} : Preload (N)
ε : Basic factor to calculate rigidity ($\varepsilon = 0.1$. Use 0.05 for P Preload)

<<Axial rigidity of the screw shaft calculation example (4)>>

Obtain axial rigidity of the nut under the following conditions.

<Use conditions>

Nut model : DFT 4010-5
Preload : $F_{a0} = 4000$ N
F_{a0} = Rigidity when $\varepsilon\ C_a$: $K = 1388$ N/μm
(From the dimension table)
Basic factor to calculate rigidity when D Preload: $\varepsilon = 0.1$

<Calculation>

By Formula II-23

$$K_N = 0.8 \times K \left(\frac{F_{a0}}{\varepsilon \cdot C_a} \right)^{1/3}$$

$$= 0.8 \times 1388 \times \left(\frac{4000}{0.1 \times 52000} \right)^{1/3}$$

$$= 1017 \ (\text{N/μm})$$

The criterion of the preload to ball screw

Nut rigidity increases by a larger preload volume. But excessive preload shortens life, and generates heat. Set the maximum preload about at 0.1 C_a (0.05 for *P* Preload). Table 6.1 shows the criteria for preload for different application.

Table 6.1 Criteria of preload

Ball screw application	Preload (relative to dynamic load rating C_a)
Robots,material handling systems, etc.	Axial play or under 0.01 C_a
Semiconductor manufacturing systems, etc. That require highly accurate positioning	0.01 C_a – 0.04 C_a
Medium- high-speed machine tools for cutting	0.03 C_a – 0.07 C_a
Low to medium-speed systems that require especially high rigidity	0.07 C_a – 0.1 C_a

(4) Axial rigidity of support bearing: K_B

Rigidity of the combined thrust angular contact ball bearings which is widely used as a support bearing of the ball screw for high-precision equipment can be obtained by the following formula.

$$K_B \fallingdotseq \frac{3F_{a0}}{\delta_{a0}} \text{ (N/μm)} \qquad (\text{Ⅱ-24})$$

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)

$$\delta_{a0} \fallingdotseq \frac{0.44}{\sin\alpha}\left(\frac{Q^2}{D_W}\right)^{1/3} \text{ (μm)} \qquad (\text{Ⅱ-25})$$

$$Q = \frac{F_{a0}}{Z} \cdot \sin\alpha$$

α : Contact angle

D_W : Ball diameter (mm)

Z : Number of balls

Refer to Page B457 for data regarding thrust angular contact ball bearings which support high-precision ball screws (TAC Series).

(5) Axial rigidity of the ball nut and bearing mounting section: K_H

The effect of rigidity of mounting section on positioning accuracy is big, we recommend incorporating high rigidity of the mounting sections of ball nut and support bearings into the design at the early stage of designing the machine.

(a) Torsional rigidity of the feed screw system

Major torsion factors in the rotating system that bring about error in positioning accuracy are given three points below.

- Torsional deformation of the screw shaft
- Torsional deformation of the joint section
- Torsional deformation of the motor

The value of the effect of torsional strain to positioning accuracy is smaller than axial deformation. However, check the effect when designing equipment that requires high positioning accuracy.

(b) Suppress thermal error

It is necessary to minimize the thermal error for ever increasing demand for positioning accuracy give three points below.

- Suppress heat
- Forced cooling
- Avoid effect of temperature rise

Refer to "Measures against thermal expansion" on Page B44.

B-2-7 Friction Torque and Drive Torque

Operations that use ball screw drives require a motor torque which is equivalent to the total of two:

- Friction torque, i.e. the friction of the ball screw itself
- Drive torque which is required for operation

B-2-7.1 Friction Torque

(1) Starting friction torque (Break away torque)

A large torque is necessary to start ball screw. This is called "starting friction torque" or "brakeaway torque." This torque is 2 to 2.5 times larger than preloaded dynamic (friction) torque which is described below. Starting friction torque quickly diminishes once the ball screw begins to move.

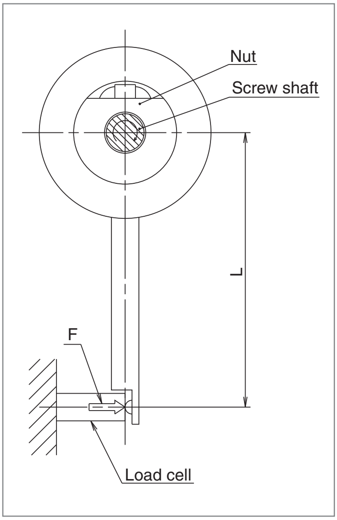


Fig. 7.2 Preload dynamic torque measuring method

(2) Dynamic preloaded drag torque (preloaded dynamic friction torque)

When the ball screw is moving, two types of torque generate: 1. Dynamic friction torque by preload; 2. Friction torque associated with ball recirculation. JIS B1192 sets standard of dynamic preloaded torque, which is the total of these two torque types. They are defined in Fig. 7.1.

The preload dynamic friction torque is calculated by following formula. When screw shaft is rotated as Fig. 7.2 in following measure condition, measuring the nut stop power F and the distance from action line and right angle direction to the measured screw shaft multiple by it's power value F.

$$T_p = F \cdot L \qquad (\text{II-26})$$

- Measuring rotational speed 100 min^{-1}
- Viscosity of lubrication is prescribed in JIS K 2001 ISO VG 68
- Without measurement Seal

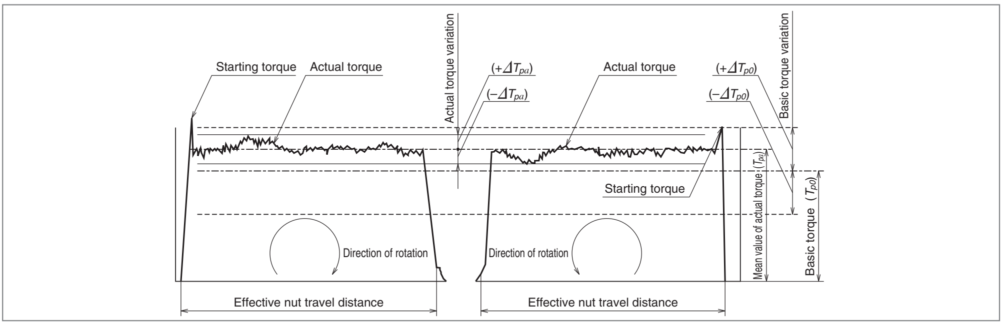


Fig. 7.1 Definitions of dynamic preloaded drag torque

(3) Calculation of basic torque

Basic torque of preloaded ball screw T_{p0} can be obtained by the following formula.

$$T_{p0} = K \frac{F_{a0} \bullet l}{2\pi} \fallingdotseq 0.014 F_{a0} \sqrt{dm \bullet l} \quad (\mathrm{N} \cdot \mathrm{cm}) \qquad (\text{II-27})$$

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 the ball screw

① Normal drive

The torque when converting rotational motion to linear motion (normal operation) is obtained by the following formula.

$$T_a = \frac{F_a \bullet l}{2\pi \bullet \eta_1} \quad (\mathrm{N} \cdot \mathrm{cm}) \qquad (\text{II-28})$$

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 – 0.95)

② Back-drive operation

The torque when converting linear motion to rotational motion (back-drive operation) is obtained by the following formula.

$$T_b = \frac{F_a \bullet l \bullet \eta_2}{2\pi} \quad (\mathrm{N} \cdot \mathrm{cm}) \qquad (\text{II-29})$$

In this formula:

T_b : Reverse operation torque (N · cm)

η_2 : Reverse efficiency (η_2 = 0.9 - 0.95)

③ Dynamic drag torque of the preloaded ball screw

Operation torque of preloaded ball screw can be obtained by Formula II-27.

Table 7.1 Range of allowable values of torque variation rates (Source: JIS B 1192)

Basic torque (N · cm)		Effective length of the screw thread (mm)										
		4000 or under								Over 4000 and 10000 or under		
		Slenderness ratio[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	1000	—	±15%	±15%	±20%	—	—	±20%	±25%	—	±25%	±30%

Remarks 1. Slenderness ratio: The value obtained by dividing the length of the screw thread section of screw shaft (mm) by diameter of the screw shaft (mm).
2. NSK independently sets torque standards which are under 20 N • cm.

(2) Drive torque of the motor

① Drive torque at constant speed

Torque which is necessary to drive a ball screw at constant speed resisting to external loads can be obtained by the following formula.

$$T_1 = (T_a + T_{pmax} + T_u) \times \frac{N_1}{N_2} \qquad (\text{II-30})$$

In this formula:

T_a : Drive torque at constant speed

$$T_a = \frac{F_a \bullet l}{2\pi \bullet \eta_1} \qquad (\text{II-28})$$

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.

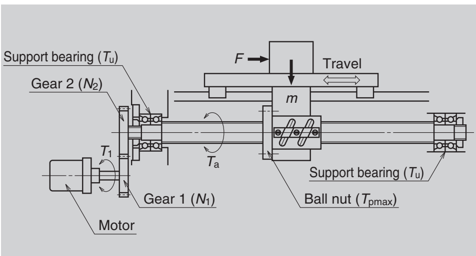


Fig. 7.3 Driving mechanism of ball screw

② Drive torque at acceleration

Accelerating the ball screw resisting axial load requires maximum torque. Drive torque necessary for this occasion can be obtained by the following formula.

$$T_2 = T_1 + J \bullet \dot{\omega} \qquad (\text{II-31})$$

$$J = J_M + J_{G1}\left(\frac{N_1}{N_2}\right)^2\left[J_{G2} + J_S + m\left(\frac{l}{2\pi}\right)^2\right] \ (\text{kg} \cdot \text{m}^2) \qquad (\text{II-32})$$

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 maximum drive torque T_2 at time of acceleration of ball screw.

Calculation of the moment of inertia of a cylindrical object (ball screw, gear, etc.), please refer to below.

Formula for the moment of inertia of a cylindrical object

$$J = \frac{\pi \bullet \gamma}{32} D^4 \bullet L \ (\text{kg} \cdot \text{cm}^2) \qquad (\text{II-33})$$

In this formula:

γ : Material density (kg/cm^3)

D : Diameter of the cylindrical object (cm)

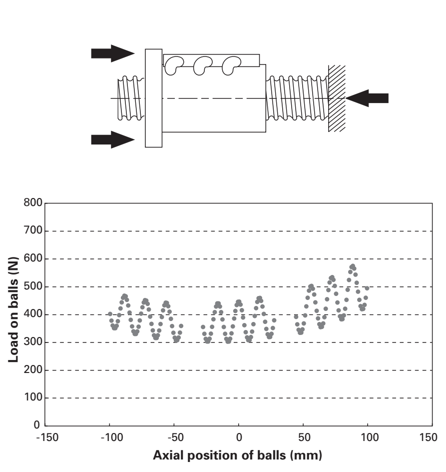
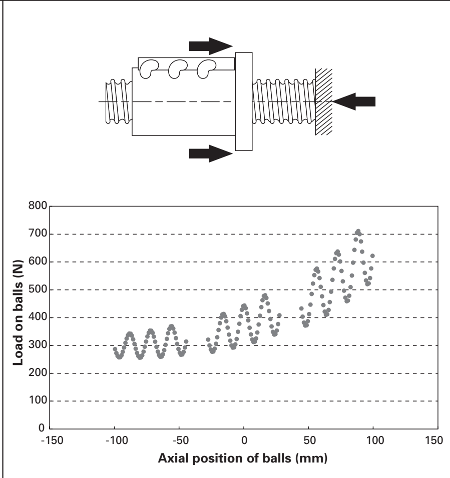
L : Length of the cylindrical object (cm)

B-2-8 Even Load Distribution in Ball Nut

Generally, the distribution of loaded balls in a ball nut is three-dimensionally asymmetric, thus resulting in uneven load distribution to the balls and ball nut. NSK has taken the measures for even load distribution to the balls by an optimal arrangement of the position of ball recirculation circuits.

Additionally, a heavier load results in a measurable axial deformation of the screw shaft and the ball nut, thus further increasing the unevenness of load distribution. We have lessened the unevenness of load distribution to the balls by arranging the load acting point of the ball nut and the screw shaft opposite to each other. The relation between loading points and load distribution is shown in Fig. A, while Table B shows the result of load distribution analysis.

Fig. 8.1 The result of equalization of load distribution

<table>
<tr><th></th><th>NSK recommended mounting direction</th><th>Conventional (mounting direction)</th></tr>
<tr><td>Conventional design</td><td>
</td><td>
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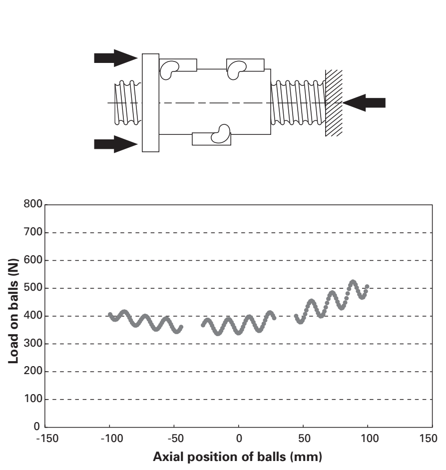
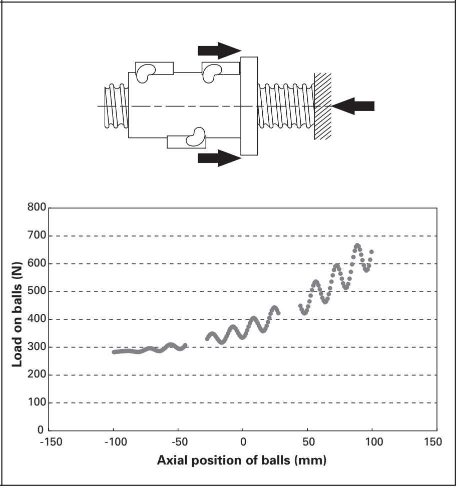
<tr><td>HTF design</td><td>
</td><td>
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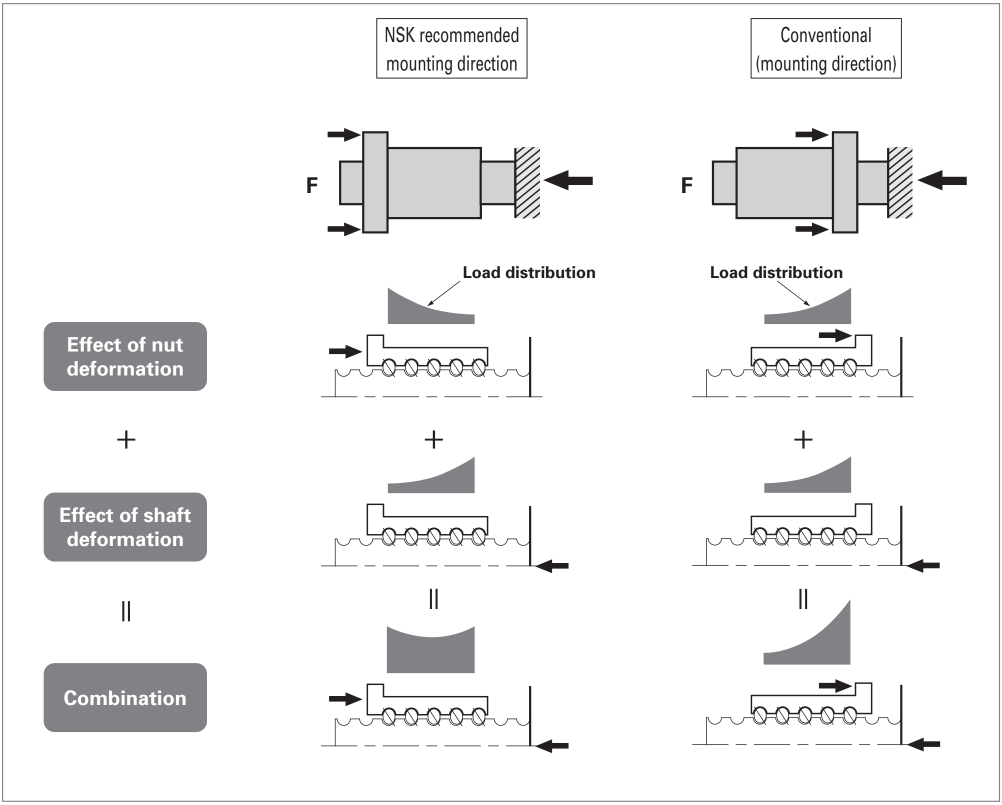

Fig. 8.1 The relationship between acting point of load and load distribution

B-2-9 Lubrication of Ball Screw

Lithium soap-based grease at viscosity 30 to 140 mm^2/s (40°C) is used for grease lubrication. Oil with ISO VG 32 to 100 is used for oil lubrication.

In general, lubricants with low base oil viscosity are recommended when the ball screw is used for high speed, and it is important to reduce thermal elongation of the screw shaft. On the other hand, lubricants with high base oil viscosity are recommended when the ball screw is used for low speed, high temperature, with vibration, or under high load.

Please consult NSK about greases for high-load drive and high-temperature applications.

NSK Grease Unit for ball screw lubrication includes:

1) Various types of grease in the bellows-tube which can be instantly attached to the grease pump;

2) Hand grease pump which is compact and easy to use;

3) Nozzles.

Table 9.1 shows NSK greases, and names of other ball screw greases.

Table 9.2 explains checking points in lubrication and standard intervals between replenishments.

It is important to wipe off old grease from the screw shaft prior to applying new grease. Page D16 also explains in detail concerning the replenishing methods.

Table 9.1 Grease for ball screw

Product name	Thickener	Base oil	Base oil viscosity mm^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 NF2	Urea composite type	Synthetic oil combined with mineral oil	27	–40 – 130	Fretting resistant

*Refer to Page D13 for the nature of NSK greases.

Table 9.2 Checking lubricant and intervals of replenishment

Lubricating method	Checking intervals	Check points	Replenish/replacing interval
Intermittent automatic oil supply	Once a week	Remaining volume, contamination	Supply oil when checking (depending on the tank volume)
Grease	2 – 3 months after start of use	Clean, foreign matters	Generally once a year (replenish when necessary)
Oil bath	Every day, when start to work	Oil level	Specify according to oil consumption

B-2-10 Dust Prevention for Ball Screw

If foreign matters enter inside the ball nut, all screw may wear rapidly, or it may malfunction due to damage of groove or ball recirculation system. Use bellows and telescopic pipe (Fig. 10.1) to keep foreign matters from entering into the feed screw system. Install these items so as to shut foreign matters completely from the ball screw.

Also it is even more effective to add seal on the ball nut as shown in Fig. 10.2 to10.6. We provide seals in Table 10.2.

Table 10.1 Seal

	Sealing capability	Torque	Heat	Application
Thin plastic seal	○	○	○	End deflector type, HMD type, BSL type
Plastic seal	×	◎	◎	Tube type, Defiector 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.)

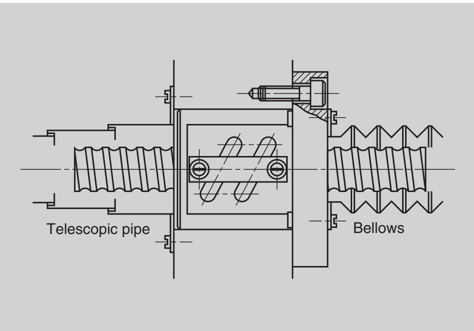

Fig. 10.1 Dust prevention by telescopic pipe and bellows

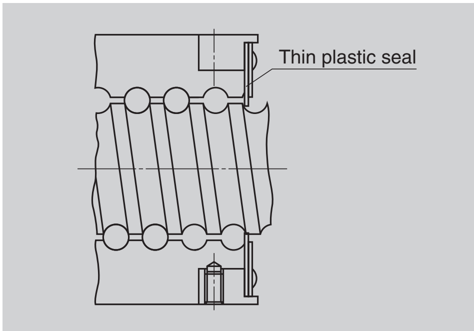

Fig. 10.2 Thin plastic seal

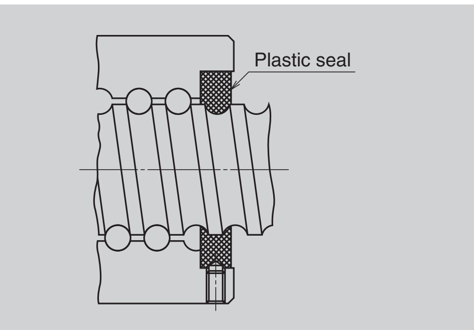

Fig. 10.3 Plastic seal

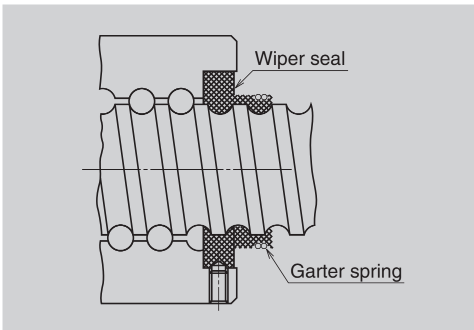

Fig. 10.4 Wiper seal

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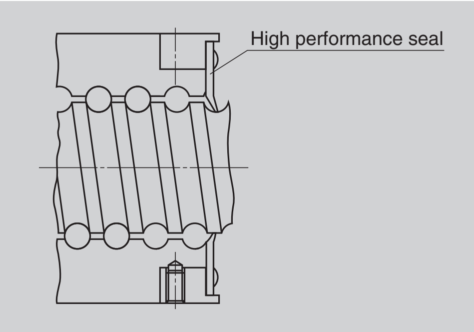


Fig. 10.5 High performance seal

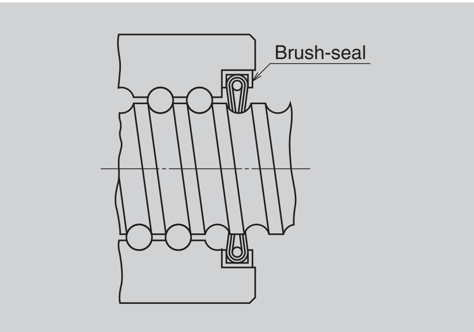


Fig. 10.6 Brush-seal for R Series

B-2-11 Rust Prevention and Surface Treatment of Ball Screws

(1) Stainless steel ball screw

Stainless products KA is standard ball screw and available in stock. Please consult NSK if you require custom made stainless steel ball screw.

(2) Types of surface treatment

The following are common types of treatment.

○Low temperature chrome plating
- Used to prevent corrosion and light reflection, and for cosmetic purpose.

○Fluoride low temperature chrome plating
- Fluoroplastic coating is provided following the low temperature chrome plating.
- Resistance to corrosion is higher than low temperature chrome plating.

○Hard chrome plating
- Has high hardness. Increases resistance to both wear and corrosion.

○Electroless nickel plating
- Creates a film of consistent thickness on complex shaped items.
- For corrosion prevention.

(3) Recommended surface treatment

Among the surface treatments mentioned above, we recommend "Low temperature chrome plating" and "fluoride low temperature chrome plating" for rust prevention because of the result of humidity chamber test for antirust characteristics.

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

Table 11.1 Surface treatment length

	Applicable length
Low temperature chrome plating	5 m or less
Fluoride low temperature chrome plating	4 m or less

Refer to 1.3 "Rust Prevention and Surface Treatment" (Page D5) for the results of humidity chamber test.

B-2-12 Ball Screw Specifications for Special Environment

B-2-12.1 Clean Environment

NSK manufactures NSK Clean Grease "LG2 and LGU" for NSK linear guides, ball screws, and Monocarriers which are used under normal temperature and pressure in a clean room.

LG2 and LGU grease are far more superior in stable torque characteristics than the vacuum grease which has been used as a countermeasure against dust generation. LG2 and LGU also have a sufficient durability and dust prevention capability.

Features of "LG2 and LGU"

① Generates less dust than vacuum grease and other general greases. Cleanliness is enhanced by simply switching the grease to LG2 or LGU.

② Has extremely low and stable torque characteristics. It is ideal for high speeds.

③ Unlike vacuum grease, LG2 and LGU have a nature similar to general grease. Its effect is long-lasting, and sufficiently durable. They greatly contribute to minimize the frequency of maintenance.

④ They have an equal capability in rust prevention as general grease, and also is reliable.

When using NSK linear guides, ball screws, or Monocarriers in a clean environment, request LG2 or LGU as a packed lubricant prior to delivery. NSK also makes bellows-tubes which contain 80 grams of LG2 or LGU. The tube is easy to use, and is ideal for maintenance. (Refer to Pages B455 and D20). Wash to remove adipose substances prior to use.

Refer to Page D8 for detailed nature, functions and characteristics of LG2 and LGU.

B-2-12.2 Measures for Use under Vacuum

NSK developed MoS_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 making 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 peal off and stick to surface of ball grooves repeatedly, causing the torque to rise momentarily on some occasions. The drive motor should be of large capacity to handle this drastic variation of torque.

Refer to Page D7 for test data of ball screws for vacuum.

For ball screw specifications for special environment, refer to Page D2.

B-2-13 Noise and Vibration

B-2-13.1 Consideration to Lowering Noise

As the machine operates at higher speeds, noise levels tend to increase. Covering the nut section is insufficient to lower noise. NSK has abundant data (NSK Motion & Control Technical Journal No.4, etc.), and offers advice to users regarding selecting ball screw.

To lower noise level in general, the following points should be taken into consideration.

① Use as a large lead as possible to reduce rotational speed.

② Use a ball screw with smaller outer diameter as possible.
(It often requires designing for critical dimensions, mandating special specification. Please consult NSK.)

For reference, noise levels by ball screws alone are plotted below. Formula for calculation is also shown below.

①Average value at measuring distance of 400 mm

$$\text{dB (A)} = 25.2\,\{\log_{10}(D_w \cdot d_m \cdot n \times 10^{-5})\} + 63.9 \qquad (\text{II-34})$$

②Upper 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).

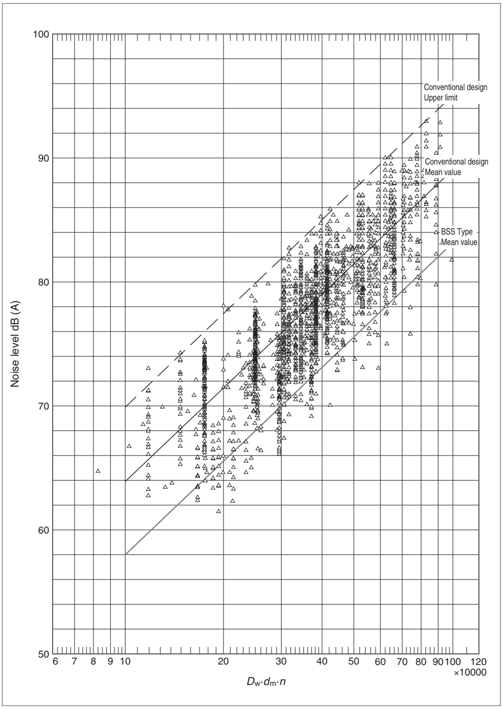


Fig. 13.1 Noise levels of ball screws

<<Example of calculation of noise levels>>

<Use conditions>

Nut model: DFT4010-5

From the dimension table: $D_w = 6.350$

$d_m = 41$

Maximum rotational speed: 2000 min^{-1}

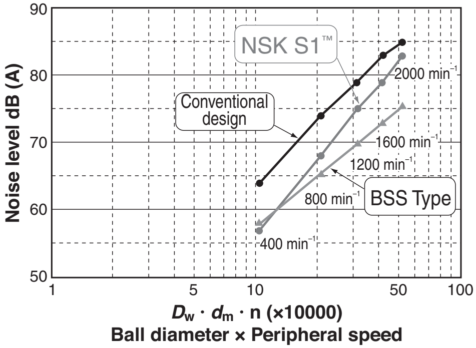
<Calculation>

By Formula II-34:

$$\text{dB (A)} = 25.2\,\{\log_{10}(D_w \cdot d_m \cdot n \times 10^{-5})\} + 63.9$$
$$= 25.2\,\{\log_{10}(6.350 \times 41 \times 2000 \times 10^{-5})\} + 63.9$$
$$= 82 \text{ dB (A)}$$

The average value of noise level by ball screws alone at maximum rotational speed (measuring distance 400 mm) is 82 dB (A).
Upper limit is: 82 dB (A) + 6 dB (A) = 88 dB (A)
If the measuring distance is 1 m, the average value of noise level is 74 dB (A), and upper limit is 80 dB (A).
When installed, the noise of ball screw becomes higher by the noise of the machine and characteristics of machine vibration.

By using NSK S1, the noise is reduced and softened compared to conventional ball screws.
The BSS type will furthermore reduce and soften the noise.



B-2-13.2 Consideration to operational characteristics

Smooth motion is achieved by using spacer balls on conventional ball return tube type ball screws. By using NSK S1 the smoothness is further improved. BSS type will achieve the smoothness equivalent to Ball screws with NSK S1.

B-2-13.3 Consideration to Ball Screw Support System

Ball screw has low radial rigidity because its support span is longer compare to its shaft diameter. It has only small damping capacity, requiring as much support rigidity as possible through design.
Simplify support bearing system to cut costs invites noise and vibration problems. Therefore, the necessity to consideration to ball screw support system of both shaft ends is increasingly becoming important as the machine is operated at higher speeds.
If one shaft end must be left unfixed without support bearing due to structural reasons, noise and vibration problems may occur. These problems are related to the natural vibration frequency of the screw shaft on the unsecured end. This problem can be averted by installing an impact damper to the shaft end (Fig. 13.2). Please consult NSK.

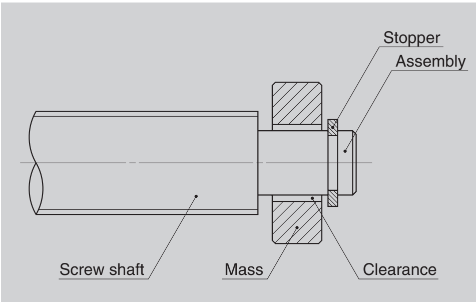
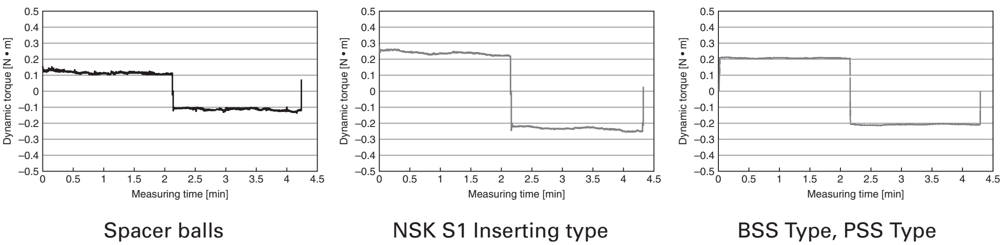


Fig. 13.2 Impact damper (NSK patent)



B-2-14 Installation of Ball Screw

B-2-14.1 Installation

Follow the flowchart in Figure 14.1 for installation procedures.

(1) Centering of the units

Align the centers of housings for the ball nut and the support bearing to which a ball screw is fixed. The centering is critical for life, smooth operation, and positioning accuracy of a ball screw.

We generally recommend the centering accuracy as follows for a precision grade ball screw.

- Inclination of center line: 1/2 000 or less (Target: 1/5 000 or less)
- Eccentricity: 0.020 mm or less

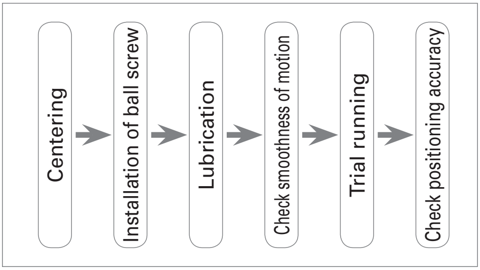


Fig. 14.1 Flowchart of ball screw installation

(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.

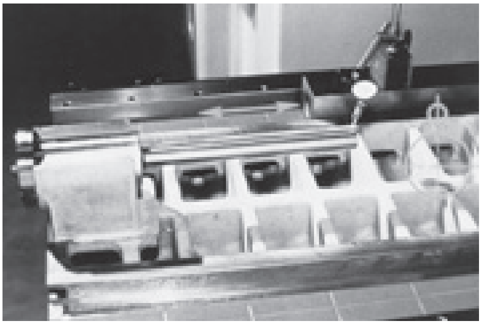


Photo 14.1 Centering of ball nut housing

(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.

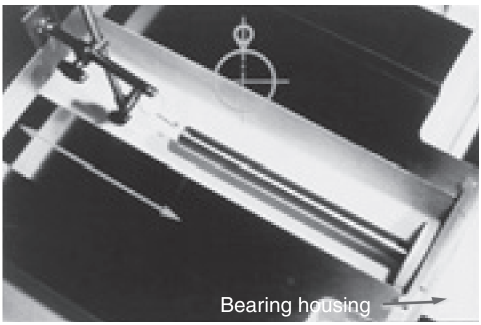


Photo 14.2 Centering of the housing of support bearing

(4) Eccentricity of the housings

Measuring way of eccentricity between the two housings is shown in Figure 14.3. Set the table on the guide way (such as linear guides, etc), and fix a dial indicator on it. Check eccentricity of the test bar of support bearing housing against the test bar of ball nut housing. Adjust position of support unit housing so that the eccentricity gets in 0.020 mm or less, then fix the housing of support bearing.

Photo 14.3 Eccentricity of the housings

(5) Installation of ball nut

Photo 14.4 shows a procedure for installation of the ball nut to the housing. Wipe off outside of the ball nut and bore of the housing with thin rags. (Applying a small amount of machine oil with low viscosity to both parts is effective in rust prevention.) Insert the ball nut to the housing while holding the ball screw in horizontal position and fix it. Do not handle the ball screw roughly, like hammering ends of the ball screw, because it may induce failure of the ball screw.

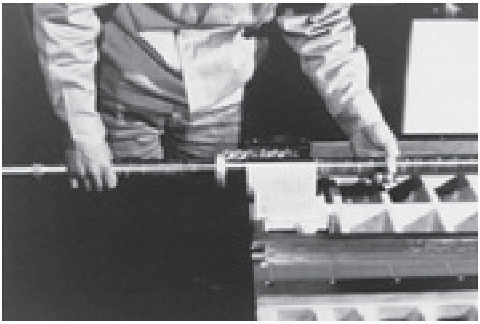


Photo 14.4 Installation of ball nut

(6) Installation of support bearings in ball screw

Photo 14.5 shows a procedure for installation of support bearings. Select bearings that have appropriate fitting tolerance to the screw shaft, then install them. We recommend using a special sleeve as shown in the photo not to apply impact to the bearings.

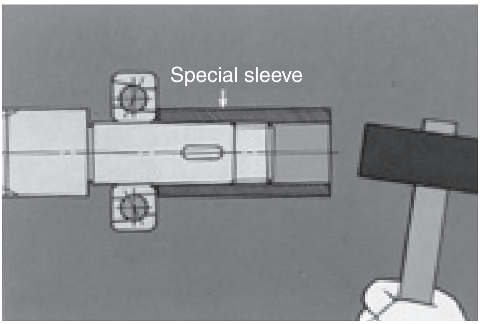


Photo 14.5 Installation of support bearings in ball screw

(7) Installation of bearings in the housing

Photo 14.6 shows the procedure for installing the support bearings to the bearing housing. When fixing the bearing with a lock nut, tighten the lock nut with specified tightening torque while checking run-out of screw shaft end. Take measures against loose lock nut. (Refer to assembly procedure of support bearing unit. Page B81)

For easy installation work of ball screws, NSK provides Support Unit (Page B433 to B452) that consists of bearings and Bearing Lock Nuts (Page B453) of which surface run-out is made to a specification.

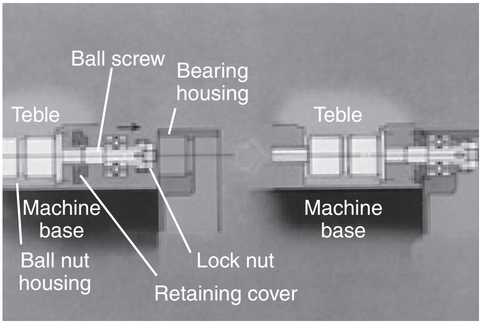


Photo 14.6 Installation of bearings

(8) Replenish lubrication grease

Photo 14.7 shows the replenishing procedure of lubrication grease. Applying grease prior to its operation is not necessary when the grease is packed into the ball nut. Please confirm it.

If grease is not used, we apply antirust oil to ball screws when shipping. Wipe off the oil and pack grease fully into the ball nut as shown in the photo.

Photo 14.7 Replenish lubrication grease

(9) Check motion smoothness

Photo 14.8 shows a checking procedure for motion smoothness. This is to confirm if the table is assembled accurately. Use a torque wrench to measure starting torque of the ball screw for full stroke of the table. Check for abnormality in starting torque as well as unevenness of rotation by feeling.

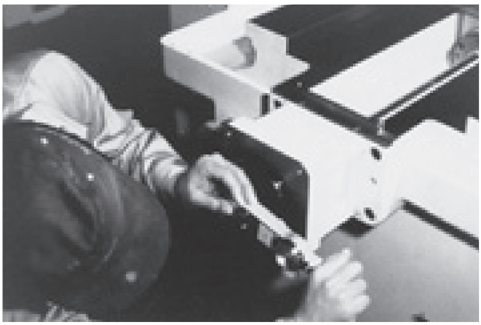


Photo 14.8 Check motion smoothness

(10) Trial operation

Photo 14.9 shows a seen of trail 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.

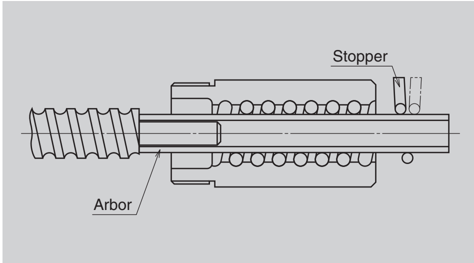


Fig. 14.2 Inserting nut into screwshaft

Photo 14.9 Trial operation

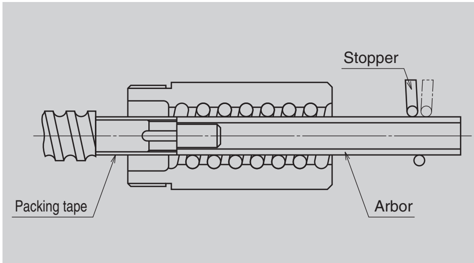


Fig. 14.3 Arbor and shaft end configuration

B-2-14.2 Inserting R Series Nut into Rolled Screw Shaft

When delivered, the nut of R series is separated from the screw shaft, and inserted into an arbor shaft. The nut must be inserted to the screw shaft when mounting ball screw.

(1) Consideration to end configuration of screw shaft

The balls may fall out during moving the assembled nut from the arbor to the screw shaft if the sizes and shapes of the arbor and the screw shaft are not appropriate.
If the end of the ball groove can touch the end of the arbor, connect both ends and move the assembled nut from the arbor to the screw shaft (Fig. 14.2).
If the end face of the arbor cannot connect to the end face of the screw because of configuration of both ends of screw shaft, wrap a tape outside of ball screw shaft so that the layers of tape is equal with the outside diameter of the arbor (Fig. 14.3).
If there is a key way or a nick along the way, fill such gaps prior to moving the ball nut.

(2) Installation of arbor

Confirm the correct nut orientation for installation. Remove the stop ring on the side from where the assembled nut is to be removed. Align the centers of the screw shaft and the arbor while pressing firmly the screw shaft end against the arbor.

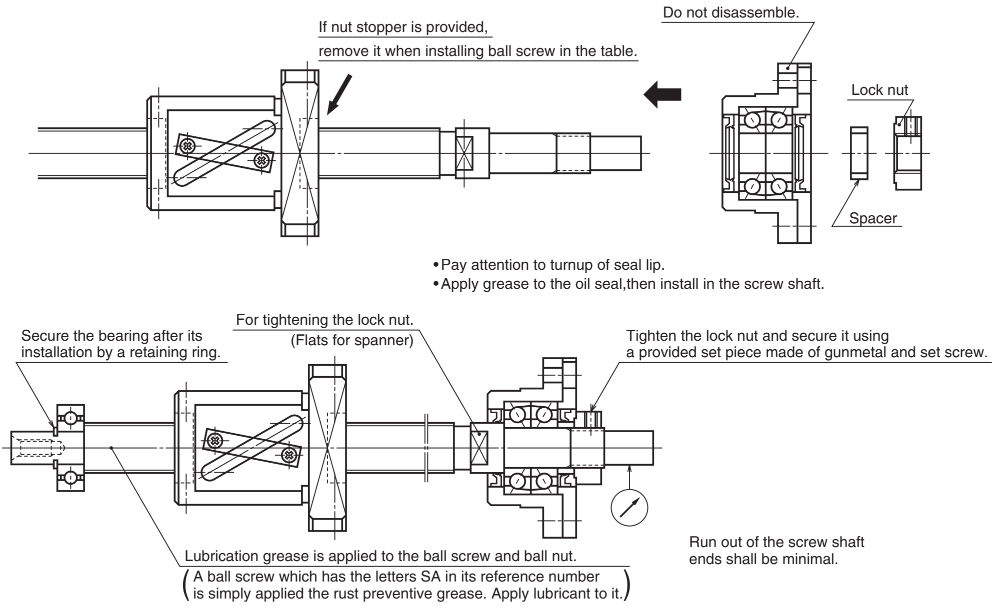
(3) Moving the nut

Slide the nut until it lightly touches the shoulder of the ball groove section, and stop it. Turn the ball nut to the direction so that it moves to the ball grooves, while pressing the arbor to the screw shaft. Do not separate the arbor from the screw shaft until the ball groove end appears completely in the ball nut.

B-2-14.3 Installation of Ball Screw and Support Unit

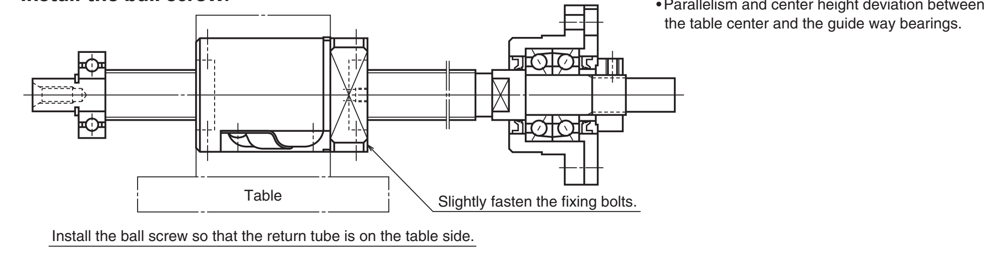
The illustrations below show typical installation procedures of a standard ball screw and a support unit.

(1) Assembly of support unit

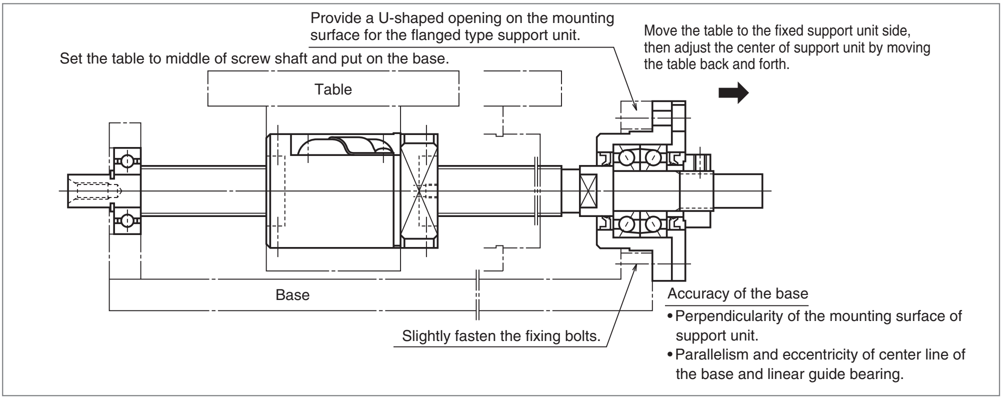


(2) Installation of ball nut to the table

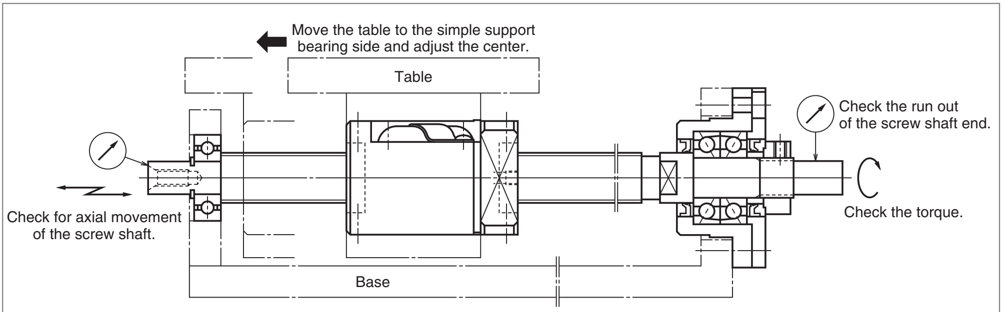
Installation example: Turn the table upside down, and install the ball screw.



(3) Base and the support unit installation on the fixed support side

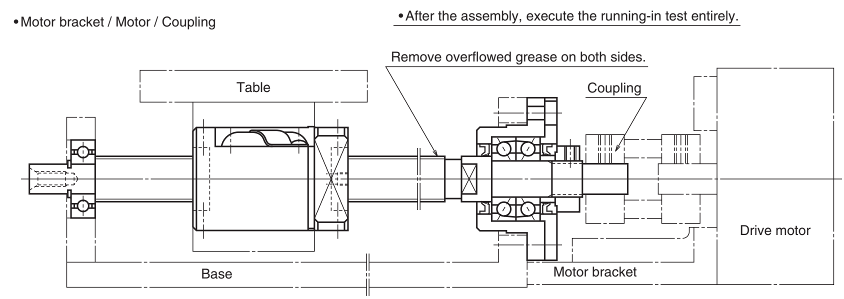


(4) Base and bearing installation on simple support side, and confirming assembling accuracy.



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

Shaft end is machined in the following three occasions.

* Precision ball screws with blank shaft end.
* Ball screws in R Series with blank shaft end.
* Additional machining of a completed ball screw

The following are summaries of machining of these shaft ends. For details, please contact NSK.

(1) Additional machining of precision ball screw with blank shaft

① Cutting screw shaft
Use a cutting whetstone, etc. to cut the shaft, leaving stock for turning. Keep the nut in the assembled state to the screw shaft, and open only one side of the plastic wrapping bag, expose only the shaft end section to be machined, then cut the screw shaft. This prevents foreign matters from entering to the ball screw section. Do the same for other machining.

② Precautions in cutting shaft end
Outside of the screw shaft is ground with precision. There is a center hole in the ends. Use them for centering. Do not rotate the shaft quickly or stop it suddenly, or the nut might move along the shaft. We recommend securing the nut with tape. To machine a very long shaft, apply work rests to the screw shaft surface to suppress vibration (especially caused by critical speed).

③ Turning by lathe
Cut to the length, turn shaft end steps, turn thread screw, and provide the center hole. Refer to JIS B1192 which sets standards for shaft end accuracy.

④ Processing by grinding
Apply the same precautions as for cutting for centering, securing nut, and work rest. Grind sections where the bearings and a "Spann ring" are installed.

⑤ Milling processing
Process key way and lockwasher tooth seat.

⑥ Deburring, washing, rust prevention
Wash with clean white kerosene after processing. Apply lubricant for immediate use. For later use, apply rust preventive agent.
[Note]
Contact NSK if nut is accidentally removed.

(2) Additional machining of R Series ball screw shaft end

① Cutting screw shaft
Carry out the same process as for Precision ball screw with blank shaft above.

② Annealing the shaft end (Heat the section of the shaft end to be machined with an acetylene torch. Then gradually cool it in ambient atmosphere.)
* The area not machined loses hardness if exposed to heat. This shortens ball screw life. Cool with water the areas where should not be heated to avoid heat conduction.

③ The following process is the same as Precision ball screw with blank shaft above.

B-2-15 Precautions for Designing Ball Screw

B-2-15.1 Safety System

As shown in the illustration on Page B80, a stopper is installed in some cases to prevent the nut from overrunning due to malfunction of the safety system of the machine itself, or human error during operation.
The travel stopper should be installed at a place where it will not come into contact with the nut when the nut reaches the designed stroke end.
An impact absorbing travel stopper (NSK patent, refer to Page B456) is available at NSK.

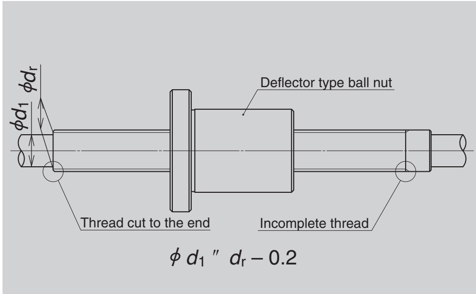


Fig. 15.1 Shaft end of a deflector recirculation system ball screw

B-2-15.2 Design Cautious to Assembling Ball Screw

(1) Cutting through the thread screw to the end

For the deflector, end cap and a part of end defiector ball recirculation system ball screws, one end of the thread screw should be cut through. This is for convenience of assembly for ball nut to the screw shaft (Fig. 15.1).
In this case, the shaft end diameter, where this thread cut through is made, should be 0.2 mm or smaller than the ball groove root diameter "d_r" (See the dimension table). A similar precaution is required when it is absolutely necessary to remove the nut from the screw shaft in order to install the ball screw to the machine. Also, in case using the cut-through end as the shoulder of the support bearing, make certain that a sufficient amount of the effective flat surface is left from the root diameter. If it is insufficient, the bearing cannot be installed in perpendicular to the bearing seat. (Fig. 15.2)

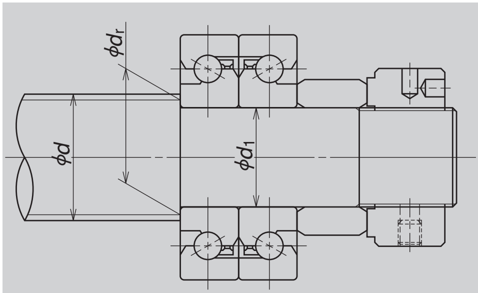


Fig. 15.2 Support bearing and end face (shoulder) for installation

(2) Designing screw shaft end and the nut area

When installing a ball screw to the machine, avoid a design which makes it necessary to separate the nut from the screw shaft as shown in Fig. 15.3. If separated, the balls may fall out. Separation may also deteriorate the ball screw accuracy, or may damage the ball screw. If separating them is unavoidable, please furnish NSK with the component which is to be installed between the nut and screw shaft. NSK will install the component prior to delivery.

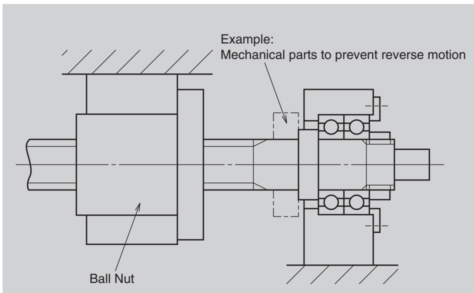


Fig. 15.3 Nut and ball screw are required to be separated when installing in this structure.

(3) Removing nut from the shaft at time of assembly

If it is unavoidable, use an arbor (Fig. 15.4), keeping the balls in the nut. In this case, the outside diameter of the arbor should be approximately 0.2 to 0.4 mm smaller than the ball groove root diameter "d_r."

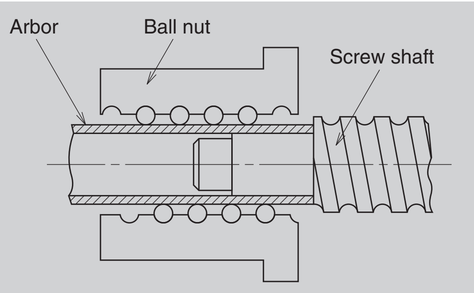


Fig. 15.4 Arbor to install and remove nut

(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.

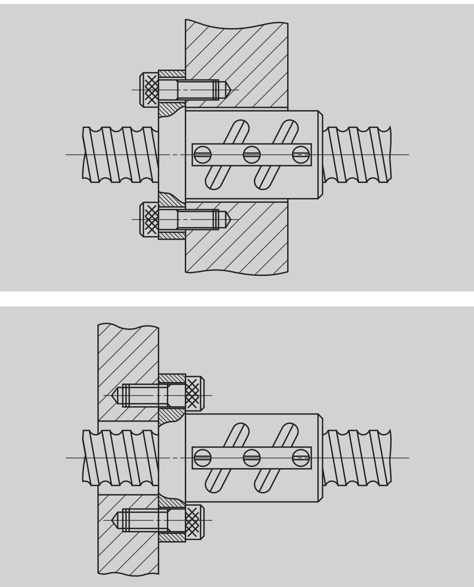


Fig. 15.5 Fixing a ball nut by flange

(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 Series of R Series ball screw, apply an agent which prevents the nut from loosening.

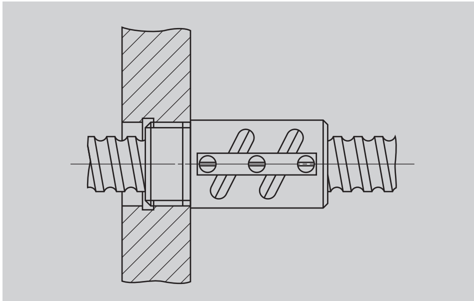


Fig. 15.6 Fixing a ball nut with thread screw

(6) Installation of brush-seal to the nut

If the brush-seal is installed at the thread screw side of the nut which comes with a thread screw, the brush-seal should be designed to be secured as shown in Fig. 15.7.

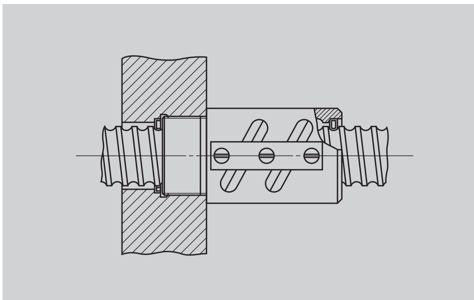


Fig. 15.7 Installation of brush-seal to a ball nut with thread screw

B-2-15.3 Effective Stroke of Ball Screw

Rigidity of a ball screw which is hardened by the induction hardening may be slightly low at both ends of the screw section. Consider this low hardness prior to determining the length of effective stroke. Please consult NSK for details.

B-2-15.4 Matching after Delivery

Please inform NSK on the position and size if it is necessary to machine the screw shaft end, or if a knock pin at the nut installation section is needed after delivery.
NSK takes a measure and protects designated spots from heat treatment prior to delivery to make subsequent machining easy.

B-2-15.5 NSK K1™ Lubrication Unit

When using NSK K1 lubrication unit, be aware of the operating temperature and chemicals that come to contact for keeping the best performance of K1.

Temperature range for use:

Maximum temperature for use; 50°C
Momentary maximum temperature in use; 80°C

Chemicals that should not come to contact:

Do not leave K1 Seal in organic solvent, white kerosene such as hexane, thinner which removes oil, and rust preventive oil which contains white kerosene.
Water-type cutting oil, oil-type cutting oil, grease such as mineral-type AS2 and ester-type PS2 do not damage K1 Seal.

B-2-16 Ball Screw Selection Exercise

[Drill 1] High-speed transporting system

1. Design conditions

Table mass :	m_1 = 40 kg
Mass of the transporting item :	m_2 = 20 kg
Maximum stroke :	S_{max} = 700 mm
Rapid traverse speed :	V_{max} = 1000 mm/sec (60 m/min)
Positioning accuracy :	±0.05/700 mm (0.005 mm/pulse)
Repeatability :	±0.005 mm
Required life :	L_t = 25000 h (5 years)
Guide way (rolling) :	μ = 0.01 (friction coefficient)
Drive motor :	AC servo motor (N_{max} = 3000 min^{-1})

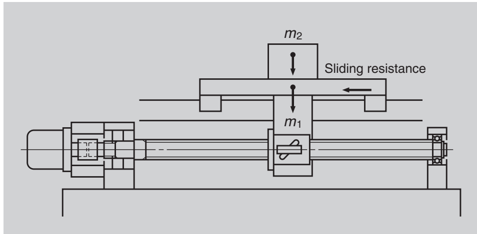


Fig. 16.1 System appearance

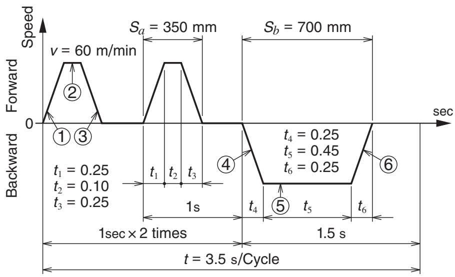


Fig. 16.2 Operating condition

2. Selection of basic factors

(1) Selection of accuracy grade and axial play

According to Table 4.1 Accuracy grades of ball screw and their application (B19), accuracy grade of industrial robots cartesian type and other purposes are C5 to 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 (B20), you will require accuracy grade C5 if the axial play is below 0.005 mm. Therefore select accuracy grade C5, and axial play 0 mm (Z preload)

(2) Selection of lead

Calculate lead l based on AC servo motor maximum speed and rapid traverse speed V_{max}.

$$l \geq \frac{V_{max}}{N_{max}} = \frac{1000 \times 60}{3000} = 20 \text{ (mm)}$$

Select a lead l of 20 mm or larger.

(3) Selection of screw shaft diameter

According to "Table 4.6 Shaft diameter, lead and stroke of standard ball screw" on Page B23, the screw shaft diameter d which has a lead l larger than 20 mm should be in the range of 15 mm to 32 mm. Select the smallest 15 mm.

(4) Selection of stroke

From "Table 4.6 Screw shaft diameter, lead, and stroke of standard ball screw" on page B23, ball screw with shaft diameter d = 15 mm and lead l = 20 mm meets maximum stroke 700 mm, therefore it is possible to select from standard ball screw. Primary selection is as follows:

Primary selection:

Shaft diameter :	15 (mm)
Lead :	20 (mm)
Stroke :	700 (mm)
Accuracy grade :	C5
Axial play :	Z

3. Confirmation of standard ball screw

In consideration of delivery time and price, select from the standard ball screw finished shaft end.

Primary candidate: W1507FA-3PG-C5Z20

4. Checking basic safety

Calculate for the primary candidate.

(1) Allowable axial load

① Calculation of allowable axial load

From Fig. 16.2: Acceleration α_1 at accelerating / decelerating is:

$$\alpha_1 = \frac{V_{max}}{t_1} = \frac{1000}{0.25} = 4000\ (\text{mm/s}^2) = 4\ (\text{m/s}^2)$$

Axial load F_i is:

(At time of acceleration ①④)

$$F_1 = \mu(m_1 + m_2) \times g + (m_1 + m_2) \times \alpha_1$$
$$= 0.01 \times (40 + 20) \times 9.80665 + (40 + 20) \times 4$$
$$= 246\ (\text{N})$$

(At time of constant speed ②⑤)

$$F_2 = \mu(m_1 + m_2) \times g = 0.01 \times (40 + 20) \times 9.80665$$
$$= 6\ (\text{N})$$

(At time of deceleration ③⑥)

$$F_3 = -\mu(m_1 + m_2) \times g + (m_1 + m_2) \times \alpha_1$$
$$= -0.01 \times (40 + 20) \times 9.80665 + (40 + 20) \times 4$$
$$= 234\ (\text{N})$$

Thus, the maximum axial load P is 246 N.

② Buckling load

W1507FA-3PG-C5Z20 has distance La = 804 mm (per specifications on Page B277), table maximum axial load P = 246 (N). Supporting condition of screw shaft is Fixed - Simple support, and supporting condition of ball nut is Fixed. Due to the direction of the load, supporting condition is Fixed – Fixed support (Factor m = 19.9).

From Fomula (Ⅱ-2) on Page B48:

$$d_r \geq \left(\frac{P \bullet L_a^2}{m} \times 10^{-4}\right)^{1/4} = \left(\frac{246 \times 804^2}{19.9} \times 10^{-4}\right)^{1/4}$$
$$= 5.3\ (\text{mm})$$

W1507FA-3PG-C5Z20 has dimension dr = 12.2 mm per dimension chart (Page B277) and therefore meets the condition.

<u>Result: Acceptable</u>

(2) Checking allowable value of rotational speed

The permissible rotational speed listed in the dimension table is 3000 min^{-1}. Since the motor maximum rotational speed is 3000 min^{-1}, the operation is in the range of permissible rotational speed.

<u>Result: Acceptable</u>

(3) Checking life expectation

① Mean load F_m, mean rotational speed N_m

From calculation of axial load. Rotational speed N_i and operating time t_i is:

(At time of acceleration ①④)

$$F_1 = 246\ (\text{N})$$
$$N_1 = \frac{n}{2} = \frac{3000}{2} = 1500\ (\text{min}^{-1})$$
$$t_a = 2 \times t_1 + t_4 = 0.75\ (\text{s})$$

(At time of constant speed ②⑤)

$$F_2 = 6\ (\text{N})$$
$$N_2 = 3000\ (\text{min}^{-1})$$
$$t_b = 2 \times t_2 + t_5 = 0.65\ (\text{s})$$

(At time of deceleration ③⑥)

$$F_3 = 234\ (\text{N})$$
$$N_3 = 1500\ (\text{min}^{-1})$$
$$t_c = 2 \times t_3 + t_6 = 0.75\ (\text{s})$$

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)
① ④	F_1 = 246	N_1 = 1500	t_a = 0.75
② ⑤	F_2 = 6	N_2 = 3000	t_b = 0.65
③ ⑥	F_3 = 234	N_3 = 1500	t_c = 0.75

From Formulas (Ⅱ-11) and (Ⅱ-12) on Page B57:

$$F_m = \left(\frac{F_1^3 \bullet N_1 \bullet t_a + F_2^3 \bullet N_2 \bullet t_b + F_3^3 \bullet N_3 \bullet t_c}{N_1 \bullet t_a + N_2 \bullet t_b + N_3 \bullet t_c}\right)^{1/3}$$
$$= 195\ (\text{N})$$

$$N_m = \frac{N_1 \bullet t_a + N_2 \bullet t_b + N_3 \bullet t_c}{t}$$
$$= 1200\ (\text{min}^{-1})$$

② Calculation of life expectation

W1507FA-3PG-C5Z20 (Clearance Z) is C_a=4320N (From dimension table on Page B277), from Formulas (Ⅱ-8) and (Ⅱ-9) on Page B57:

$$L_t = \left(\frac{C_a}{F_m \bullet f_w}\right)^3 \times \frac{1}{60 N_m} \times 10^6$$

$$= \left(\frac{4320}{195 \times 1.2}\right)^3 \times \frac{1}{60 \times 1200} \times 10^6$$

$$\fallingdotseq 87400$$

This grade satisfies the required life.

Result: Acceptable

5. Check whether the following figures meet requirements

(1) Accuracy and axial play

From the dimension table and the permissible value of lead accuracy on Page B42:

According to Table 1.2:

Accuracy grade: C5

e_p = ±0.035/800 (mm)

υ_u = 0.025 (mm)

This grade satisfies the required positioning accuracy ±0.05/700 mm.

Checking axial play is omitted here since it is explained in "2. Selection of basic factors."

(2) Drive torque

Required specifications are as follows.

Motor rotational speed : 3000 min^{-1}

Time to reach maximum speed : Under 0.25 sec

① Load (converted to motor axis)

Using Formula (Ⅱ-32) and (Ⅱ-33) on Page B68, calculate the moment of inertia whereas γ is density.

(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 (kg · 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

Assuming that WBK12-01 compact light load type will be used, as recommended for W1507FA-3PG-C5Z20, and moment of inertia of motor J_M = 3.1 (kg · cm^2) = 3.1×10^{-4} (kg · m^2).

(At time of constant speed)

Torque which is necessary to drive a ball screw at constant speed resisting to external loads is per Formula (Ⅱ-30) on Page B68

$$T_1 = T_a + T_{pmax} + T_u$$

in this Formula, T_a is drive torque at constant speed, T_{pmax} is upper limit of the dynamic friction torque of ball screw, T_u is friction torque of the support bearing.

From dimension chart on Page B227 T_{pmax} = 7.8 (N · cm) and from Page B444 T_u = 2.1 (N · cm)

$$T_a = \frac{F_a \bullet l}{2\pi\eta_1}$$

Using Formula (Ⅱ-28) on Page B67, Drive torque at constant speed T_1 is:

$$T_1 = \frac{F_a \bullet l}{2\pi \bullet \eta_1} + T_{pmax} + T_u$$

$$= \frac{6 \times 2}{2\pi \times 0.9} + 7.8 + 2.1$$

$$= 12 \ (\text{N} \cdot \text{cm}) = 0.12 \ (\text{N} \cdot \text{m})$$

(At time of acceleration)

Drive torque necessary for accelerating the ball screw resisting axial load can be calculated by Formula (Ⅱ-31) on Page 68

$$T_2 = T_1 + J \bullet \frac{2\pi \bullet n}{60 t_1}$$

$$= T_1 + (J_L + J_M) \bullet \frac{2\pi \bullet n}{60 t_1}$$

$$= 0.12 + (6.7 \times 10^{-4} + 3.1 \times 10^{-4}) \frac{2\pi \times 3000}{60 \times 0.25}$$

$$= 1.35 \ (\text{N} \cdot \text{m})$$

(At time of deceleration)

Similarly at time of acceleration.

$$T_3 = T_1 - J \bullet \frac{2\pi \bullet n}{60t_3}$$

$$= T_1 - (J_L + J_M) \bullet \frac{2\pi \bullet n}{60t_3}$$

$$= 0.12 - (6.7 \times 10^{-4} + 3.1 \times 10^{-4}) \frac{2\pi \times 3000}{60 \times 0.25}$$

$$= -1.11 \ (\mathrm{N} \cdot \mathrm{m})$$

③ Selection of motor

Selection conditions are as follows.

Maximum rotational speed: $N_M \geq 3000 \ (\mathrm{min}^{-1})$

Motor rating torque: $T_M \geq T_{rms} \ (\mathrm{N} \cdot \mathrm{m})$

(T_{rms}: Effective torque)

Motor's rotor inertia -- $J_M > J_L/3$ or more

Form above: select an AC servo motor with the following specifications.

Motor specifications: Rating power output: $W_M = 300$ (W) Maximum rotational speed: $N_M = 3000 \ (\mathrm{min}^{-1})$ Rating torque: $T_M = 1 \ (\mathrm{N} \cdot \mathrm{m}) = 1 \times 10^2 \ (\mathrm{N} \cdot \mathrm{cm})$ Rotor inertia: $J_M = 3.1 \times 10^{-4} \ (\mathrm{kg} \cdot \mathrm{m}^2)$ $= 3.1 \ (\mathrm{kg} \cdot \mathrm{cm}^2)$

④ Checking effective torque

Effective torque T_{rms} can be calculated as follows:

$$T_{rms} = \sqrt{\frac{T_2^2 \times t_a + T_1^2 \times t_b + T_3^2 \times t_c}{t}}$$

$$= \sqrt{\frac{1.35^2 \times 0.75 + 0.12^2 \times 0.55 + 1.11^2 \times 0.75}{3.5}}$$

$$= 0.81$$

and meets $T_M \geq {}_{rms}$.

⑤ Checking time to reach maximum speed

Time required to reach rapid traverse speed can be calculated as follows whereas $T_M' = 2 \times T_M$

$$t_a = \frac{(J_L + J_M) \ 2 \ \ n}{(T_M' - T_1)} \times 1.4$$

$$= \frac{(6.7 \times 10^{-4} + 3.1 \times 10^{-4}) \times 2\pi \times 3000}{(2 \times 1 - 0.12) \times 60} \times 1.4$$

$$= 0.23$$

and meets requirement 0.25 sec or less.

From above: Use W1507FA-3PG-C5Z20

B 90

[Drill 2] Processing table for special machines

1. Design conditions

Table mass: m_1 = 1000 kg
Mass of the moving item: m_2 = 600 kg
Maximum stroke: S_{max} = 1000 mm
Maximum speed: V_{max} = 15000 mm/min
Positioning accuracy: ±0.035/1000 mm (no load)
∗ Attitude accuracy of the table and thermal displacement are not included in the accuracy requirement of the ball screw.
Repeatability: ±0.005 mm (no load)
Lost motion: 0.020 mm (no load)
Required life expectancy: L_t = 20000 h
($16^{h} \times 250^{days} \times 10^{years} \times 0.5^{rate\ of\ operation}$)
Guide way (sliding): μ = 0.15 (friction coefficient)
Processing: Milling and drilling
Drive motor: AC servo motor (N_{max} = 2000 min^{-1})

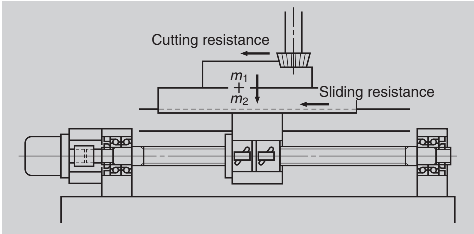


Fig. 16.3 System appearance

Table 16.2 Operating conditions

Operation	Axial load (N)		Feed speed (mm/min)	Use time ratio (%)
	Cutting resistance	Sliding resistance		
Rapid traverse	0	2354	15000	30
Light/medium cutting	4000	2354	500	50
Heavy cutting	8000	2354	100	20

∗ Sliding resistance: $F_r = \mu (m_1 + m_2) g = 0.15 \times (1000 + 600) \times 9.80665 = 2354$ (N)
∗ Ignore inertia at time of acceleration/deceleration because their time ratios are small.

2. Selection of basic factors

(1) Selection of accuracy grade and axial play

Accuracy grade should be in the range from C1 to C5 according to "Table 4.1 Precision grades of ball screw and their applications" on Page B19. Assuming nut length 200 mm and extra stroke 100 mm, shaft length L_0 is assumed as follows:

L_0 = Maximum stroke + nut length + margin
= 1000 = (200) + (100) = 1300

From "Table 1.2 Tolerance on specified travel and travel variation of the positioning ball screws" on Page B42, the accuracy that satisfies required function is possibly:

Accuracy C3 grade

e_p = ±0.029/1600 (mm)

υ_u = 0.018 (mm)

Considering importance on the volume of lost motion, select Z code (axial play 0 mm and less) for axial play.

(2) Selection of lead

From the maximum rotational speed of AC servo motor N_{max} and rapid traverse speed of table V_{max} , lead l is :

$$l \geq \frac{V_{max}}{N_{max}} = \frac{15000}{2000} = 7.5 \text{ (mm)}$$

Larger lead l would be beneficial for feed speed. But from the view of the control system (resolution), limit the lead l to 8 mm or 10 mm.

(3) Selection of screw shaft diameter

According to "Table 4.6 shaft diameter, lead and stroke of standard ball screw" on Page B23, shafts whose lead l is 8 mm or 10 mm are in the range of 10 mm to 50 mm. Placing more importance on rigidity than to the volume of lost motion, select a relatively large size in the range of 32 mm to 50 mm.

(4) Selection of stroke

Select 1000 mm, the maximum stroke in request.

Primary selection:		
	Standard ball screw	
	Shaft diameter:	32, 36, 40, 45, 50 mm
	Lead:	8, 10 mm
	Stroke:	1000 mm
	grade:	C3
	Axial play code:	Z

3. Confirmation of standard ball screw

Giving consideration to delivery time and price, select from the standard series.

C3 grade chosen in the Primary selection was not found in the standard ball screw. Let us check whether there is a C3 grade among ball screw.

4. Confirmation of made-to-order ball screw

Because standard ball screw does not meet accuracy grade requirement, we will consider made-to-order ball screw which is based on standard ball screw but with accuracy grade C3.

Second selection:		
	Made-to-order ball screw	
	Shaft diameter :	32, 36, 40, 45, 50 mm
	Lead :	8, 10 mm
	Stroke :	1000 mm
	Accuracy grade :	C3
	Axial play :	Z

5. Selection of screw shaft diameter, lead, and nut

(1) Dynamic load rating

Obtain required load carrying capacity of each lead through load conditions. From table 16.2 operating conditions on Page B91, calculate the rotation speed N_i as shown in Table 16.3.

$$N_i \geq \frac{V_i}{l}$$

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 = 2354	N_1 = 1875	N_1 = 1500	t_1 = 30
Light/medium cutting	F_2 = 6354	N_2 = 62.5	N_2 = 50	t_2 = 50
Heavy cutting	F_3 = 10354	N_3 = 12.5	N_3 = 10	t_3 = 20

By using Formula (Ⅱ-11) and (Ⅱ-12) on Page B57, calculate mean load F_m and mean rotational speed N_m as shown below.

$$F_m = \left(\frac{F_1^3 \cdot N_1 \cdot t_1 + F_2^3 \cdot N_2 \cdot t_2 + F_3^3 \cdot N_3 \cdot t_3}{N_1 \cdot t_1 + N_2 \cdot t_2 + N_3 \cdot t_3} \right)^{1/3}$$

$$N_m = \frac{N_1 \cdot t_a + N_2 \cdot t_b + N_3 \cdot t_c}{t}$$

Table 16.4 Mean load and mean rotational speed

Lead (mm)	8	10
Mean load F_m (N)	3122	3122
Mean rotational speed N_m (min^{-1})	596	477

Required dynamic load rating C_a is:

From Formulas (Ⅱ-8) and (Ⅱ-9) on Page B57:

$$C_a \geq (60 N_m \bullet L_t)^{1/3} \bullet F_m \bullet f_w \times 10^{-2}\ (N)$$

Whereas required life expectancy L_1 = 20000 (h), load coefficient f_w = 1.2 (refer to Page B57),

l = 8 (mm)············$C_a \geq$ 33500 (N)

l = 10 (mm)··········$C_a \geq$ 31100 (N)

(2) Selection of the nut

Due to lost motion requirements rigidity will be important, so the nut will be selected as follows. Table 16.5 shows the dynamic load rating of each specification.

- Standard nut ball screw, tube type
- Model: ZFT, DFT (Pages B475 to B504)
- Number of turns of balls : Select from 2.5 turns 2 circuits or 2.5 turns 3 circuits

From Table 16.5 select item that meets required dynamic load rating C_a as follows:

Third selection: In the range surrounded by the dotted lines ☐ in Table 16.5

Table 16.5 Dynamic load rating of each specification

Screw shaft diameter (mm)	Dynamic load rating *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	37300	–	54500	–
36	–	–	58000	–
40	41100	–	61200	–
45	–	–	65800	93300
50	45700	64800	68100	96500

(3) Permissible rotational speed

① Critical speed

Calculate based on rapid traverse speed V_{max} = 15000 mm/min. Ball screw rotational speed at each lead N is:

l = 8 (mm)·······N = 1875 (min^{-1})

l = 10 (mm)·····N = 1500 (min^{-1})

Based on Formula (Ⅱ-7) on Page B51, 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
= 1000 + 100 + 200 = 1300 (mm)

Supporting condition of screw shaft is Fixed - Fixed support, and supporting condition of ball nut is Fixed. Therefore, supporting condition is Fixed - Fixed support (Factor f = 21.9)

l = 8 (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 B54, as the d·n is 70000 or less, screw shaft diameter to meet the d·n value is:

$$d \leq \frac{70000}{N}\ (\text{mm})$$

l = 8 (mm)············$d \leq$ 37.3 (mm)

l = 10 (mm)··········$d \leq$ 46.7 (mm)

Based on nut specifications (Page B475-504) select item that meets screw shaft root diameter and screw shaft diameter.

＊Please consult NSK if it is necessary to use at d • n > 70000.

Fourth selection: In the range surrounded by the solid-lines in Table 16.5

(4) Rigidity of the ball screw system

Set the lost motion of the ball screw system (screw shaft, nut and support bearing) at 80% of the specified value. Then calculate the system rigidity. The lost motion is:

20 (μm) × 0.8 = 16 (μm)

At this time, the single-direction elastic deformation ΔL of the major factors of ball screw system becomes half.

$\Delta L \leq$ 8 (μm)

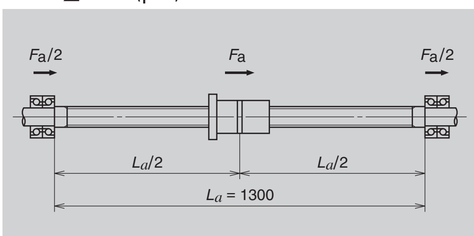


Fig. 16.3 Unsupported length

① Rigidity of the screw shaft K_S

Calculate at the screw shaft center where axial deformation becomes the largest. Because supporting condition of screw shaft is Fixed - Fixed support, from Formula (Ⅱ-21) on Page B62:

$$K_s = \frac{\pi \bullet d_r^2 \bullet E}{L_a} \times 10^{-3} \text{ (N/mm)}$$

Whereas E is Elastic Modules. From Formula (Ⅱ-17) on page B61, elastic deformation of the screw shaft $\varDelta L_S$ is

$$\varDelta L_s = \frac{F_a}{K_s} = \frac{F_a \bullet L_a}{\pi \bullet d_r^2 \bullet E} \times 10^3 \text{ (μm)}$$

F_a: Sliding resistance

$$F_a = \mu\ (m_1 + m_2) = 0.15 \times (1000 + 600)$$
$$= 2354 \text{ (N)}$$

Table 16.7 shows the rigidity of screw shaft K_S and the elastic deformation $\varDelta L_S$.

② Rigidity of the nut K_N

Set about 1/3 of the maximum axial load as the preload value.

$$F_{a0} = \frac{F_{max}}{3} = \frac{10354}{3} = 3452 \rightarrow 3500 \text{ (N)}$$

From Formula (Ⅱ-23) on Page B64:

Rigidity:

$$K_N = 0.8 \times K \left(\frac{F_{a0}}{\varepsilon \bullet C_a}\right)^{1/3} = 0.8 \times K \left(\frac{3500}{0.1 \bullet C_a}\right)^{1/3} \text{(N/μm)}$$

K: Theoretical rigidity

From Formula (Ⅱ-17) on page B62, elastic deformation of the ball nut $\varDelta L_N$ is

$$\varDelta L_N = \frac{F_a}{K_N} = \frac{2354}{K_N}$$

Table 16.7 shows the rigidity of nut K_N and the elastic deformation $\varDelta L_N$.

③ Rigidity of the support bearing K_B

The bearing is thrust angular contact ball bearing for ball screw support (TAC Series). Assume each shaft diameter is as shown in Table 16.6 (Refer to Page B457).

Table 16.6 Bearing code

Screw shaft diameter (mm)	Bearing code
32	25TAC62BDF
36	25TAC62BDF
40	30TAC62BDF
45	35TAC72BDF

Refer to Page B461 for rigidity K_B of each bearing (axial spring modulus). Elastic deformation of bearing $\varDelta L_B$ 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	1000	1.2	10.8
DFT3610-5	460	5.1	907	2.6			8.9
DFT4010-5	589	4.0	973	2.4	1030	1.1	7.5
DFT4510-5	772	3.0	1050	2.2	1180	1.0	6.2
DFT4510-7.5			1375	1.7			5.7

Choose the most economical ball screw which meets single direction deformation requirement $\varDelta L$ is 8 μm or less.

The selected ball screw:

Nut model code : DFT4010-5

Shaft diameter : 40 (mm)

Lead : 10 (mm)

Dynamic load rating : 52000 (N)

6. Decision of screw shaft length

Nut reference number DFT4010 has nut length 193 mm and unsupported length L_a is:

$$L_a = \text{Maximum stroke} + \text{nut length} + \text{margin}$$
$$= 1000 + 193 + 100 = 1293 \rightarrow 1300 \text{ mm}$$

7. Checking basic safety

(1) Permissible axial load

Calculate buckling load for conditions shown in Fig. 16.4 with P = 10354 (N) and L_1 = 1210 (mm)

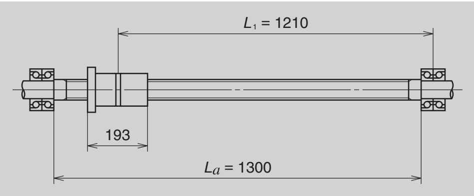


Fig. 16.4 Examination of bucking load

Supporting condition is Fixed - Fixed support, from buckling load calculation Formula (Ⅱ-2) on Page B48, screw shaft diameter d_r to prevent buckling

$$d_r \geq \left[\frac{P \bullet L_1^2}{m} \times 10^{-4}\right]^{1/4}$$

$$= \left[\frac{10354 \times 1210^2}{19.9} \times 10^{-4}\right]^{1/4} = 16.6 \text{ (mm)}$$

From DFT4010-5 specifications (page B493) shaft root diameter is d_r = 34.4 and meets requirement.

Result: Acceptable

(2) Permissible rotational speed

① Critical speed n

From critical speed calculation Formula (Ⅱ-7) on Page B51,

$$n = f \bullet \frac{d_r}{L_1^2} \times 10^7 = 21.9 \times \frac{34.4}{1210^2} \times 10^7$$

$$\fallingdotseq 5140$$

Maximum rotational speed N_{max} = 1500 min^{-1} is smaller than critical speed and meets requirement.

Result: Acceptable

② $d \bullet n$ value

$d \bullet n$ value is:

$$d \bullet n = 40 \times 1500 = 60000$$

From Table 3.2 on Page B54, d·n of tube type is 70000 or less and meets requirement.

Result: Acceptable

(3) Life L_t

Dynamic load rating C_a = 61200 N (See dimension table on page B493), and from Formulas (Ⅱ-8) and (Ⅱ-9) on Page B57,

$$L_t = \left(\frac{C_a}{f_w \bullet F_m}\right)^3 \times 10^6 \times \frac{1}{60 \bullet N_m}$$

$$\fallingdotseq 155000$$

and meets required life 20000 (h).

Result: Acceptable

8. Check whether the following factors satisfy requirements

(1) Checking accuracy

① Positioning accuracy

Positioning accuracy ±0.035/1000 mm, and therefore from "Table 1.2 Tolerance of specified travel and travel variation" on Page B42:

Accuracy grade : C3
e_p = ±0.029/1600 (mm)
υ_u = 0.018 (mm)

and meets required positioning accuracy.

② Measures against thermal expansion

Provide pre-tension force equivalent to the elongation of 3°C temperature rise, taking in consideration of the load carrying capacity of bearing. Also, adjust the travel compensation for the specified travel by a volume equivalent to 3°C temperature rise. (Refer to Page B44)

(a) Thermal elongation : ΔL_θ

From Formula (Ⅱ-1) on Page B44:

$$\Delta L_\theta = \rho \bullet \theta \bullet L_a = 12.0 \times 10^{-6} \times 3 \times 1300$$

$$= 0.047 \text{ (mm)}$$

(b) Pre-tension force : F_θ

$$F_\theta = \Delta L_\theta \bullet Ks = \frac{\Delta L_\theta \bullet E \bullet \pi \bullet d_r^2}{4L_a}$$

$$= \frac{0.047 \times 2.06 \times 10^5 \times \pi \times 34.4^2}{4L \times 1300}$$

$$\fallingdotseq 6922 \rightarrow 6900 \text{ (N)}$$

Travel compensation :	–0.047/1300 (mm)
Pre-tension force :	6900 (N)
Tension (elongation) volume :	0.047 (mm)

③ Selection of support bearing

Assuming that the ratio of basic dynamic load rating of support bearing (C_a) and pre-tension force (F_θ) is ε, select a bearing which generally satisfies:

$\varepsilon = F_\theta / C_B < 0.20$

Design the bearing supporting configuration to which pre-tension force is applied in such way that the axial load is received by the duplex combination or more. Please consult to NSK when one bearing must sustain the pre-tension load.

Table 16.8 Comparison of dynamic load rating and pre-tension force

Bearing reference number	C_B (N)	ε
30TAC62BDF	29200	0.23
30TAC62BDFD	47500	0.14

Selected support bearing: 30TAC62BDFD

(2) Checking drive torque of motor

Selection of driving motor

❬Required specifications❭

Motor rotational speed : 1500 min^{-1}

Time to reach maximum speed : Under 0.16 sec

(At time of rapid traverse)

① Load (converted to the motor load)

Calculate the moment of inertia of ball screw.

From Formulas (Ⅱ-32) and (Ⅱ-33) of Page B68, moment of inertia of ball screw parts J are calculated as follows, whereas γ is material density and ball screw shaft length L_o = 1550 mm

(Screw shaft)

$$J_B = \frac{\pi \bullet \gamma}{32} D^4 \bullet L_o = \frac{\pi \times 7.8 \times 10^{-3}}{32} \times 4^4 \times 155$$

$$= 30 \ (\mathrm{kg \cdot cm^2})$$

(Moving part)

$$J_w = m \times \left(\frac{l}{2\pi}\right)^2 = 1600 \times \left(\frac{1}{2\pi}\right)^2$$

$$= 40 \ (\mathrm{kg \cdot cm^2})$$

(Coupling)

$$J_c = 10 \ (\mathrm{kg \cdot cm^2}) \cdots \text{assumed}$$

(Total)

$$J_L = J_B + J_w + J_c = 30 + 40 + 10$$

$$= 80 \ (\mathrm{kg \cdot cm^2}) \rightarrow 80 \times 10^{-4} \ (\mathrm{kg \cdot m^2})$$

② Driving torque

Necessary torque to drive a ball screw resisting to external loads T_1 can be obtained by Formula (Ⅱ-29) on Page 66:

$$T_1 = T_A + T_P + T_U$$

In this formula, T_A is drive torque at constant speed, T_P is dynamic friction torque, and, T_U is friction torque of the support bearing. From Formula (Ⅱ-26) on page B66 and Formula (Ⅱ-27) on B67, T_A and T_P are:

$$T_A = \frac{Fa \bullet l}{2\pi \eta_1}$$

$$T_P = 0.014 F_{a0} \sqrt{\mathrm{d_m} \bullet l}$$

$$\eta_1 = 0.9$$

Refer to the starting torque value in Table 2.7 on Page B461:

T_U is:

$$T_U = 33 + 33 = 66 \ (\mathrm{N \cdot cm})$$

So, the required drive torque during rapid traverse and heavy cutting T_{11} and T_{13} are:

(At time of rapid traverse)

$$T_{11} = T_{A1} + T_{P1} + T_{U1}$$

$$= \frac{2354 \times 1}{2\pi \times 0.9} + 0.014 \times 3500 \sqrt{4.1 \times 1} + 66$$

$$= 580 \ (\mathrm{N \cdot cm}) \rightarrow 580 \times 10^{-2} \ (\mathrm{N \cdot m})$$

(At time of heavy cutting)

$$T_{12} = T_{A2} + T_{P2} + T_{U2}$$

$$= \frac{10354 \times 1}{2\pi \times 0.9} + 0.014 \times 3500 \sqrt{4.1 \times 1} + 66$$

$$= 1995 \ (\mathrm{N \cdot cm}) \rightarrow 1995 \times 10^{-2} \ (\mathrm{N \cdot m})$$

③ Selection of the motor

❬Selection conditions❭

Maximum rotational speed : $N_M \geq 1500$ (min^{-1})

Motor rating torque : $T_M > T_1$ (N · m)

Motor's rotor inertia : $J_M > J_L / 3$ (kg · m^2)

Based on this, select AC servo motor as below.

B 96

Motor specifications		
Rating power output:	W_M	$= 1.8$ (kW)
Maximum rotational speed:		
	N_M	$= 1500$ (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 time to reach maximum speed:
Required time to reach rapid traverse speed can be calculated as follows, whereas $T_M' = 2 \times T_M$

$$t_a = \frac{(J_L + J_M) \times 2\pi \times N}{(T_M' - T_1) \times 60} \times 1.4$$

$$= \frac{(80 \times 10^{-4} + 190 \times 10^{-4}) \times 2\pi \times 1500}{(2 \times 22.5 - 580 \times 10^{-2}) \times 60} \times 1.4$$

$$= 0.15 \text{ (sec)}$$

and meets requirement 0.16 sec or less.

[Drill 3] Cartesian type robot Z axis (vertical axis)

1. Design conditions

Mass of the traveling item : m = 300 kg
Maximum travel : S_{max} = 1500 mm
Rapid traverse speed : V_{max} = 10000 mm/min
Repeatability : 0.3 mm
Required life : L_t = 24000 h
($16^{hours} \times 300^{days} \times 5^{years}$)
Screw shaft supporting condition :
Fixed -- Simple support
Nut: Flanged single nut
Guide way (rolling) : μ = 0.01 (friction coefficient)
Drive motor : AC servo motor (N_{max} = 1000 min^{-1})
Environment : Slightly dusty

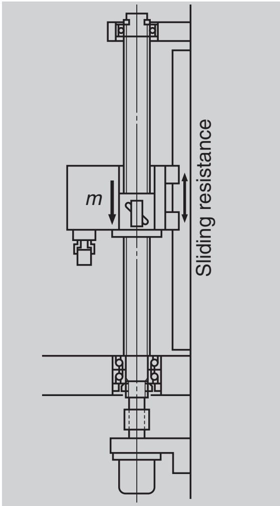


Fig. 16.5 System appearance

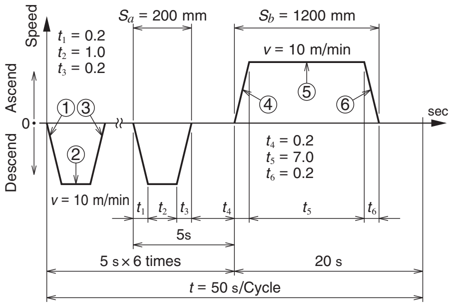


Fig. 16.6 Operating condition

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, possibility is to use ball screw for transfer equipment R series, because the required repeatability is 0.3 mm that is not very high.

(2) Selection of lead

From the maximum rotational speed of AC motor:

$$l \geq \frac{V_{max}}{N_{max}} = \frac{10000}{1000} = 10 \text{ (mm)}$$

Select a lead 10 mm or over.

(3) Selection of screw shaft diameter

According to "Table 4.5 Shaft diameter, lead and standard screw length of R Series" on Page B22, the shaft diameters whose lead is 10 mm or over are in the range of 12 mm to 50 mm.

(4) Selection of stroke

From Table 4.5 Screw shaft diameter, lead and standard screw shaft length of R series on page B22, it is possible to select from R series because diameter d = 15 to 50 mm and lead l = 10 mm will meet the required maximum stroke 1500 mm.

Primary selection : R Series ball screw for transfer equipment		
	Screw shaft diameter :	15 – 50(mm)
	Lead :	10(mm)
	Stroke :	1500(mm)

3. Confirmation of standard ball screw

Select from Flanged single nuts of R Series ball screw for transfer equipment.

Second selection : R Series ball screw for transfer equipment		
	Screw shaft diameter :	16, 20, 25, 32, 36 40, 45, 50 (mm)
	Lead :	10 (mm)
	Stroke :	1500 (mm)

4. Decision of screw length

Screw length L_o is:

L_o = Stroke + nut length + margin + shaft end length

= 1500 + 100 + 100 + 200 = 1900 (mm)

Normally, $L_o/d \le 70$ is recommended.

Therefore, screw shaft diameter d is:

$$d \ge \frac{L_s}{70} = \frac{1900}{70} = 27.1 \text{ (mm)}$$

Third selection : R Series ball screw for transfer equipment		
	Shaft diameter:	32, 36, 40, 45, 50 (mm)
	Lead:	10 (mm)
	Stroke:	1500 (mm)

5. Checking basic safety

(1) Allowable axial load

①Calculation of allowable axial load

Accelerating/decelerating time is:

$$\alpha = \frac{V}{60\,t} = \frac{10 \times 10^3}{60 \times 0.2} = 833 \text{ (mm/s}^2\text{)}$$

$$= 0.833 \text{ (m/s}^2\text{)}$$

$$t = t_1 = t_3 = t_4 = t_6$$

①, ⑥ ······$F_1 = mg - m\alpha$

$= 300 \times 9.80665 - 300 \times 0.833$

$= 2690$ (N)

②, ⑤ ······$F_2 = mg = 2940$ (N)

③, ④ ······$F_3 = mg + m\alpha = 3190$ (N)

②Buckling load

For condition in Fig. 16.7, use values below.

P = 3190 N, L_1 = 1600 mm

Bearing supporting condition is common Fixed -- Simple support.

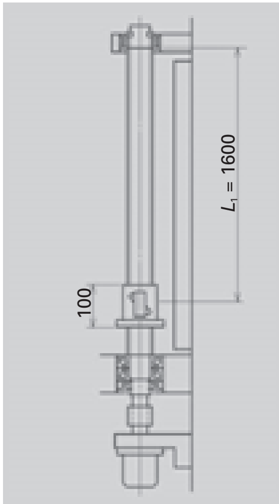


Fig. 16.7 Checking the buckling load

From Formula (Ⅱ-2) on Page B48:

$$d_r \ge \left(\frac{P \bullet L_1^2}{m} \times 10^{-4}\right)^{1/4}$$

$$= \left(\frac{3190 \times 1600^2}{10.0} \times 10^{-4}\right)^{1/4} = 16.8 \text{ (mm)}$$

(2) Checking permissible rotational speed

① Critical speed

Use values below.

n = 1000 (min^{-1}), L_1 = 1600 (mm)

From Formula (Ⅱ-7) on Page B51:

$$d_r \ge \frac{n \bullet L_1^2}{f} \times 10^{-7} = \frac{1000 \times 1600^2}{15.1} \times 10^{-7}$$

$$= 17 \text{ (mm)}$$

② $d \cdot n$ value

From Table 3.2 on Page B54:

$$d \leq \frac{50000}{n} = \frac{50000}{1000}$$

$$= 50 \text{ (mm)}$$

∗ Please consult NSK if d • n > 50000 is required.

(4) Checking life (dynamic load rating)

Determine required load carrying capacity from load conditions of Table 16.9.

Table 16.9 Load conditions

Operating condition	Axial load (N)	Rotational speed (mean) (min^{-1})	Use time (s)
①$_{\times 6}$⑥	$F_1 = 2690$	$N_1 = 500$	$t_a = 1.4$
②$_{\times 6}$⑤	$F_2 = 2940$	$N_2 = 1000$	$t_b = 13.0$
③$_{\times 6}$④	$F_3 = 3190$	$N_3 = 500$	$t_c = 1.4$

Calculate mean load F_m and mean rotational speed N_m from Formulas (Ⅱ-11) and (Ⅱ-12) on Page B57:

Required load carrying capacity is:

$$F_m = \left(\frac{F_1^3 \cdot N_1 \cdot t_a + F_2^3 \cdot N_2 \cdot t_b + F_3^3 \cdot N_3 \cdot t_c}{N_1 \cdot t_a + N_2 \cdot t_b + N_3 \cdot t_c} \right)^{1/3}$$

$$= 2940 \text{ (N)}$$

$$N_m = \frac{N_1 \cdot t_a + N_2 \cdot t_b + N_3 \cdot t_c}{t}$$

$$= 288 \text{ (min}^{-1}\text{)}$$

From Formulas (Ⅱ-8) and (Ⅱ-9) on Page B57:

$$C_a \geq (60 N_m \cdot L_t)^{1/3} \cdot F_m \cdot f_w \times 10^{-2} \ (N)$$

$$= (60 \times 288 \times 24000)^{1/3} \times 2940 \times 1.2 \times 10^{-2}$$

$$= 26300 \text{ (N)}$$

(5) Checking static load rating

$$C_{0a} = F_{max} \times f_s = 3190 \times 2$$

$$= 6380 \text{ (N)}$$

In consideration of expense:

Fourth selection : R Series ball screw for transfer equipment

Shaft diameter :	32 (mm)
Lead :	10 (mm)
Stroke :	
Turns of balls and circuit number :	2.5 × 2
Screw length :	2000 (mm)
Basic dynamic load rating :	42000 (N)

6. Selection of nut

Select a "standard nut with a flange and a seal (Brush-seals contained inside)" based on the necessity as well as on the environmental conditions.

Selected ball screw:

Nut assembly	RNFTL3210A5S
Screw shaft	RS3210A20

B-2-17 Reference

"NSK Motion & Control (technical journal)" was compiled to introduce NSK products and its technologies. You will find data summaries which are imperative in selecting ball screws in this catalog. If you need detailed technical data, other than described in this catalog, please refer to "NSK Motion & Control" technical journal.

For inquiries and orders, please contact NSK branch offices, sales offices, and representatives assigned at various locations.

Table 17.1 NSK Motion & Control (technical journal) : Issues relating to ball screws (1980-)

No.	Issued Date	Title
No.4	Jun. 1998	Recent Technical Trends in Ball Screws
No.8	May. 2000	Ball Screw with Rotating Nut and Vibration Damper
No.9	Oct. 2000	WFA Standard-Stock Ball Screws
No.10	Apr. 2001	High Performance Seals for Ball Screws
No.11	Oct. 2001	Development of NSK S1 Series Ball Screws and Linear Guides
No.11	Oct. 2001	Low Inertia Series of Nut Rotatable Ball Screws
No.13	Oct. 2002	Development of HTF Series Ball Screws for High Load Drive Application
No.13	Oct. 2002	High Lead Precision Rolled Ball Screws
No.14	May. 2003	High Speed and Low Noise Ball Screws HMC-B02 Series
No.15	Dec. 2003	Clean Support Units for Ball Screws
No.16	Aug. 2004	Development of High Speed and Low Noise Ball Screws
No.18	Aug. 2005	S3 Ball Screws: Super Low Noise Ball Screws for Automation Equipment
No.19	Sep. 2006	High-Speed and Low-Noise Ball Screw for Standard Stock - Compact FA Series

B-2-18 Guide to Technical Services

(1) CAD data

■Web page

http://www.jp.nsk.com/app01/en/catalog/

■CD-ROM

Catalog No.7110 (CD-ROM) contains precision machine components and rolling bearings.

(2) Telephone consultation with NSK engineers

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

(3) Additional machining (processing) some part of standard ball screws in stock

NSK processes standard ball screw blank shaft end. NSK also cuts linear guide rails to required length for you. Service is available at NSK processing factories throughout the world. Requests are taken by branch offices and agencies.

B-2-19 Precautions When Handling Ball Screws

Ball screws are precision products. They require careful handling as described below.

Confirm lubrication

Lubrication

(1) Confirm the state of lubrication before use. Insufficient lubrication causes loss of ball screw functions in a short period.

(2) Use without lubrication if grease is already applied to the ball screws. Remove dust or swarf if they stuck to the greased surface during handling. Wipe with clean white kerosene, then apply the same type of new lubricant before use. Avoid using different types of grease at the same time.

Consult NSK for special oil lubricant if it is required to your application.

(3) Check lubricant after two to three months of operation. Wipe off grease if it is excessively contaminated, and apply sufficient volume of a fresh coat of grease. After the initial check, check and replenish lubricant approximately every year. Check more often if environment requires.

* Refer to Pages B71 and D13 for lubrication.

Do not disassemble

Do not reassemble

Watch out for falling objects

Handle with care

Do not apply shock

Handling

(1) Never disassemble ball screw. It invites dust to enter, and lowers precision, or may cause an accident.

(2) User should never reassemble ball screw by himself. Loss of ball screw function is apt to occur if a mistake is made. Please send ball screw to NSK for repair or re-assembly. It will be reworked at the minimum service charge.

(3) Ball screw shaft or nut may fall due to its own weight. Watch out for such falling object. If it falls, the ball groove or ball recirculation component may be damaged and the function might have been lost. Make certain to return such item to NSK for check. There will be the minimum charge for this service.

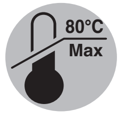
(4) If recirculation component, shaft outside, or ball groove is scratched or damaged by impact, recirculation operation becomes deficient, and may cause loss of function.

* Refer to Page B77 for assembling components.

Prevent dust

Rotational speed limitation

Do not overrun



Temperature limitation

Precautions in use

(1) Ball screws should be used in a clean environment. Use a dust cover to keep dust and swarf from entering into the system. Insufficient dust protection causes not only the ball screw function to deteriorate but also brings about damage to the recirculation components if dust plugs the system. This may result in more serious accident such as a fall of the table.

(2) For rotational speed in operation, refer to the applicable section in this catalogue which describes permissible rotational speeds, or to specification drawing furnished by NSK. Exceeding permissible rotational speed damages recirculation components, and may cause the table to fall. A precaution system such as a safety nut is recommended in vertical use of ball screw. Please consult NSK for safety system.

(3) Overrunning ball nut (removed from the ball thread) causes the balls to fall out, damages recirculation components, and dent ball groove, resulting in insufficient operation. Continued use under such conditions may cause premature wear, and damages recirculation components. For these reasons, avoid overrun by all means. If overrun occurs, please request NSK to check. There will be a minimum charge for this service.

(4) Ball screws are designed to be used at a temperature of less than 80°C. Do not operate at temperatures higher than this limit. Use at a higher temperature may damage recirculation and seal components. Please consult NSK if it is necessary to use at a temperature higher than the limit.

When using NSK K1 lubrication unit, the operating temperature should be 50°C or less. (Momentary maximum temperature in use: 80°C)

* Please read Page B84 before designing.

Store in the correct position

Storage

(1) Store in the original NSK package. Do not unwrap or tear the inner wrapping if it is not necessary. This allows dust to enter and rust to set in, and may deteriorate functions.

(2) The following position is recommended when storing ball screws.

① Keep in the NSK original package, and place it flat.

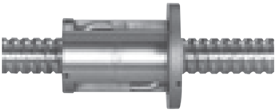
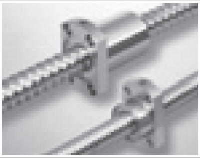
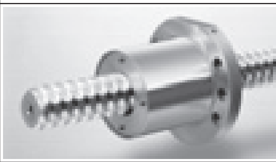
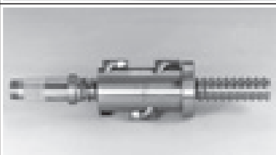
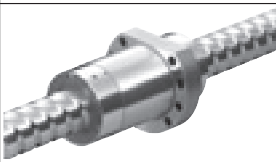
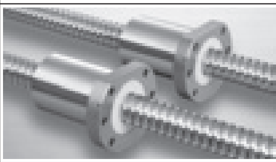
② Place flatly on supports; store in a clean area.

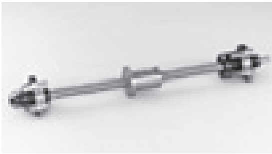
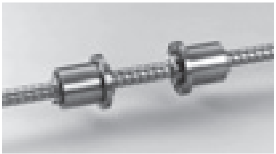
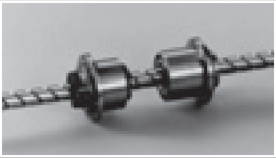
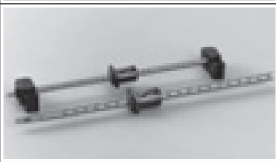
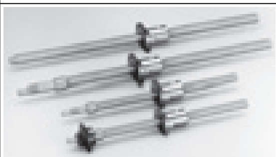
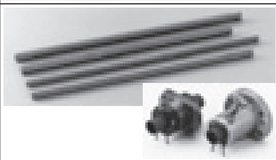
③ Hang vertically in a clean place.

B-3 Ball Screw Dimension Table

B-3-1 Dimension Table and Reference Number of Application-Oriented Ball Screws

◇Features and application examples of application-oriented ball screws

Application		Shape	Feature	Application	Page
High-Speed Machine Tools	HMD Type		High-speed operation: 64 to 120 m/min Rigidity: 5% greater than the HMC series. High-load carrying capacity: 7% greater than the HMC type New recirculation system reduces the noise level by 5 dB or more compared with the HMC type	High-speed machining center High-speed combined machine tools Die mold processing machine	B109
	HMC Type		High-speed: 40 to 120 m/min Rigidity: 30% greater than existing tube type ball screws High-Load carrying capacity: 14% greater than existing tube type ball screws Noise reduced by small-diameter balls	High-speed machining center High-speed combined machine tools Die mold processing machine	B113
Small Lathe	BSL Type		Compact nut: 50% less ball nut volume than NSK existing products. High-dust protection by thin plastic seal Special high-load capacity ball screw support bearings are available.	Small lathe Multi-axis lathe Small machining center	B119
High-Load Drive	HTF-SRC Type		High-load capacity High-speed operation by high-speed rotation: 930 mm/sec Even load distribution to balls in the ball nut for high-load drive Improved durability by NSK S1™	Injection axis of injection molding machine Servo press machine Press brake Bending machine	B123
	HTF-SRD Type		High-load capacity High-speed operation by large screw lead: 1600 mm/sec Improved durability by NSK S1™	Clamping axis of injection molding machine Die cast machine Punch press Lifting and lowering device	B127
	HTF Type		High-load capacity Even load distribution to the balls in a ball nut for high-load drive Improved durability by NSK S1™ Provide a wide range of screw diameter and lead combinations.	Injection molding machine Press machine Press fitting machine Lifting and lowering device	B131
For Contaminated Environment	VSS Type		High dust-resistant performance: Reduces particle penetration rate to less than 1/15 (compared with existing plastic seal). More than four times longer service life than existing plastic seal under contaminated environments.	Woodworking machine Laser cutting machine Graphite milling machine Tire molding machine Transfer equipment	B139
Twin-Drive System	TW Series		Controlled screw lead accuracy and variation of preload torque for twin drive. Improved axial rigidity, expected life and controllability by the paired up two ball-screw driving systems	Machining center Combined machine tools Large-size machine tools	B143

Application		Shape	Feature	Application	Page
For High-Precision Machine tools	Hollow Shaft Ball Screws		Suppress thermal deformation by cooling the shaft center Prevent the machine base from deforming due to thermal expansion. NSK special support units and seal units are available.	High-precision die processing machine High-precision combined machine tools High-precision machining center High-precision lathe	B144
Nut-Rotatable Ball Screws	NDT and NDD Type		Angular contact support bearings are integrated into the ball nut. Two or more ball nuts can be installed in a single ball screw shaft. The NDD type ball screws can surpass the critical speed. A special vibration damper enables long-stroke-high-speed operation.	Woodworking machine Laser cutting machine Electronic component mounting device Liquid crystal display transfer equipment Transfer equipment	B149
Robot	∑ Series		A ball screw and a ball spline are made in one shaft, combining a drive and guide system. A ball screw nut, a ball spline nut and support bearings are combined to the unit. Hollow shaft has an effect for weight saving. The hollow can be used for wiring and piping.	SCALA type robot Electronic-component mounting system	B157
Transfer Equipment	VFA Type		A finished shaft end can be combined with the support unit for immediate use. Flexible stroke as screw shaft outside is used for the simple support bearing seat. The high-helix leads for high-speed operation. The lead accuracy is made to JIS Ct7 grade.	Transfer equipment Actuators Packing/Packaging equipment	B169
	RMA and RMS Type		The RMA type has a finished shaft end. Shaft ends of the RMS type are unprocessed blank. These types can be combined with the NSK support kits for immediate use. JIS Ct7 grade miniature ball screws.	Semiconductor transfer equipment Test/Measuring equipment	B169
	R Series		A wide variety of screw diameters and screw leads combinations (128 combinations) Ball screw shafts and ball nut assemblies are in stock separately. Accuracy grade of JIS Ct10	Transfer equipment Actuators Robot Platform door system Injection molding machine	B169
Equipped with “NSK K1” Lubrication Unit			Long-term, maintenance-free operation Maintains lubrication efficiency for a prolonged time in contaminated environments Does not pollute the environment Made of compatible material with the FDA regulations is also available.	Automotive manufacturing machine Woodworking machine Laser cutting machine Semiconductor/Liquid crystal display manufacturing equipment Food processing/Medical equipment	B209

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B-3-1.1 HMD Type for High-Speed Machine Tools

This product is patented by NSK.

1. Features

● High speed

The permissible rotational speed (d·n value) has greatly increased to 160 000 compared with 135 000 of the HMC type.

● Low noise

Noise reduced by 5 dB or more compared with the HMC type ball screws for high-speed machine tools because of the end-deflector and middle-deflector systems.

● Nut mounting dimensions

The ball nut diameters are the same as those of the HMC type.

2. Specifications

(1) Recirculation system

Fig.1 shows the structure of the middle-deflector recirculation system of the HMC type.

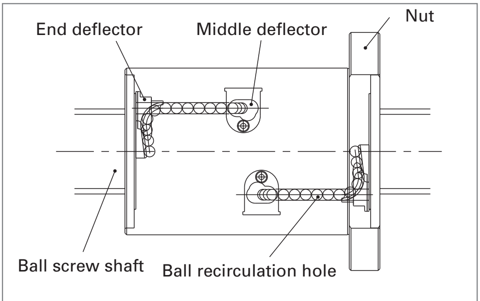


Fig. 1 Structure of middle-deflector recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	C3, C5
Axial play	0 mm (Preloaded product)

(3) Allowable d·n value and the criterion of maximum rotational speed

Allowable d·n value and the criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Allowable d·n value: 160 000 or less

Criterion of maximum rotational speed

: 4 000 min^{-1}

Note: Please also review the critical speed. See "Technical Description: Permissible rotational speed" (Page B51) for details.

(4) Options

● For twin-drive systems (Refer to page B143)

Upon request, the variations in lead accuracy and preload torque between two ball screws of a pair of the TW series are controlled for the further improvement of the reliability.

● Hollow shaft ball screw (Refer to page B144)

The temperature rise and measures against thermal expansion of ball screw driving mechanism are the most challenging for high-speed machine tools. For the HMD type ball screws, we recommend to utilize the hollow for forced cooling system.

(5) Seal

Compact, thin plastic seal is available. Nut outside diameter is compact compare with the return tube recirculation system.

3. Design precautions

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B103).

4. Product categories

The HMD type has a model as follows.

Table 2 HMD type product categories

Nut models	Shape	Flange shape	Nut shape	Preload system
EM		Flanged Circular Ⅱ	Circular	Z Preload (medium preload)

5. Example of model number in dimension tables

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇Model number

EM 40 20 - 6E

- Nut model : EM
- Screw shaft diameter (mm)
- Lead (mm)
- Effective turns of balls

◇Reference number for ball screw

W 40 07 - ** Z M X T - C5 Z 20

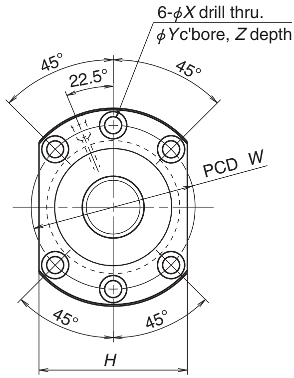
- Product code
- Screw shaft diameter (mm)
- Effective threaded length (in the unit of 100 mm)
- NSK design serial number
- Preload code: Z; Z preload
- Middle-deflector recirculation system
- Ball screw specification/appearance
- Hollow shaft specification
- Accuracy grade: C3 or C5
- Axial play code: Z
- Lead (mm)

6. Handling Precautions

Maximum operating temperature: 80°C

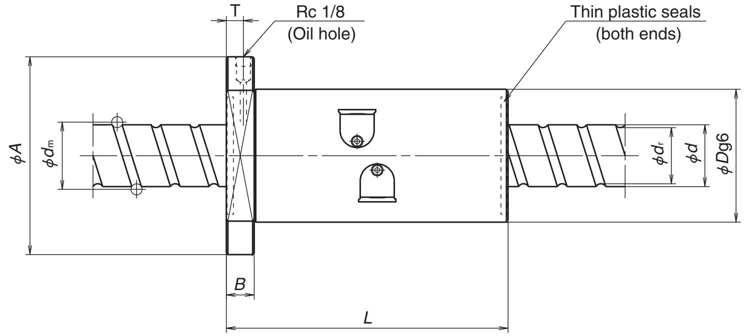
If using NSK K1, operating temperature should not exceed 50°C. Refer to "Designing Precautions" (Page B84).

HMD Type for high-speed machine tools



Model No.	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Basic load rating(N) Dynamic C_a	Basic load rating(N) Static C_{0a}	Axial rigidity K (N/μm)
EM4016-4E	40	16	7.144	41.5	34.1	66900	131000	1020
EM4020-6E		20	6.350	41	34.4	77900	166000	1340
EM4025-6E		25	7.144	41.5	34.1	91300	191000	1370
EM4030-6E		30	7.144	41.5	34.1	90400	190000	1350
EM4516-4E	45	16	7.144	46.5	39.1	69900	146000	1060
EM4520-6E		20	6.350	46	39.4	83200	187000	1470
EM4525-6E		25	7.144	46.5	39.1	95700	214000	1510
EM5016-4E	50	16	7.144	51.5	44.1	72700	161000	1150
EM5020-6E		20	6.350	51	44.4	85700	205000	1600
EM5025-6E		25	7.144	51.5	44.1	103000	232000	1620
EM5030-6E		30	7.144	51.5	44.1	102000	235000	1630
EM6316-4E	63	16	9.525	65	55.2	131000	338000	1600

Remarks 1. The right turn screw is standard. Please consult NSK for left turn screw.
2. Rigidity listed under the K column is when a 5% dynamic load rating is applied as preload.



Unit: mm

Nut length	Ball nut dimensions									Max. feeding speed
	Nut dia.	Flange dia.	Flange width	Flange size	Bolt hole size			Bolt hole PCD	Oil hole position	
L	*D*	*A*	*B*	*H*	*X*	*Y*	*Z*	*W*	*T*	(m/min)
160	86	128	18	96	11	17.5	11	106	11	64
150										80
182										100
213										120
160	92	134	18	102	11	17.5	11	112	11	56
150										70
182										88
160	98	140	18	107	11	17.5	11	118	11	51
150										64
182										80
213										96
170	122	180	28	138	18	26	17.5	150	14	40

B-3-1.2 HMC Type for High-Speed Machine Tools

This product is patented by NSK.

1. Features

● High-speed traveling

High helix leads of 16 mm to 36 mm are used. Furthermore, the ball recirculation return tube is reinforced to make a high-speed traveling of 40 to 120 m/min. possible.

● High rigidity, high load carrying capacity

Double start thread increases the number of effective turns of balls, and a smaller ball size increases the number of the balls. Together they contribute to have high rigidity and high load carrying capacity, despite the high helix lead.

● Compact nut

The size of nut diameter and length were reduced.

Comparison with current products -- about 50% reduction in volume.

2. Specifications

(1) Recirculation System

The ball recirculation circuits and grooves are suited for high-speed operation. Structure of recirculation system is shown in Fig. 1.

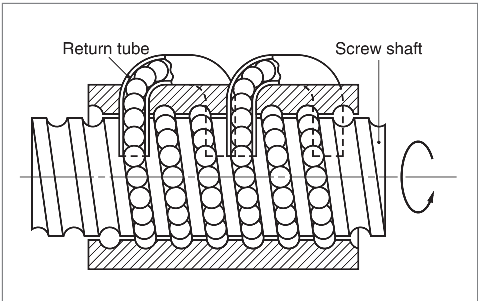


Fig. 1 Structure of return tube recirculation system

(2) Accuracy grades and axial play

Standard accuracy grades and axial play are shown in Table 1. Please consult NSK for other grade.

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 (Refer to page B143)

Upon request, the variations in lead accuracy and preload torque between two ball screws of a pair of the TW series are controlled for the further improvement of the reliability.

● Hollow shaft ball screw specifications

The temperature rise and measures against thermal expansion of ball screw driving mechanism are the most challenging for high-speed machine tools. For the HMD type ball screws, we recommend to utilize the hollow for forced cooling system.

● Vertical axis type

For the vertical axis ball screw, which head load is constantly applied, a high load capacity ball screw is required. A high load capacity type with compact design is available for the nut model Ⅰ and Ⅱ in the dimension table. For details, please consult NSK.

(4) Allowable d·n value and the criterion of maximum rotational speed

Allowable d·n value and the criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Allowable d•n value: HZC, HDC; 100000 or less
HZF, HDF; 135000 or less

Criterion of maximum rotational speed: 3750 min^{-1}

Note: Please also review the critical speed. See "Technical Description: Permissible rotational speed" (Page B51) for details.

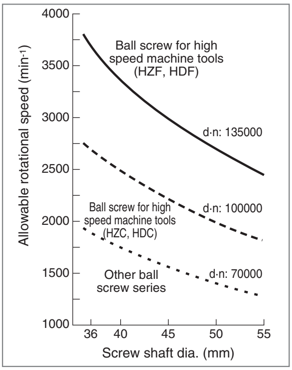


Fig. 2 Comparison of permissible rotational speed

(5) Other specifications

For other specifications not listed in the dimension tables such as high-speed, high-load capacity, and NSK K1 installed type, please consult NSK.

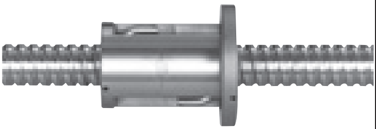
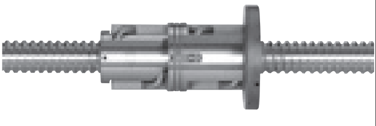
3. Design precautions

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B103).

4. Product categories

HMC type has two different preload systems with several models (Table 2).

Table 2 HMC type product categories

Nut models	Shape	Flange shape	Preload system
HZC HZF		Flanged Circular I	Z preload (medium preload)
HDC HDF		Flanged Circular I	D preload (medium preload)

7. Example of model number in dimension tables

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇Model number

HZF 36 16 - 5

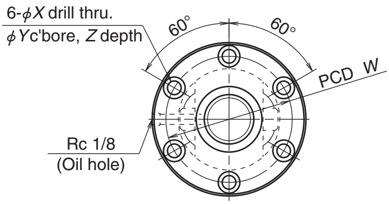
- HZF: Nut model
- 36: Screw shaft diameter (mm)
- 16: Lead (mm)
- 5: Effective turns of balls

◇Reference number for ball screw

W 36 05 - ** Z X T - C5 Z 16

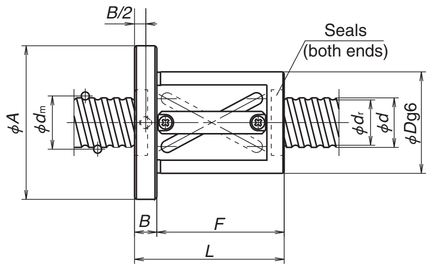
- W: Product code
- 36: Screw shaft diameter (mm)
- 05: Effective threaded length (in the unit of 100 mm)
- **: Design serial number
- Z: Preload code : Z, Z preload; D, D preload
- X: Appearance/specification code
- T: Hollow shaft ball screw
- C5: Accuracy grade: C3, C5
- Z: Axial play code: Z
- 16: Lead (mm)

HMC Type for high-speed machine tools

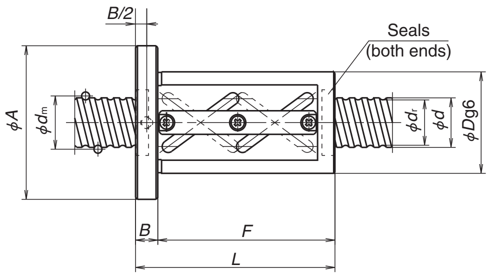


Model No.	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls	Nut model	Basic load rating (N) Dynamic C_a	Basic load rating (N) Static C_{0a}	Axial rigidity K (N/μm) 5% C_a	Axial rigidity K (N/μm) 10% C_a
HZF3616-5 **HZC3616-5**	36	16	4.7625	36.5	31.7	5	Ⅱ	47000	102000	1130	1420
HZF3620-3.5 **HZC3620-3.5**		20	6.35	37	30.6	3.5	Ⅰ	51100	98600	830	1050
HZF4016-5 **HZC4016-5**	40	16	4.7625	40.5	35.7	5	Ⅱ	49500	113000	1230	1550
HZF4020-3.5 **HZC4020-3.5**		20	6.35	41	34.6	3.5	Ⅰ	53600	107000	900	1130
HZF4020-5 **HZC4020-5**			6.35	41	34.6	5	Ⅱ	72900	154000	1260	1590
HZF4516-5	45	16	4.7625	45.5	40.7	5	Ⅱ	51400	126000	1340	1690
HZF4516-7.5						7.5		72800	189000	1960	2470
HZF4520-3.5 **HZC4520-3.5**		20	6.35	46	39.6	3.5	Ⅰ	57300	121000	990	1240
HZF4520-5 **HZC4520-5**			6.35	46	39.6	5	Ⅱ	77900	172000	1380	1740
HZF4525-3.5 **HZC4525-3.5**		25	7.1438	46.5	39.3	3.5	Ⅰ	65900	137000	1010	1280
HZF5020-3.5 **HZC5020-3.5**	50	20	6.35	51	44.6	3.5	Ⅰ	59000	132000	1080	1360
HZF5020-5 **HZC5020-5**			6.35	51	44.6	5	Ⅱ	80200	189000	1520	1910
HZF5025-3.5 **HZC5025-3.5**		25	7.1438	51.5	44.3	3.5	Ⅰ	70700	152000	1100	1390
HZF5025-5 **HZC5025-5**			7.1438	51.5	44.3	5	Ⅱ	96100	217000	1540	1940
HZF5030-3.5 **HZC5030-3.5**		30	7.1438	51.5	44.3	3.5	Ⅰ	70200	152000	1100	1390
HZF5520-3.5	55	20	6.35	56	49.6	3.5	Ⅰ	62100	146000	1150	1450
HZF5520-5			6.35	56	49.6	5	Ⅱ	84300	207000	1630	2050
HZF5525-3.5		25	7.1438	56.5	49.3	3.5	Ⅰ	73100	165000	1190	1560
HZF5525-5			7.1438	56.5	49.3	5	Ⅱ	99300	236000	1680	2120
HZF5530-3.5		30	7.1438	56.5	49.3	3.5	Ⅰ	72700	167000	1190	1560

Remarks 1. Ball screws of 32 or 36 mm lead have triple start threads. Others have double start threads.
2. Rigidity listed under the 5%Ca column is when a 5% dynamic load rating is applied as preload. Similarly, those listed under the 10%Ca column means a 10% dynamic load rating is applied.



Nut model I (Offset preload)

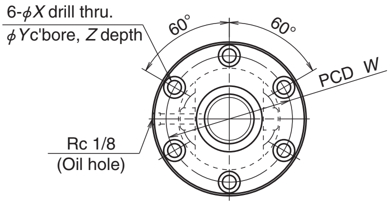


Nut model II (Offset preload)

Unit: mm

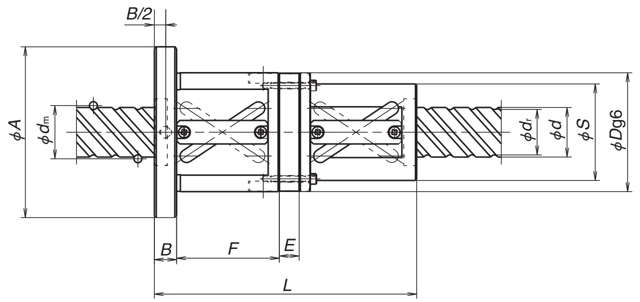
Ball nut dimensions									Max. feeding speed (m/min)
Nut entire length. *L*	Nut dia. *D*	Flange dia. *A*	Flange width *B*	Nut length *F*	Bolt hole demensions *X*	*Y*	*Z*	Bolt hole PCD *W*	
134	78 71	120 113	18	116	11	17.5	11	98 91	60 44
121	94 78	136 120	18	103	11	17.5	11	114 98	75 56
134	79 76	121 118	18	116	11	17.5	11	99 96	54 40
121	96 82	138 124	18	103	11	17.5	11	116 102	67 50
161	96 82	138 124	18	143	11	17.5	11	116 102	67 50
134	82	124	18	116	11	17.5	11	102	48
187	82	128	22	165	14	20	13	104	48
122	98 88	140 130	18	104	11	17.5	11	118 108	60 44
162	98 88	140 130	18	144	11	17.5	11	118 108	60 44
141	101 92	143 134	18	123	11	17.5	11	121 112	75 56
122	101 95	143 137	18	104	11	17.5	11	121 115	54 40
162	101 95	143 137	18	144	11	17.5	11	121 115	54 40
141	103 98	145 140	18	123	11	17.5	11	123 118	67 50
191	103 98	145 140	18	173	11	17.5	11	123 118	67 50
159	103 98	145 140	18	141	11	17.5	11	123 118	81 60
122	103	145	18	104	11	17.5	11	123	49
162	103	145	18	144	11	17.5	11	123	49
141	105	147	18	123	11	17.5	11	125	61
191	105	147	18	173	11	17.5	11	125	61
159	105	147	18	141	11	17.5	11	125	73

HMC Type for high-speed machine tools



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) Dynamic C_a	Basic load rating (N) Static C_{0a}	Axial rigidity K (N/μm) 5% C_a	Axial rigidity K (N/μm) 10% C_a
HDF3620-5 **HDC3620-5**	36	20	6.35	37	30.6	5	Ⅲ	69400	139000	1160	1460
HDF4025-5 **HDC4025-5**	40	25	7.1438	41.5	34.3	5	Ⅲ	85500	176000	1320	1660
HDF4030-5 **HDC4030-5**		30	7.1438	41.5	34.3	5	Ⅲ	84600	175000	1320	1660
HDF4032-7.5 **HDC4032-7.5**		32	6.35	41	34.6	7.5	Ⅲ	104000	232000	1920	2420
HDF4036-4.5		36	6.35	41	34.6	4.5	Ⅲ	66500	137000	1170	1480
HDF4525-5 **HDC4525-5**	45	25	7.1438	46.5	39.3	5	Ⅲ	89600	195000	1430	1800
HDF4530-5 **HDC4530-5**		30	7.1438	46.5	39.3	5	Ⅲ	91800	197000	1430	1800
HDF4532-7.5 **HDC4532-7.5**		32	6.35	46	39.6	7.5	Ⅲ	108000	259000	2090	2630
HDF4536-4.5		36	6.35	46	39.6	4.5	Ⅲ	69200	155000	1280	1620
HDF5030-5 **HDC5030-5**	50	30	7.1438	51.5	44.3	5	Ⅲ	95500	216000	1540	1940
HDF5032-7.5 **HDC5032-7.5**		32	6.35	51	44.6	7.5	Ⅲ	112000	285000	2270	2860
HDF5530-5	55	30	7.1438	56.5	49.3	5	Ⅲ	98700	235000	1680	2120
HDF5532-7.5		32	6.35	56	49.6	7.5	Ⅲ	118000	312000	2420	3050

Remarks 1. Ball screws of 32 or 36 mm lead have triple start threads. Others have double start threads.
2. Rigidity listed under the 5%Ca column is when a 5% dynamic load rating is applied as preload. Similarly, those listed under the 10%Ca column means a 10% dynamic load rating is applied.



Nut model Ⅲ (Double nut spacer, preload)
(the figure indicates use of double start threads)

Unit: mm

Ball nut dimensions											Max. feeding speed (m/min)
Nut entire length. *L*	Nut dia. *D*	*S*	Flange dia. *A*	Flange width *B*	Nut length *F*	Spacer dimensions *E*	Bolt hole size *X*	*Y*	*Z*	Bolt hele PCD *W*	
191	94	76	136	18	77	5	11	17.5	11	114	75
	78	60	120							98	56
228.5	98	80	140	18	91	13.5	11	17.5	11	118	84
	86	68	128							106	63
248	98	80	140	18	104	8	11	17.5	11	118	101
	86	68	128							106	75
265	96	78	142	22	109	11	14	20	13	118	108
	82	64	128							106	80
200	96	78	138	18	83	4	11	17.5	11	116	120
228.5	101	83	143	18	91	13.5	11	17.5	11	121	75
	92	74	134							112	56
248	101	83	143	18	104	8	11	17.5	11	121	90
	92	74	134							112	67
266	98	80	144	22	109	11	14	20	13	120	96
	88	70	134							110	71
200	98	80	140	18	83	4	11	17.5	11	118	108
249	103	85	145	18	104	8	11	17.5	11	123	81
	98	80	140							118	60
266	101	83	147	22	109	11	14	20	13	123	86
	95	77	141							117	64
249	105	87	147	18	104	8	11	17.5	11	125	73
266	103	85	149	22	109	11	14	20	13	125	78

B-3-1.3 BSL Type for Miniature Lathe

1. Features

● Prompt delivery

Screw shaft configuration and ball nut shape are standardized for prompt delivery.

● High speed and low noise

Adoption of end-deflector recirculation system realized high-speed operation with low noise.

● Excellent dust resistance

Thin plastic seal and specially designed ball grooves prevent the entry of foreign matters.

2. Specifications

(1) Recirculation system

End-deflector recirculation system has features of high-speed operation with low-noise, and compact ball nut. The structure of recirculation system is shown in Fig.1.

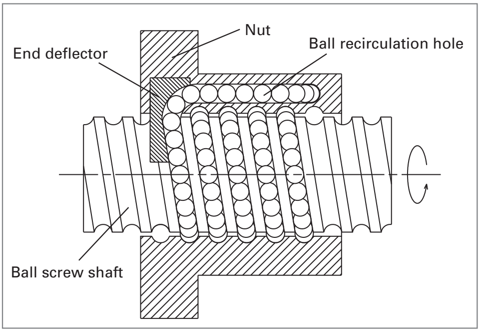


Fig. 1 Structure of end-deflector recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	C5
Axial play	0 mm (Preloaded product)

(3) Allowable d·n value and the criterion of maximum rotational speed

Allowable d·n value and the criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Allowable d·n value: 180 000 or less

Criterion of maximum rotational speed

: 4 000 min^{-1}

Note: Please also review the critical speed. See "Technical Description: Permissible rotational speed" (Page B51) for details.

(4) Options

Optional NSK K1 lubrication unit, molded from resin and impregnated with lubrication oil, supplies fresh oil onto ball rolling surface, ensuring long-term, maintenance-free operation. Please consult NSK when using NSK K1.

3. Design Precautions

When designing the screw shaft end, one end of the screw must meet either one of the following conditions. If not, we cannot install the ball nut on the screw shaft.

- Cut the ball groove through to the shaft end.
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove "dr" specified on the dimension table.

Special bearings which have higher-load carrying capacity are available.

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B103).

4. Product categories

The BSL type has a model as follows.

Table 2 BSL type product categories

Nut models	Shape	Flange shape	Preload system
BSL		Circular Ⅲ	P Preload (Slight preload)

5. Example of model number in dimension table

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇Model number

BSL 20 05

- BSL: Nut model : BSL
- 20: Screw shaft diameter (mm)
- 05: Lead (mm)

◇Reference number for ball screw

W 20 05 - ** P SS - C5 Z 5

- W: Product code
- 20: Screw shaft diameter (mm)
- 05: Effective threaded length (in the unit of 100 mm)
- **: NSK design serial number
- P: Preload code: P; P preload
- SS: Middle-deflector recirculation system
- C5: Accuracy grade: C5
- Z: Axial play code: Z
- 5: Lead (mm)

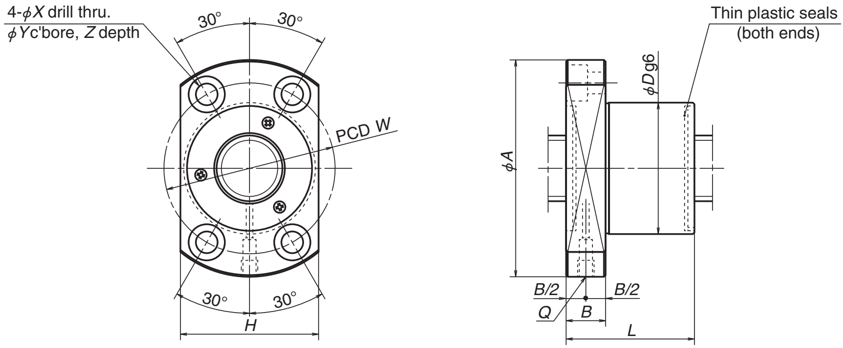
6. Handling Precautions

Maximum operating temperature: 80°C

If using NSK K1, operating temperature should not exceed 50°C. Refer to "Designing Precautions" (Page B84).

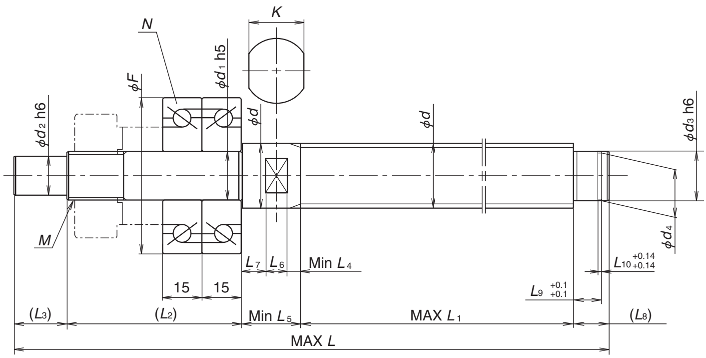
B
120

BSL™ Type for small lathe



Model No.	Main factor							Ball nut dimensions										
	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Basic load rating (N)		External dimensions					Bolt hole dimensions				Oil hole	
						Dynamic	Static											
	d	l	D_w	d_m	d_r	C_a	C_{0a}	D	A	H	B	L	W	X	Y	Z	Q	d_1
BSL2005	20	5	3.175	20.5	17.2	10500	16200	36	63	38	12	37	49	6.6	11	6.5	M6×1.0	15
BSL2006		6	3.9688	20.5	16.4	14000	20000	40	65	42		45	51					
BSL2505	25	5	3.175	25.5	22.2	11700	20400	40	65	42	12	38	51	6.6	11	6.5	M6×1.0	20
BSL2506		6	3.9688	25.5	21.4	15700	25400	43	69	45		44	55					
BSL2508		8	4.7625	25.5	20.5	20100	29900	46	72	48		55	58					
BSL2510		10	4.7625	25.5	20.5	20000	29800	46	72	48		65	58					
BSL3210	32	10	6.35	33	26.4	32500	51800	61	93	63	18	68	76	9	14	8.5	M6×1.0	25
BSL3212		12	6.35	33	26.4	32400	51600					77						

Remarks 1. The right turn screw is standard. Please consult NSK for left turn screw.
2. Shaft dimensions are for reference. Shaft length L_1 and shaft entire length L are the maximum length.



Unit: mm

Shaft configuration and dimensions (reference)																			
Shaft dimension																Exclusive bearing N		Basic dynamic load rating	Permissible axial load
d_2	d_3	d_4	L	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}	K	M	Bearing reference number	F	C_a	(N)
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	21900	26600
							4	21											
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	28500	40500
							4	28											
							5	29											
							5	29											
20	25	$23.9^{0}_{-0.21}$	1000	800	71	33	6	33	12	15	20	16.35	1.35	27	M25×1.5	25TAC62B	62	28500	40500
							7	34											

B-3-1.4.1 HTF-SRC Type for High-Load Drive

1. Features

● High-speed operation and low noise

The SRC recirculation system contributes to more than twice the feed speed (d·n value: 140000 and 160000) and the noise level of less than 8 to 10 dB (half to 1/3 of noise) compared with the HTF type.

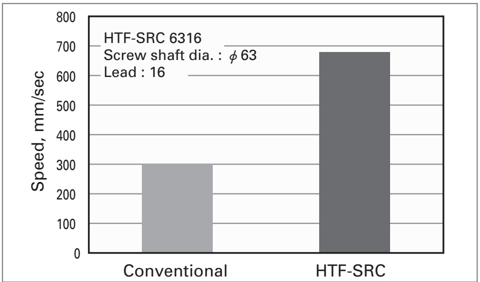


Fig. 1 Feed speed comparison

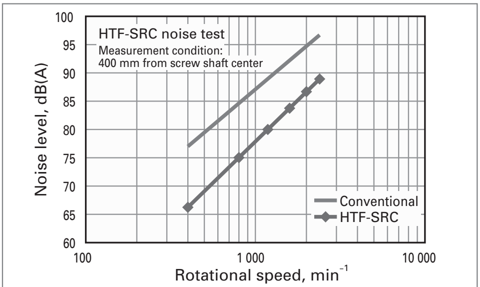


Fig. 2 Noise level comparison

2. Specifications

(1) Recirculation system

The SRC recirculation system picks up balls in the direction they are moving, and contributed high-speed operation with low noise. Structure of recirculation system is as follows.

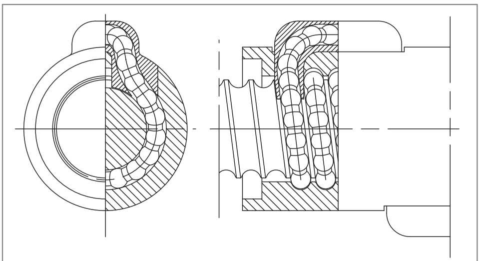


Fig. 3 Structure of SRC recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	Ct7
Axial play	S,0.020 mm or less; N,0.050 mm or less

(3) Allowable d·n value and the criterion of maximum rotational speed

Allowable d·n value and the criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Table 2 Allowable d·n value and the criterion of maximum rotational speed

Lead	14, 16 mm	20, 25 mm
Allowable d·n value	160000 or less	140000 or less
Criterion of maximum rotational speed	4225 min^{-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 B51) for details.

(4) Ball retaining piece NSK S1™

The NSK S1, resin retainers between the balls, significantly extend ball screw durability to the moment load.

(5) Other

Please consult NSK for special requests, such as the addition of a recirculation circuit to increase the load capacity, or the arrangement of all recirculation circuits on the same phase of ball nut circumference.

3. Design Precautions

The HTF-SRC type is designed to distribute the load uniformly to the load balls for high-load drive mechanism. We recommend installing the ball screws in the way shown below for the full use of this characteristic.

In addition, we will make full analysis when you use the HTF-SRC type under extreme conditions such as application of extremely high load or operating in short stroke. Contact NSK about operating conditions. (Refer to page B31)

When designing the screw shaft end, one end of the screw shaft must meet either one of the following conditions. If not, we cannot install the ball nut on the screw shaft.

- Cut the ball groove through to the shaft end.
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove "dr" specified on the dimension table.

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B103).

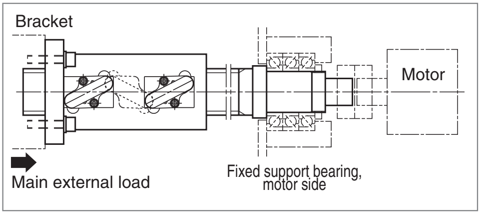


Fig. 4 Recommended installing direction of high-load drive ball screw

4. Product categories

The HTF-SRC type has a model as follows.

Table 3 HTF-SRC type product categories

Nut models	Shape	Flange shape	Preload system
HTF-SRC		Flanged Circular I	Non-preload Slight axial play

5. Example of model number in dimension tables

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇Model number

HTF-SRC 63 20 - 7.5

- Nut model : HTF-SRC
- Screw shaft diameter (mm)
- Lead (mm)
- Effective turns of balls

◇Reference number for ball screw

W 63 04 - ＊＊ RC SP - C7 S 20

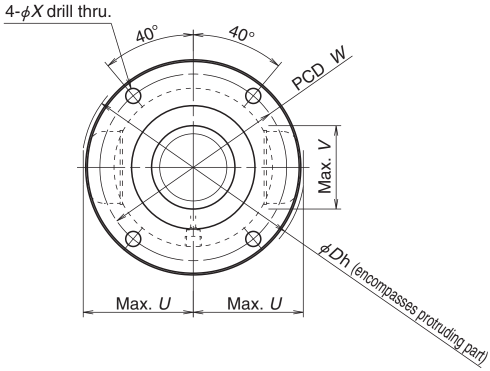
- Product code
- Screw shaft diameter (mm)
- Effective threaded length (in the unit of 100 mm)
- NSK design serial number
- SRC recirculation system
- Ball retaining pieces NSK S1 specification
- Accuracy grade: C7 (Ct7)
- Axial play code: S, N
- Lead (mm)

6. Handling Precautions

Maximum operating temperature: 70°C
(at outside diameter of ball nut)

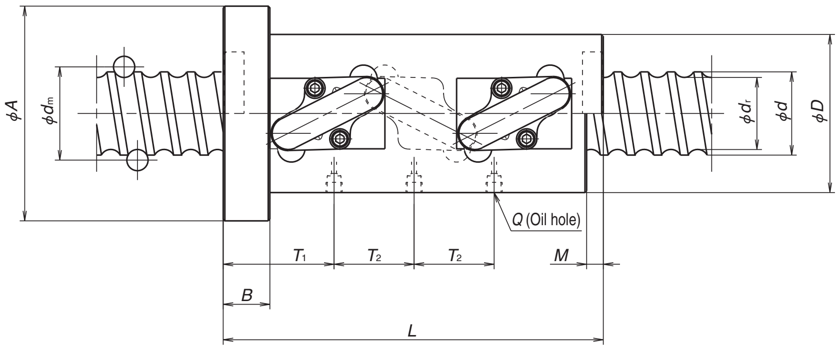
Please consult NSK in the case of a short stroke operation less than or equal to four times the length of the ball screw lead.

HTF-SRC Type for high-load drive



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) Dynamic C_a	Static C_{0a}	Allowable axial load (kN)
HTF-SRC5014-7.5	50	14	9.525	51.4	41.6	2.5×3	245	634	73.1
HTF-SRC5016-7.5		16	12.7	52	39		355	814	91.1
HTF-SRC6316-7.5	63	16	12.7	65	52	2.5×3	398	1050	119.7
HTF-SRC6316-10.5		16	12.7	65	52	3.5×3	522	1440	167.6
HTF-SRC6320-7.5		20	15.875	65.5	49	2.5×3	530	1310	147.1
HTF-SRC6325-10.5		25	15.875	65.5	49	3.5×3	692	1790	170.0
HTF-SRC8016-10.5	80	16	12.7	82	69	3.5×3	582	1860	221.3
HTF-SRC8020-10.5		20	15.875	82.5	66	3.5×3	778	2290	267.4
HTF-SRC8025-7.5		25	19.05	83	63	2.5×3	732	2010	221.1
HTF-SRC10020-10.5	100	20	15.875	102.5	86	3.5×3	870	2910	345.9
HTF-SRC10025-10.5		25	19.05	103	83		1120	3480	408.4
HTF-SRC12020-7.5	120	20	15.875	122.5	106	2.5×3	722	2550	304.6
HTF-SRC12025-10.5		25	19.05	123	103	3.5×3	1210	4190	498.0

Remarks
1. The right hand screw is the standard. For specifications on left hand screws, contact NSK.
2. The ball nut length with no seals is shorter by M than that length of a ball nut with seals.
3. Please consult NSK if load exceeds the allowable axial load.
4. The allowable axial load is determined in accordance with the mounting conditions of ball screws recommended by NSK (Refer to page B124). If your mounting conditions differ from those provided, please consult NSK.



Unit: mm

Ball nut dimensions													Max. feeding speed
Nut length.	Nut dia.	Flange dia.	Flange width	Seal width	Bolt hole PCD	Bolt hole size	Protruding tube dimensions			Oil hole	Oil hole position		
L	D	A	B	M	W	X	U	V	Dh	Q	T_1	T_2	(mm/sec)
202	80	114	28	10	97	9	54.5	46	111	M6×1	69	42	750
228	95	129			112		66	50	134	Rc1/8	74.5	48	860
228	105	139	28	10	122	9	72.5	50	148	Rc1/8	74.5	48	680
276	105	139	28	10	122	9	72.5	50	148		74.5	64	680
279	117	157	32	12	137	11	80	62	163		90	60	740
405	117	157	32	12	137	11	81.5	61	167		101.75	100	930
278	120	154	32	10	137	9	80	60	165	Rc1/8	78.5	64	540
339	130	170	32	12	150	11	88	64	180		90	80	590
347	145	185	40	17	165	11	99.5	73	202		111.75	75	730
339	145	185	32	12	165	11	97	78	199	Rc1/8	90	80	470
422	159	199	40	17	179		108	79	220		111.75	100	590
287	173	213	40	12	193	11	109.5	88	229	Rc1/8	98	60	390
421	173	213	40	17	193		116	92	238		111.25	100	490

B-3-1.4.2 HTF-SRD Type for High-Load Drive

This product is patented by NSK.

1. Features

● High-speed operation and low noise

Used with end deflectors, HTF-SRD type ball screws achieve the maximum feed speed of 1600 mm/s. The ball nut body surface is completely round, thus enabling well balanced ball nut rotation.

Double start thread structure which has more recirculation circuits, and large diameter balls contribute to have high load carrying capacity.

● Low noise and compact design

End deflector system using a ball scooping mechanism in the direction of screw spiral offers smoother ball recirculation system, thus contributing to less than half the noise level compared with existing ball screws equipped with a return tube.

Compact, high-performance seal is available. Nut outside diameter is compact compare with the return tube recirculation system.

Also, compact, thin plastic seal is available. Nut outside diameter is compact compare with the return tube recirculation system.

2. Specifications

(1) Recirculation system

End-deflector recirculation system has features of high-speed operation with low-noise, and compact nut. The structure of recirculation parts are as follows.

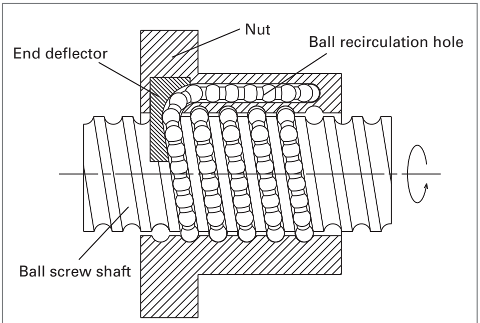


Fig. 1 Structure of End-deflector recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	Ct7
Axial play	S, 0.020 mm or less; N, 0.050 mm or less

(3) Allowable d·n value and the criterion of maximum rotational speed

Allowable d·n value and the criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Table 2 Allowable d·n value and the criterion of maximum rotational speed

Allowable d·n value	120000 or less
Criterion of maximum rotational speed	2400 min^{-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 B51) for details.

(4) Ball retaining piece NSK S1™

The NSK S1, resin retainers between the balls, significantly extend ball screw durability to the moment load.

3. Design Precautions

The HTF-SRD type is designed to distribute the load uniformly to the load balls for high-load drive mechanism. We recommend installing the ball screws in the way shown below for the full use of this characteristic.

In addition, we will make full analysis when you use the HTF-SRC type under extreme conditions such as application of extremely high load or operating in short stroke. Contact NSK about operating conditions. (Refer to page B31)

When designing the screw shaft end, one end

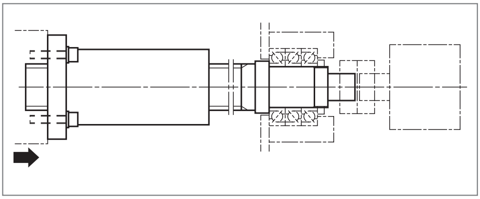


Fig. 2 Recommended installing direction of high-load drive ball screw

of the screw shaft must meet either one of the following conditions. If not, we cannot install the ball nut on the screw shaft.

- Cut the ball groove through to the shaft end.
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove "dr" specified on the dimension table.

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B103).

4. Product categories

The HTF-SRC type has a model as follows.

Table 3 HTF-SRD type product categories

Nut models	Shape	Flange shape	Preload system
HTF-SRD		Semicircular Ⅲ	Non-preload Slight axial play

5. Example of model number in dimension tables

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇Model number

HTF-SRD 50 40 - 6E

- Nut model : HTF-SRD
- Screw shaft diameter (mm)
- Lead (mm)
- Effective turns of balls

◇Reference number for ball screw

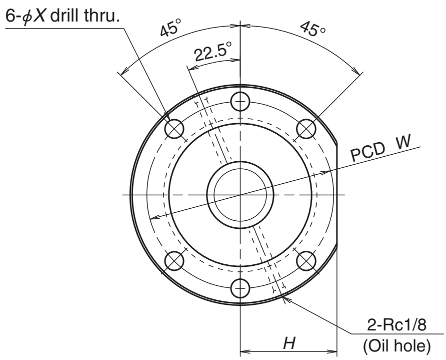
W 50 18 - ** SS SP X - C7 N 40

- 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)
- Axial play code: S, N
- Lead (mm)

6. Handling Precautions

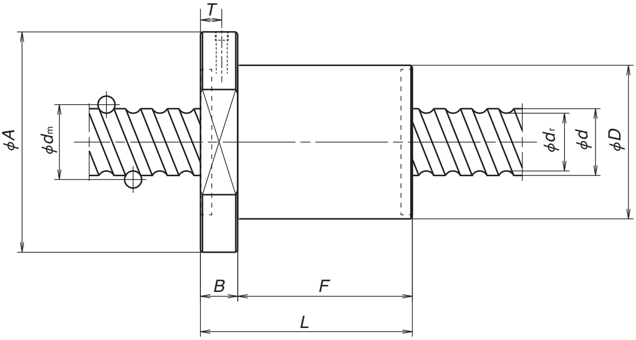
Maximum operating temperature: 70°C
(at outside diameter of ball nut)
Please consult NSK in the case of a short stroke operation less than or equal to four times the length of the ball screw lead.

HTF-SRD Type for high-load drive



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 (kN) Dynamic C_a	Basic load rating (kN) Static C_{0a}	Allowable axial load (kN)
HTF-SRD5040-6E	50	40	12.7	52	39	6	218	491	67.6
HTF-SRD5040-8E						8	286	673	92
HTF-SRD6332-4E	63	32	15.875	65.5	49	4	267	595	72.6
HTF-SRD6340-6E		40				6	330	776	106.3
HTF-SRD6340-8E						8	433	1060	144.7
HTF-SRD8050-6E	80	50	19.05	83	63	6	480	1190	163.7
HTF-SRD8050-8E						8	629	1640	224.1

Remarks 1. The right hand screw is the standard. For specifications on left hand screws, contact NSK.
2. Please consult NSK if load exceeds the allowable axial load.
3. The allowable axial load is determined in accordance with the mounting conditions of ball screws recommended by NSK (Refer to page B127). If your mounting conditions differ from those provided, please consult NSK.



Unit: mm

<table>
<tr><th colspan="9">Ball nut dimensions</th><th rowspan="2">Max. feeding speed (mm/sec)</th></tr>
<tr><th>Nut entire length L</th><th>Nut dia. D</th><th>Flange dia. A</th><th>Notch size H</th><th>Flange width B</th><th>Nut length F</th><th>Bolt hole PCD W</th><th>Bolt hole size X</th><th>Oil hole position T</th></tr>
<tr><td>159</td><td rowspan="2">115</td><td rowspan="2">165</td><td rowspan="2">72.5</td><td rowspan="2">28</td><td>131</td><td rowspan="2">140</td><td rowspan="2">14</td><td rowspan="2">16</td><td rowspan="2">1600</td></tr>
<tr><td>199</td><td>171</td></tr>
<tr><td>176</td><td rowspan="3">140</td><td>190</td><td>85</td><td rowspan="3">32</td><td>144</td><td>165</td><td>14</td><td rowspan="3">18</td><td>1000</td></tr>
<tr><td>163</td><td rowspan="2">200</td><td rowspan="2">90</td><td>131</td><td rowspan="2">170</td><td rowspan="2">18</td><td rowspan="2">1250</td></tr>
<tr><td>203</td><td>171</td></tr>
<tr><td>194</td><td rowspan="2">175</td><td rowspan="2">250</td><td rowspan="2">110</td><td rowspan="2">40</td><td>154</td><td rowspan="2">210</td><td rowspan="2">22</td><td rowspan="2">18</td><td rowspan="2">1250</td></tr>
<tr><td>244</td><td>204</td></tr>
</table>

B-3-1.4.3 HTF Type for high load drive

This product is patented by NSK.

1. Features

● High load carrying capacity

Has an ideal design to bear heavy load. It significantly enhances load rating as well as maximum permissible load.

● Abundant diameter / lead combinations

Twenty five types of shaft diameter/lead combinations are available. Please consult NSK when you require other combination.

● Respond to various shaft end configuration

Additional ball screw shaft machining is not required. HTF type responds to various shaft ends that convey high torque.

HTF type can be used with: involute spline (JIS B 1603), straight sided spline (JIS B 1601), Key seat, etc.

2. Specifications

(1) Recirculation system

Structure of recirculation system is shown in Fig. 1.

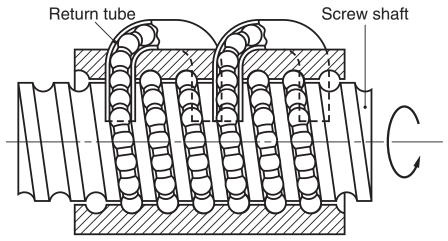


Fig. 1 Structure of return tube recirculation system

(2) Accuracy grade and axial play

The allowable standard accuracy grade and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	Ct7
Axial play	S, 0.020 mm or under; N, 0.050 mm or under

(3) Allowable d·n value and the criterion of maximum rotational speed

Allowable d·n value and the criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below. For higher-speed operation, HTF-SRC type is recommended.

Table 2 Allowable d•n value and the criterion of maximum rotational speed

Lead		– 20 mm	25 mm	30 – 32 mm
Allowable d·n value	Standard specification	70000 or less	70000 or less	50000 or less
	High-speed specification	100000 or less	–	–
Criterion of maximum rotational speed		3125 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 B51) for details.

(4) Ball retaining piece NSK S1™

The NSK S1, resin retainers between the balls, significantly extend ball screw durability to the moment load.

(5) Other

Please consult NSK for special requests, such as the addition of a recirculation circuit to increase the load capacity, or the arrangement of all recirculation circuits on the same phase of ball nut circumference.

3. Design precautions

For designing shaft end configuration, you should take into account that the HTF type ball screws are dedicated to high load drive.

The HTF type is designed to distribute the load uniformly to the load balls for high load drive mechanism. (This product is patented by NSK.)

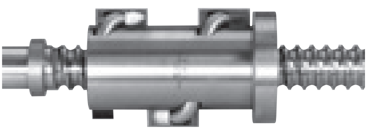
We recommend installing the ball screws in the way shown in Fig. 2 for the full use of this characteristic. In addition, we will make full analysis when you use the HTF type under extreme conditions such as application of extremely high load or operating in short stroke. Contact NSK about operating conditions. (Refer to page B31)

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B103).

4. Product categories

The HTF type has a model as follows.

Table 3 HTF type product categories

Nut model	Shape	Flange shape	Preload system
HTF		Flanged Circular Ⅰ	Non-preloaded Slight axial play

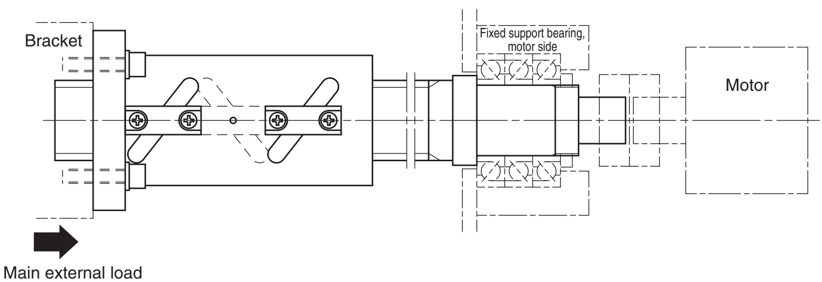


Fig. 2 Recommended installing direction of ball screws for high load drive

5. Example of model number in dimension table

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇Model number

HTF 63 20 - 7.5

- HTF: Nut model: HTF
- 63: Screw shaft diameter (mm)
- 20: Lead (mm)
- 7.5: Effective turns of balls

◇Reference number for ball screw

W 63 18 - ✻✻ **SP - C7 N 20**

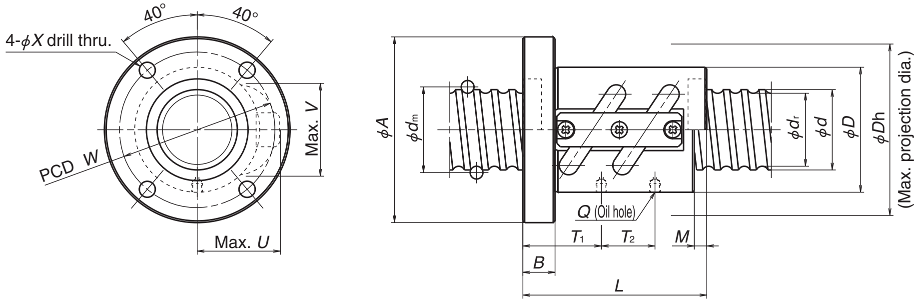
- W: Product code
- 63: Screw shaft diameter (mm)
- 18: Effective threaded length (unit in 100 mm)
- ✻✻: Design serial number
- SP: Ball retaining pieces NSK S1 specification
- C7: Accuracy grade: C7 (Ct7)
- N: Axial play code: S, N
- 20: Lead (mm)

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℃
(at outside diameter of ball nut)

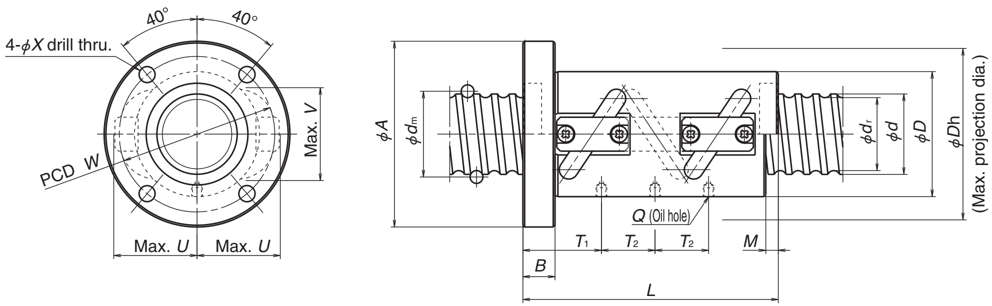
HTF Type for high load drive



Nut model Ⅰ

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	Nut model	Basic load rating (kN) Dynamic C_a	Basic load rating (kN) Static C_{0a}	Permissible axial load (kN)
HTF3210-5	32	10	7.144	33	25.6	2.5×2	Ⅰ	80.5	165	20.3
HTF3610-5	36	10	7.144	37	29.6	2.5×2	Ⅰ	86.8	186	23.4
HTF3612-5		12	7.938	37.25	29			109	233	28.3
HTF4010-7.5	40	10	7.144	41	33.6	2.5×3	Ⅱ	140	337	39.6
HTF4012-7.5		12	7.938	41.25	33			170	420	48
HTF4510-7.5	45	10	7.144	46	38.6	2.5×3	Ⅱ	147	382	45.3
HTF4512-7.5		12	7.938	46.25	38			181	472	55
HTF5010-7.5	50	10	7.144	51	43.6	2.5×3	Ⅱ	153	426	51
HTF5012-7.5		12	7.938	51.25	43			190	523	62
HTF5014-7.5		14	9.525	51.5	41.7			245	634	73.1
HTF5016-7.5		16	12.700	52	39			355	814	91.1
HTF5510-7.5	55	10	7.144	56	48.6	2.5×3	Ⅱ	159	471	55.7
HTF5512-7.5		12	7.938	56.25	48			199	584	69.1
HTF5514-7.5		14	9.525	56.5	46.7			250	694	81.2
HTF5516-7.5		16	12.700	57	44			370	918	101.9
HTF6312-7.5	63	12	7.938	64.25	56	2.5×3	Ⅱ	211	667	80.3
HTF6314-7.5		14	9.525	64.5	54.7	2.5×3		271	798	93.5
HTF6316-7.5		16	12.700	65	52	2.5×3		398	1050	119.7
HTF6316-10.5		16	12.700	65	52	3.5×3		522	1440	167.6
HTF6320-7.5		20	15.875	66	49	2.5×3		529	1310	147.3

Remarks 1. The right hand screw is the standard. "L" is added to the end of the model code for the left turn screw.
2. If there is no seal, the nut length is shorter by the lengths of "M" than those with a seal.



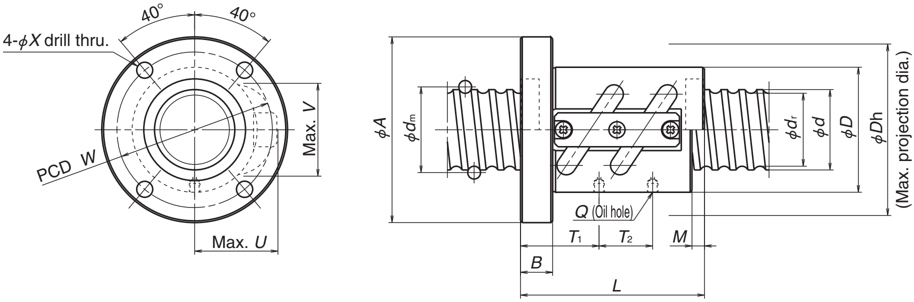
Nut model Ⅱ

Unit: mm

Ball nut dimensions													Max. feeding speed (mm/sec)
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	
103	58	92	18	7	75	9	40.5	42	82	M6×1	36.5	30	520
103	62	96	18	7	79	9	43	45	87	M6×1	36.5	30	460
123	66	100	22	8	83		46.5	46	94		44	36	550
143	66	100	18	7	83	9	45	48	91	M6×1	46.5	30	410
171	70	104	22	8	87		47.5	50	96		56	36	500
143	70	104	18	7	87	9	47	52	95	M6×1	46.5	30	370
171	72	106	22	8	89		49.5	54	100		56	36	440
143	75	109	18	7	92	9	49	57	99	M6×1	46.5	30	330
171	77	111	22	8	94		52	59	105	M6×1	56	36	400
200	80	114	28	10	97		55.5	61	112	M6×1	66.5	42	460
223	95	129	28	10	112		68	66	137	Rc1/8	73	48	530
143	80	114	18	7	97	9	51.5	62	104	M6×1	46.5	30	300
171	82	116	22	8	99		54.5	63	110	M6×1	56	36	360
200	85	119	28	10	102		57.5	65	116	M6×1	66.5	42	420
223	99	133	28	10	116		70	70	141	Rc1/8	73	48	480
171	92	126	22	8	109	9	58.5	70	118	M6×1	56	36	310
200	94	128	28	10	111	9	61.5	72	124	M6×1	66.5	42	370
223	105	139	28	10	122	9	72.5	76	146	Rc1/8	73	48	420
271	105	139	28	10	122	9	72.5	76	146	Rc1/8	73	64	420
273	117	157	32	12	137	11	83.5	81	168	Rc1/8	88	60	520

3. Please consult NSK if load exceeds the allowable axial load.
4. The allowable axial load is determined in accordance with the mounting conditions of ball screws recommended by NSK (Refer to page B132). If your mounting conditions differ from those provided, please consult NSK.

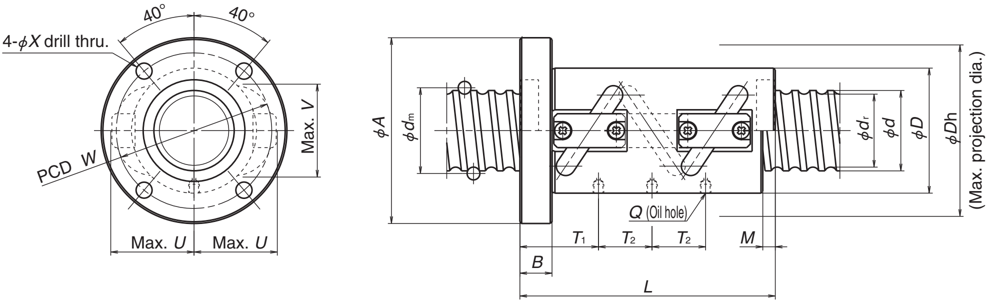
HTF Type for high load drive



Nut model Ⅰ

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	Nut model	Basic load rating (kN) Dynamic C_a	Basic load rating (kN) Static C_{0a}	Permissible axial load (kN)
HTF8014-7.5	80	14	9.525	81.5	71.7	2.5×3	Ⅱ	304	1020	121.9
HTF8016-7.5		16	12.7	82	69	2.5×3		444	1340	159
HTF8016-10.5		16	12.7	82	69	3.5×3		582	1860	221.3
HTF8020-7.5		20	15.875	83	66	2.5×3		593	1680	192.6
HTF8020-10.5		20	15.875	83	66	3.5×3		778	2290	272.4
HTF8025-7.5		25	19.05	84	64	2.5×3		768	2010	228.3
HTF10016-7.5	100	16	12.7	102	89	2.5×3	Ⅱ	492	1710	202.3
HTF10020-7.5		20	15.875	103	86	2.5×3		663	2130	248.6
HTF10025-7.5		25	19.05	104	84	2.5×3		851	2540	293.2
HTF10025-10.5		25	19.05	104	84	3.5×3		1120	3480	409.1
HTF12016-7.5	120	16	12.7	122	109	2.5×3	Ⅱ	532	2050	248.9
HTF12020-7.5		20	15.875	123	106	2.5×3		721	2550	304.7
HTF12025-7.5		25	19.05	124	104	2.5×3		920	3070	358.2
HTF12025-10.5		25	19.05	124	104	3.5×3		1210	4190	505.7
HTF14020-7.5	140	20	15.875	143	126	2.5×3	Ⅱ	771	3000	360.9
HTF14025-7.5		25	19.05	144	124			979	3610	423.1
HTF14030-7.5		30	22.225	144	121			1210	4180	487.1
HTF14032-7.5		32	25.4	144	118			1480	4730	549.3
HTF16025-7.5	160	25	19.05	164	144	2.5×3	Ⅱ	1060	4140	495.3
HTF16030-7.5		30	22.225	164	141			1300	4750	564.3
HTF16032-7.5		32	25.4	164	138			1550	5360	636
HTF20030-7.5	200	30	22.225	204	181	2.5×3	Ⅱ	1440	5950	718.8
HTF20032-7.5		32	25.4	204	178			1710	6830	809.4

Remarks 1. The right hand screw is the standard. "L" is added to the end of the model code for the left turn screw.
2. If there is no seal, the nut length is shorter by the lengths of "M" than those with a seal.



Nut model Ⅱ

Unit: mm

Ball nut dimensions													Max. feeding speed (mm/sec)
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	
200	116	150	28	10	133	9	72	87	146	M6×1	66.5	42	290
227	120	154	32	10	137	9	80	92	161	Rc1/8	77	48	330
275	120	154	32	10	137	9	80	92	161	Rc1/8	77	64	330
273	130	170	32	12	150	11	89.5	96	181	Rc1/8	88	60	410
333	130	170	32	12	150	11	89.5	96	181	Rc1/8	88	80	410
338	145	185	40	17	165	11	102	100	206	Rc1/8	109.25	75	360
227	145	185	32	10	165	11	91	109	184	Rc1/8	77	48	260
273	145	185	32	12	165		97.5	114	196		88	60	330
338	159	199	40	17	179		108.5	118	219		109.25	75	290
413	159	199	40	17	179		108.5	118	219		109.25	100	290
227	173	213	32	10	193	11	104	126	210	Rc1/8	77	48	220
281	173	213	40	12	193		111	131	223		96	60	270
338	173	213	40	17	193		116	135	233		109.25	75	240
413	173	213	40	17	193		116	135	233		109.25	100	240
281	204	250	40	12	226	14	122.5	148	248	Rc1/8	96	60	230
338	204	250	40	17	226	14	127.5	153	258		109.25	75	200
411	222	282	50	22	252	18	139	160	281		134.5	90	170
465	222	296	70	22	259	22	148	163	299		166.5	96	190
338	234	280	40	17	256	14	138	173	279	Rc1/8	109.25	75	180
411	234	294	50	22	264	18	148	177	299		134.5	90	150
465	234	308	70	22	271	22	152	181	307		166.5	96	160
411	290	350	50	22	320	18	178	212	359	Rc1/8	134.5	90	120
465	290	364	70	22	327	22	182	215	367		166.5	96	130

3. Please consult NSK if load exceeds the allowable axial load.
4. The allowable axial load is determined in accordance with the mounting conditions of ball screws recommended by NSK (Refer to page B132). If your mounting conditions differ from those provided, please consult NSK.

B-3-1.5 VSS Type for Contaminated Environments

1. Features

● High dust-resistance

Specially profiled screw shaft grooves and high performance seals prevent the entry of fine contaminants. Reduces particle penetration rate to less than 1/15 of existing standard products.

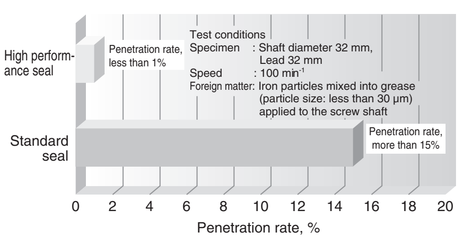
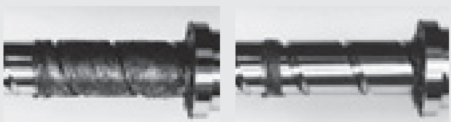


Fig. 1 Particle penetration rate



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.

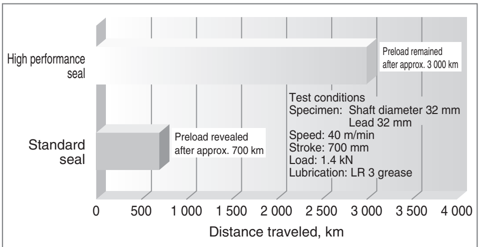


Fig. 3 Extreme durability test results using iron particles

● 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) Recirculation system

End-deflector recirculation system has features of high-speed operation with low-noise, and compact ball nut. The structure of recirculation system is shown in Fig.4.

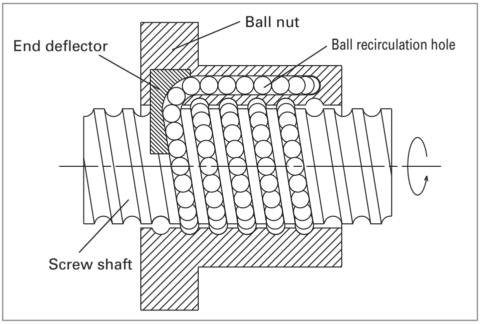


Fig. 4 Structure of end deflector recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	C5
Axial play	Z, 0 mm (Preloaded) T, 0.005 mm or less; S, 0.020 mm or less

(3) Allowable d•n value and the criterion of maximum rotational speed

Allowable d·n value and the criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Allowable d·n value: 150000 or less

Criterion of maximum rotational speed: 3000 min^{-1}

Note: Please also review critical speed. See

"Technical Description: Permissible rotational speed" (Page B51) for details.

(4) High performance seal

High performance seal (Japan patents: 3646452, 3692203) with special lip that contacts screw shaft cross-section and prevents entry of fine contaminants.

(5) Lubrication unit

Incorporates NSK K1 lubrication unit to sufficiently lubricate the high performance seal lip, reduce friction, and improve durability.

(6) optional

Non-contact metal protector that traces the ball screw grooves and safeguards the seal against high-temperature foreign matter.

3. Design precaution

When designing the screw shaft end, one end of the screw must meet either one of the following conditions. If not, we cannot install the ball nut on the screw shaft.

- Cut the ball groove through to the shaft end.
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove "dr" specified on the dimension table.

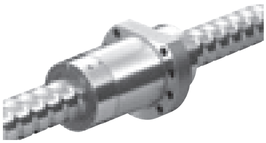
High performance seals may increase torque, which may in turn increase temperature. Please consult with NSK prior to usage under severe service conditions.

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B103).

4. Product categories

VSS Type has the model as follows.

Table 2 VSS type product categories

Nut model	Shape	Flange shape	Preload system
VSS		Circular Ⅱ	Non-preload, Slight axial play
			P preload (light preload)

5. Example of model number in dimension table

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇Model number

VSS 32 10 - 6E

- VSS: Nut model: VSS
- 32: Screw shaft diameter (mm)
- 10: Lead (mm)
- 6E: Effective turns of balls

◇Reference number for ball screw

W 36 12 - ** P SS V1 - C5 Z 10

- W: Product code
- 36: Screw shaft diameter (mm)
- 12: Effective threaded length (in the unit of 100 mm)
- **: Design serial number
- P: Preload code: P ; P Preload
- SS: End-deflector recirculation system
- V1: High performance seal V1
- C5: Accuracy grade: C5
- Z: Axial play: Z, T, S
- 10: Lead (mm)

6. Handling Precautions

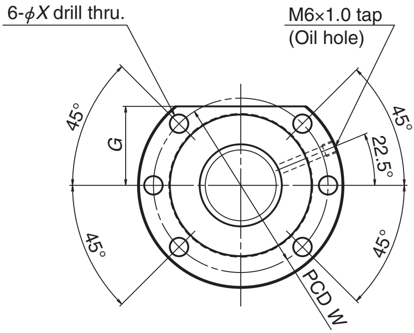
Maximum operating temperature: 50˚C

Maximum momentary operating temperature: 80˚C

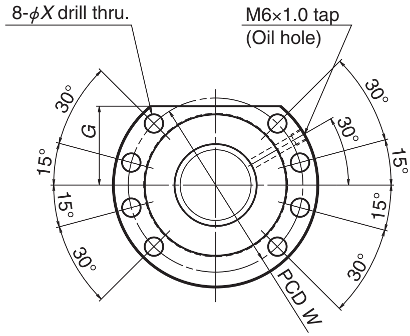
Chemical precautions: Never expose the ball screw to grease-removing organic solvents such as hexane or thinner. Never immerse the ball screw in kerosene or rust preventive oils which contain kerosene.

VSS Type for contaminated environments

View *X*-*X*



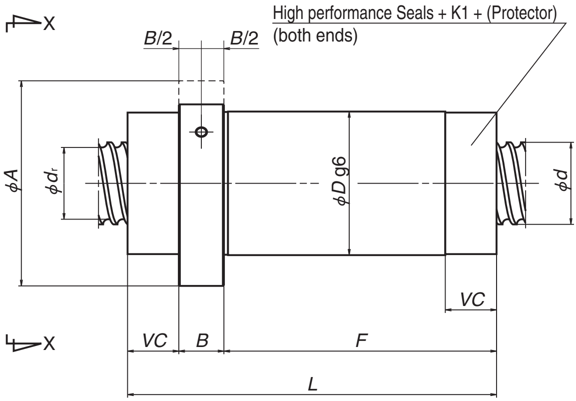
Flange TYPE Ⅰ



Flange TYPE Ⅱ

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	Flange shape	Basic load rating (N) Dynamic C_a	Static C_{0a}	Axial rigidity K (N/μm)
VSS3210-6E	32	10	5.5563	33	27.5	6	Ⅰ	50900	110000	682
VSS3216-5E		16				5		44300	90800	563
VSS3220-5E		20				5		43900	91200	561
VSS3232-4E		32				4		28900	59300	387
VSS4040-4E	40	40	6.35	41	34.4	4	Ⅱ	38600	84800	472
VSS5050-4E	50	50	6.35	51	44.4	4	Ⅱ	42600	105000	559

Remarks
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 B41) 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)”



Unit: mm

Ball nut dimensions									Maximum shaft length
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	
132	56	86	18	89.5	34	24.5	71	9	2800
150				107.5					
169				126.5					
122				79.5					
144	70	100	22	94	38.5	27.5	85	9	3800
164	82	118	22	114.5	46	27.5	100	11	5000

B-3-1.6 TW Series for Twin-Drive Systems

(1) Features

Variations in lead accuracy and preload torque between two ball screws, which consists of a unit of TW Series, are controlled, resulting improved travel accuracy and ball screw operating lifetime. Fig. 1 shows measures variation in lead accuracy while Fig. 2 displays an example of variation in thermal expansion between the two ball screws. Fig. 3 is a schematic diagram comparing travel accuracy between the TW Series and conventional model.

● High rigidity and long lifetime

Twin-drive systems are superior to single-drive systems in system rigidity, supporting the design of long-life feeding mechanism even if they make the shaft diameter one size smaller.

● High responsiveness to positioning commands

Twin-drive systems permit the use of screw shaft diameters that are one size smaller, thereby reducing screw shaft inertia by up to 50%, offering high responsiveness to positioning commands.

● Improved high-speed capability and noise level

Twin-drive systems allow the use of smaller screw diameters, resulting in no increase in the level of noise. The end-deflector recirculation system significantly improves high-speed capability and noise level compared with the existing return tube recirculation system, offering high-speed feeding of up to 1200 mm/min (shaft dia. 40 mm, lead 30 mm, rotational speed 4000 min^{-1}).

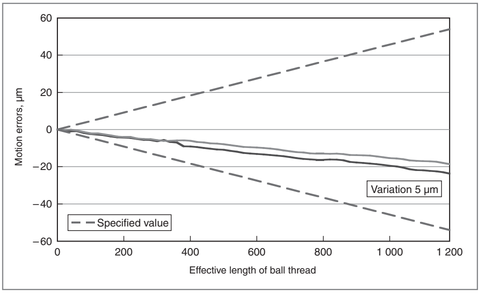


Fig. 1 Example of measured variation in lead accuracy

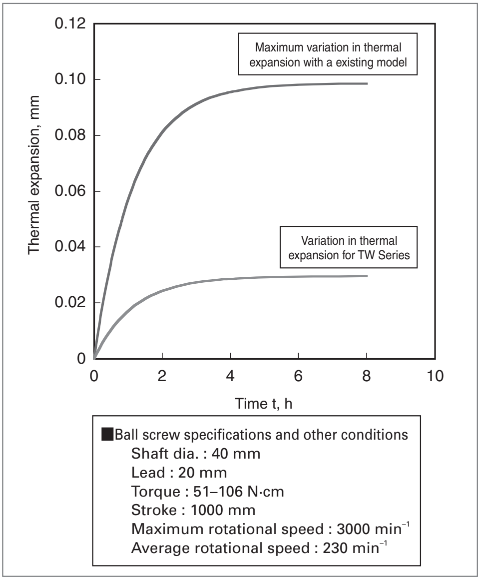


Fig. 2 Calculation example of the variation of thermal expansion

(2) Specifications

Table 1 Specifications of twin-drive systems

Recirculation systems	End-deflector recirculation system, Return tube system, Deflector system
Shaft dia.	ϕ 32 – 63 mm
Lead	10 – 30 mm
Accuracy grade	C5
Screw shaft length	3 m or less

(3) Optional specifications

• Hollow shaft ball screw

• Provides high accuracy through the use of forced cooling. Please refer to hollow shaft ball screw (page B144) for more details.

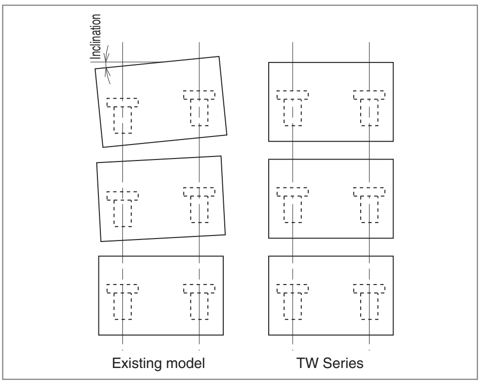


Fig. 3 Schematic diagram of travel accuracy

B-3-1.7 Hollow Shaft Ball Screw for high accuracy machine tools

The increase in speed of the feeding mechanism for highly accurate positioning may require some measures against thermal expansion of the ball screw (forced cooling using hollow ball screw). NSK standardized hollowed screw shafts and shaft ends configuration (sealing section and support bearing seat). NSK recommends this as the most effective measure against thermal expansion.

1. Features

●Stable positioning accuracy

Suppresses expansion of the ball screw shaft by rising temperature, and provides stable, precise positioning.

● Prevents displacement of various sections

Minimizes deformation of the ball screw support bearings as well as of the machine base which is caused by thermal expansion of ball screw. Forced cooling keeps the heat from spreading to other sections, and prevents the processing table from deforming due to heat.

● Reduces warm-up time

Temperature does not rise high, therefore cuts machine warm-up period.

● Maintains lubricant's effect

Removes heat from the ball screw, deterring lubricant deterioration.

● Easy designing for installation

Use support bearing unit exclusive for NSK ball screws (high load capacity for machine tools, see Page B449) and seal unit (Page B147) to standardized shaft end. This makes designing of mounting ball screw easy.

2. Design precautions

Refer to HMC type, end-deflector recirculation system, return tube recirculation system, and deflector recirculation system for ball screw specifications. If the overall ball screw length exceeds 3000 mm, contact NSK. For general precautions regarding ball screw, refer to "Design Precautions" (Page B84) and "Handling precautions" (Page B497).

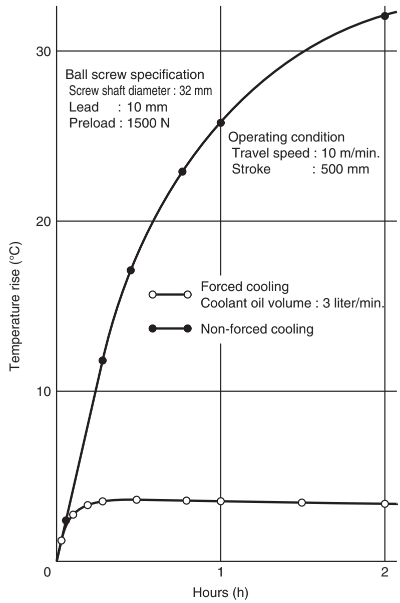


Fig. 1 Effect of forced cooling by hollow shaft ball screw

3. Model example of dimension table

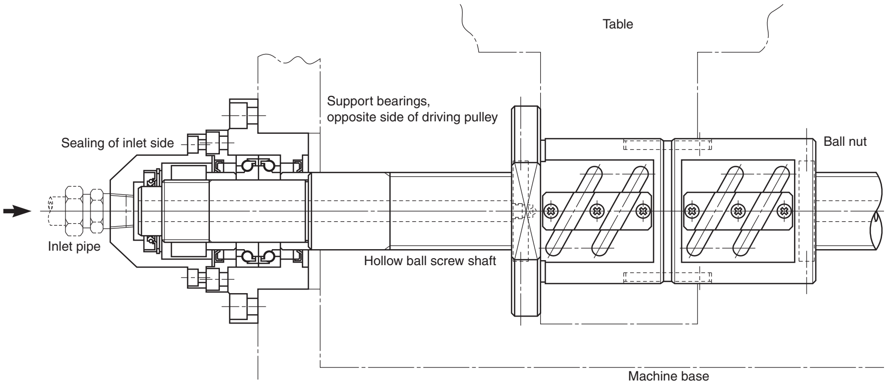
A model number that indicates specification factors is structured as shown below.

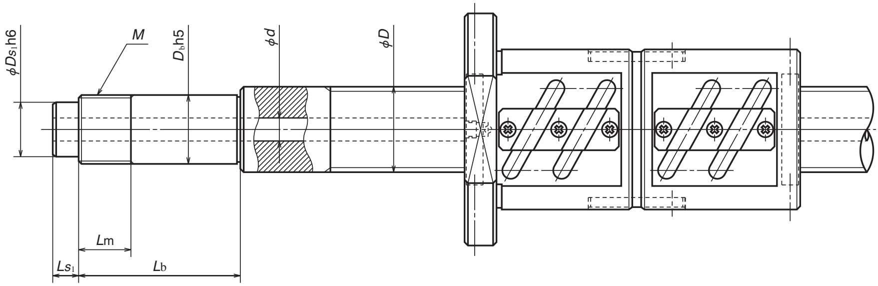
◇Example of model

H 32 - 10

- H: Screw shaft model H
- 32: Screw shaft diameter (mm)
- 10: Hollow bore (mm)

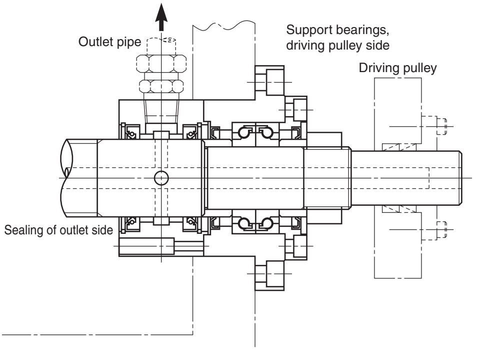
4. Example installation and standard dimensions

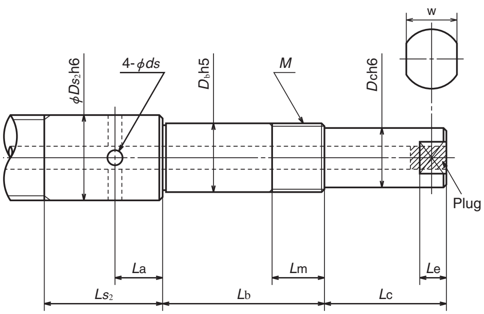




Hollow shaft ball screw Model No.	Screw shaft		Bearing seat				Sealing					
	Diameter	Hollow	Diameter	Lock nut			Inlet		Outlet			
	D	*d*	*D*b	*M*	*L*m	*L*b	*D*s$_1$	*L*s$_1$	*D*s$_2$	*L*s$_2$	*L*a	*d*s
H32-10	32	10	25	M25×1.5	26	89 104 119	20	15	32	60	25	6
H40-12	40	12	30	M30×1.5	26	89 104 119	25	15	40	60	25	7
H50-15	50	15	40	M40×1.5	30	92 107 122	32	15	50	65	27	8

Remarks 1. Please consult NSK for other models.





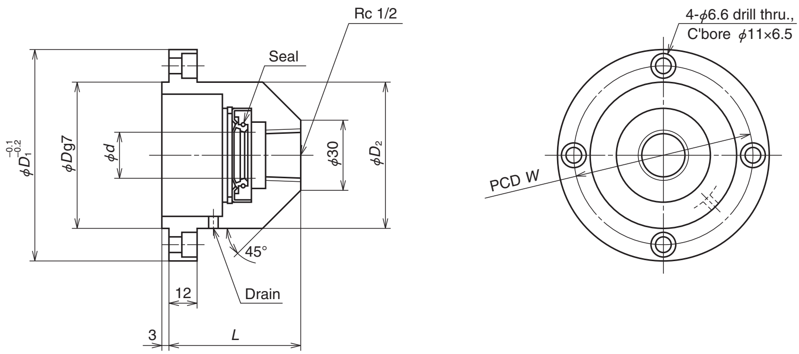
Unit: mm

Drive side		Spanner flats		Applicable support unit	Used bearing	Equipped seal unit	
Dc	*Lc*	*w*	*Le*			Shaft end	Shaft outer surface
20	40	17	8	WBK25DF-31 WBK25DFD-31	25TAC62BDFC10PN7A 25TAC62BDFDC10PN7A (25TAC62BDFFC10PN7A)	WSK20A-01	WSK32B-01
25	50	22	10	WBK30DF-31 WBK30DFD-31	30TAC62BDFC10PN7A 30TAC62BDFDC10PN7A (30TAC62BDFFC10PN7A)	WSK25A-01	WSK40B-01
35	70	30	13	WBK40DF-31 WBK40DFD-31 WBK40DFF-31	40TAC72BDFC10PN7A 40TAC72BDFDC10PN7A 40TAC72BDFFC10PN7A	WSK32A-01	WSK50B-01

5. Seal units for hollow ball screw shaft (available by order)

This is an exclusive joint for coolant of the hollow ball screw shaft.

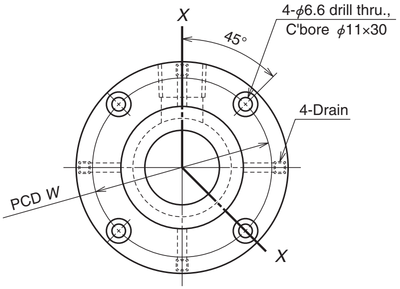
A Type
(for shaft end)

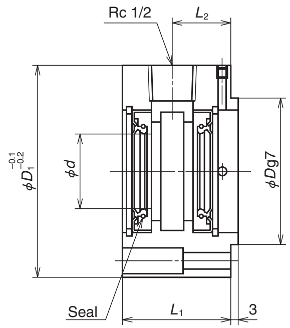


Unit: mm

Reference number	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 number	*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 in Page B449) for installation in order to maintain the eccentricity between screw shaft and seal unit.
- Apply grease to the lip section for protection at the time of installation to the ball screw.
- Make certain that the drain holes (one for A Type, four for B Type) of the seal unit directly face downward when the unit is installed.

B-3-1.8 ND Series for Nut-Rotatable Drive

• This product is patented by NSK.

A nut rotatable ball screw is developed as a unit into which angular contact support ball bearings are integrated. It is best suited for an application that requires rotation of the ball nut while the screw shaft is fixed.

NDT model

1. Structure

Balls are installed between the assembly housing and the ball nut. The outer bearing rings are integrated into the assembly housing and thus, compact design are attained.
A timing pulley (prepared by the user) is directly secured to the end face of the nut.

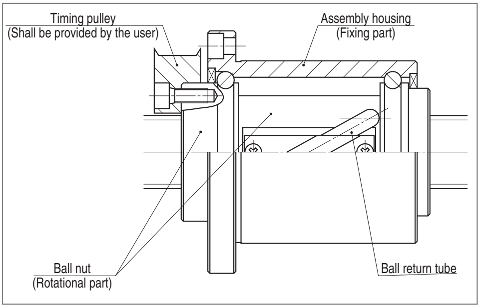


Fig. 1 Ball nut structure

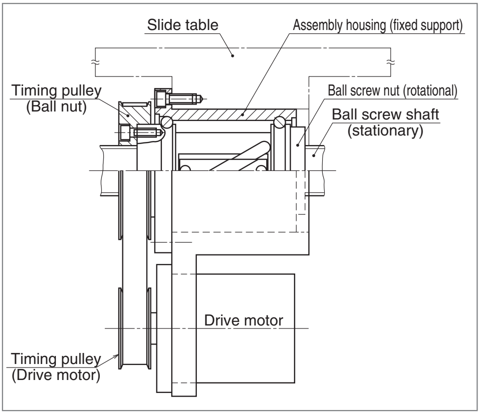


Fig. 2 Example of installation to the table

2. Features

● Multi-nut drive
Two or more nut units can be installed in a single ball screw shaft. They can be operated by respective motors.
● High operation speed
High feeding speed operation, but yet low rotational speed, is feasible by means of medium to high-helix lead ball screws.
● Easy installation
Merely install a mount housing to the table of the machine to take advantage of this multi-nut rotation system.
● Simple shaft end configuration
Shaft end configuration is simple because this unit does not need support bearings.
● Shaft diameter/lead combination
There are 10 types of "shaft diameter/lead" combinations.
Selections are: Shaft diameters -- 32, 40, 50 mm; Leads -- 20, 25, 32, 40, 50 mm.
● Low inertia
Compared to the NSK current product (end cap ball recirculation system), rotational inertia was reduced by 16% at most.

3. Specifications

(1) Recirculation system

The structure of return tube recirculation system is shown below.

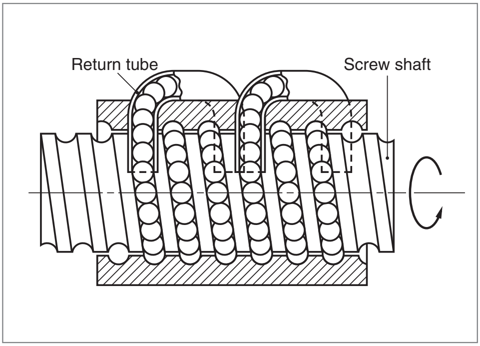


Fig. 3 Structure of ball return tube recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are as follows. Please consult NSK for other grades.

Table 1 Axial play

Axial play code	Z	T	S
Axial play	0	0.005 mm or less	0.020 mm or less

Table 2 Combination of accuracy grades and axial play

Accuracy grade	C3	C5	Ct7
Axial play code	Z, T, S	Z, T, S	S

4. Allowable d•n value and the criterion of maximum rotational speed

Allowable d·n value and the criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Note: The basic concept is the same as that of general ball screws. Refer to "Technical Description: Permissible rotational speed" (Page B51).

Table 3 Allowable d•n value and the criterion of maximum rotational speed

Allowable d·n value	Standard specification	70000 or less
	High-speed specification	100000 or less
Criterion of maximum rotational speed	3000 min^{-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.

$$n_c = f \cdot \frac{d_r}{L_i^2} \times 10^7 \ (min^{-1}) \qquad (Ⅲ\text{-}1)$$

d_r: Screw shaft root diameter [See the dimension table]

L_i: Unsupported length (mm) [See Fig. 4 Unsupported length]

f : Factor determined by the ball screw shaft end mounting condition

Table 4

Shaft end mounting condition	*f*
Fixed -- Fixed support	21.9
Fixed -- Simple support	15.1
Fixed -- Free support	3.4

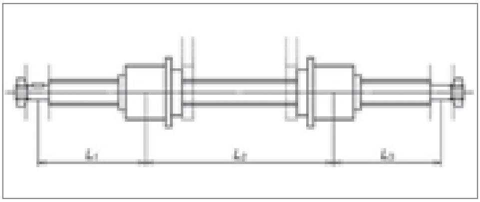


Fig. 4 Installation example

5. Design precautions

One end of the screw thread should be cut-through. Also, if the nut must be removed from the screw shaft, the user should have an arbor to prevent the balls from falling out during this process. (NSK manufactures arbors on request.)

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B103).

B 150

NDD Type: (Incorporating vibration damper)

An increase in stroke length may restrict required rotational speed of a ball screw due to the issue of critical speed even if there is no problem on d·n limitation.

In such a case, we recommend using NDD Type nut rotatable ball screws equipped with vibration damper.

It will make it possible to operate a ball screw exceeding the critical speed, which is conventionally considered being impossible.

Note: 1) However, NDD Type cannot be used exceeding the d·n limitation. Please consult with NSK in such a case.
2) You cannot rotate the screw shaft of NDD Series.

1. Structure

Hollow ball screw shaft has a mechanism to absorb vibration energy (vibration damper). This increases dynamic rigidity of the screw shaft and lowers vibration when exceeding the critical speed.

Construction of the ball nuts are the same as those of NDT Type.

2. Features

● No need for measures against critical speed.

Conventionally, an increase in screw shaft diameter or use of intermediate support is the measure against the issue of critical speed. NDD Type ball screw will make these measures needless.

● Dimensional 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.

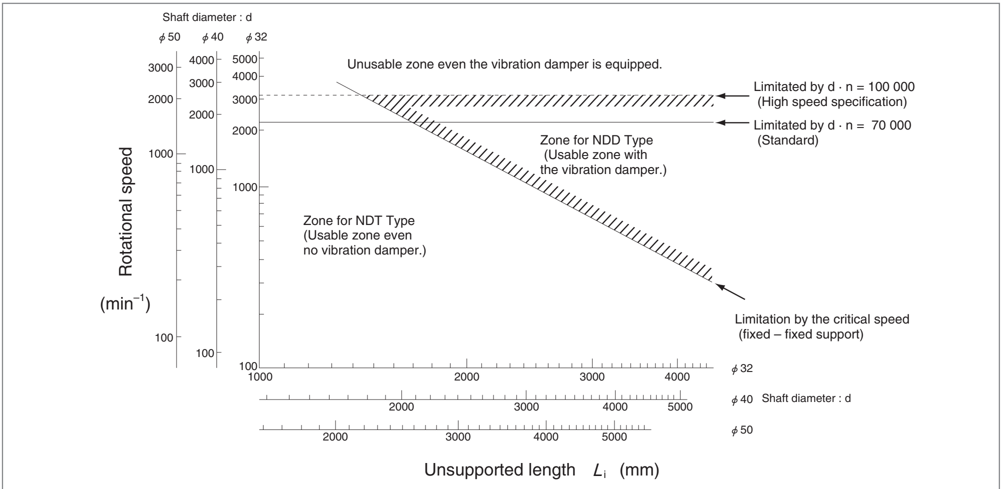
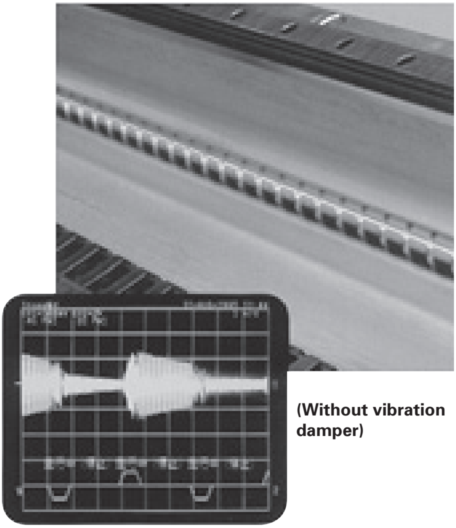
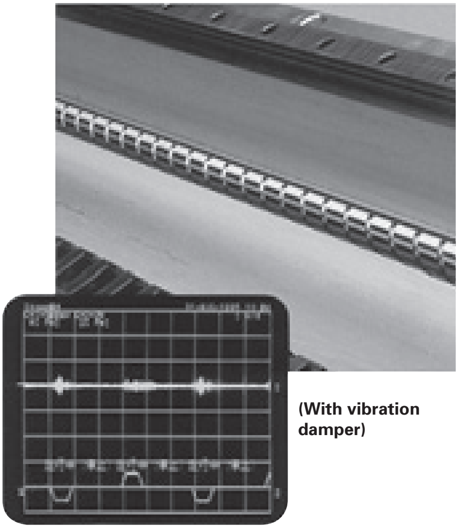


Fig. 5 Type composition to rotational speed and unsupported length



(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 at below.
Does this system operate appropriately if: both ends of the ball screw (shaft diameter 40 mm/ lead 40 mm) are fixed, and the travel speed is at 60 m/min?

[Answer]
The rotational speed n (min^{-1}) when the lead of the ball screw is 40 mm, and the travel speed is at 60 m/min is:

$$n = \frac{60 \times 10^3}{40} = 1500\ (\text{min}^{-1})$$

● Calculate d • n value
As the d • n value of standard specification is 7000, therefore, the permissible rotational speed is;

$$n \leq \frac{70000}{40} = 1750\ (\text{min}^{-1})$$

● Calculate critical speed
The maximum unsupported length comes between Nut A and B.

$L_2 = 3300$ (mm)
$f = 21.9$ (Fixed-Fixed)
Root diameter: $d_r = 35.1$ (mm)

Therefore, the permissible rotational speed is;

$$n \leq \frac{21.9 \times 35.1}{3300^2} \times 10^7 = 706\ (\text{min}^{-1})$$

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 1500 min^{-1}.

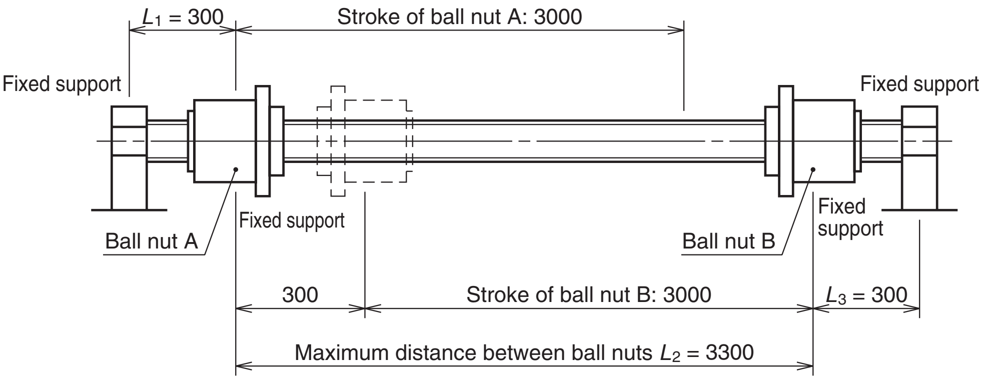


Fig. 8 Calculation example of permissible rotational speed

Example of model number in dimension table

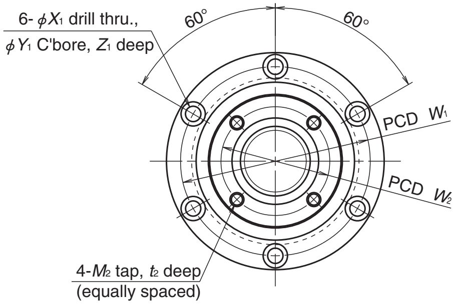
A structure of "Reference number for ball screw" is as follows.

◇Reference number for ball screw

W 40 15 - ** P XU - C5 Z 40

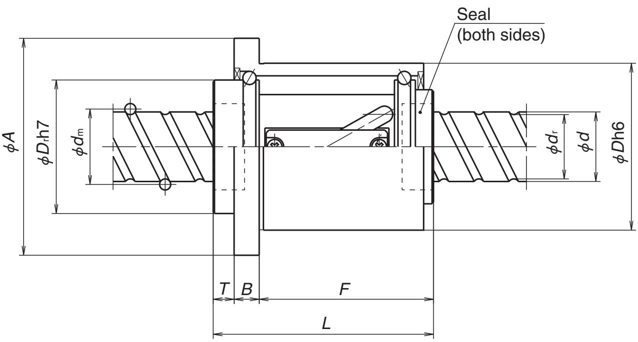
- W: Product code
- 40: Screw shaft diameter (mm)
- 15: Effective threaded length (in the unit of 100 mm)
- **: Design serial number
- P: Preload code: No code, Non-preload; P, P preload
- XU: Appearance/specification code ("T" is added for NDD Type)
- C5: Accuracy grade: C3, C5, C7 (Ct7)
- Z: Axial play code: Z, T, S
- 40: Lead (mm)

ND Series for nut-rotatable drive



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 (N) Dynamic C_a	Static C_{0a}	Moment of inertia, ball nut J (kg·cm^2)	Ball nut mass W (kg)
NDT/NDD 3220-2.5	32	20	4.762	33.25	28.3	2.5×1	20700	41900	6.2	2.9
NDT/NDD 3225-2.5		25	4.762	33.25	28.3	2.5×1	20400	42200	6.7	3.2
NDT/NDD 3232-1.5		32	4.762	33.25	28.3	1.5×1	13300	25200	6.2	2.9
NDT/NDD 3232-3						1.5×2	21700	45300		
NDT/NDD 4025-2.5	40	25	6.35	41.75	35.1	2.5×1	34100	70100	19.3	6.0
NDT/NDD 4032-1.5		32	6.35	41.75	35.1	1.5×1	21600	41300	18.0	5.5
NDT/NDD 4032-3						1.5×2	35400	74400		
NDT/NDD 4040-1.5		40	6.35	41.75	35.1	1.5×1	21200	42000	19.2	6.0
NDT/NDD 4040-3						1.5×2	34700	75600		
NDT/NDD 5025-2.5	50	25	7.938	52.25	44.0	2.5×1	51300	110000	45.7	8.5
NDT/NDD 5032-2.5		32	7.938	52.25	40.0	2.5×1	50900	109000	48.9	9.4
NDT/NDD 5040-1.5		40	7.938	52.25	44.0	1.5×1	32300	64600	45.5	8.5
NDT/NDD 5040-3						1.5×2	52800	116000		
NDT/NDD 5050-1.5		50	7.938	52.25	44.0	1.5×1	31700	65700	48.7	9.4
NDT/NDD 5050-3						1.5×2	51800	118000		

Remarks 1. The right hand screw is the standard. Consult NSK for the left hand screws.
2. Seal is standard.



Unit: mm

Ball nut dimensions													Tap hole PCD
Nut entire length	Nut outside diameter	Flange outside diameter	Flange width	Nut length	Projection tube dimensions		Bolt hole dimensions			Bolt hole PCD	Tap hole dimensions		
L	D	A	B	F	D_r	T	X_1	Y_1	Z_1	W_1	M_2	t_2	W_2
107	78	105	12	83	60	12	6.6	11	6.5	91	M6	12	50
120	78	105	12	96	60	12	6.6	11	6.5	91	M6	12	50
107	78	105	12	83	60	12	6.6	11	6.5	91	M6	12	50
136	100	133	15	106	76	15	9	14	8.5	116	M8	16	62
122	100	133	15	92	76	15	9	14	8.5	116	M8	16	62
136	100	133	15	106	76	15	9	14	8.5	116	M8	16	62
140	120	156	18	107	96	15	11	17.5	11	136	M10	18	78
158	120	156	18	125	96	15	11	17.5	11	136	M10	18	78
140	120	156	18	107	96	15	11	17.5	11	136	M10	18	78
158	120	156	18	125	96	15	11	17.5	11	136	M10	18	78

B-3-1.9 ∑ Series for Robbot

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.

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.

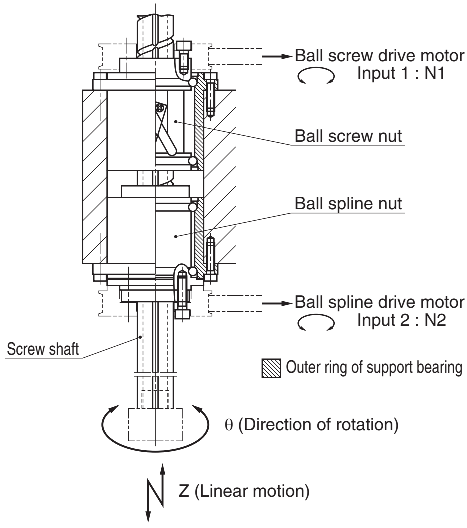


Fig. 1 Example structure of Z axis plus θ axis actuator

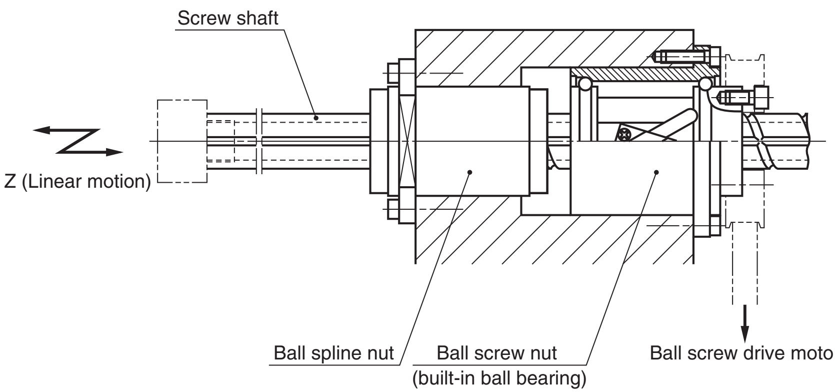


Fig. 2 Example structure of single Z axis unit

Table 1 Power input and output of Σ 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})	Remarks
Up, down N1× l	Stop 0	Rotate N1	Stop 0	–
Stop 0	Rotate N2	Rotate N1	Rotate N2	N1 = N2
Up, down N2× l	Rotate N2	Stop 0	Rotate N2	–
Up, down N1–N2× l	Rotate N2	Rotate N1	Rotate N2	N1≠N2

3. Specifications

(1) Recirculation system

A structure of return tube recirculation system is shown below.

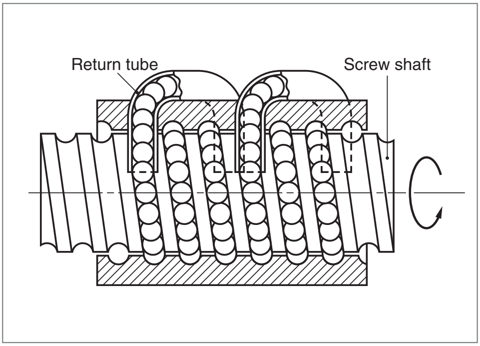


Fig. 3 Structure of return tube recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play for ball screw are as follows. The axial play for spline is 0 mm (preloaded product). Please consult NSK for other grades.

Table 2 Accuracy grade and axial play

Accuracy grade	C3, C5, Ct7
Axial play	Z, 0 mm (Preloaded) T, 0.005 mm or less; S, 0.020 mm or less

(3) Allowable d•n value and the criterion of maximum rotational speed

Allowable d·n value and the criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Permissible d•n value: 70000 or less

Criterion of maximum rotational speed: 3000 min^{-1}

Note: Please also review the critical speed.

For details, see "Technical Description: Permissible rotational speed" (Page B51).

(4) Application

SCALA type and Cartesian type industrial robots, semiconductor manufacturing machines, machines for automobile production facilities, material handling systems, other Z (vertical) axis and Z axis plus 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 B84) and "Precautions in Handling" (Page B103).

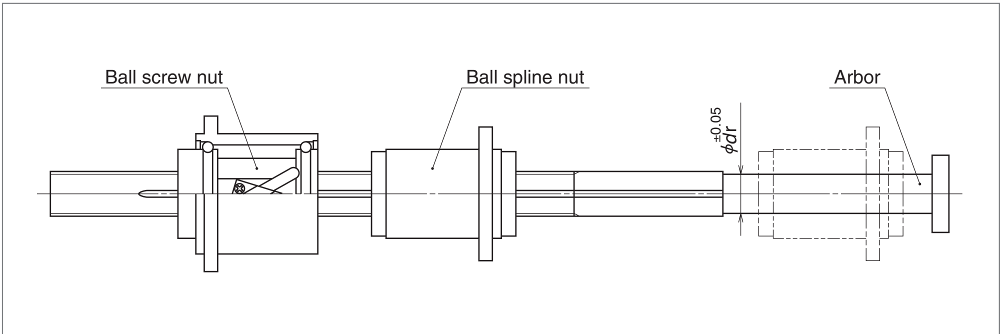
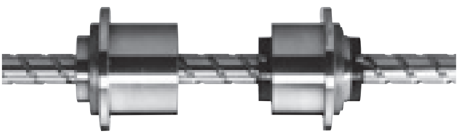
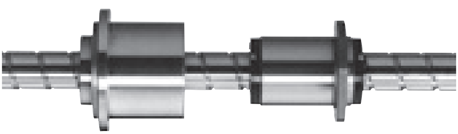
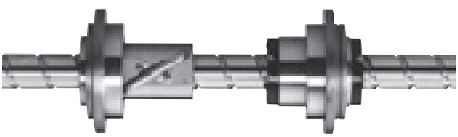
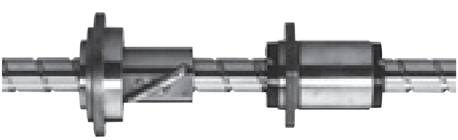


Fig. 4 Removing spline nut

5. Product categories

∑ 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)
∑		Standard	Z+θ Unit
∑Z		Standard	Z Unit
∑C		Compact	Z+θ Unit
∑CZ		Compact	Z Unit

6. Load rating and life

The relationship between load rating of the ball spline section and life is the same as in other NSK liner motion products. However, various loads that apply to Robotte must be taken into account. For example, the following factors must be considered in calculating life when the product is used as shown in Fig. 5.

- Fa : Load that is generated when the shaft moves in up-down direction. (Load is applied to the ball screw nut.)
- T : Torque that is generated to the shaft by Fa.
- Fr : Load that is generated by moment of inertia of the shaft and the work attached to Robotte as well as by centrifugal force when the arm rotates.
- 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.

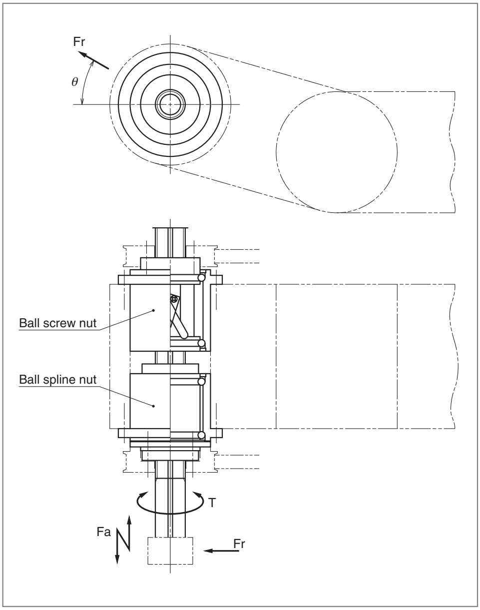


Fig. 5 Example structure of Z axis plus θ axis actuator

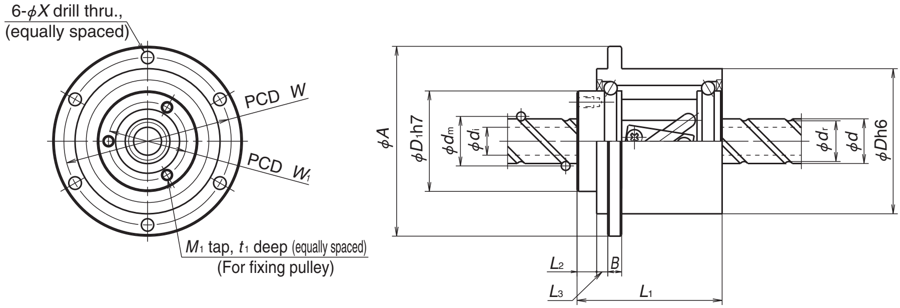
7. Example of model number in dimension table

A structure of "Reference number for ball screw" is as follows.

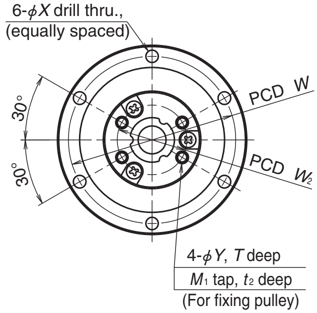
◇Reference number for ball screw

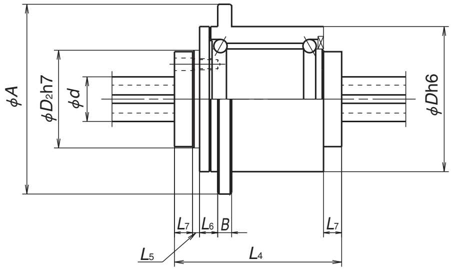
PW 25 02 - ** P T U - C5 Z 20

- PW: Product code
- 25: Screw shaft diameter (mm)
- 02: Effective threaded length (unit in 100 mm)
- **: Design serial number
- P: Preload code: No code ; Non-preload
- T: Hollow shaft ball screw specification
- U: Use support unit
- C5: Accuracy grade: C3, C5, C7 (Ct7)
- Z: Axial play code: Z, T, S
- 20: Lead (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
							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	(kg·cm²)
∑1610	16	10	3.175	16.75	13.4	(8)	5670	8300	48	64	5	47	7	4	3-M4	6	28	35	56	4.5	0.41
∑1632		32					3240	4680				52									0.44
∑2010	20	10	3.175	20.75	17.4	(14)	9560	17300	54	70	6	57	8	4	3-M4	6	32	40	62	4.5	0.64
∑2020		20					6100	10500				63									0.65
∑2040		40					3640	6310				57									0.64
∑2510	25	10	3.175	25.75	22.4	(18)	10700	22000	58	74	6	57	8	4	3-M4	6	38	45	66	4.5	1.10
∑2520		20					6860	13100				63									1.18
∑2525		25					6720	13300				72									1.30
∑3220	32	20	3.175	32.75	29.4	(25)	7710	16900	70	95	8	70	10	6	3-M5	10	44	53	82	6.6	2.60
∑3232		32					7590	16700				91									3.15
∑4020	40	20	3.969	41.0	36.9	(30)	11600	26500	85	110	8	73	10	6	4-M5	10	58	67	96	6.6	5.96
∑4040		40					11300	26200				107									7.85
∑4520	45	20	3.969	46.0	41.9	(35)	12000	30000	90	115	8	73	10	6	4-M5	10	63	72	101	6.6	7.73
∑4540		40					11800	29700				107									10.3





Unit: mm

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_4	L_5	L_6	L_7	Y	T	M_2	t_2	W_2	D_2	W	X	(kg·cm^2)	(kg)
0.50	5530	7270	61.5	91.3	48	64	5	60	2.5	6.5	6.5	4.5	6.5	M4	7	25	35	56	4.5	0.71	0.63
0.55	5890	8000	65.5	100																	
0.74	6260	8720	86.3	135	54	70	6	65	2.5	6.5	6.5	5.5	6.5	M5	8	30.5	40	62	4.5	1.15	0.87
0.81	6610	9450	91.1	145																	
0.74	6610	9450	91.1	145																	
0.81	6630	9450	115	185	58	74	6	70	2.5	6.5	6.5	5.5	6.5	M5	8	35.5	45	66	4.5	1.88	1.03
0.88	7290	10900	125	210																	
1.00	7290	10900	125	210																	
1.46	7630	11600	165	285	70	95	8	75	2.5	7.5	6.5	5.5	6.5	M5	8	42	50	82	6.6	3.80	1.62
1.83	7950	12400	175	305																	
2.02	10600	14800	290	455	85	110	8	80	4	7.5	8	5.5	8	M5	8	55	65	96	6.6	9.74	2.38
2.85	11200	15900	305	490																	
2.17	11200	15900	340	550	90	115	8	85	4	7.5	8	5.5	8	M5	8	60	70	101	6.6	12.5	2.56
3.06	11700	17000	360	590																	

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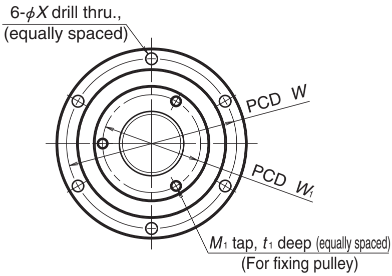
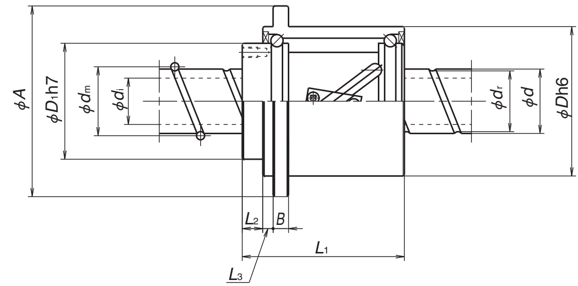
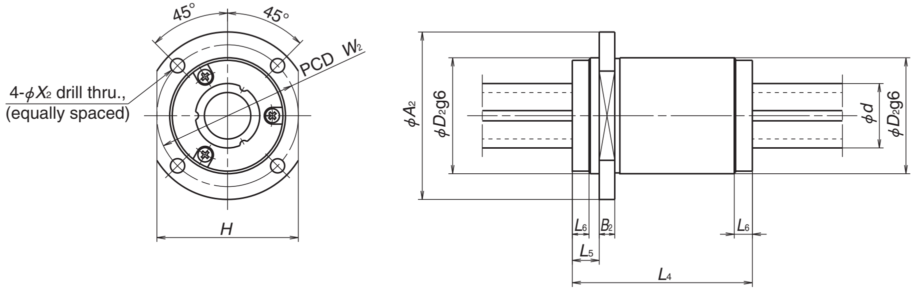
∑ Series for Robotte





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	M_1	t_1	W_1	D_1	W	X
∑Z1610	16	10	3.175	16.75	13.4	(8)	5670	8300	48	64	5	47	7	4	3-M4	6	28	35	56	4.5
∑Z1632		32					3240	4680				52								
∑Z2010	20	10	3.175	20.75	17.4	(14)	9560	17300	54	70	6	57	8	4	3-M4	6	32	40	62	4.5
∑Z2020		20					6100	10500				63								
∑Z2040		40					3640	6310				57								
∑Z2510	25	10	3.175	25.75	22.4	(18)	10700	22000	58	74	6	57	8	4	3-M4	6	38	45	66	4.5
∑Z2520		20					6720	13100				63								
∑Z2525		25					6720	13300				72								
∑Z3220	32	20	3.175	32.75	29.4	(25)	7710	16900	70	95	8	70	10	6	3-M5	10	44	53	82	6.6
∑Z3232		32					7590	16700				91								
∑Z4020	40	20	3.969	41.0	36.9	(30)	11600	26500	85	110	8	73	10	6	4-M5	10	58	67	96	6.6
∑Z4040		40					11300	26200				107								
∑Z4520	45	20	3.969	46.0	41.9	(35)	12000	30000	90	115	8	73	10	6	4-M5	10	63	72	101	6.6
∑Z4540		40					11800	29700				107								



Unit: mm

Moment of inertia (kg·cm^2)	Mass (kg)	Ball spline nut: Basic load rating (N) Dynamic C_r	Static C_{0r}	Basic torque (N·m) Dynamic C_t	Static C_{0t}	Dimensions D_2	A_2	B_2	L_4	L_5	L_6	H	W_2	X	Mass (kg)
0.41	0.50	5530	7270	61.5	91.3	35	55	6	60	10.5	6.5	4.5	4.5	4.5	0.35
0.44	0.55	5890	8000	65.5	100										
0.64	0.74	6260	8720	86.5	135	40	60	6	65	10.5	6.5	50	50	5.5	0.46
0.65	0.81	6610	9450	91.1	145										
0.64	0.74	6610	9450	91.1	145										
1.10	0.81	6630	9450	115	185	45	65	6	70	10.5	6.5	55	55	5.5	0.57
1.18	0.88	7290	10900	125	210										
1.30	1.00	7290	10900	125	210										
2.60	1.46	7630	11600	165	285	50	70	6	75	10.5	6.5	60	60	5.5	0.64
3.15	1.83	7950	12400	175	305										
5.96	2.02	10600	14800	290	455	65	88	8	80	12	8	76	76	6.6	1.20
7.85	2.85	11200	15900	305	490										
7.73	2.17	11200	15900	340	550	70	93	8	85	12	8	81	81	6.6	1.39
10.3	3.06	11700	17000	360	590										

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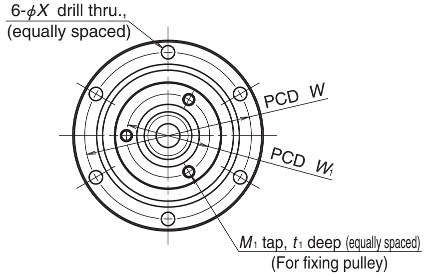
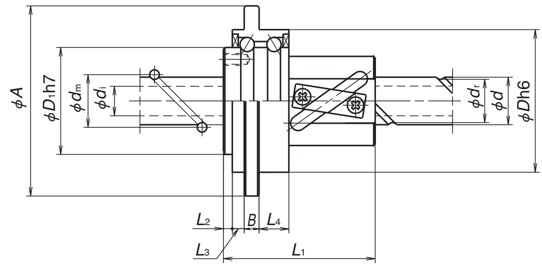
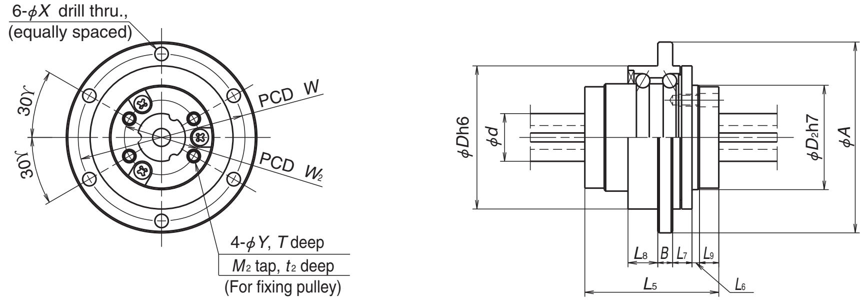




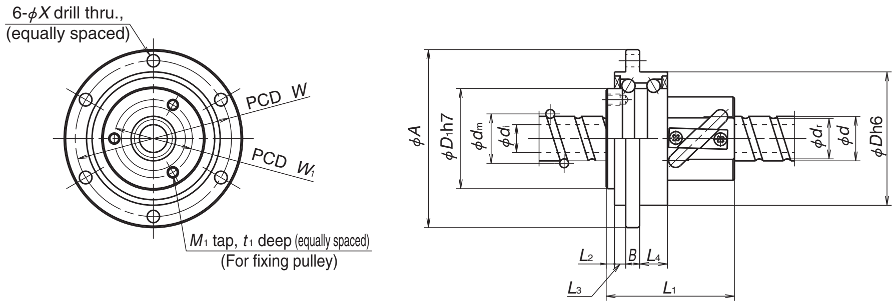
Model No.	Shaft dia.	Lead	Ball dia.	Ball circle dia.	Root dia.	Screw shaft hollow	Ball screw nut															
							Basic load rating(N)		Dimensions													Moment of inertia
							Dynamic	Static														
	d	l	D_w	d_m	d_r	d_i	C_a	C_{0a}	D	A	B	L_1	L_2	L_3	L_4	M_1	t_1	W_1	D_1	W	X	(kg·cm²)
∑C1610	16	10	3.175	16.75	13.4	(8)	5670	8300	48	64	5	46	3	4	10	3-M4	6	28	35	56	4.5	0.40
∑C1632		32					3240	4680				51			10							0.43
∑C2010	20	10	3.175	20.75	17.4	(14)	9560	17300	54	70	6	56	4	4	10	3-M4	6	32	40	62	4.5	0.63
∑C2020		20					6100	10500				63			10							0.65
∑C2040		40					3640	6310				56			10							0.63
∑C2510	25	10	3.175	25.75	22.4	(18)	10700	22000	58	74	6	56	4	4	10	3-M4	6	38	45	66	4.5	1.04
∑C2520		20					6860	13100				63			10							1.13
∑C2525		25					6720	13300				71			10							1.24



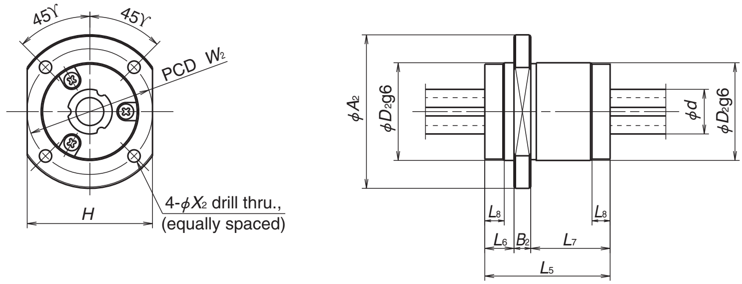
Unit: mm

Mass	Ball spline nut																					
	Basic load rating(N)		Basic torque(N·m)		Dimensions																Moment of inertia	Mass
	Dynamic	Static	Dynamic	Static																		
(kg)	C_r	C_{0r}	C_t	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)
0.41	4300	5090	47.9	63.9	48	64	5	45	2.5	6.5	10	6.5	4.5	6.5	M4	7	25	35	56	4.5	0.52	0.42
0.43	4300	5090	47.9	63.9																		
0.53	4730	5820	65.1	90.5	54	70	6	50	2.5	6.5	10	6.5	5.5	6.5	M5	8	30.5	40	62	4.5	0.86	0.56
0.56	5110	6540	70.5	100																		
0.53	5110	6540	70.5	100																		
0.60	5130	6540	87.8	125	58	74	6	55	2.5	6.5	10	6.5	5.5	6.5	M5	8	35.5	45	66	4.5	1.44	0.67
0.64	5870	8000	100	155																		
0.69	5870	8000	100	155																		

∑ Series for Robotte



Model No.	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Screw shaft hollow d_i	Ball screw nut: Basic load rating(N) Dynamic C_a	Static C_{0a}	Dimensions D	A	B	L_1	L_2	L_3	L_4	M_1	t_1	W_1	D_1	W	X
∑CZ1610	16	10	3.175	16.75	13.4	(8)	5670	8300	48	64	5	46	3	4	10	3-M4	6	28	35	56	4.5
∑CZ1632		32					3240	4680				51									
∑CZ2010	20	10	3.175	20.75	17.4	(14)	9560	17300	54	70	6	56	4	4	10	3-M4	6	32	40	62	4.5
∑CZ2020		20					6100	10500				63									
∑CZ2040		40					3640	6310				56									
∑CZ2510	25	10	3.175	25.75	22.4	(18)	10700	22000	58	74	6	56	4	4	10	3-M4	6	38	45	66	4.5
∑CZ2520		20					6860	13100				63									
∑CZ2525		25					6720	13300				71									



Unit: mm

Moment of inertia	Mass	Ball spline nut														
		Basic load rating(N)		Basic torque(N·m)		Dimensions										Mass
$(kg{\cdot}cm^2)$	(kg)	Dynamic C_r	Static C_{0r}	Dynamic C_t	Static C_{0t}	D_2	A_2	B_2	L_5	L_6	L_7	L_8	H	W_2	X_2	(kg)
0.40	0.41	4300	5090	47.9	63.9	35	55	6	45	10.5	28.5	6.5	45	45	4.5	0.26
0.43	0.43	4300	5090	47.9	63.9											
0.63	0.53	4730	5820	65.1	90.5	40	60	6	50	10.5	33.5	6.5	50	50	5.5	0.35
0.65	0.56	5110	6540	70.5	100											
0.63	0.53	5110	6540	70.5	100											
1.04	0.60	5130	6540	87.8	125	45	65	6	55	10.5	38.5	6.5	55	55	5.5	0.44
1.13	0.64	5870	8000	100	155											
1.24	0.69	5870	8000	100	155											

B-3-1.10 Ball Screws for Transfer Equipment

1. Features

● Transporting mechanism

Ct7 and Ct10 grades series demonstrate high ball screw performance for transporting mechanism of Cartesian type robots and single axis actuators. The following types are categorized ball screw for transfer equipment. VFA and RMA types have finished shaft ends. RMS type, R series of RNFTL, 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) Recirculation system

Fig. 1, 2, and 3 show the structures of ball return tube, deflector, and end cap recirculation systems. Deflector recirculation system has the feature of compact nut outside diameter for small lead. End cap recirculation system is for screws with high helix lead and multiple start threads. Since the leads are in the range larger than 1.3 times of the screw shaft diameter, it is suitable for high-speed operation.

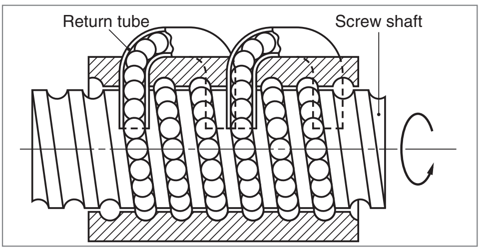


Fig. 1 Structure of return tube recirculation system

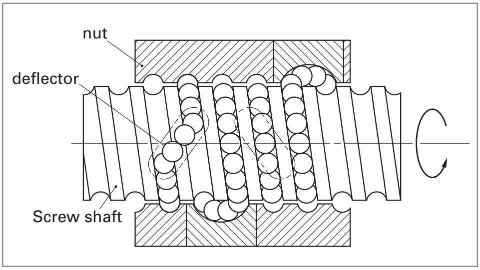


Fig. 2 Structure of deflector recirculation system

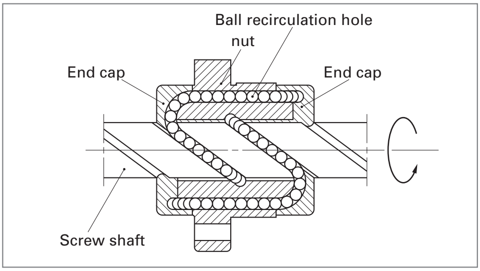


Fig. 3 Structure of end cap recirculation system

(2) Accuracy grade and axial play

Standard lead accuracy and axial play are shown on Table 2. Axial play varies with internal specification. Refer to the dimension tables.

Table 2 Accuracy grade and axial play

Accuracy grade	VFA type, RMA type, RMS type : Ct7 R Series : Ct10
Axial play	See dimension tables

(3) Allowable d·n value and the criterion of maximum rotational speed

Allowable d·n value and the criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Table 2 Allowable d·n value and the criterion of maximum rotational speed

Allowable d·n value	50000 or less
Criterion of maximum rotational speed	3000 min^{-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 B51) for details.

3. Design precautions

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B497).

(1) Nut installation

Nut assembly and the screw shaft are separated at the time of delivery. Refer to "Technical description: Installation of Ball Screw" (page B77) for installation of ball nut assembly.

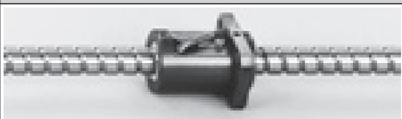
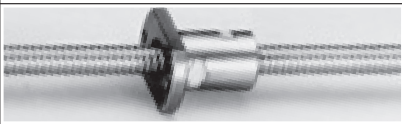
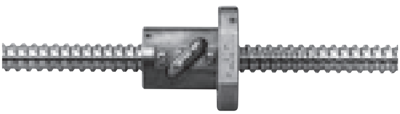
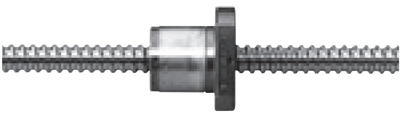
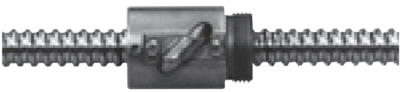
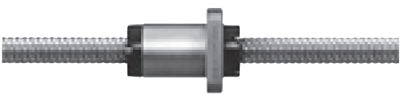
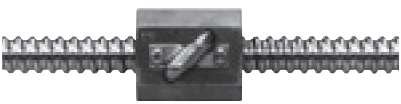
(2) Shaft end machining

It is necessary to machine screw shaft end of RMS and R series. Refer to "Selection Guide to NSK Ball Screw: Configuration of shaft end" (Page B27) if you use standard support units. Refer to "Technical Description: Shaft end machining" (Page B83) for procedures and precautions.

4. Product categories

Ball screws for transfer equipment have models as follows.

Table 4 Product categories of ball screws for transfer equipment

Nut models	Shape	Flange shape	Recirculation system	Preload system	Page
VFA		Flanged rectangular	Return tube type	Non-preload Slight axial play	B173 – B178
RMA RMS		Flanged Circular Ⅲ	Deflector type	Non-preload Slight axial play	B179 – B192
RNFTL		Flanged Circular Ⅰ Projecting tube type	Return tube type	Non-preload Slight axial play	B193 – B196
RNFBL		Flanged Circular Ⅱ	Return tube type	Non-preload Slight axial play	B199
RNCT		V-thread (no flange) Projecting tube type	Return tube type	Non-preload Slight axial play	B201
RNFCL		Flanged Circular Ⅲ	End cap type	Non-preload Slight axial play	B203 – B206
RNSTL		Square type	Return tube type	Non-preload Slight axial play	B207

5. Example of model number in dimension table

A structure of "Reference number for ball screw" is as follows.

◇Reference number for VFA, RMA, and RMS types

VFA 15 10 - C7 S - 500

- VFA: Ball screw for transfer equipment: VFA, RMA, RMS
- 15: Screw shaft diameter (mm)
- 10: Lead (mm)
- C7: Accuracy grade code
- S: Axial play
- 500: Screw shaft length (mm)

◇Reference number for R series

Nut assembly (example)

RNFTL 25 10 A 5 S

- RNFTL: Nut model : RNFTL, RNFBL, RNCT, RNFCL, RNSTL
- 25: Screw shaft diameter (mm)
- 10: Lead (mm)
- A: Internal design code
- 5: Effective turns of balls (turns of balls × number of circuit)
- S: Seal code S: With seal; No code: Without seal

Screw shaft (example)

RS 25 10 A 20

- RS: Product code
- 25: Screw shaft diameter (mm)
- 10: Lead (mm)
- A: Internal design code
- 20: Screw shaft length (x 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.

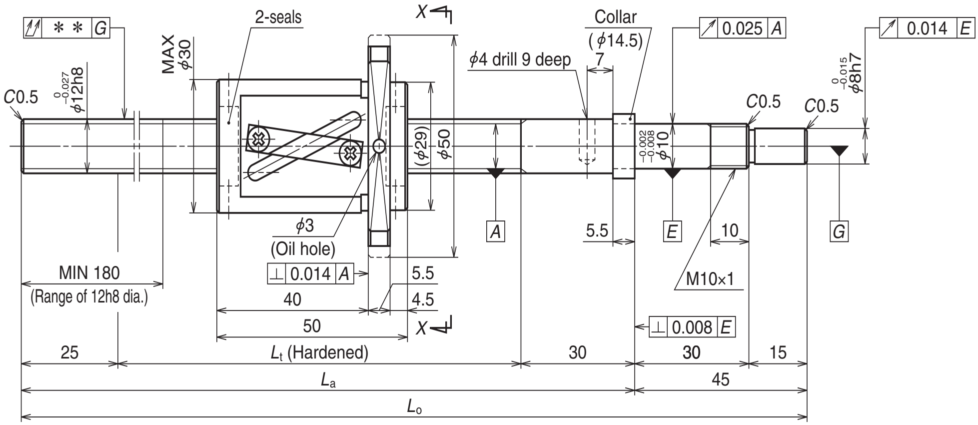
Table 5 Combinations of shaft diameter and lead for VFA, RMA, RMS types

Screw shaft diameter \ Lead	1	1.5	2	10	20
6	B179, 191				
8	B181, 191	B183, 191	B185, 191		
10			B187, 191		
12			B189, 191	B173	
15				B175	B177

Table 6 Combinations of shaft diameter and lead for R series

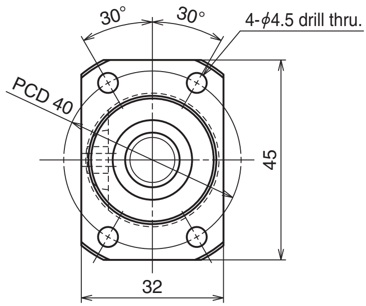
Screw shaft diameter (mm)	Lead (mm)														
	3	4	5	6	8	10	12	16	20	25	32	40	50	64	80
10	○B193 △B201			○B193●B199											
12					○B193●B199		○B197◎B203								
14		○B193●B199 △B201□B207	○B193●B199 △B201□B207												
15									◎B203						
16						○B193		○B197 ◎B203			◎B205				
18					○B193●B199 △B201□B207										
20			○B193●B199 △B201□B207			○B193●B199 □B207			○B197 ◎B203			◎B205			
25			○B193●B199 △B201□B207			○B193●B199 △B201□B207				○B197 ◎B203			◎B205		
28				○B195●B199 △B201□B207											
32						○B195●B199 △B201□B207					○B197 ◎B203			◎B205	
36						○B195●B199 △B201□B207									
40						○B195△B201 ●B199						○B197 ◎B203			◎B205
45							○B195 △B201□B207								
50						○B195 △B201		○B195 △B201					◎B203		

○ : RNFTL ● : RNFBL △ : RNCT ◎ : RNFCL □ : RNSTL



Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t-nut length)	L_t	L_a	L_o
VFA1210C7S-410	250	260	310	365	410
VFA1210C7S-610	450	460	510	565	610

Remarks
1. We recommend NSK support units (page B433). WBK12SF-01 (on the simple support side) supports the ball screw directly on the shaft OD.
2. NSK grease LR3 is recommended. The amount for grease replenishing should be about 50% of nut internal space capacity. Please refer to page D16 on details.
3. Permissible rotational speed is determined by a d · n value and a critical speed. See page B169 and page B51.



View *X-X*

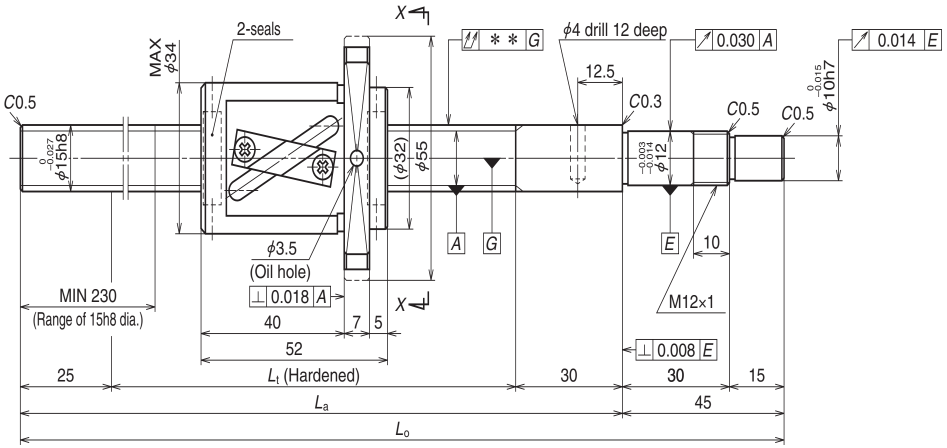
Unit: mm

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	4430
	Static C_{0a}	6430
Axial play		0.010 or less
Dynamic friction torque (N·cm)		1.5 or less
Spacer ball		None
Factory pre-packed grease		NSK grease LR3
Internal spatial volume of nut (cm^3)		1.4
Reference of grease replenishing amount		0.7

Recommend support units	
WBK10-01A	(Square, fixed side)
WBK12SF-01	(Square, simple side)
WBK10-11	(Round, fixed side)

Unit: mm

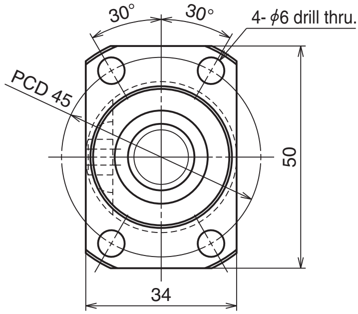
Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
T	e_p	υ_{300}			Fixed - Simple support	Fixed - Free
0	0.085	0.052	0.100	0.56	3000	3000
0	0.155	0.052	0.160	0.73	3000	1300



Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t-nut length)	L_t	L_a	L_o
VFA1510C7S-500	300	348	400	455	500
VFA1510C7S-700	500	548	600	655	700
VFA1510C7S-1000	800	848	900	955	1000

Remarks
1. We recommend NSK support units (page B433). WBK12SF-01 (on the simple support side) supports the ball screw directly on the shaft OD.
2. NSK grease LR3 is recommended. The amount for grease replenishing should be about 50% of nut internal space capacity. Please refer to page D16 on details.
3. Permissible rotational speed is determined by a d · n value and a critical speed. See page B169 and page B51.

ø15×10



View *X-X*

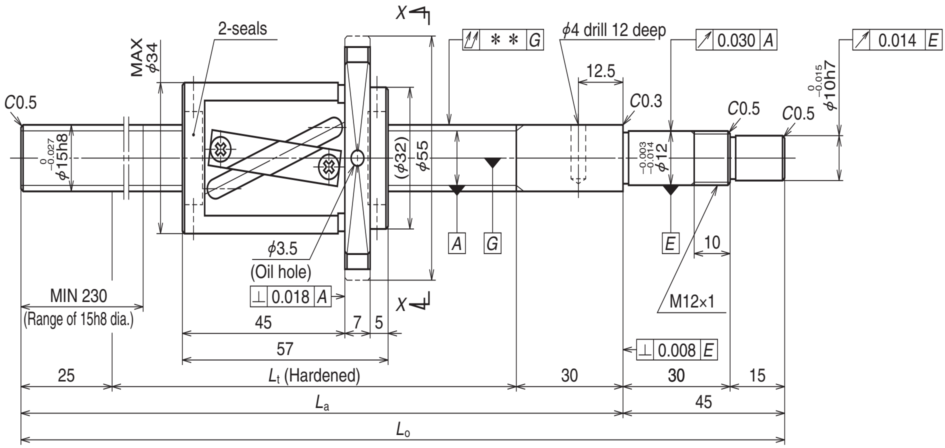
Unit: mm

Ball screw specification		
Shaft dia.xLead / Direction of turn		15×10/Right
Ball recirculation		Return tube
Ball dia. / Ball circle dia.		3.175/15.5
Screw shaft root dia.		12.2
Effective turns of balls		2.5×1
Accuracy grade / Axial play code		Ct7/S
Basic load rating (N)	Dynamic C_a	8140
	Static C_{0a}	12800
Axial play		0.010 or less
Dynamic friction torque (N·cm)		2.5 or less
Spacer ball		None
Factory pre-packed grease		NSK grease LR3
Internal spatial volume of nut (cm^3)		2.3
Reference of grease replenishing amount		1.2

Recommend support units	
WBK12-01A	(Square, fixed side)
WBK15SF-01	(Square, simple side)
WBK12-11	(Round, fixed side)

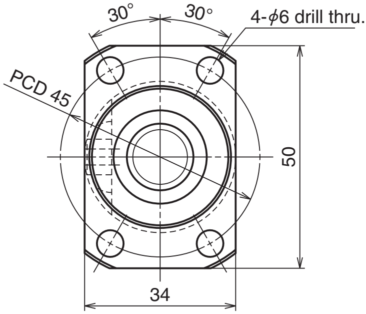
Unit: mm

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
T	e_p	υ_{300}			Fixed - Simple support	Fixed - Free
0	0.120	0.052	0.075	0.89	3000	2600
0	0.195	0.052	0.110	1.1	3000	1150
0	0.310	0.052	0.180	1.5	2340	510



Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t-nut length)	L_t	L_a	L_o
VFA1520C7S-500	300	343	400	455	500
VFA1520C7S-700	500	543	600	655	700
VFA1520C7S-1000	800	843	900	955	1000

Remarks
1. We recommend NSK support units (page B433). WBK12SF-01 (on the simple support side) supports the ball screw directly on the shaft OD.
2. NSK grease LR3 is recommended. The amount for grease replenishing should be about 50% of nut internal space capacity. Please refer to page D16 on details.
3. Permissible rotational speed is determined by a d · n value and a critical speed. See page B169 and page B51.



View *X-X*

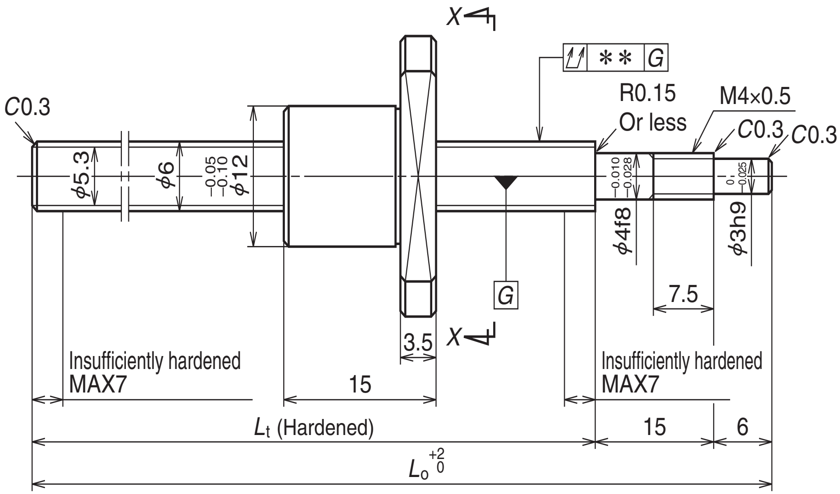
Unit: mm

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	5080
	Static C_{0a}	7460
Axial play		0.010 or less
Dynamic friction torque (N·cm)		2.5 or less
Spacer ball		None
Factory pre-packed grease		NSK grease LR3
Internal spatial volume of nut (cm³)		2.3
Reference of grease replenishing amount		1.4

Recommend support units	
WBK12-01A	(Square, fixed side)
WBK15SF-01	(Square, simple side)
WBK12-11	(Round, fixed side)

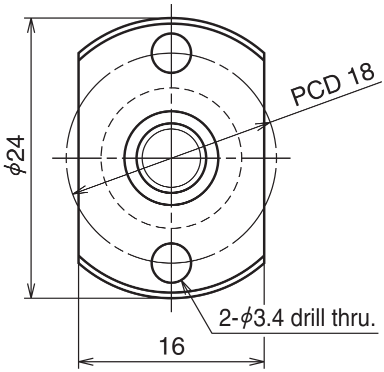
Unit: mm

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
T	e_p	υ_{300}			Fixed - Simple support	Fixed - Free
0	0.120	0.052	0.075	0.94	3000	2630
0	0.195	0.052	0.110	1.2	3000	1160
0	0.310	0.052	0.180	1.6	2350	510



Ball screw No.	Stroke		Screw shaft length	
	Nominal	Maximum (L_t-Nut length)	L_t	L_o
RMA0601C7S-160	100	124	139	160
RMA0601C7S-260	200	224	239	260

Remarks 1. We recommend NSK support bearing kit (page B445).
2. Only rust preventive oil is applied at time of delivery. Please apply lubricant (oil or grease) before use.
Refer to page D13 on details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B169 and page B51.



View *X-X*

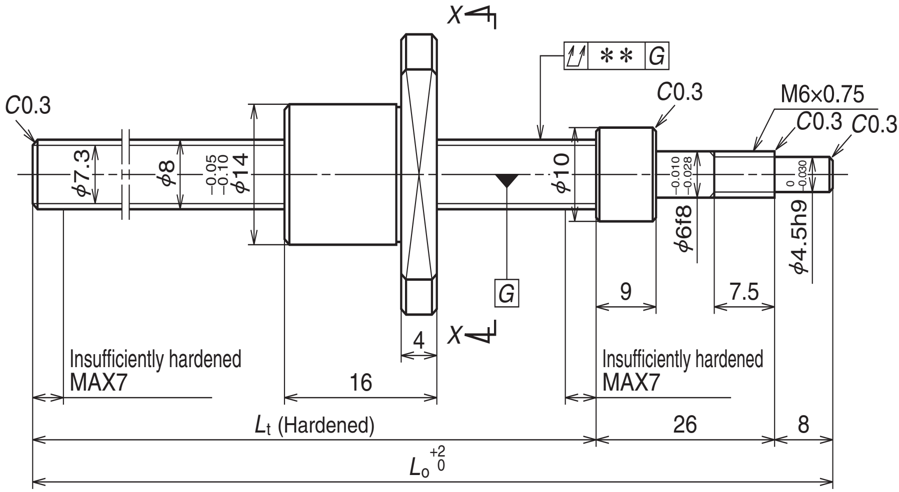
Unit: mm

Ball screw specification		
Shaft dia.xLead / Direction of turn		6×1/Right
Ball recirculation		Deflector
Ball dia. / Ball circle dia.		0.800/6.2
Screw shaft root dia.		5.2
Effective turns of balls		1×3
Accuracy grade / Axial play code		Ct7/S
Basic load rating (N)	Dynamic C_a	610
	Static C_{0a}	920
Axial play		0.020 or less
Dynamic friction torque (N·cm)		1.0 or less
Spacer ball		None
Factory pre-packed grease		**Refer to the remarks 2.**

Recommend support unit	
WBK04R-11	(Round, fixed side)

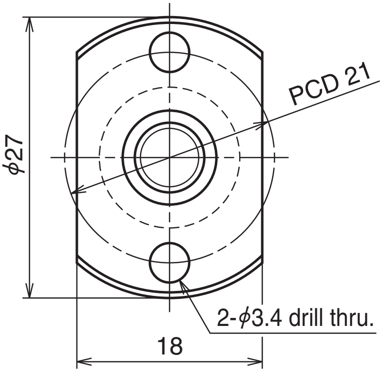
Unit: mm

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min^{-1})
Target compensation T	Deviation e_p	Variation υ_{300}			
0	0.052	0.052	0.060	0.045	3000
0	0.085	0.052	0.090	0.065	3000



Ball screw No.	Stroke		Screw shaft length	
	Nominal	Maximum (L_t-Nut length)	L_t	L_o
RMA0801C7S-180	100	130	146	180
RMA0801C7S-280	200	230	246	280

Remarks
1. We recommend NSK support bearing kit (page B445).
2. **Only rust preventive oil is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to page D13 on details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B169 and page B51.



View *X-X*

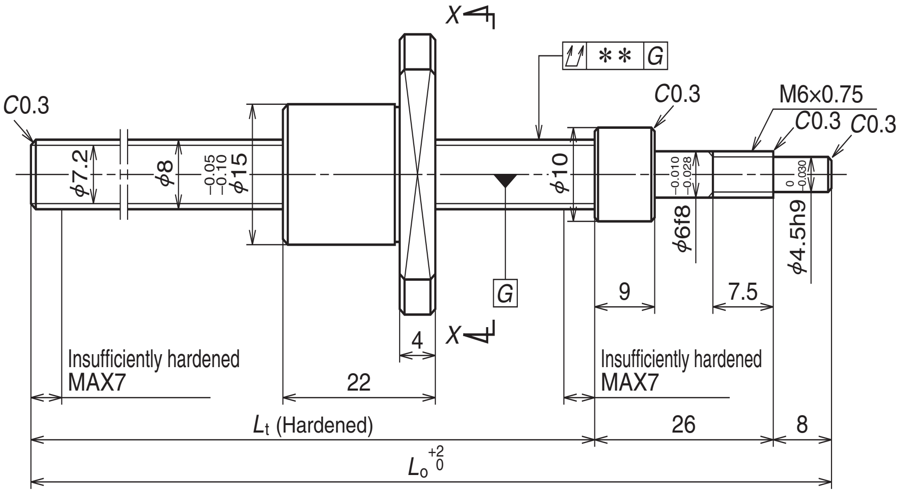
Unit: mm

Ball screw specification		
Shaft dia.×Lead / 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	710
	Static C_{0a}	1290
Axial play		0.020 or less
Dynamic friction torque (N·cm)		1.0 or less
Spacer ball		None
Factory pre-packed grease		**Refer to the remarks 2.**

Recommend support unit	
WBK06R-11	(Round, fixed side)

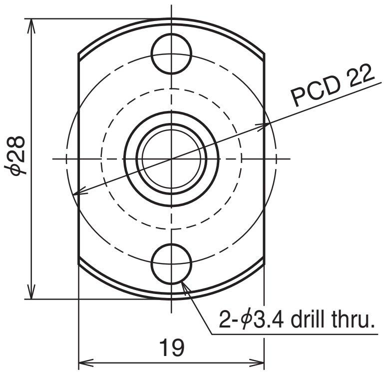
Unit: mm

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min^{-1})
Target compensation *T*	Deviation e_p	Variation υ_{300}			
0	0.052	0.052	0.060	0.085	3000
0	0.085	0.052	0.090	0.12	3000



Ball screw No.	Stroke		Screw shaft length	
	Nominal	Maximum (L_t-Nut length)	L_t	L_o
RMA0801.5C7S-180	100	124	146	180
RMA0801.5C7S-280	200	224	246	280

Remarks
1. We recommend NSK support bearing kit (page B445).
2. **Only rust preventive oil is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to page D13 on details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B169 and page B51.



View *X-X*

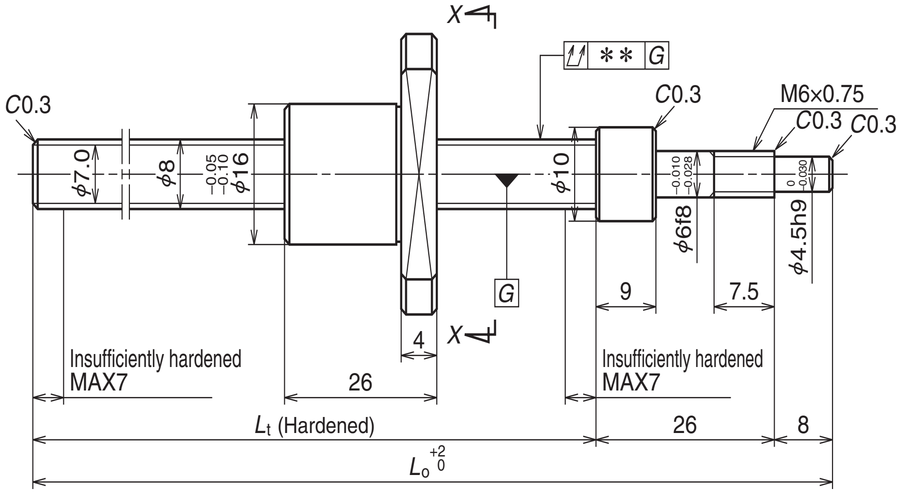
Unit: mm

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	955
	Static C_{0a}	1580
Axial play		0.020 or less
Dynamic friction torque (N·cm)		1.0 or less
Spacer ball		None
Factory pre-packed grease		**Refer to the remarks 2.**

Recommend support unit	
WBK06R-11	(Round, fixed side)

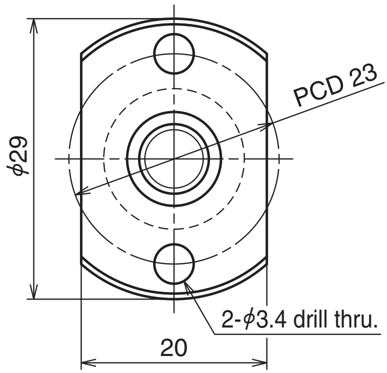
Unit: mm

Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min^{-1})
Target compensation T	Deviation e_p	Variation υ_{300}			
0	0.052	0.052	0.060	0.093	3000
0	0.085	0.052	0.090	0.13	3000



Ball screw No.	Stroke		Screw shaft length	
	Nominal	Maximum (L_t-Nut length)	L_t	L_o
RMA0802C7S-180	100	120	146	180
RMA0802C7S-280	200	220	246	280

Remarks 1. We recommend NSK support bearing kit (page B445).
2. Only rust preventive oil is applied at time of delivery. Please apply lubricant (oil or grease) before use.
Refer to page D13 on details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B169 and page B51.



View *X*-*X*

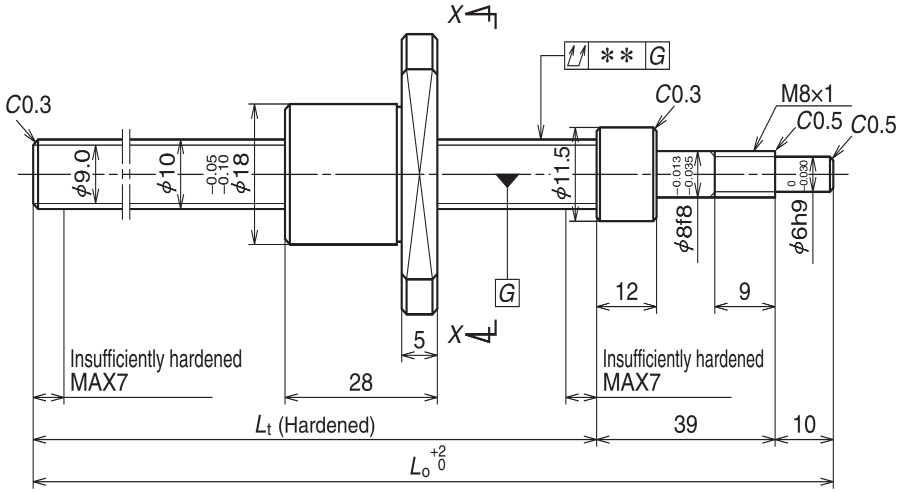
Unit: mm

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	1260
	Static C_{0a}	1940
Axial play		0.020 or less
Dynamic friction torque (N·cm)		1.0 or less
Spacer ball		None
Factory pre-packed grease		**Refer to the remarks 2.**

Recommend support unit	
WBK06R-11	(Round, fixed side)

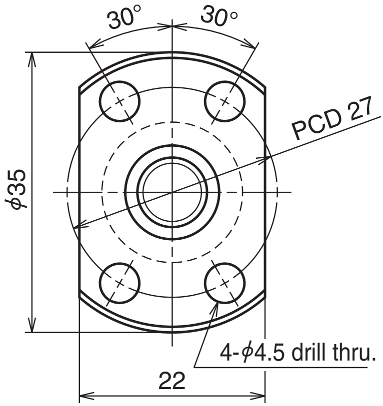
Unit: mm

Lead accuracy			Shaft run-out** ⌰	Mass (kg)	Permissible rotational speed N (min^{-1})
Target compensation *T*	Deviation e_p	Variation υ_{300}			
0	0.052	0.052	0.060	0.10	3000
0	0.085	0.052	0.090	0.14	3000



Ball screw No.	Stroke		Screw shaft length	
	Nominal	Maximum (L_t-Nut length)	L_t	L_o
RMA1002C7S-250	150	173	201	250
RMA1002C7S-350	250	273	301	350

Remarks 1. We recommend NSK support bearing kit (page B445).
2. Only rust preventive oil is applied at time of delivery. Please apply lubricant (oil or grease) before use.
Refer to page D13 on details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B169 and page B51.



View *X-X*

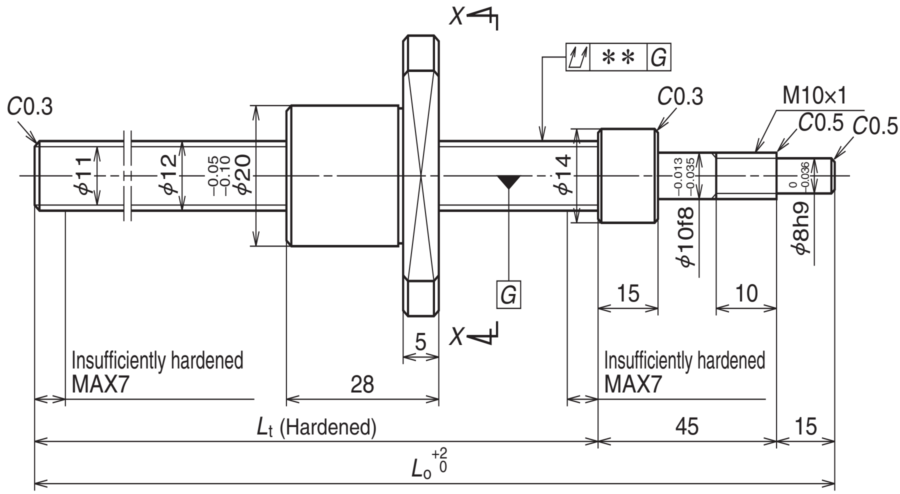
Unit: mm

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	1460
	Static C_{0a}	2620
Axial play		0.020 or less
Dynamic friction torque (N·cm)		1.0 or less
Spacer ball		None
Factory pre-packed grease		**Refer to the remarks 2.**

Recommend support unit	
WBK08-01A	(Square, fixed side)
WBK08-11	(Round, fixed side)

Unit: mm

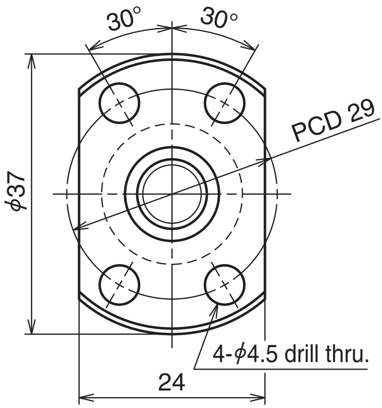
Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min^{-1})
Target compensation *T*	Deviation e_p	Variation υ_{300}			
0	0.085	0.052	0.070	0.19	3000
0	0.085	0.052	0.100	0.25	3000



Ball screw No.	Stroke		Screw shaft length	
	Nominal	Maximum (L_t-Nut length)	L_t	L_o
RMA1202C7S-250	150	162	190	250
RMA1202C7S-350	250	262	290	350

Remarks
1. We recommend NSK support bearing kit (page B445).
2. **Only rust preventive oil is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to page D13 on details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B169 and page B51.

ø12×2



View *X-X*

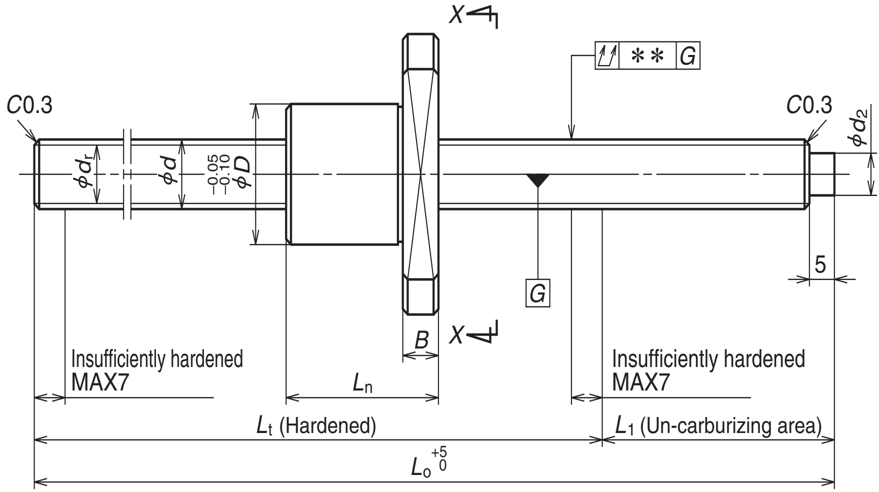
Unit: mm

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	1590
	Static C_{0a}	3190
Axial play		0.020 or less
Dynamic friction torque (N·cm)		1.0 or less
Spacer ball		None
Factory pre-packed grease		**Refer to the remarks 2.**

Recommend support unit	
WBK10-01A	(Square, fixed side)
WBK10-11	(Round, fixed side)

Unit: mm

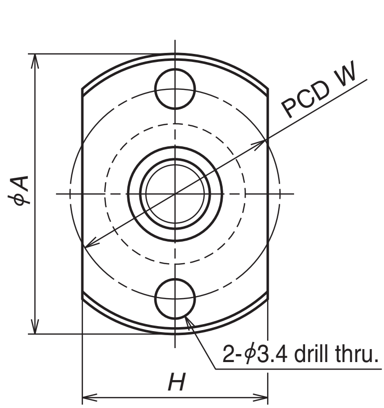
Lead accuracy			Shaft run-out**	Mass (kg)	Permissible rotational speed N (min^{-1})
Target compensation T	Deviation e_p	Variation υ_{300}			
0	0.060	0.052	0.070	0.26	3000
0	0.085	0.052	0.100	0.34	3000



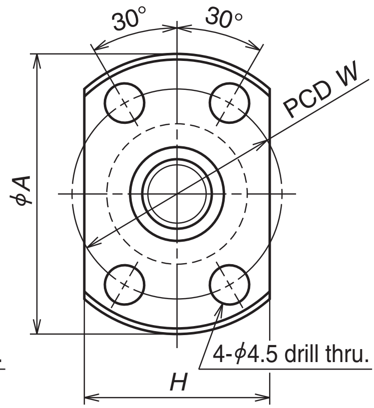
Ball screw No.	Stroke Max. L_t-L_n	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls	Basic load rating (N) Dynamic C_a	Static C_{0a}	Axial play Max.
RMS0601C7S-300	235	6	1	0.800	6.2	5.3	3	610	920	0.02
RMS0801C7S-300	234	8	1	0.800	8.2	7.3	3	710	1290	0.02
RMS0801.5C7S-300	228		1.5	1.000	8.3	7.2		955	1580	
RMS0802C7S-300	224		2	1.200	8.3	7.0		1260	1940	
RMS1002C7S-350	262	10	2	1.200	10.3	9.0	3	1460	2620	0.02
RMS1202C7S-350	262	12	2	1.200	12.3	11.0	3	1590	3190	0.02

Remarks
1. We recommend NSK support unit (page B433) or support kit (page B445).
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use** Refer to page D13 on details.
3. Seal is not installed.
4. Permissible rotational speed is determined by a d·n value and a critical speed. See page B169 and page B51.

ø6×1, ø8×1, ø8×1.5
ø8×2, ø10×2, ø12×2



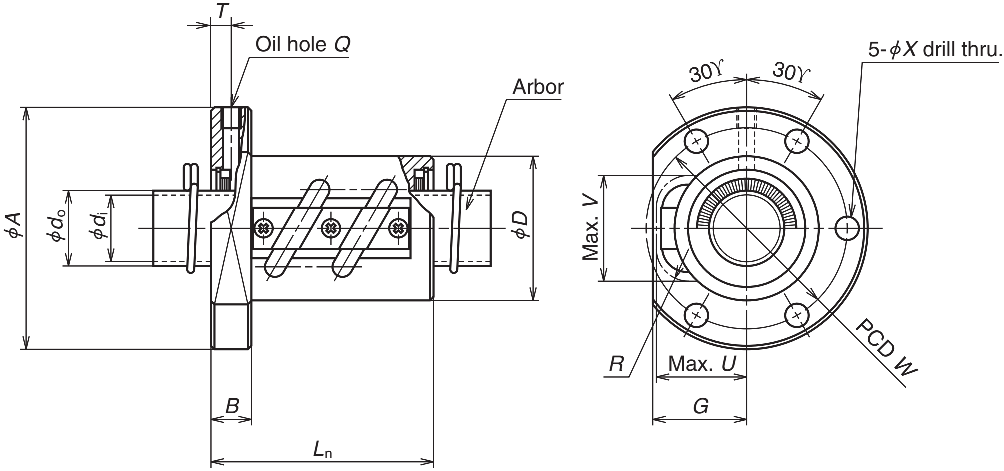
View *X-X*
(For screw shaft of 6 and 8 dia.)



View *X-X*
(For screw shaft of 10 and 12 dia.)

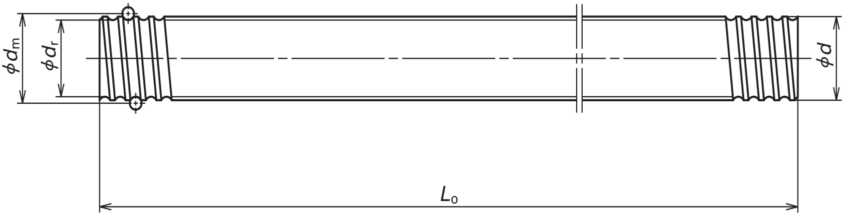
Unit: mm

Nut dimensions						Screw shaft dimensions				Lead accuracy			Shaft run-out**	Mass (Kg)	Permissible rotational speed N (min⁻¹)
						Effective thread length	Shaft end		Overall length	Target compensation	Deviation	Variation			
D	A	H	B	L_n	W	L_t	L_1	d_2	L_o	T	e_p	υ_{300}			
12	24	16	3.5	15	18	250	50	4	300	0	0.085	0.052	0.09	0.075	
14	27	18		16	21									0.13	
15	28	19	4	22	22	250	50	6	300	0	0.085	0.052	0.09	0.14	3000
16	29	20		26	23									0.15	
18	35	22	5	28	27	290	60	8	350	0	0.085	0.052	0.10	0.25	
20	37	24	5	28	29	290	60	10	350	0	0.085	0.052	0.10	0.35	



Ball nut No.	Shaft dia. 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	Static C_{0a}	Axial play Max.	Ball nut dimensions Outside dia. D
RNFTL 1003A3.5	10	3	2.381	10.65	8.0	3.5×1	4440	6700	0.10	20
RNFTL 1006A2.5S	10	6	2.381	10.65	8.1	2.5×1	3280	4730	0.10	20
RNFTL 1208A2.5S	12	8	2.778	12.65	9.6	2.5×1	4290	6610	0.10	25
RNFTL 1404A3.5S	14	4	2.778	14.5	11.5	3.5×1	6310	10800	0.10	25
RNFTL 1405A2.5S	14	5	3.175	14.5	11.0	2.5×1	6170	9940	0.10	30
RNFTL 1610A2.5 **RNFTL 1610A2.5S**	16	10	3.175	16.75	13.3	2.5×1	6810	11600	0.10	30
RNFTL 1808A3.5 **RNFTL 1808A3.5S**	18	8	4.762	18.5	13.5	3.5×1	15500	26200	0.15	34
RNFTL 2005A2.5 **RNFTL 2005A2.5S**	20	5	3.175	20.5	17.0	2.5×1	7500	14200	0.10	40
RNFTL 2010A2.5 **RNFTL 2010A2.5S**	20	10	4.762	21.25	16.2	2.5×1	12700	21600	0.15	40
RNFTL 2505A5 **RNFTL 2505A5S**	25	5	3.175	25.5	22.0	2.5×2	15100	36300	0.10	42
RNFTL 2510A2.5 **RNFTL 2510A2.5S**	25	10	6.35	26	19.0	2.5×1	20500	34900	0.20	44
RNFTL 2510A5 **RNFTL 2510A5S**						2.5×2	37300	69800		44

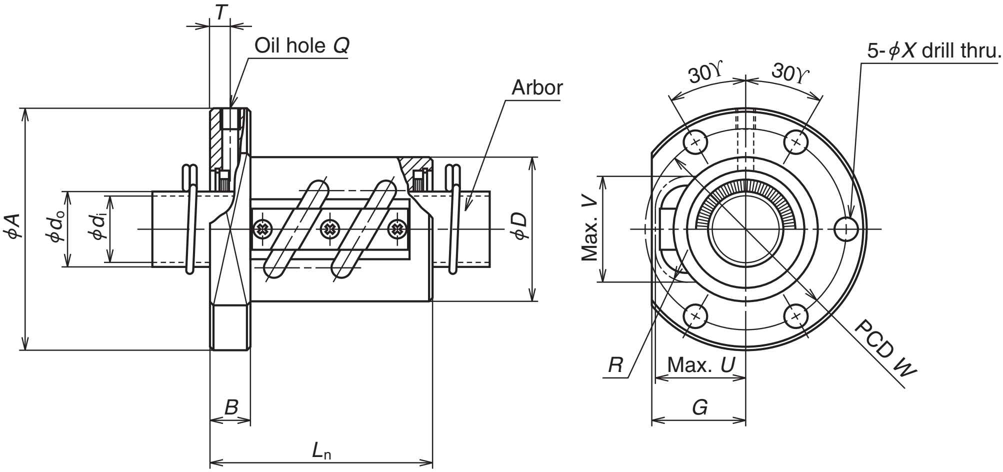
Remarks
1. Protruding portion of the tube does not have any interference with the ball nut housing if its dimensions corresponding to U and V are large enough.
2. The overall screw shaft length may be slightly longer than nominal length L_0 due to manufacturing tolerance.
3. Only ball nut part numbers ending “S” are equipped with seals. External dimensions of nuts with seals are the same as those without.
In the side view of the ball nut, view above the centerline shows internal seals, and view beneath the external geometry.
Seals for shaft diameters 14 mm or less are made of synthetic resin. Seals for 16 mm diameter or greater are "Brush" seals.



Unit: mm

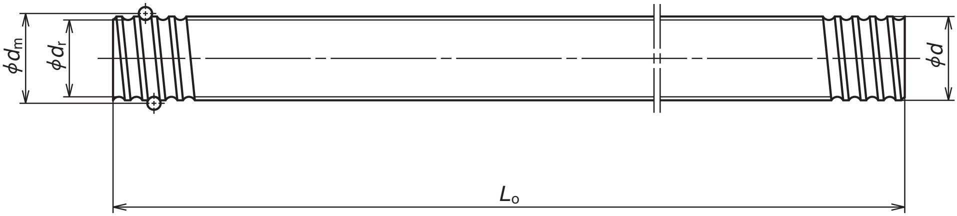
Ball nut dimensions											Nut Mass. (kg)	Arbor		Screw shaft				Shaft mass/m (kg)	Internal spatial volume of nut (cm^3)	Standard volume of greas replenishing (cm^3)
Flange			Length	Bolt hole		Oil hole		Projecting tube				Outside dia.	Bore	Standard length			Screw shaft No.			
A	*G*	*B*	L_n	*W*	*X*	*Q*	*T*	*U*	*V*	*R*		d_0	d_i	L_o						
40	15	6	34	30	4.5	M3×0.5	3.0	15	15	7	0.092	8.1	6.1	400	800	–	RS1003A··	0.50	–	–
40	15	6	36	30	4.5	M3×0.5	3.5	15	15	5	0.095	8.1	6.1	400	800	–	RS1006A··	0.56	1.1	0.6
45	19	8	46	35	4.5	M3×0.5	5.5	19	18	7	0.18	9.6	7.6	400	800	–	RS1208A··	0.74	1.8	0.9
50	19	10	43	40	4.5	M6×1	5.0	19	20	7	0.20	11.5	9.5	500	1000	–	RS1404A··	1.02	2.0	1.0
50	22	10	45	40	4.5	M6×1	5.0	22	21	8	0.26	11.0	9.0	500	1000	–	RS1405A··	1.00	2.4	1.2
53	23	10	54	41	5.5	M6×1	5.5	23	22.5	8	0.28	13.3	11.3	500	1000	1500	RS1610A··	1.37	2.7	1.4
63	27	12	58	49	6.6	M6×1	6.0	27	27	8	0.43	13.6	11.6	500	1000	1500	RS1808A··	1.60	5.2	2.6
60	28	10	46	50	4.5	M6×1	5.0	28	27	10	0.42	17.0	14.6	500	1000	2000	RS2005A··	2.17	3.5	1.8
67	30	12	59	53	6.6	M6×1	6.0	30	29	12	0.55	16.2	13.8	500	1000	2000	RS2010A··	2.18	7.1	3.6
71	28	12	66	57	6.6	M6×1	6.0	28	31	10	0.62	22.0	19.6	1000	2000	2500	RS2505A··	3.47	6.5	3.3
80	34	15	62	62	9	M6×1	7.5	34	37	17	0.75	19.0	16.6	1000	2000	2500	RS2510A··	3.13	13	6.5
80	34	15	92	62	9	M6×1	7.5	34	37	17									18	9.0

Remarks
4. Nut assembly with arbor and screw shaft are shipped separately.
5. In the portion of the screw shaft reference number indicated by ··, enter the value obtained by diving the standard screw shaft length by 100 mm.
6. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.
7. The internal spatial volume of nut and standard volume of grease replenishing in the dimension table are the values with seal. The amount for grease replenishing should be about 50% of nut internal space capacity.
If there is no seal, spread the screw shaft with grease or move the ball nut by hand while replenishing grease, so the grease permeates all area of nut. Please refer to page D16 for details.



Ball nut No.	Shaft dia. 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	8760	20200	0.10	50
RNFTL 2806A5 **RNFTL 2806A5S**						2.5×2	15900	40500		50
RNFTL 3210A5 **RNFTL 3210A5S**	32	10	6.35	33.75	27.0	2.5×2	42000	91800	0.20	55
RNFTL 3610A2.5 **RNFTL 3610A2.5S**	36	10	6.35	37	30.0	2.5×1	24700	50800	0.20	60
RNFTL 3610A5 **RNFTL 3610A5S**						2.5×2	44900	102000		60
RNFTL 4010A7 **RNFTL 4010A7S**	40	10	6.35	41.75	35.0	3.5×2	63100	164000	0.20	65
RNFTL 4512A5 **RNFTL 4512A5S**	45	12	7.144	46.5	39.0	2.5×2	58500	147000	0.23	70
RNFTL 5010A7 **RNFTL 5010A7S**	50	10	6.35	51.75	45.0	3.5×2	70100	205000	0.20	80
RNFTL 5016A5 **RNFTL 5016A5S**	50	16	9.525	52	42.0	2.5×2	117000	299000	0.23	85

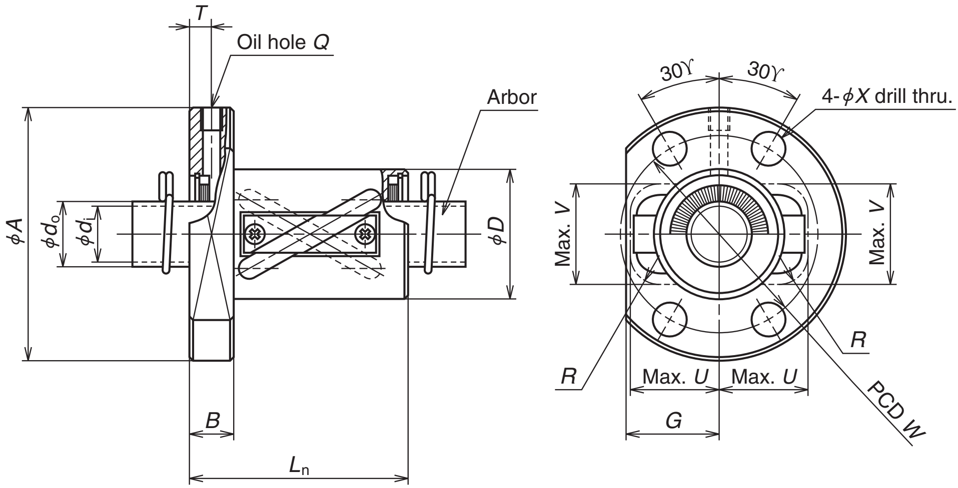
Remarks
1. Protruding portion of the tube does not have any interference with the ball nut housing if its dimensions corresponding to U and V are large enough.
2. The overall screw shaft length may be slightly longer than nominal length L_0 due to manufacturing tolerance.
3. Only ball nut part numbers ending “S” are equipped with seals. External dimensions of nuts with seals are the same as those without.
   In the side view of the ball nut, view above the centerline shows internal seals, and view beneath the external geometry.
   Seals for shaft diameters 14 mm or less are made of synthetic resin. Seals for 16 mm diameter or greater are "Brush" seals.



Unit: mm

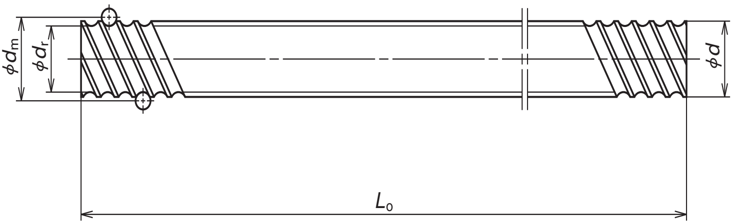
Ball nut dimensions											Nut Mass. (kg)	Arbor		Screw shaft				Shaft mass/m (kg)	Internal spatial volume of nut (cm^3)	Standard volume of greas replenishing (cm^3)
Flange			Length	Bolt hole		Oil hole		Projecting tube				Outside dia.	Bore	Standard length			Screw shaft No.			
A	G	B	L_n	W	X	Q	T	U	V	R		d_0	d_i	L_o						
79	33	15	55	65	6.6	M6×1	7.5	33	34	10	0.85	25.0	22.6	1000	2000	2500	RS2806A··	4.47	5.9	3.0
79	33	15	79	65	6.6	M6×1	7.5	33	34	10	1.07								8.4	4.2
97	39	18	97	75	11	M6×1	9.0	39	42	17	1.55	27.0	24.6	1000	2000	3000	RS3210A··	5.53	29	15
102	42	18	68	80	11	M6×1	9.0	42	46	17	1.47	30.0	27.6	1000	2000	3000	RS3610A··	6.91	21	11
102	42	18	98	80	11	M6×1	9.0	42	46	17	1.80								33	17
114	44	20	120	90	14	M6×1	10.0	44	50	20	2.49	35.0	31.8	2000	3000	4000	RS4010A··	8.87	42	21
130	47	22	116	100	18	M6×1	11.0	47	55	20	3.07	39.0	35.8	2000	3000	4000	RS4512A··	11.16	49	25
140	52	22	122	110	18	M6×1	11.0	52	59	20	4.06	45.0	41.8	2000	3000	4000	RS5010A··	14.15	53	27
163	57	28	146	125	22	M6×1	14.0	57	63	25	6.42	42.0	38.8	2000	3000	4000	RS5016A··	13.48	94	47

Remarks
4. Nut assembly with arbor and screw shaft are shipped separately.
5. In the portion of the screw shaft reference number indicated by ··, enter the value obtained by diving the standard screw shaft length by 100 mm.
6. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.
7. The internal spatial volume of nut and standard volume of grease replenishing in the dimension table are the values with seal. The amount for grease replenishing should be about 50% of nut internal space capacity.
If there is no seal, spread the screw shaft with grease or move the ball nut by hand while replenishing grease, so the grease permeates all area of nut. Please refer to page D16 for details.



Ball nut No.	Shaft dia. 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	Static C_{0a}	Axial play Max.	Ball nut dimensions Outside dia. D
RNFTL 1212A3	12	12	2.381	12.65	10.1	1.5 × 2	3900	6250	0.10	24
RNFTL 1616A3 **RNFTL 1616A3S**	16	16	2.778	16.65	13.5	1.5 × 2	5440	9550	0.10	30
RNFTL 2020A3 **RNFTL 2020A3S**	20	20	3.175	20.75	17.3	1.5 × 2	8080	15700	0.10	35
RNFTL 2525A3 **RNFTL 2525A3S**	25	25	3.969	26	22.0	1.5 × 2	12100	24500	0.12	45
RNFTL 3232A3 **RNFTL 3232A3S**	32	32	4.762	33.25	28.0	1.5 × 2	17600	37700	0.15	55
RNFTL 4040A3 **RNFTL 4040A3S**	40	40	6.35	41.75	35.0	1.5 × 2	28100	62900	0.20	70

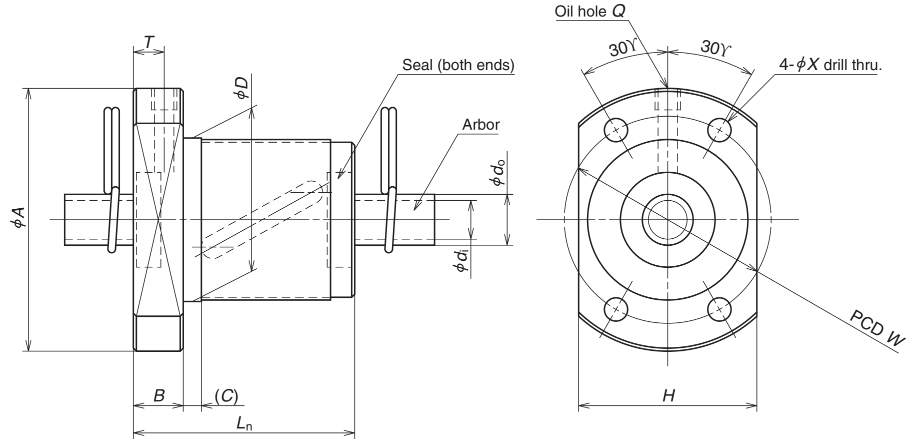
Remarks
1. Protruding portion of the tube does not have any interference with the ball nut housing if its dimensions corresponding to U and V are large enough.
2. The overall screw shaft length may be slightly longer than nominal length L_0 due to manufacturing tolerance.
3. Only ball nut part numbers ending “S” are equipped with seals. External dimensions of nuts with seals are the same as those without.
In the side view of the ball nut, view above the centerline shows internal seals, and view beneath the external geometry.
Seals for shaft diameters 14 mm or less are made of synthetic resin. Seals for 16 mm diameter or greater are "Brush" seals.



Unit: mm

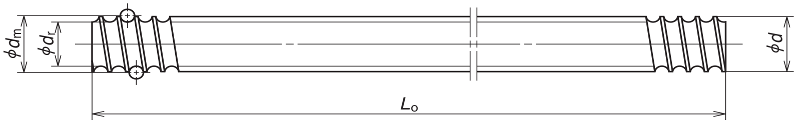
Ball nut dimensions											Nut Mass. (kg)	Arbor		Screw shaft				Shaft mass/m (kg)	Internal spatial volume of nut (cm^3)	Standard volume of greas replenishing (cm^3)
Flange			Length	Bolt hole		Oil hole		Projecting tube				Outside dia.	Bore	Standard length			Screw shaft No.			
A	G	B	L_n	W	X	Q	T	U	V	R		d_0	d_i	L_o						
44	17	8	44	34	4.5	M3 x 0.5	4.0	17	16	5	0.16	10.1	8.1	400	800		RS1212A··	0.74	1.7	0.9
55	22	10	50	43	6.6	M6 x 1	5.0	22	22	7	0.29	13.6	11.6	500	1000	1500	RS1616A··	1.37	2.8	1.4
68	25	12	59	52	9	M6 x 1	6.0	25	27	8	0.49	17.3	14.9	500	1000	2000	RS2020A··	2.19	4.9	2.5
80	31	12	69	63	9	M6 x 1	6.0	31	32	10	0.80	22.0	19.6	1000	2000	2500	RS2525A··	3.43	9.1	4.6
100	37	15	84	80	11	M6 x 1	7.5	37	40	12	1.46	28.0	25.6	1000	2000	3000	RS3232A··	5.71	19	9.5
120	46	18	103	95	14	M6 x 1	9.0	46	49	15	2.69	35.0	31.8	2000	3000	4000	RS4040A··	8.82	39	20

Remarks
4. Nut assembly with arbor and screw shaft are shipped separately.
5. In the portion of the screw shaft reference number indicated by ··, enter the value obtained by diving the standard screw shaft length by 100 mm.
6. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.
7. The internal spatial volume of nut and standard volume of grease replenishing in the dimension table are the values with seal. The amount for grease replenishing should be about 50% of nut internal space capacity.
If there is no seal, spread the screw shaft with grease or move the ball nut by hand while replenishing grease, so the grease permeates all area of nut. Please refer to page D16 for details.



Ball nut No.	Shaft dia. 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_{oa}	Axial play Max.	Ball nut dimensions Outside dia. D
RNFBL 1006A2.5S	10	6	2.381	10.65	8.1	2.5×1	3280	4730	0.10	26
RNFBL 1208A2.5S	12	8	2.778	12.65	9.6	2.5×1	4290	6610	0.10	29
RNFBL 1404A3.5S	14	4	2.778	14.5	11.5	3.5×1	6310	10800	0.10	31
RNFBL 1405A2.5S	14	5	3.175	14.5	11.0	2.5×1	6170	9940	0.10	32
RNFBL 1808A3.5S	18	8	4.762	18.5	13.5	3.5×1	15500	26200	0.15	50
RNFBL 2005A2.5S	20	5	3.175	20.5	17.0	2.5×1	7500	14200	0.10	40
RNFBL 2010A2.5S	20	10	4.762	21.25	16.2	2.5×1	12700	21600	0.15	52
RNFBL 2505A2.5S	25	5	3.175	25.5	22.0	2.5×1	8340	18100	0.10	43
RNFBL 2505A5S						2.5×2	15100	36300		
RNFBL 2510A2.5S	25	10	6.35	26	19.0	2.5×1	20500	34900	0.20	60
RNFBL 2510A5S						2.5×2	37300	69800		
RNFBL 2806A2.5S	28	6	3.175	28.5	25.0	2.5×1	8760	20200	0.10	50
RNFBL 2806A5S						2.5×2	15900	40500		
RNFBL 3210A2.5S	32	10	6.35	33.75	27.0	2.5×1	23100	45900	0.20	67
RNFBL 3210A5S						2.5×2	42000	91800		
RNFBL 3610A2.5S	36	10	6.35	37	30.0	2.5×1	24700	50800	0.20	70
RNFBL 3610A5S						2.5×2	44900	102000		
RNFBL 4010A5S	40	10	6.35	41.75	35.0	2.5×2	47200	116000	0.20	76

Remarks
1. The overall screw shaft length may be slightly longer than nominal length L_0 due to manufacturing tolerance.
2. Nut assembly with arbor and screw shaft are shipped separately.
3. In the portion of the screw shaft reference number indicated by ··, enter the value obtained by diving the standard screw shaft length by 100 mm.

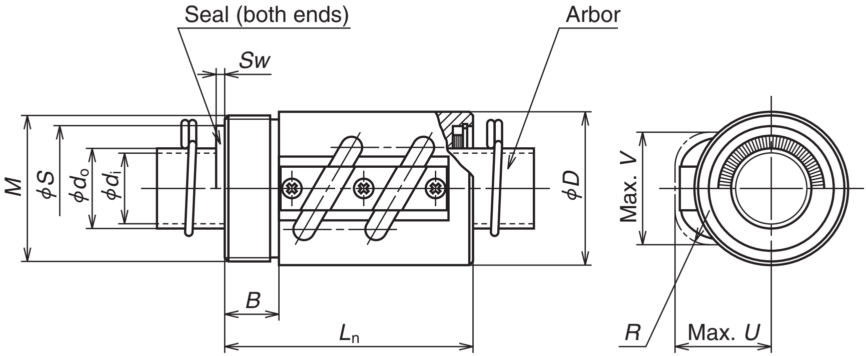


Unit: mm

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			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						
42	29	8	36	3	34	4.5	M3×0.5	5.0	0.16	8.1	6.1	400	800		RS1006A··	0.56	1.1	0.6
45	32	8	44	3	37	4.5	M3×0.5	5.5	0.21	9.6	7.6	400	800		RS1208A··	0.81	1.6	0.8
50	37	10	40	4	40	4.5	M6×1	5.0	0.25	11.5	9.5	500	1000		RS1404A··	1.02	2.4	1.2
50	38	10	40	4	40	4.5	M6×1	5.0	0.26	11.0	9.0	500	1000		RS1405A··	1.00	1.9	1.0
80	60	12	61	4	65	6.6	M6×1	6.0	1.00	13.6	11.6	500	1000	1500	RS1808A··	1.60	5.8	2.9
60	46	10	40	4	50	4.5	M6×1	5.0	0.37	17.0	14.6	500	1000	2000	RS2005A··	2.17	2.8	1.4
82	64	12	61	5	67	6.6	M6×1	6.0	1.05	16.2	13.8	500	1000	2000	RS2010A··	2.18	7.6	3.8
67	50	10	40 55	4	55	5.5	M6×1	5.0	0.40 0.50	22.0	19.6	1000	2000	2500	RS2505A··	3.47	3.5 4.7	1.8 2.4
96	72	15	66 96	5	78	9.0	M6×1	7.5	1.52 1.99	19.0	16.6	1000	2000	2500	RS2510A··	3.13	14 19	7.0 9.5
80	60	12	47 65	5	65	6.6	M6×1	6.0	0.70 0.87	25.0	22.6	1000	2000	2500	RS2806A··	4.47	4.5 7.6	2.3 3.8
103	78	15	67 97	5	85	9.0	M6×1	7.5	1.72 2.25	27.0	24.6	1000	2000	3000	RS3210A··	5.53	20 28	10 14
110	82	17	69 99	5	90	11.0	M6×1	8.5	1.97 2.53	30.0	27.6	1000	2000	3000	RS3610A··	6.91	21 29	11 15
116	88	17	99	5	96	11.0	M6×1	8.5	2.86	35.0	31.8	2000	3000	4000	RS4010A··	8.87	36	18

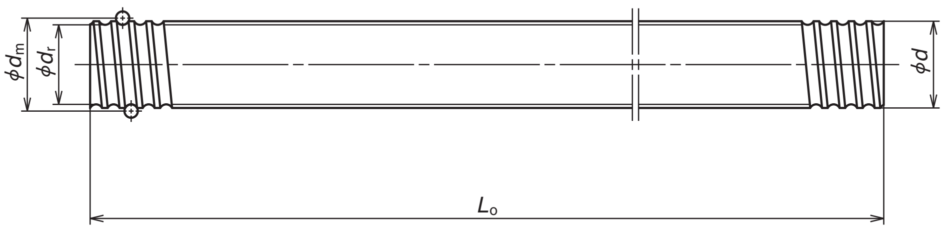
Remarks
4. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.
5. Seal for shaft diameters 14 mm or less are made of synthetic resin. Seal for 16 mm diameter or greater are "Brush" seals.
6. The amount for grease replenishing should be about 50% of nut internal space capacity. Please refer to page D16 on details.

B 200



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_{oa}	Axial play Max.	Ball nut dimensions Outside dia. *D*
RNCT 1003A3.5	10	3	2.381	10.65	8.0	3.5 × 1	4440	6700	0.10	20
RNCT 1404A3.5S	14	4	2.778	14.5	11.5	3.5 × 1	6310	10800	0.10	25
RNCT 1405A2.5S	14	5	3.175	14.5	11.0	2.5 × 1	6170	9940	0.10	30
RNCT 1808A3.5 **RNCT 1808A3.5S**	18	8	4.762	18.5	13.5	3.5 × 1	15500	26200	0.15	34
RNCT 2005A2.5 **RNCT 2005A2.5S**	20	5	3.175	20.5	17.0	2.5 × 1	7500	14200	0.10	40
RNCT 2505A5 **RNCT 2505A5S**	25	5	3.175	25.5	22.0	2.5 × 2	15100	36300	0.10	42
RNCT 2510A5 **RNCT 2510A5S**	25	10	6.35	26	19.0	2.5 × 2	37300	69800	0.20	44
RNCT 2806A5 **RNCT 2806A5S**	28	6	3.175	28.5	25.0	2.5 × 2	15900	40500	0.10	50
RNCT 3210A5 **RNCT 3210A5S**	32	10	6.35	33.75	27.0	2.5 × 2	42000	91800	0.20	55
RNCT 3610A5 **RNCT 3610A5S**	36	10	6.35	37	30.0	2.5 × 2	44900	102000	0.20	60
RNCT 4010A7 **RNCT 4010A7S**	40	10	6.35	41.75	35.0	3.5 × 2	63100	164000	0.20	65
RNCT 4512A5 **RNCT 4512A5S**	45	12	7.144	46.5	39.0	2.5 × 2	58500	147000	0.23	70
RNCT 5010A7 **RNCT 5010A7S**	50	10	6.35	51.75	45.0	3.5 × 2	70100	205000	0.20	80
RNCT 5016A5 **RNCT 5016A5S**	50	16	9.525	52	42.0	2.5 × 2	117000	299000	0.23	85

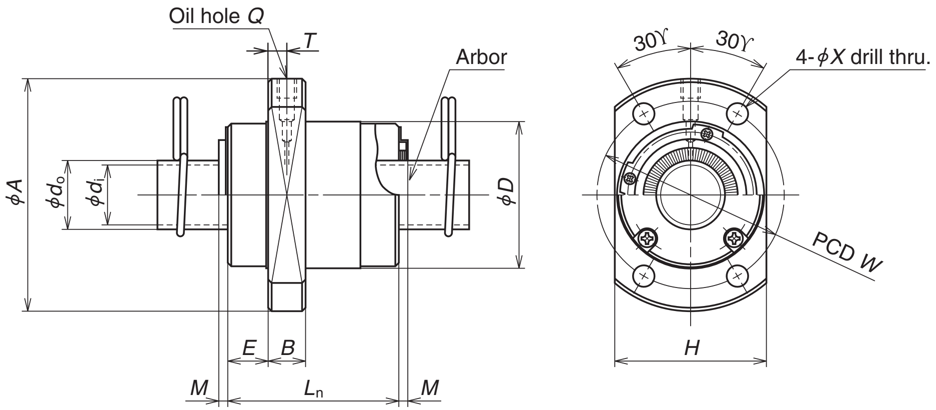
Remarks
1. Protruding portion of the tube does not have any interference with the ball nut housing if its dimensions corresponding to U and V are large enough.
2. The overall screw shaft length may be slightly longer than nominal length L_0 due to manufacturing tolerance.
3. Only ball nut part numbers ending "S" are equipped with seals. External dimensions of nuts with seals are the same as those without.
   In the side view of the ball nut, view above the centerline shows internal seals, and view beneath the external geometry.
   Seals for shaft diameters 14 mm or less are made of synthetic resin. Seals for 16 mm diameter or greater are "Brush" seals.



Unit: mm

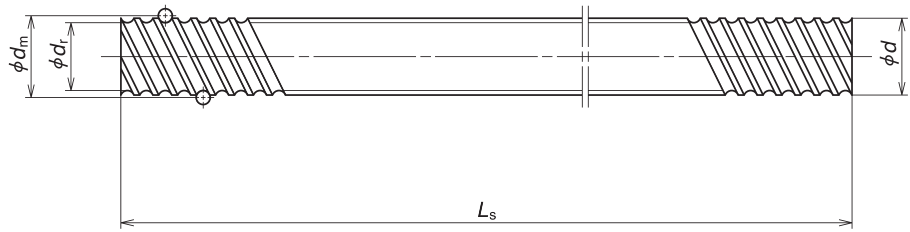
Ball nut dimensions						Nut Mass. (kg)	Seal dimensions		Arbor		Screw shaft				Shaft mass/m (kg)	Internal spatial volume of nut (cm^3)	Standard volume of greas replenishing (cm^3)
V-thread		Length	Projecting tube				Diameter	Thickness	Outside dia.	Bore	Standard length			Screw shaft No.			
M	B	L_n	U	V	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	1000		RS1404A··	1.02	2.7	1.4
M26 × 1.5	10	45	22	21	8	0.15			11.0	9.0	500	1000		RS1405A··	1.00	3.1	1.6
M32 × 1.5	12	58	27	27	8	0.21	28.5	2.5	13.6	11.6	500	1000	1500	RS1808A··	1.60	6.6	3.3
M36 × 1.5	12	48	28	27	10	0.28	29.5	2.5	17.0	14.6	500	1000	2000	RS2005A··	2.17	4.8	2.4
M40 × 1.5	15	69	28	31	10	0.38	34.5	2.5	22.0	19.6	1000	2000	2500	RS2505A··	3.47	8.4	4.2
M42 × 1.5	15	92	34	37	17	0.49	38.5	2.5	19.0	16.6	1000	2000	2500	RS2510A··	3.13	21	1
M45 × 1.5	15	79	33	34	10	0.68	37.5	2.5	25.0	22.6	1000	2000	2500	RS2806A··	4.47	9.7	4.9
M50 × 1.5	18	97	39	42	17	0.79	45.5	2.5	27.0	24.6	1000	2000	3000	RS3210A··	5.53	32	16
M55 × 2	18	98	42	46	17	0.97	50.5	3.0	30.0	27.6	1000	2000	3000	RS3610A··	6.91	32	16
M60 × 2	25	125	44	50	20	1.37	54.5	3.0	35.0	31.8	2000	3000	4000	RS4010A··	8.87	51	26
M65 × 2	30	124	47	55	20	1.42	60.5	3.0	39.0	35.8	2000	3000	4000	RS4512A··	11.16	60	30
M75 × 2	40	140	52	59	20	2.41	64.5	3.0	45.0	41.8	2000	3000	4000	RS5010A··	14.15	76	38
M80 × 2	40	158	57	63	25	3.14	68.5	3.0	42.0	38.8	2000	3000	4000	RS5016A··	13.48	114	57

Remarks
4. Nut assembly with arbor and screw shaft are shipped separately.
5. In the portion of the screw shaft reference number indicated by ··, enter the value obtained by diving the standard screw shaft length by 100 mm.
6. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.
7. The internal spatial volume of nut and standard volume of grease replenishing in the dimension table are the values with seal. The amount for grease replenishing should be about 50% of nut internal space capacity.
If there is no seal, spread the screw shaft with grease or move the ball nut by hand while replenishing grease, so the grease permeates all area of nut. Please refer to page D16 for details.



Ball nut No.	Shaft dia. 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_{oa}	Axial play Max.	Ball nut dimensions Outside dia. D
RNFCL 1212A3	12	12	2.381	12.65	10.1	1.7 × 2	4350	6580	0.10	26
RNFCL 1212A6						1.7 × 4	7890	13200		
RNFCL 1520A3 **RNFCL 1520A3S**	15	20	3.175	15.5	12.2	1.7 × 2	7510	12300	0.10	33
RNFCL 1616A3 **RNFCL 1616A3S**	16	16	2.778	16.65	13.5	1.7 × 2	6060	10300	0.10	32
RNFCL 1616A6 **RNFCL 1616A6S**						1.7 × 4	11000	20500		
RNFCL 2020A3 **RNFCL 2020A3S**	20	20	3.175	20.75	17.3	1.7 × 2	9000	16700	0.10	39
RNFCL 2020A6 **RNFCL 2020A6S**						1.7 × 4	16300	33400		
RNFCL 2525A3 **RNFCL 2525A3S**	25	25	3.969	26	22.0	1.7 × 2	13400	26100	0.12	47
RNFCL 2525A6 **RNFCL 2525A6S**						1.7 × 4	24400	52200		
RNFCL 3232A3 **RNFCL 3232A3S**	32	32	4.762	33.25	28.0	1.7 × 2	19600	39800	0.15	58
RNFCL 3232A6 **RNFCL 3232A6S**						1.7 × 4	35600	79600		
RNFCL 4040A3 **RNFCL 4040A3S**	40	40	6.35	41.75	35.0	1.7 × 2	31300	66800	0.20	73
RNFCL 4040A6 **RNFCL 4040A6S**						1.7 × 4	56900	134000		
RNFCL 5050A3 **RNFCL 5050A3S**	50	50	7.938	52.25	44.0	1.7 × 2	46800	104000	0.25	90
RNFCL 5050A6 **RNFCL 5050A6S**						1.7 × 4	85000	209000		

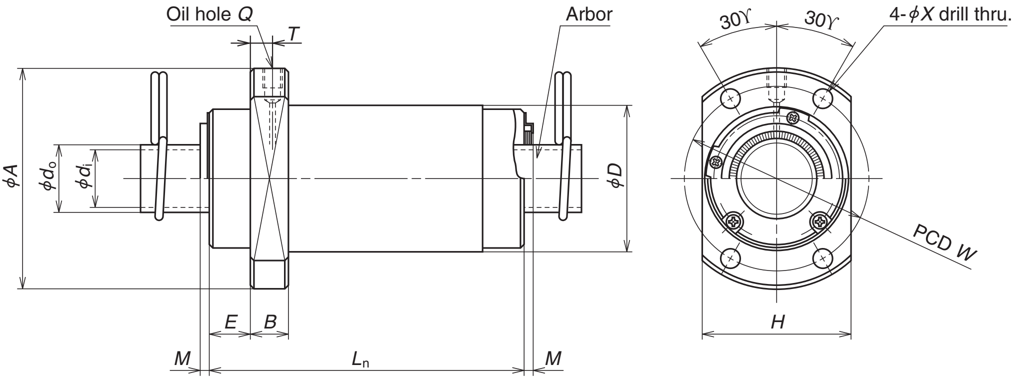
Remarks
1. The overall screw shaft length may be slightly longer than nominal length L_0 due to manufacturing tolerance.
2. Nut assembly with arbor and screw shaft are shipped separately.
3. In the portion of the screw shaft reference number indicated by ··, enter the value obtained by diving the standard screw shaft length by 100 mm.
4. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.
5. The entire length of the nut becomes longer by "2 x M " for those with a seal. The seal is "Brush" seal.



Unit: mm

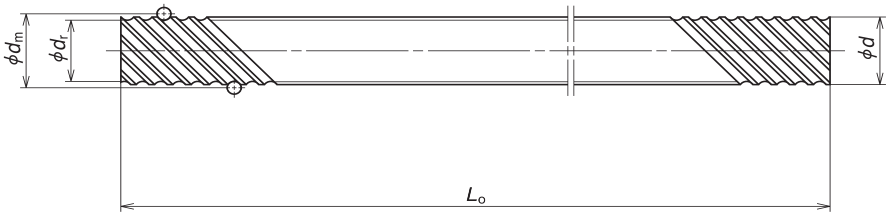
Ball nut dimensions: Flange A	Flange H	Flange B	Length E	Length L_n	Length M	Bolt hole W	Bolt hole X	Oil hole Q	Oil hole T	Nut Mass. (kg)	Arbor Outside dia. d_0	Arbor Bore d_i	Screw shaft Standard length L_0			Screw shaft No.	Shaft mass/m (kg)	Internal spatial volume of nut (cm³)	Standard volume of greas replenishing (cm³)
44	28	6	9	30	–	35	4.5	M3 × 0.5	3.0	0.12	10.1	8.1	400	800		RS1212A··	0.74		
51	35	10	11	45	– 3	42	4.5	M6 × 1	5.0	0.28	12.2	10.2	500	1000	1500	RS1520A··	1.15	3.3	1.7
53	34	10	10	38	– 3	42	4.5	M6 × 1	5.0	0.23	13.5	11.5	500	1000	1500	RS1616A··	1.37	2.6	1.3
					– 3													2.6	1.3
62	41	10	11.5	46	– 3	50	5.5	M6 × 1	5.0	0.37	17.3	14.9	500	1000	2000	RS2020A··	2.19	4.4	2.2
					– 3													4.9	2.5
74	49	12	13	55	– 3	60	6.6	M6 × 1	6.0	0.62	22.0	19.6	1000	2000	2500	RS2525A··	3.43	8.2	4.1
					– 3													8.9	4.5
92	60	12	16	70	– 3	74	9	M6 × 1	5.5	1.10	28.0	25.6	1000	2000	3000	RS3232A··	5.71	16	8.0
					– 3													17	8.5
114	75	15	19.5	85	– 3.5	93	11	M6 × 1	6.5	2.09	35.0	31.8	2000	3000	4000	RS4040A··	8.82	32	16
					– 3.5													33	17
135	92	20	21.5	107	– 3.5	112	14	M6 × 1	7.0	3.90	44.0	40.8	2000	3000	4000	RS5050A··	13.81	64	32
					– 3.5													68	34

Remarks 6. The internal spatial volume of nut and standard volume of grease replenishing in the dimension table are the values with seal. The amount for grease replenishing should be about 50% of nut internal space capacity.
If there is no seal, spread the screw shaft with grease or move the ball nut by hand while replenishing grease, so the grease permeates all area of nut. Please refer to page D16 for details.



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	Static C_{oa}	Axial play Max.	Ball nut dimensions Outside dia. D
RNFCL 1632A2 **RNFCL 1632A2S**	16	32	2.778	16.65	13.5	0.7 × 4	4880	8330	0.10	32
RNFCL 1632A3 **RNFCL 1632A3S**						1.7 × 2	5760	10300		
RNFCL 1632A6 **RNFCL 1632A6S**						1.7 × 4	10500	20500		
RNFCL 2040A2 **RNFCL 2040A2S**	20	40	3.175	20.75	17.3	0.7 × 4	7170	13200	0.10	38
RNFCL 2040A3 **RNFCL 2040A3S**						1.7 × 2	8480	16500		
RNFCL 2040A6 **RNFCL 2040A6S**						1.7 × 4	15400	33100		
RNFCL 2550A2 **RNFCL 2550A2S**	25	50	3.969	26	22.0	0.7 × 4	10700	20700	0.12	46
RNFCL 2550A3 **RNFCL 2550A3S**						1.7 × 2	12700	26500		
RNFCL 2550A6 **RNFCL 2550A6S**						1.7 × 4	23000	53000		
RNFCL 3264A3 **RNFCL 3264A3S**	32	64	4.762	33.25	28.0	1.7 × 2	17900	40200	0.15	58
RNFCL 3264A6 **RNFCL 3264A6S**						1.7 × 4	32400	80300		
RNFCL 4080A3 **RNFCL 4080A3S**	40	80	6.350	41.75	35.0	1.7 × 2	29500	67900	0.20	73
RNFCL 4080A6 **RNFCL 4080A6S**						1.7 × 4	53600	136000		

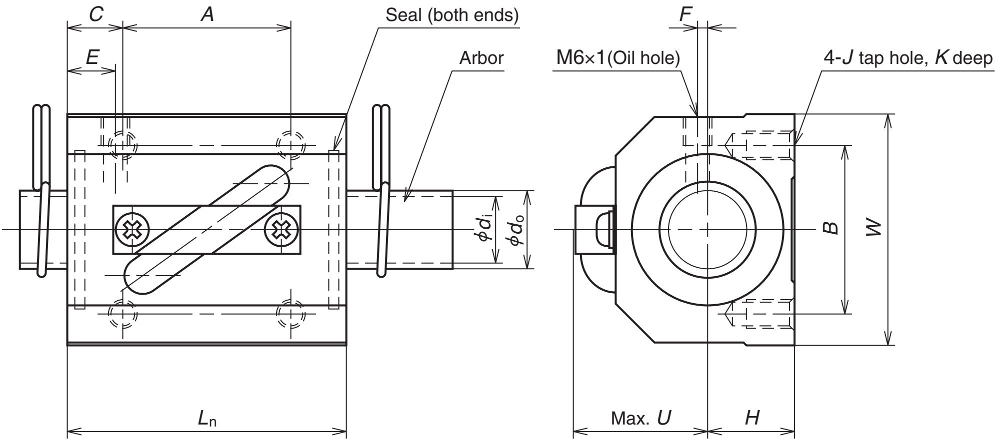
Remarks
1. The overall screw shaft length may be slightly longer than nominal length L_0 due to manufacturing tolerance.
2. Nut assembly with arbor and screw shaft are shipped separately.
3. In the portion of the screw shaft reference number indicated by ··, enter the value obtained by diving the standard screw shaft length by 100 mm.
4. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.
5. The entire length of the nut becomes longer by "2 x M " for those with a seal. The seal is "Brush" seal.



Unit: mm

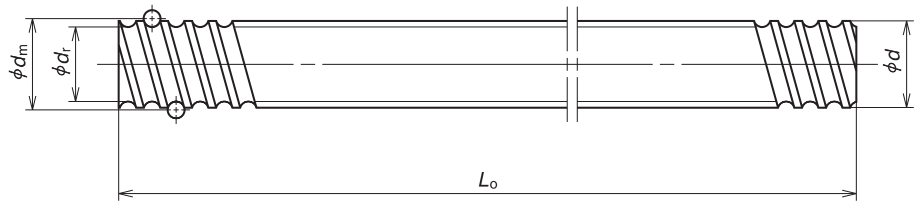
Ball nut dimensions										Nut Mass. (kg)	Arbor		Screw shaft					Shaft mass/m (kg)	Internal spatial volume of nut (cm^3)	Standard volume of greas replenishing (cm^3)
Flange			Length			Bolt hole		Oil hole			Outside dia.	Bore	Standard length				Screw shaft No.			
A	*H*	*B*	*E*	L_n	*M*	*W*	*X*	*Q*	*T*		d_0	d_i	L_o							
50	34	10	10	34	– / 3	41	4.5	M6 × 1	5.5	0.21	13.5	11.5	500	1000	1500		RS1632A··	1.34	2.4	1.2
				66	– / 3					0.33									3.9	2.0
				66	– / 3					0.33									4.1	2.1
58	40	10	11	41	– / 3	48	5.5	M6 × 1	5.5	0.31	17.3	14.9	500	1000	1500	2000	RS2040A··	2.15	4.1	2.1
				81	– / 3					0.53									6.3	3.2
				81	– / 3					0.53									7.0	3.5
70	48	12	13	50	– / 3	58	6.6	M6 × 1	7.0	0.53	22.0	19.6	1000	2000	2500		RS2550A··	3.37	8.4	4.2
				100	– / 3					0.91									14	7.0
				100	– / 3					0.91									15	7.5
92	60	12	15.5	126	– / 3	74	9	M6 × 1	7.5	1.76	28.0	25.6	1000	2000	3000	4000	RS3264A··	5.63	24	12
					– / 3														26	13
114	75	15	19	158	– / 3.5	93	11	M6 × 1	10.0	3.44	35.0	31.8	2000	3000	4000	5000	RS4080A··	8.69	52	26
					– / 3.5														55	28

Remarks 6. The internal spatial volume of nut and standard volume of grease replenishing in the dimension table are the values with seal. The amount for grease replenishing should be about 50% of nut internal space capacity.
If there is no seal, spread the screw shaft with grease or move the ball nut by hand while replenishing grease, so the grease permeates all area of nut. Please refer to page D16 for details.



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_{oa}	Axial play Max.	Ball nut dimensions: Length L_n
RNSTL 1404A3.5S	14	4	2.778	14.5	11.5	3.5×1	6310	10800	0.10	38
RNSTL 1405A2.5S	14	5	3.175	14.5	11.0	2.5×1	6170	9940	0.10	38
RNSTL 1808A3.5S	18	8	4.762	18.5	13.5	3.5×1	15500	26200	0.15	56
RNSTL 2005A2.5S	20	5	3.175	20.5	17.0	2.5×1	7500	14200	0.10	38
RNSTL 2010A2.5S	20	10	4.762	21.25	16.2	2.5×1	12700	21600	0.15	58
RNSTL 2505A2.5S	25	5	3.175	25.5	22.0	2.5×1	8340	18100	0.10	35
RNSTL 2510A5S	25	10	6.35	26	19.0	2.5×2	37300	69800	0.20	94
RNSTL 2806A2.5S	28	6	3.175	28.5	25.0	2.5×1	8760	20200	0.10	42
RNSTL 2806A5S						2.5×2	15900	40500		67
RNSTL 3210A2.5S	32	10	6.35	33.75	27.0	2.5×1	23100	45900	0.20	64
RNSTL 3210A5S						2.5×2	42000	91800		94
RNSTL 3610A2.5S	36	10	6.35	37	30.0	2.5×1	24700	50800	0.20	64
RNSTL 3610A5S						2.5×2	44900	102000		96
RNSTL 4512A5S	45	12	7.144	46.5	39.0	2.5×2	58500	147000	0.23	115

Remarks
1. The overall screw shaft length may be slightly longer than nominal length L_0 due to manufacturing tolerance.
2. Nut assembly with arbor and screw shaft are shipped separately.
3. In the portion of the screw shaft reference number indicated by ··, enter the value obtained by diving the standard screw shaft length by 100 mm.



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)
Width	Center height	Bolt hole					Oil hole				Outside dia.	Bore	Standard length			Screw shaft No.			
W	H	A	B	C	J	K	E	F	U		d_0	d_i	L_o						
34	13	22	26	8	M4	7	7	3	20	0.20	11.5	9.5	500	1000		RS1404A··	1.02	1.6	0.8
34	13	22	26	8	M4	7	7	3	21	0.20	11.0	9.0	500	1000		RS1405A··	1.00	1.8	0.9
48	17	35	35	10.5	M6	10	8	3	26	0.31	13.6	11.6	500	1000	1500	RS1808A··	1.60	3.4	1.7
48	17	22	35	8	M6	9	6	2	27	0.24	17.0	14.6	500	1000	2000	RS2005A··	2.17	2.5	1.3
48	18	35	35	11.5	M6	10	10	2	28	0.35	16.2	13.8	500	1000	2000	RS2010A··	2.18	6.3	3.2
60	20	22	40	6.5	M8	10	6	0	27	0.31	22.0	19.6	1000	2000	2500	RS2505A··	3.47	2.6	1.3
60	23	60	40	17	M8	12	10	0	32	1.32	19.0	16.6	1000	2000	2500	RS2510A··	3.13	18	9.0
60	22	18	40	12	M8	12	8	0	32	0.65	25.0	22.6	1000	2000	2500	RS2806A··	4.47	3.5	1.8
60	22	40	40	13.5						1.04								7.0	3.5
70	26	45	50	9.5	M8	12	10	0	38	1.12	27.0	24.6	1000	2000	3000	RS3210A··	5.53	18	9.0
70	26	60	50	17						1.75								27	14
86	29	45	60	9.5	M10	16	11	0	41	1.76	30.0	27.6	1000	2000	3000	RS3610A··	6.91	18	9.0
86	29	60	60	18						2.64								27	14
100	36	75	75	20	M12	20	13	0	46	1.22	39.0	35.8	2000	3000	4000	RS4512A··	11.16	47	24

Remarks
4. Items in stock do not have surface treatment. For details of standard stock products, contact NSK.
5. The entire length of the nut becomes longer by "2 x M " for those with a seal. The seal is "Brush" seal.
6. The amount for grease replenishing should be about 50% of nut internal space capacity. Please refer to page D16 on details.

B-3-1.11 Equipped with "NSK K1™" Lubrication Unit

This product is patented by NSK Ltd.

1. Features

"NSK K1™" is a new, efficient lubrication unit. Equipped with "NSK K1™", the ball screws demonstrate a superb performance as shown below.

● Long-term, maintenance-free usage

In mechanical environments where lubrication is difficult to apply, long-term running efficiency is maintained by using the "NSK K1™" in combination with grease.

[ex.] For automotive component processing lines, etc.

● Does not pollute the environment

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

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

● Good for environments where lubricant is washed away

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

[ex.] Food processing equipment, housing/construction machines, etc.

● Maintains efficiency in dusty environment

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

[ex.] Woodworking machines, etc.

● Comparative duration test of samples with and without NSK K1

Sample, testing conditions and test result are shown in Table 1 and Fig. 1.

Without lubricant, operation became impossible after running 8.6 km. With NSK K1 alone, it was possible to continue running exceeding 10000 km.

NSK conducts various tests under different conditions. Please consult NSK.

Table 1 Sample and testing conditions

Ball screw	Shaft dia. 20 mm, lead 20 mm
Lubrication	Comparison with only NSK K1 against no lubrication
Speed	4 000 min^{-1} (80 m/min)
Stroke	600 mm

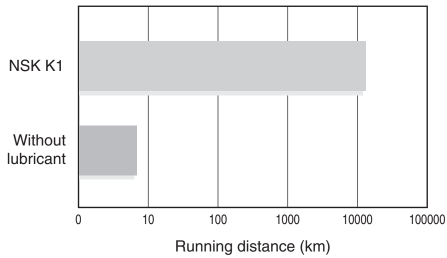


Fig. 1 Duration test results on ball screws without lubricant

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 Standard ball screw.

Combination of NSK standard grease (factory-packed in the nut) and NSK K1 are standard specifications.

Fig. 2 NSK K1

(2) Accuracy grade and axial play

Accuracy grade, clearance and preload specifications remain unchanged. There is a slight increase in torque due to the equipped NSK K1.

(3) Overall nut length after equipped with NSK K1™

The nut length become longer than standard ball screw after equipped with NSK K1. The nut length after equipped K1 shown in page B211 to 214 for each recirculation. "NSK K1" can be installed on other types not listed in the dimension table, please consult with NSK.

(4) Application examples

Ball screws equipped with NSK K1 are maintenance-free for a long period of time. Its application is expanding in various industries.

- 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 for use: 50˚C
Momentary maximum temperature in use: 80˚C

Chemicals that should not come to contact with K1:
Do not leave K1 Seal in organic solvent, white kerosene such as hexane, thinner which removes oil, and rust preventive oil which contains white kerosene.

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

4. Example of reference number

A structure of "Reference number for ball screw" is as follows.

Note: "K1" is added at the end of "nut model code" and "Specifications number".

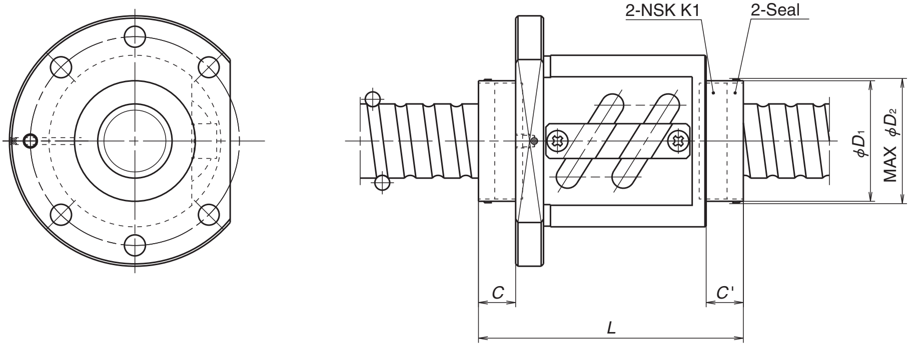
◇Reference number for ball screw equipped with NSK K1

W1401 -✻✻ P K1 - C3 Z10

K1: NSK K1 equipped type ball screw code

Equipped with "NSK K1™" lubrication unit

(1) Tube type



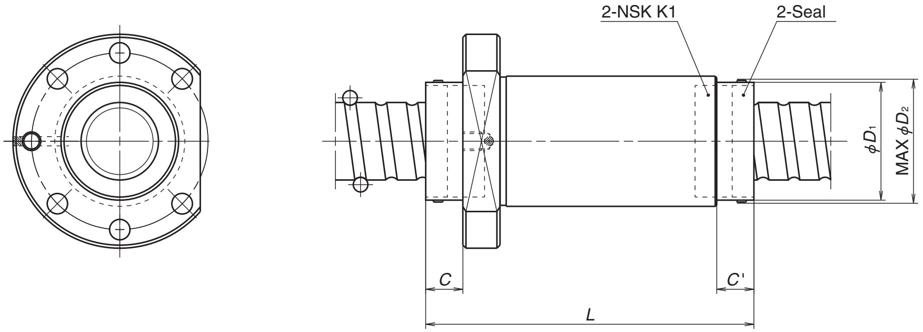
Tube type

Model No.	Screw shaft dia.	Lead	K1 installing dimension		Overall length when equipped K1	K1 cap dimension	
	d	l	C	C'	L	Cup dia. ϕD_1	Protruding dimension ϕD_2
PFT1004-2.5	10	4	14	15	61.5	ϕ22	MAX ϕ24
PFT1205-2.5	12	5	14	15	66	ϕ26.5	MAX ϕ29
LPFT1210-2.5	12	10	14	17	79	ϕ26.5	MAX ϕ29
PFT1405-2.5	14	5	14	15	65	ϕ30	MAX ϕ32
LPFT1510-2.5	15	10	14	15	76	ϕ30	MAX ϕ32
PFT1605-2.5	16	5	14	15	67	ϕ32	MAX ϕ34
PFT2005-5	20	5	14	14	81	ϕ38	MAX ϕ40
LPFT2010-2.5	20	10	14	14	78	ϕ38	MAX ϕ40
LPFT2020-1.5	20	20	14	14	84	ϕ38	MAX ϕ40
ZFT2505-10	25	5	16	17	115	ϕ44	MAX ϕ46
PFT2506-5	25	6	16	17	93	ϕ44	MAX ϕ46
PFT2510-2.5	25	10	16	17	89	ϕ44	MAX ϕ46
ZFT2510-3	25	10	16	17	103	ϕ44	MAX ϕ46
LPFT2520-2.5	25	20	12	12	109	ϕ38	MAX ϕ40
LPFT2525-1.5	25	25	12	12	98	ϕ38	MAX ϕ40
DFT2805-5	28	5	16	17	137	ϕ48	MAX ϕ50
PFT2810-2.5	28	10	16	17	90	ϕ48	MAX ϕ50
DFT2810-3	28	10	16	17	174	ϕ48	MAX ϕ50
PFT3206-5	32	6	16	17	93	ϕ52	MAX ϕ54
ZFT3206-10	32	6	16	17	129	ϕ52	MAX ϕ54
PFT3210-5	32	10	16	17	122	ϕ52	MAX ϕ54
ZFT3210-5	32	10	16	17	122	ϕ52	MAX ϕ54
DFT3210-5	32	10	16	16	212	ϕ52	MAX ϕ54
PFT3212-3	32	12	16	17	114	ϕ52	MAX ϕ54
DFT3212-3	32	12	16	16	198	ϕ52	MAX ϕ54
LPFT3225-2.5	32	25	12	12	122	ϕ46	MAX ϕ48
LPFT3232-1.5	32	32	12	12	109	ϕ46	MAX ϕ48

Remarks 1. "NSK K1" can be installed on other types not listed in the table. Please consult NSK.
2. C,C' and L are the dimensions when one NSK K1 is equipped to both ends of the nut.

Model No.	Screw shaft dia. d	Lead l	K1 installing dimension C	C'	Overall length when equipped k1 L	K1 cap dimension Cup dia. ϕD_1	Protruding dimension ϕD_2
PFT3610-5	36	10	19	20	131	ϕ 56	MAX ϕ 58
DFT3610-5	36	10	19	19	221	ϕ 56	MAX ϕ 58
HZF3616-5	36	16	19	19	163	ϕ 56	MAX ϕ 58
HZF3620-3.5	36	20	19	19	146	ϕ 56	MAX ϕ 58
PFT4008-5	40	8	19	20	117	ϕ 62	MAX ϕ 64
ZFT4008-10	40	8	19	20	165	ϕ 62	MAX ϕ 64
ZFT4010-7	40	10	19	20	152	ϕ 62	MAX ϕ 64
DFT4010-5	40	10	19	19	222	ϕ 61	MAX ϕ 64
PFT4012-5	40	12	19	20	144	ϕ 62	MAX ϕ 64
DFT4012-5	40	12	19	19	252	ϕ 61	MAX ϕ 64
HZF4016-5	40	16	19	19	164	ϕ 61	MAX ϕ 64
HZF4020-5	40	20	19	19	189	ϕ 61	MAX ϕ 64
LPFT4032-2.5	40	32	14	14	151	ϕ 54	MAX ϕ 56
LPFT4040-1.5	40	40	14	14	133	ϕ 54	MAX ϕ 56
DFT4510-5	45	10	19	19	222	ϕ 72	MAX ϕ 75
DFT4512-5	45	12	19	19	254	ϕ 72	MAX ϕ 75
HZF4520-5	45	20	19	19	190	ϕ 72	MAX ϕ 75
ZFT5010-10	50	10	19	20	194	ϕ 73	MAX ϕ 76
DFT5012-5	50	12	19	19	256	ϕ 73	MAX ϕ 76
ZFT5016-5	50	16	19	20	172	ϕ 73	MAX ϕ 76
DFT5016-5	50	16	19	19	300	ϕ 73	MAX ϕ 76
HZF5020-5	50	20	19	19	192	ϕ 73	MAX ϕ 76
HZF5025-5	50	25	19	19	221	ϕ 73	MAX ϕ 76
DFT5516-5	55	16	22	22	178	ϕ 81	MAX ϕ 87
HZF5520-5	55	20	22	22	198	ϕ 81	MAX ϕ 81
HZF5525-5	55	25	22	22	227	ϕ 81	MAX ϕ 81
DFT6316-5	63	16	22	22	322	ϕ 89	MAX ϕ 95
DFT6320-5	63	20	22	22	362	ϕ 89	MAX ϕ 95

(2) Deflector type

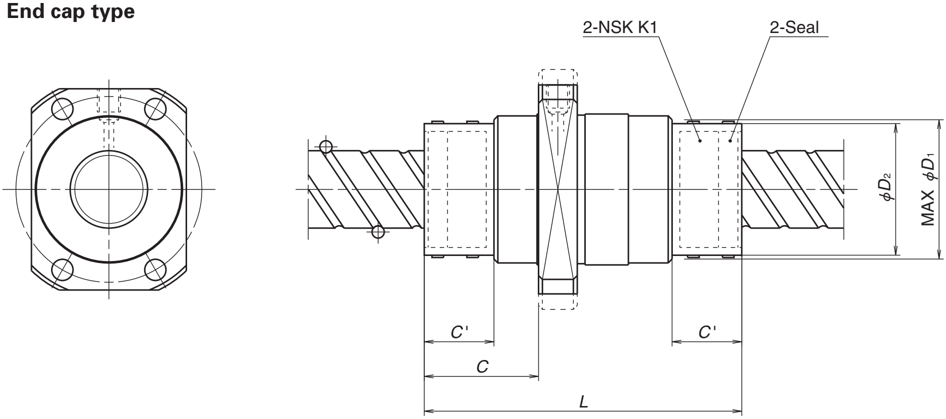


Deflector type

Model No.	Screw shaft dia. d	Lead l	K1 installing dimension C	C'	Overall length when equipped K1 L	K1 cap dimension Cup dia. ϕD_1	Protruding dimension ϕD_2
ZFD2005-6	20	5	9	9	87	ϕ 32	MAX ϕ 34
ZFD2506-6	25	6	12	–	102	ϕ 38	MAX ϕ 40
ZFD2510-4	25	10	12	12	106	ϕ 38	MAX ϕ 40
ZFD3208-8	32	8	12	12	136	ϕ 46	MAX ϕ 48
ZFD3210-6	32	10	12	12	138	ϕ 46	MAX ϕ 48
ZFD3212-6	32	12	12	12	153	ϕ 46	MAX ϕ 48
ZFD4010-8	40	10	14	14	167	ϕ 54	MAX ϕ 57
ZFD4012-8	40	12	14	14	189	ϕ 54	MAX ϕ 57
ZFD5010-8	50	10	14	14	169	ϕ 64	MAX ϕ 67
ZFD5012-6	50	12	14	14	167	ϕ 64	MAX ϕ 67

Remarks 1. "NSK K1" can be installed on other types not listed in the table. Please consult NSK.
2. C,C’ and L are the dimensions when one NSK K1 is equipped to both ends of the nut.

(3) End cap type



End cap type

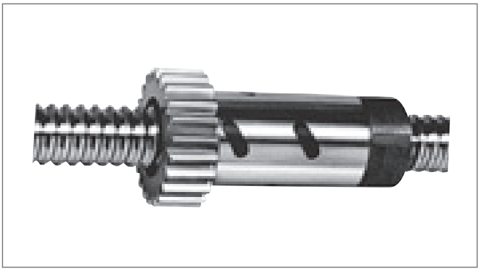
Model No.	Screw shaft dia. d	Lead l	K1 installing dimension C	C'	Overall length when equipped K1 L	K1 cap dimension Cup dia. ϕD_1	Protruding dimension ϕD_2
UPFC1520-1.5	15	20	29	18	81	ϕ30	MAX ϕ32
LPFC1616-3	16	16	28	18	74	ϕ28	MAX ϕ30
LPFC2020-3	20	20	29.5	18	82	ϕ34	MAX ϕ36
UPFC2040-1	20	40	29	18	77	ϕ32	MAX ϕ34
LPFC2525-3	25	25	34	21	97	ϕ44	MAX ϕ46
UPFC2550-1	25	50	34	21	92	ϕ44	MAX ϕ46
LPFC3232-3	32	32	37	21	112	ϕ52	MAX ϕ54
UPFC3264-1	32	64	36.5	21	104	ϕ52	MAX ϕ54
LPFC4040-3	40	40	43.5	24	133	ϕ62	MAX ϕ65
LPFC5050-3	50	50	45.5	24	155	ϕ74	MAX ϕ77

Remarks 1. "NSK K1" can be installed on other types not listed in the table. Please consult NSK.
2. C,C′ and L are the dimensions when one NSK K1 is equipped to both ends of the nut.

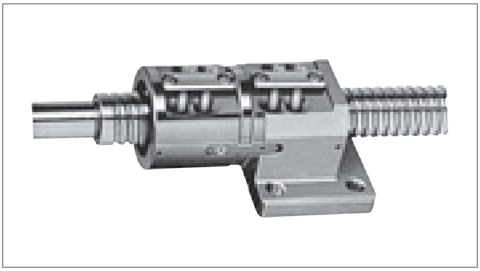
B-3-1.12 Special Ball Screws.

In addition to the standard ball screws, NSK manufactures various types of ball screws in special shapes as shown below.

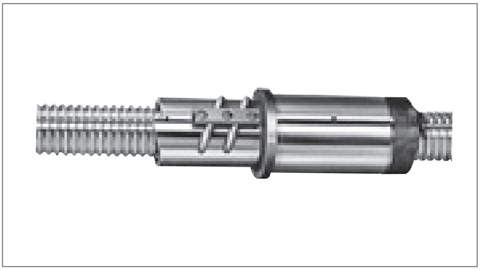
Thoroughly discuss with NSK the specifications before determining specifications and ordering ball screws in special shapes.



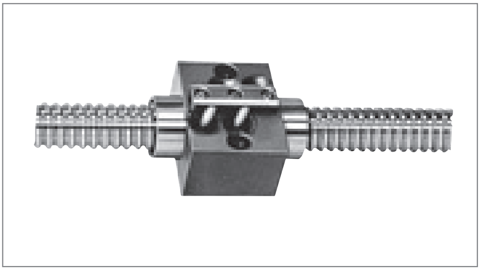
Nut with gear



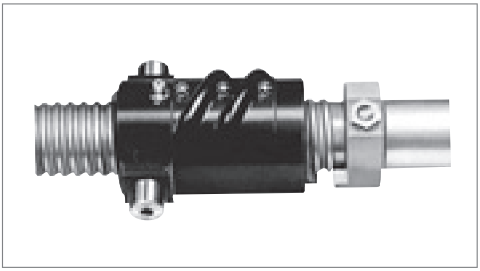
Double nut with flat mounting face



Lightly preloaded single nut with bearing seat

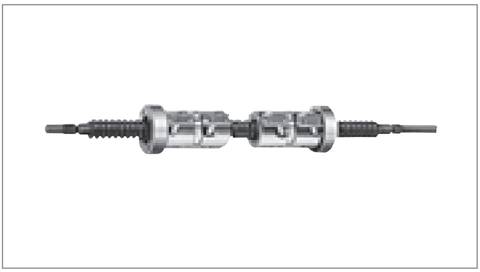


Lightly preloaded single nut with flat mounting face

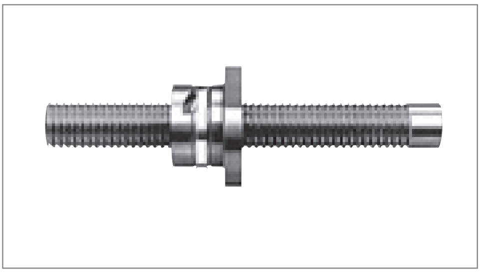


Nut with trunion

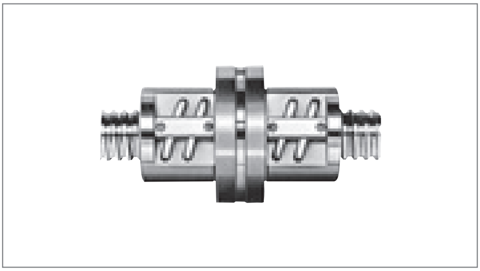
Hollow shaft, lightly preloaded single nut, with large shaft diameter and fine lead

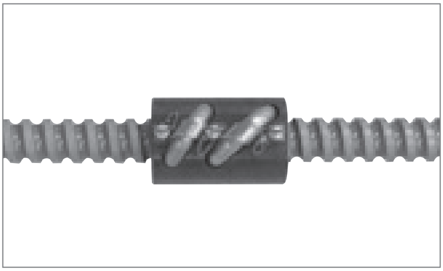


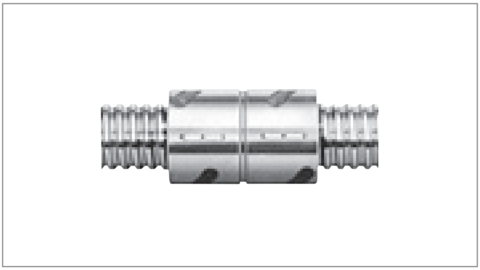
Double nut with right and left turn thread on each side of screw shaft

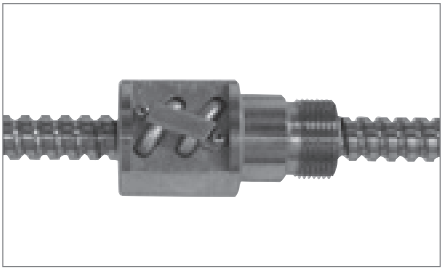


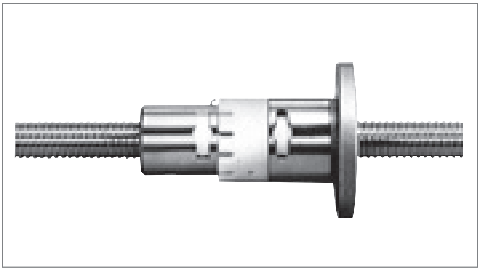
Ceramic ball screw

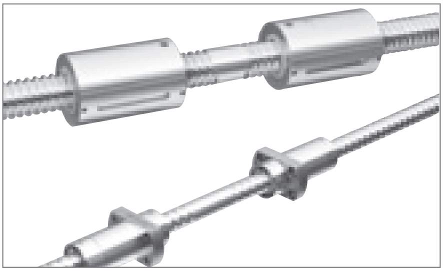

Flanged to flanged ball nut


Ball screw for aircraft


Cylindrical double nut


Ball screw for Nuclear power


Spring preload ball screw


Right and left hand thread on each side of screw

B-3-2 Dimension Table and Reference Number of Standard Ball Screws

B-3- 2.1 Compact FA PSS Type

◇**Features**

In order to respond quickly to a wide range of needs, NSK keeps end-deflector recirculation system ball screws, which offer high-speed and low-noise operation and compact design, in standard stock as the Compact FA Series. The exceptionally high performance ball screws are ready for use in a variety of fields such as semiconductor manufacturing equipment, LCD manufacturing equipment, chip mounting equipment, measuring apparatus, and medical equipment.

●**Quieter sound**

The noise level of ball screws has been reduced by 6 dB, about half of what is sensed by the ear.

●**Compact**

The outside diameter of the ball nut is as much as 30% smaller than those of NSK conventional products. This contributes to more compact design of all sorts of equipment and devices such as thinner XY tables.

●**High speed**

Permissible rotational speeds up to 5 000 min^{-1}. This capability dramatically expands the range of service conditions.

Please refer to the dimension table for details of permissible rotational speed.

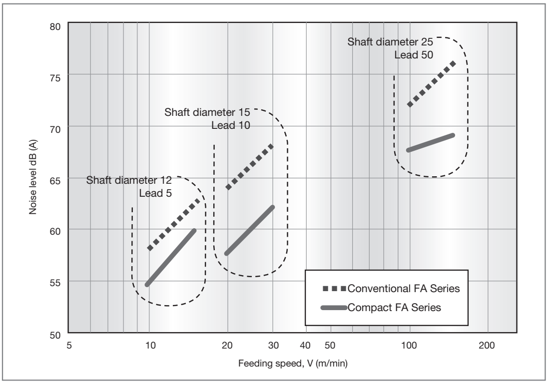
●**Grease fitting provided as standard equipment**

The new ball screws are standardly equipped with a grease fitting (M5 × 0.8). Lubrication ports are provided in 2 places to facilitate maintenance. The ball screws can be easily connected to an integrated lubrication system.

Also, compact, thin plastic seal is available. Nut outside diameter is compact compare with the return tube recirculation system.

●**Low-profile design**

The low-profile support units especially compatible with the compact FA PSS type are available for uniquely space-saving design.



(Microphone was positioned at a distance of 400 mm for all noise levels)

Fig. 1 Comparison of noise level

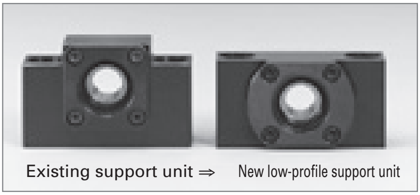


Fig. 2 Comparison of support units

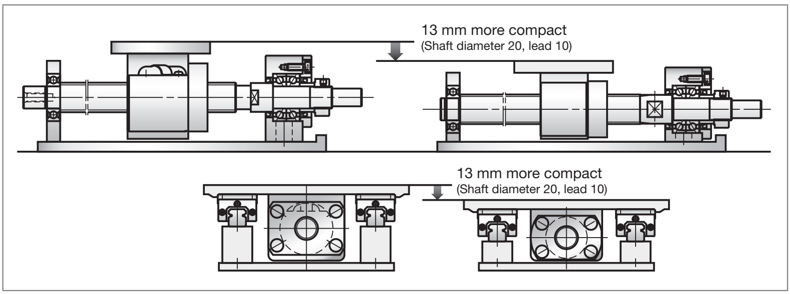


Fig. 3 Comparison of FA Type and Compact FA Series

◇**Ball screw sizes are arranged in order of the page number.**

Table begins with the smallest shaft diameter ball screw, and proceeds to the larger sizes

◇**Dimension tables**

Dimension tables show shapes/sizes as well as specification factors of each shaft diameter/ lead combination. Tables also contain data as follows:

●**Stroke**

Nominal stroke: A reference for your use.

Maximum stroke: The limit stroke that the nut can move. The figure is obtained by subtracting the nut length from the effective threaded length (L1).

●**Lead accuracy**

Lead accuracy is C5 grades

T : Travel compensation;

e_p : Tolerance on specified travel;

υ_u : Travel variation

See "Technical Description: Lead accuracy" (Page B41) for the details of the codes.

●**Permissible rotational speed**

d • n: Limited by the relative peripheral speed between the screw shaft and the nut.

Critical speed: Limited by the natural frequency of a ball screw shaft. Critical speed depends on the supporting condition of screw shaft.

The lower of the two criteria, d·n and Critical Speed, will determine the overall Permissible Rotational Speed of the ball screw. For details, see "Technical description: Permissible rotational speed" (Page B51).

◇**Other**

The seal of the ball screw and end deflector are made of synthetic resin. Consult NSK when using our ball screws under extreme environments or in special environments, or if using special lubricant or oil.

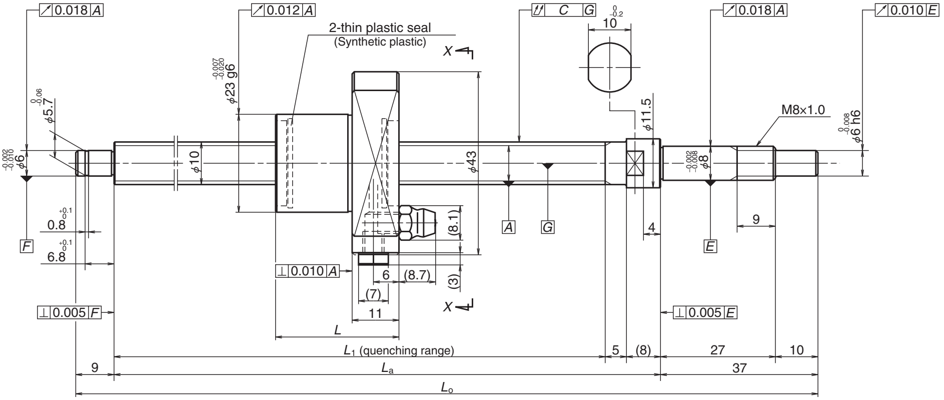
For special environments, refer to Pages B74 and D2. For lubricants, refer to Pages B71 and D13.

Note: For details of standard stock products, contack NSK.

Table 1 Combinations of screw shaft diameter and lead

Screw shaft diameter \ Lead	5	10	20	25	30	40	50	60
10	B221	B221						
12	B223	B223	B223		B223			
15	B225	B225	B227		B227			
20	B229	B229	B231		B231	B233		B233
25	B235	B235	B237	B237	B239		B239	

Compact FA PSS Type

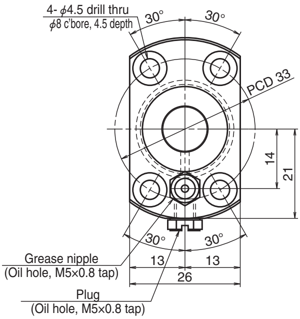


Ball screw No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions		
	d	l	Dynamic C_a	Static C_{0a}	Nominal	Max. L_t-L	L	L_t	L_a	L_o
PSS1005N1D0171					50	83		112	125	171
PSS1005N1D0221					100	133		162	175	221
PSS1005N1D0321		5	3 420	4 840	200	233	29	262	275	321
PSS1005N1D0421					300	333		362	375	421
PSS1005N1D0521	10				400	433		462	475	521
PSS1010N1D0221					100	130		162	175	221
PSS1010N1D0321		10	2 290	2 980	200	230		262	275	321
PSS1010N1D0421					300	330	32	362	375	421
PSS1010N1D0521					400	430		462	475	521

Remarks: 1. Indicates ball screw preload control value. About 2.0 N·cm of torque is added due to thin plastic seal.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0˚C to 80˚C.

Screw shaft ø10
Lead 5, 10

Unit: mm



Cross-section *X-X*

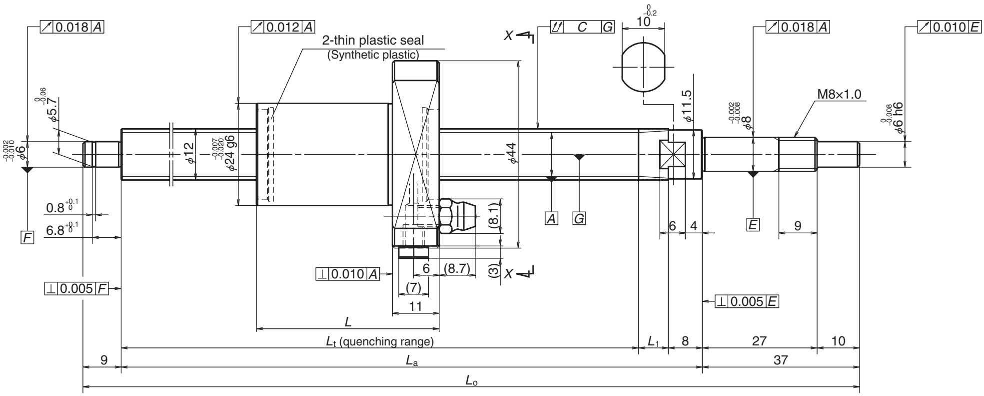
Ball screw specification	
Preload type	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	2.000 / 8.2
Ball circle dia.	10.3
Accuracy grade/axial play	C5 / 0
Factory pre-packed grease	NSK grease PS2

Recommended support unit	For drive side	For opposite to drive side
WBK08-01B (square)	○	
WBK08S-01B (square)		○
WBK08-11B (round)	○	

Unit: mm

Lead accuracy			Shaft runout	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		
T	e_p	υ_u	C	(N·cm) *1	(kg)		(cm^3)	(cm^3)
0	0.020	0.018	0.030	0.7 – 3.3	0.3	5 000	0.8	0.4
	0.020	0.018	0.045	0.7 – 3.3	0.3			
	0.023	0.018	0.060	0.6 – 4.3	0.3			
	0.025	0.020	0.070	0.6 – 4.3	0.4			
	0.027	0.020	0.085	0.4 – 4.9	0.5			
	0.020	0.018	0.045	0.7 – 3.3	0.3	5 000	0.7	0.4
	0.023	0.018	0.060	0.6 – 4.3	0.4			
	0.025	0.020	0.070	0.6 – 4.3	0.4			
	0.027	0.020	0.085	0.4 – 4.9	0.5			

Remarks: 4. NSK support unit is recommended. Refer to Page B433 for details.
5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.

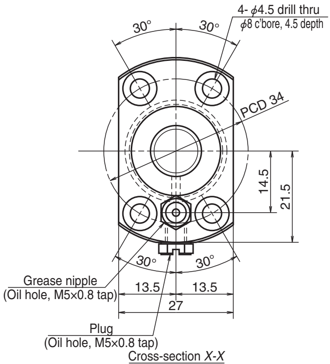


Ball screw No.	Screw shaft diameter d	Lead l	Basic load ratings (N) Dynamic C_a	Basic load ratings (N) Static C_{0a}	Stroke Nominal	Stroke Max. L_t-L	Nut length L	Screw shaft dimensions L_t	L_a	L_o	L_1
PSS1205N1D0171	12	5	3 750	5 810	50	80	30	110	125	171	7
PSS1205N1D0221					100	130		160	175	221	
PSS1205N1D0321					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	3 760	5 780	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	2 330	3 600	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	2 190	3 650	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	

Remarks: 1. Indicates ball screw preload control value. About 2.0 N·cm of torque is added due to thin plastic seal.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0˚C to 80˚C.

Screw shaft ø12
Lead 5, 10, 20, 30

Unit: mm



Cross-section *X-X*

Ball screw specification	
Preload type	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	2.000 / 10.2
Ball circle dia.	12.3
Accuracy grade/axial play	C5 / 0
Factory pre-packed grease	NSK grease PS2

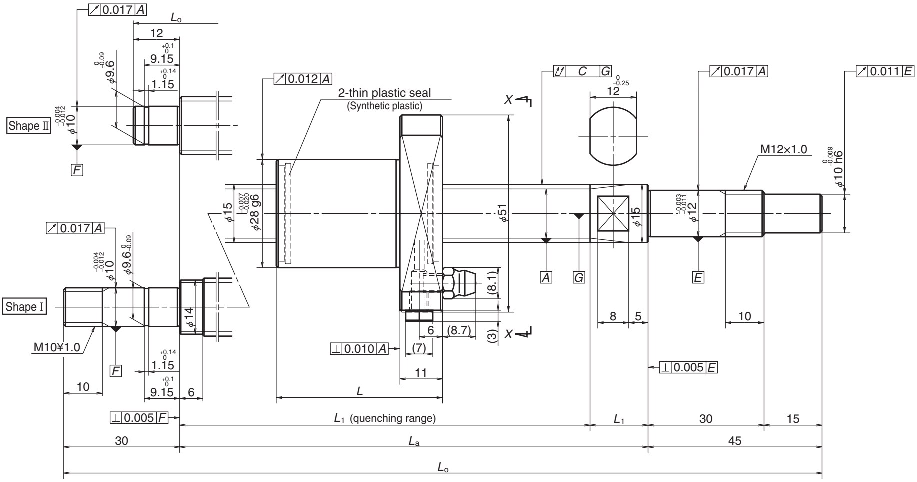
Recommended support unit	For drive side	For opposite to drive side
WBK08-01B (square)	○	
WBK08S-01B (square)		○
WBK08-11B (round)	○	

Unit: mm

Lead accuracy			Shaft runout	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		
T	e_p	υ_u	C	(N·cm) *1	(kg)		(cm^3)	(cm^3)
0	0.020	0.018	0.030	0.7 – 3.3	0.3	5 000	1.0	0.5
	0.020	0.018	0.045	0.7 – 3.3	0.3			
	0.023	0.018	0.060	0.6 – 4.3	0.4			
	0.025	0.020	0.070	0.6 – 4.3	0.5			
	0.027	0.020	0.085	0.6 – 4.3	0.6			
	0.030	0.023	0.085	0.4 – 4.9	0.7			
	0.020	0.018	0.045	0.7 – 3.3	0.4	5 000	1.0	0.5
	0.023	0.018	0.060	0.6 – 4.3	0.5			
	0.025	0.020	0.070	0.6 – 4.3	0.5			
	0.027	0.020	0.085	0.6 – 4.3	0.6			
	0.030	0.023	0.085	0.4 – 4.9	0.7			
	0.023	0.018	0.045	1.4 – 4.5	0.4	5 000	1.2	0.6
	0.023	0.018	0.060	0.9 – 4.9	0.5			
	0.027	0.020	0.070	0.9 – 4.9	0.6			
	0.030	0.023	0.085	0.6 – 5.9	0.7			
	0.030	0.023	0.110	0.6 – 5.9	0.8	4 200		
	0.023	0.018	0.045	1.4 – 4.5	0.5	5 000	1.5	0.8
	0.023	0.018	0.060	0.9 – 4.9	0.6			
	0.027	0.020	0.070	0.9 – 4.9	0.7			
	0.030	0.023	0.085	0.6 – 5.9	0.7			
	0.030	0.023	0.110	0.6 – 5.9	0.8	4 300		

Remarks: 4. NSK support unit is recommended. Refer to Page B433 for details.
5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.

Compact FA PSS Type



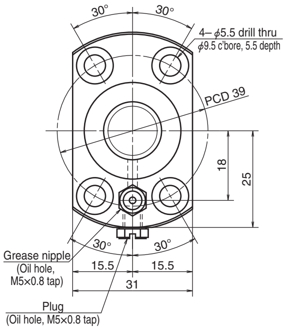
Ball screw No.	Screw shaft diameter	Lead	Basic load ratings (N)		Stroke		Nut length	Screw shaft dimensions			
			Dynamic	Static	Nominal	Max.					
	d	l	C_a	C_{0a}		L_t-L	L	L_t	L_a	L_o	L_1
PSS1505N1D0211					50	109		139	154	211	
PSS1505N1D0261					100	159		189	204	261	
PSS1505N1D0361					200	259		289	304	361	
PSS1505N1D0461		5	6 410	10 100	300	359	30	389	404	461	15
PSS1505N1D0561					400	459		489	504	561	
PSS1505N1D0661					500	559		589	604	661	
PSS1505N1D0761					600	659		689	704	761	
PSS1510N1D0261	15				100	146		189	204	261	
PSS1510N1D0361					200	246		289	304	361	
PSS1510N1D0461					300	346		389	404	461	
PSS1510N1D0561					400	446		489	504	561	
PSS1510N1D0661		10	6 530	10 200	500	546	43	589	604	661	15
PSS1510N1D0761					600	646		689	704	761	
PSS1510N1D0879					700	746		789	804	879	
PSS1510N1D0979					800	846		889	904	979	
PSS1510N1D1179					1 000	1 046		1 089	1 104	1 179	

Remarks: 1. Indicates ball screw preload control value. About 2.0 N·cm of torque is added due to thin plastic seal.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0˚C to 80˚C.

Screw shaft ø15

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	2.778 / 12.6
Ball circle dia.	15.5
Accuracy grade/axial play	C5 / 0
Factory pre-packed grease	NSK grease LR3

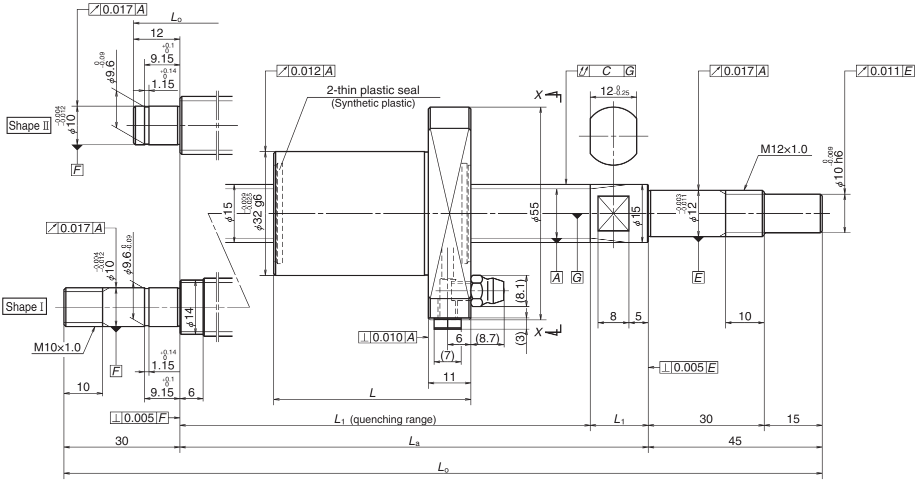
Recommended support unit	For drive side	For opposite to drive side
WBK12-01B (square)	○	
WBK12S-01B (square)		○
WBK12-11 (round)	○	
WBK10-01B (square)		○
WBK10-11 (round)		○

Unit: mm

Left shaft end (opposite driven side)	Lead accuracy Target value T	Lead accuracy Error e_p	Lead accuracy Variation υ_u	Shaft runout C	Dynamic preload torque (N·cm) *1	Mass (kg)	Permissible rotational speed (min⁻¹) *2 Fixed-Simple	Permissible rotational speed (min⁻¹) *2 Fixed-Fixed	Internal spatial volume of nut (cm³)	Standard volume of grease replenishing (cm³)
Ⅱ	0	0.020	0.018	0.035	0.2 – 6.9	0.5	5 000	—	2.0	1.0
		0.020	0.018	0.035	0.2 – 6.9	0.5				
		0.023	0.018	0.045	0.2 – 6.9	0.6				
		0.025	0.020	0.050	0.4 – 9.8	0.8				
		0.027	0.020	0.060	0.4 – 9.8	0.9				
		0.030	0.023	0.075	0.4 – 9.8	1.0				
		0.035	0.025	0.075	0.4 – 11.8	1.1	3 600			
Ⅱ		0.020	0.018	0.035	0.6 – 7.4	0.6	5 000	—	2.0	1.0
		0.023	0.018	0.045	0.6 – 7.4	0.7				
		0.025	0.020	0.050	0.4 – 9.8	0.8				
		0.027	0.020	0.060	0.4 – 9.8	1.0				
		0.030	0.023	0.075	0.4 – 9.8	1.1				
		0.035	0.025	0.075	0.4 – 11.8	1.2	3 600			
Ⅰ		0.035	0.025	0.095	0.4 – 11.8	1.4	2 700	3 400		
		0.040	0.027	0.095	0.4 – 11.8	1.5	2 200	3 400		
		0.046	0.030	0.120	0.4 – 11.8	1.7	1 400	2 300		

Remarks: 4. NSK support unit is recommended. Refer to Page B433 for details.
5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.

Compact FA PSS Type

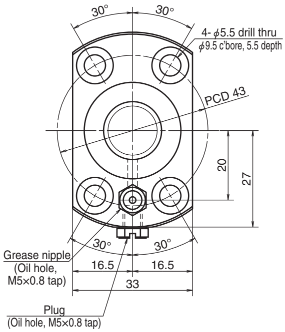


Ball screw No.	Screw shaft diameter d	Lead l	Basic load ratings (N) Dynamic C_a	Static C_{0a}	Stroke Nominal	Max. L_t-L	Nut length L	Screw shaft dimensions L_t	L_a	L_o	L_1
PSS1520N1D0261	15	20	5 660	8 700	100	135	51	186	204	261	18
PSS1520N1D0361					200	235		286	304	361	
PSS1520N1D0461					300	335		386	404	461	
PSS1520N1D0561					400	435		486	504	561	
PSS1520N1D0661					500	535		586	604	661	
PSS1520N1D0761					600	635		686	704	761	
PSS1520N1D0879					700	735		786	804	879	
PSS1520N1D0979					800	835		886	904	979	
PSS1520N1D1179					1 000	1 035		1 086	1 104	1 179	
PSS1530N1D0311		30	5 500	8 580	100	159	71	230	254	311	24
PSS1530N1D0411					200	259		330	354	411	
PSS1530N1D0511					300	359		430	454	511	
PSS1530N1D0611					400	459		530	554	611	
PSS1530N1D0711					500	559		630	654	711	
PSS1530N1D0811					600	659		730	754	811	
PSS1530N1D0929					700	759		830	854	929	
PSS1530N1D1029					800	859		930	954	1 029	
PSS1530N1D1229					1 000	1 059		1 130	1 154	1 229	

Remarks: 1. Indicates ball screw preload control value. About 2.0 N·cm of torque is added due to thin plastic seal.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0˚C to 80˚C.

Screw shaft ø15
Lead 20, 30

Unit: mm



Cross-section *X-X*

Ball screw specification	
Preload type	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	3.175 / 12.2
Ball circle dia.	15.5
Accuracy grade/axial play	C5 / 0
Factory pre-packed grease	NSK grease LR3

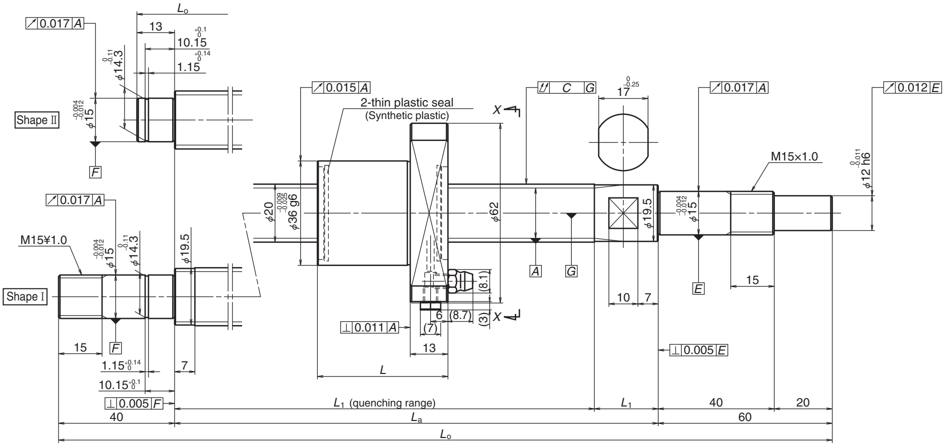
Recommended support unit	For drive side	For opposite to drive side
WBK12-01B (square)	○	
WBK12S-01B (square)		○
WBK12-11 (round)	○	
WBK10-01B (square)		○
WBK10-11 (round)		○

Unit: mm

Left shaft end (opposite driven side)	Lead accuracy Target value T	Lead accuracy Error e_p	Lead accuracy Variation υ_u	Shaft runout C	Dynamic preload torque (N·cm) *1	Mass (kg)	Permissible rotational speed (min^{-1}) *2 Fixed-Simple	Permissible rotational speed (min^{-1}) *2 Fixed-Fixed	Internal spatial volume of nut (cm^3)	Standard volume of grease replenishing (cm^3)
Ⅱ	0	0.020	0.018	0.035	0.8 – 8.8	0.7	5 000	—	2.8	1.4
		0.023	0.018	0.045	0.8 – 8.8	0.8				
		0.025	0.020	0.050	0.8 – 10.8	0.9				
		0.027	0.020	0.060	0.8 – 10.8	1.1				
		0.030	0.023	0.075	0.8 – 10.8	1.2				
		0.035	0.025	0.075	0.8 – 13.8	1.3	3 700			
Ⅰ		0.035	0.025	0.095	0.8 – 13.8	1.5	2 900	4 200		
		0.040	0.027	0.095	0.8 – 13.8	1.6	2 200	3 300		
		0.046	0.030	0.120	0.8 – 13.8	1.9	1 500	2 200		
Ⅱ		0.023	0.018	0.035	1.2 – 9.3	0.8	5 000	—	3.4	1.7
		0.025	0.020	0.050	0.8 – 10.8	1.0				
		0.027	0.020	0.060	0.8 – 10.8	1.1				
		0.030	0.023	0.060	0.8 – 10.8	1.2				
		0.030	0.023	0.075	0.8 – 13.8	1.4	4 500			
		0.035	0.025	0.095	0.8 – 13.8	1.5	3 300			
Ⅰ		0.040	0.027	0.095	0.8 – 13.8	1.6	2 600	3 800		
		0.040	0.027	0.120	0.8 – 13.8	1.8	2 000	3 000		
		0.046	0.030	0.120	0.8 – 13.8	2.0	1 400	2 000		

Remarks: 4. NSK support unit is recommended. Refer to Page B433 for details.
5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.

Compact FA PSS Type



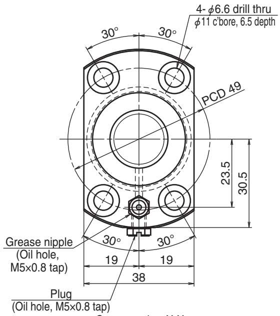
Ball screw No.	Screw shaft diameter d	Lead l	Basic load ratings (N) Dynamic C_a	Basic load ratings (N) Static C_{0a}	Stroke Nominal	Stroke Max. L_t-L	Nut length L	Screw shaft dimensions L_t	L_a	L_o	L_1
PSS2005N1D0323	20	5	10 400	18 500	150	197	31	228	250	323	22
PSS2005N1D0373					200	247		278	300	373	
PSS2005N1D0473					300	347		378	400	473	
PSS2005N1D0573					400	447		478	500	573	
PSS2005N1D0673					500	547		578	600	673	
PSS2005N1D0773					600	647		678	700	773	
PSS2005N1D0873					700	747		778	800	873	
PSS2005N1D1000					800	847		878	900	1000	
PSS2010N1D0387		10	10 200	18 600	200	247	45	292	314	387	22
PSS2010N1D0487					300	347		392	414	487	
PSS2010N1D0587					400	447		492	514	587	
PSS2010N1D0687					500	547		592	614	687	
PSS2010N1D0787					600	647		692	714	787	
PSS2010N1D0887					700	747		792	814	887	
PSS2010N1D1014					800	847		892	914	1014	
PSS2010N1D1214					1 000	1047		1092	1 114	1214	
PSS2010N1D1414					1 200	1247		1292	1 314	1414	

Remarks: 1. Indicates ball screw preload control value. About 2.0 N·cm of torque is added due to thin plastic seal.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0˚C to 80˚C.

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 pre-packed grease	NSK grease LR3

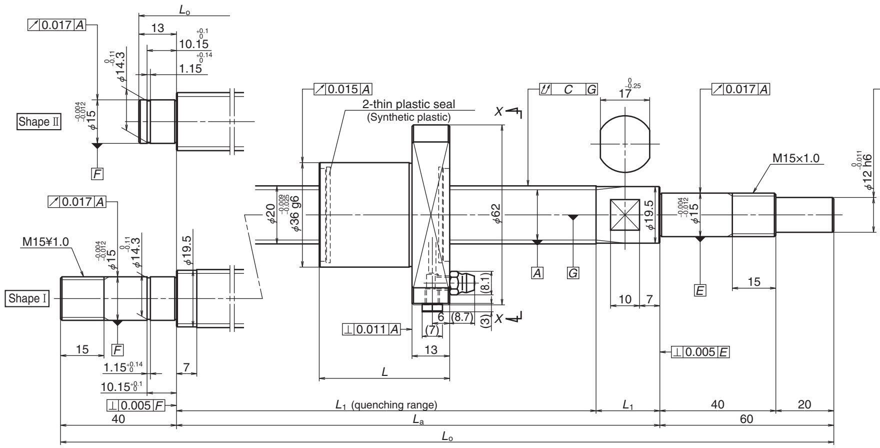
Recommended support unit	For drive side	For opposite to drive side
WBK15-01B (square)	○	○
WBK15S-01B (square)		○
WBK15-11 (round)	○	○

Unit: mm

Left shaft end (opposite driven side)	Lead accuracy: Target value T	Lead accuracy: Error e_p	Lead accuracy: Variation υ_u	Shaft runout C	Dynamic preload torque (N·cm) *1	Mass (kg)	Permissible rotational speed (min⁻¹) *2: Fixed-Simple	Permissible rotational speed (min⁻¹) *2: Fixed-Fixed	Internal spatial volume of nut (cm³)	Standard volume of grease replenishing (cm³)
		0.023	0.018	0.045	0.6 – 7.4	1.0				
		0.023	0.018	0.045	0.6 – 7.4	1.1				
		0.025	0.020	0.050	0.6 – 7.4	1.3	5 000			
Ⅱ		0.027	0.020	0.060	0.4 – 9.8	1.5		—	3.4	1.7
		0.030	0.023	0.075	0.4 – 9.8	1.7				
		0.035	0.025	0.075	0.4 – 9.8	1.9				
		0.035	0.025	0.095	0.4 – 9.8	2.2	4 000			
Ⅰ		0.040	0.027	0.095	0.4 – 11.8	2.4	3 200	4 700		
	0	0.023	0.018	0.045	1.2 – 9.3	1.2				
		0.025	0.020	0.050	1.2 – 9.3	1.4				
Ⅱ		0.027	0.020	0.060	0.8 – 10.8	1.7	5 000	—		
		0.030	0.023	0.075	0.8 – 10.8	1.9				
		0.035	0.025	0.075	0.8 – 10.8	2.1			3.2	1.6
		0.035	0.025	0.095	0.8 – 10.8	2.4	4 000			
		0.040	0.027	0.120	0.8 – 13.8	2.6	3 100	4 600		
Ⅰ		0.046	0.030	0.120	0.8 – 13.8	3.1	2 100	3 100		
		0.054	0.035	0.160	0.8 – 13.8	3.6	1 500	2 200		

Remarks: 4. NSK support unit is recommended. Refer to Page B433 for details.
5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.

Compact FA PSS Type

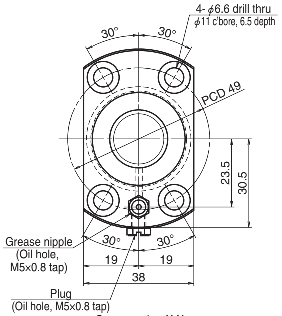


Ball screw No.	Screw shaft diameter d	Lead l	Basic load ratings (N) Dynamic C_a	Static C_{0a}	Stroke Nominal	Max. L_t-L	Nut length L	Screw shaft dimensions L_t	L_a	L_o	L_1
PSS2020N1D0508					300	359		413	435	508	
PSS2020N1D0608					400	459		513	535	608	
PSS2020N1D0708					500	559		613	635	708	
PSS2020N1D0808					600	659		713	735	808	
PSS2020N1D0908		20	6 790	11 800	700	759	54	813	835	908	22
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	20				1 600	1 659		1 713	1 735	1 835	
PSS2030N1D0408					200	234		308	335	408	
PSS2030N1D0508					300	334		408	435	508	
PSS2030N1D0608					400	434		508	535	608	
PSS2030N1D0708					500	534		608	635	708	
PSS2030N1D0808		30	6 550	11 800	600	634	74	708	735	808	27
PSS2030N1D0908					700	734		808	835	908	
PSS2030N1D1035					800	834		908	935	1 035	
PSS2030N1D1235					1 000	1 034		1 108	1 135	1 235	
PSS2030N1D1435					1 200	1 234		1 308	1 335	1 435	

Remarks: 1. Indicates ball screw preload control value. About 2.0 N·cm of torque is added due to thin plastic seal.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0˚C to 80˚C.

Screw shaft ø20
Lead 20, 30

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 pre-packed grease	NSK grease LR3

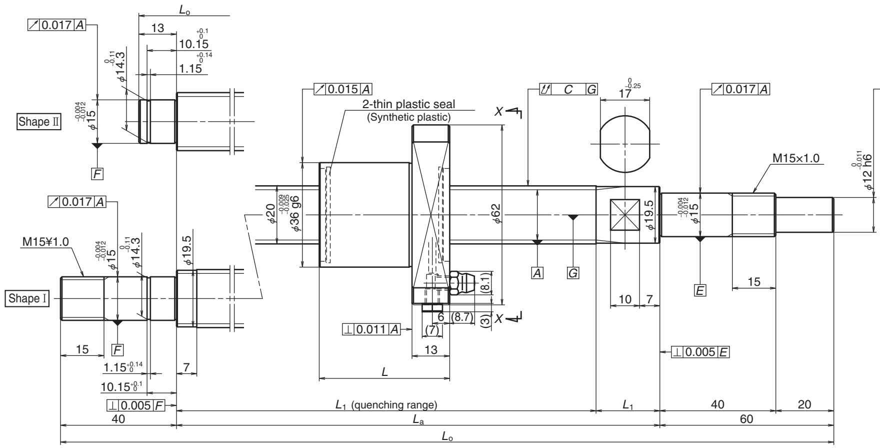
Recommended support unit	For drive side	For opposite to drive side
WBK15-01B (square)	○	○
WBK15S-01B (square)		○
WBK15-11 (round)	○	○

Unit: mm

Left shaft end (opposite driven side)	Lead accuracy			Shaft runout	Dynamic preload torque	Mass	Permissible rotational speed (min⁻¹) *2		Internal spatial volume of nut	Standard volume of grease replenishing
	Target value T	Error e_p	Variation υ_u	C	(N·cm) *1	(kg)	Fixed-Simple	Fixed-Fixed	(cm^3)	(cm^3)
Ⅱ	0	0.027	0.020	0.060	1.4 – 11.8	1.6	5 000	—	3.2	1.6
		0.030	0.023	0.060	1.4 – 11.8	1.8				
		0.030	0.023	0.075	1.4 – 11.8	2.0				
		0.035	0.025	0.095	1.4 – 11.8	2.3				
		0.040	0.027	0.095	0.8 – 13.8	2.5	3 700			
Ⅰ		0.040	0.027	0.120	0.8 – 13.8	2.8	3 000	4 500		
		0.046	0.030	0.120	0.8 – 13.8	3.3	2 000	3 000		
		0.054	0.035	0.160	0.8 – 13.8	3.8	1 400	2 100		
		0.065	0.040	0.200	0.8 – 13.8	4.7	800	1 200		
Ⅱ		0.023	0.018	0.050	1.6 – 9.8	1.4	5 000	—	4.6	2.3
		0.027	0.020	0.060	1.4 – 11.8	1.7				
		0.030	0.023	0.060	1.4 – 11.8	1.9				
		0.030	0.023	0.075	1.4 – 11.8	2.1				
		0.035	0.025	0.095	1.4 – 11.8	2.4				
		0.040	0.027	0.095	0.8 – 13.8	2.6	3 900			
Ⅰ		0.040	0.027	0.120	0.8 – 13.8	2.9	3 100	4 600		
		0.046	0.030	0.120	0.8 – 13.8	3.4	2 100	3 000		
		0.054	0.035	0.160	0.8 – 13.8	3.9	1 500	2 200		

Remarks: 4. NSK support unit is recommended. Refer to Page B433 for details.
5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.

Compact FA PSS Type



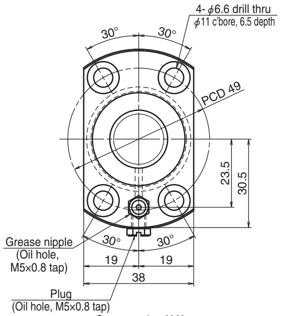
Ball screw No.	Screw shaft diameter d	Lead l	Basic load ratings (N) Dynamic C_a	Static C_{0a}	Stroke Nominal	Max. L_t-L	Nut length L	Screw shaft dimensions L_t	L_a	L_o	L_1
PSS2040N1D0658					400	461		553	585	658	
PSS2040N1D0758					500	561		653	685	758	
PSS2040N1D0858					600	661		753	785	858	
PSS2040N1D0958					700	761		853	885	958	
PSS2040N1D1085		40	6 380	11 600	800	861	92	953	985	1 085	32
PSS2040N1D1285					1 000	1 061		1 153	1 185	1 285	
PSS2040N1D1485					1 200	1 261		1 353	1 385	1 485	
PSS2040N1D1885					1 600	1 661		1 753	1 785	1 885	
PSS2040N1D2285	20				2 000	2 061		2 153	2 185	2 285	
PSS2060N1D0708					400	464		593	635	708	
PSS2060N1D0808					500	564		693	735	808	
PSS2060N1D0908					600	664		793	835	908	
PSS2060N1D1008					700	764		893	935	1 008	
PSS2060N1D1135		60	5 680	11 800	800	864	129	993	1 035	1 135	42
PSS2060N1D1335					1 000	1 064		1 193	1 235	1 335	
PSS2060N1D1535					1 200	1 264		1 393	1 435	1 535	
PSS2060N1D1935					1 600	1 664		1 793	1 835	1 935	
PSS2060N1D2335					2 000	2 064		2 193	2 235	2 335	

Remarks: 1. Indicates ball screw preload control value. About 2.0 N·cm of torque is added due to thin plastic seal.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0˚C to 80˚C.

Screw shaft ø20

Lead 40, 60

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 pre-packed grease	NSK grease LR3

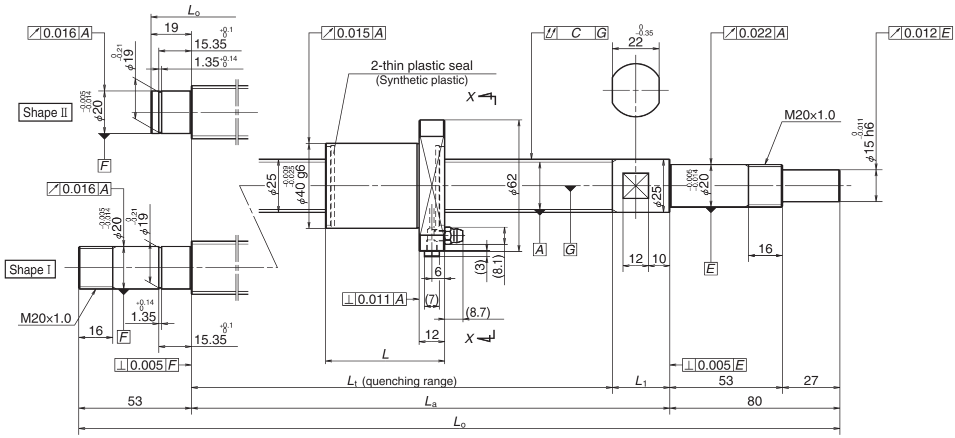
Recommended support unit	For drive side	For opposite to drive side
WBK15-01B (square)	○	○
WBK15S-01B (square)		○
WBK15-11 (round)	○	○

Unit: mm

Left shaft end (opposite driven side)	Lead accuracy			Shaft runout	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *2		Internal spatial volume of nut	Standard volume of grease replenishing
	Target value T	Error e_p	Variation υ_u	C	(N·cm) *1	(kg)	Fixed-Simple	Fixed-Fixed	(cm^3)	(cm^3)
Ⅱ	0	0.030	0.023	0.075	2.2 – 12.8	2.1	5 000	—	5.3	2.7
		0.035	0.025	0.075	2.2 – 12.8	2.4				
		0.035	0.025	0.095	2.2 – 12.8	2.6				
		0.040	0.027	0.095	1.8 – 14.8	2.8	3 500			
Ⅰ		0.040	0.027	0.120	1.8 – 14.8	3.1	2 800	4 200		
		0.046	0.030	0.160	1.8 – 14.8	3.6	1 900	2 800		
		0.054	0.035	0.160	1.8 – 14.8	4.1	1 400	2 000		
		0.065	0.040	0.200	1.8 – 14.8	5.1	800	1 200		
		0.077	0.046	0.240	1.8 – 14.8	6.0	500	800		
Ⅱ		0.030	0.023	0.075	2.7 – 13.8	2.4	5 000	—	7.0	3.5
		0.035	0.025	0.095	2.7 – 13.8	2.6				
		0.035	0.025	0.095	2.7 – 13.8	2.9	4 200			
		0.040	0.027	0.120	1.8 – 14.8	3.1	3 300			
Ⅰ		0.040	0.027	0.120	1.8 – 14.8	3.4	2 600	3 900		
		0.046	0.030	0.160	1.8 – 14.8	3.9	1 800	2 700		
		0.054	0.035	0.160	1.8 – 14.8	4.4	1 300	1 900		
		0.065	0.040	0.200	1.8 – 14.8	5.4	800	1 100		
		0.077	0.046	0.240	1.8 – 14.8	6.3	500	700		

Remarks: 4. NSK support unit is recommended. Refer to Page B433 for details.
5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.

Compact FA PSS Type



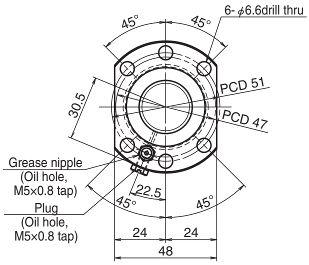
Ball screw No.	Screw shaft diameter *d*	Lead *l*	Basic load ratings (N) Dynamic C_a	Basic load ratings (N) Static C_{0a}	Stroke Nominal	Stroke Max. L_t-L	Nut length *L*	Screw shaft dimensions L_t	L_a	L_o	L_1
PSS2505N1D0349	25	5	11 500	23 500	150	191	32	223	250	349	27
PSS2505N1D0399					200	241		273	300	399	
PSS2505N1D0499					300	341		373	400	499	
PSS2505N1D0599					400	441		473	500	599	
PSS2505N1D0699					500	541		573	600	699	
PSS2505N1D0899					700	741		773	800	899	
PSS2505N1D0999					800	841		873	900	999	
PSS2505N1D1233					1 000	1 041		1 073	1 100	1 233	
PSS2510N1D0549		10	15 000	32 400	300	367	56	423	450	549	27
PSS2510N1D0649					400	467		523	550	649	
PSS2510N1D0749					500	567		623	650	749	
PSS2510N1D0849					600	667		723	750	849	
PSS2510N1D0949					700	767		823	850	949	
PSS2510N1D1049					800	867		923	950	1 049	
PSS2510N1D1283					1 000	1 067		1 123	1 150	1 283	
PSS2510N1D1883					1 600	1 667		1 723	1 750	1 883	

Remarks: 1. Indicates ball screw preload control value. About 2.0 N·cm of torque is added due to thin plastic seal.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0˚C to 80˚C.

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 pre-packed grease	NSK grease LR3

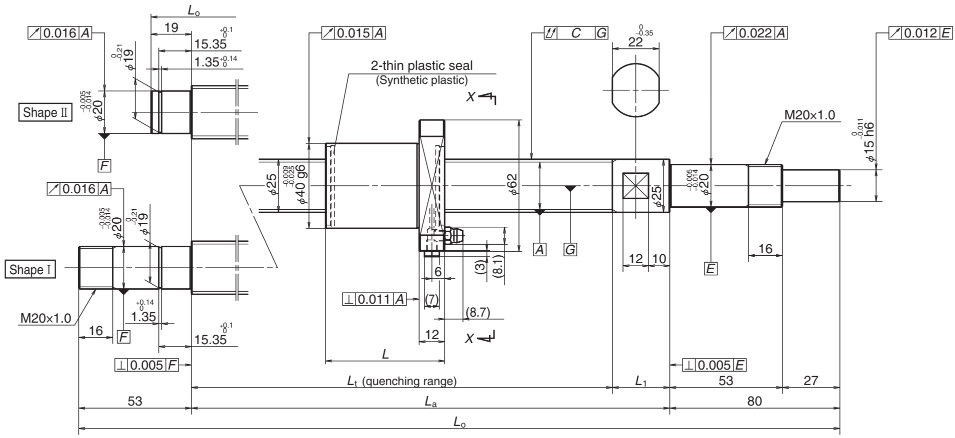
Recommended support unit	For drive side	For opposite to drive side
WBK20-01 (square)	○	○
WBK20S-01 (square)		○
WBK20-11 (round)	○	○

Unit: mm

<table>
<tr><th rowspan="2">Left shaft end (opposite driven side)</th><th colspan="3">Lead accuracy</th><th rowspan="2">Shaft runout
C</th><th rowspan="2">Dynamic preload torque
(N·cm) *1</th><th rowspan="2">Mass
(kg)</th><th colspan="2">Permissible rotational speed (min^{-1}) *2</th><th rowspan="2">Internal spatial volume of nut
(cm^3)</th><th rowspan="2">Standard volume of grease replenishing
(cm^3)</th></tr>
<tr><th>Target value
T</th><th>Error
e_p</th><th>Variation
υ_u</th><th>Fixed-Simple</th><th>Fixed-Fixed</th></tr>
<tr><td rowspan="7">Ⅱ</td><td rowspan="16">0</td><td>0.023</td><td>0.018</td><td>0.035</td><td>1.2 – 9.3</td><td>1.5</td><td rowspan="6">5 000</td><td rowspan="7">—</td><td rowspan="8">4.4</td><td rowspan="8">2.2</td></tr>
<tr><td>0.023</td><td>0.018</td><td>0.035</td><td>1.2 – 9.3</td><td>1.6</td></tr>
<tr><td>0.025</td><td>0.020</td><td>0.040</td><td>1.2 – 9.3</td><td>2.0</td></tr>
<tr><td>0.027</td><td>0.020</td><td>0.045</td><td>1.2 – 9.3</td><td>2.3</td></tr>
<tr><td>0.030</td><td>0.023</td><td>0.055</td><td>0.8 – 10.8</td><td>2.7</td></tr>
<tr><td>0.035</td><td>0.025</td><td>0.065</td><td>0.8 – 10.8</td><td>3.4</td></tr>
<tr><td>0.040</td><td>0.027</td><td>0.065</td><td>0.8 – 10.8</td><td>3.7</td><td>4 100</td></tr>
<tr><td>Ⅰ</td><td>0.046</td><td>0.030</td><td>0.080</td><td>0.8 – 13.8</td><td>4.5</td><td>2 700</td><td>4 000</td></tr>
<tr><td rowspan="6">Ⅱ</td><td>0.027</td><td>0.020</td><td>0.045</td><td>3.1 – 11.8</td><td>2.4</td><td rowspan="5">5 000</td><td rowspan="6">—</td><td rowspan="8">4.7</td><td rowspan="8">2.4</td></tr>
<tr><td>0.030</td><td>0.023</td><td>0.055</td><td>2.2 – 12.8</td><td>2.7</td></tr>
<tr><td>0.030</td><td>0.023</td><td>0.055</td><td>2.2 – 12.8</td><td>3.1</td></tr>
<tr><td>0.035</td><td>0.025</td><td>0.065</td><td>2.2 – 12.8</td><td>3.5</td></tr>
<tr><td>0.040</td><td>0.027</td><td>0.065</td><td>2.2 – 12.8</td><td>3.8</td></tr>
<tr><td>0.040</td><td>0.027</td><td>0.080</td><td>2.2 – 12.8</td><td>4.2</td><td>3 600</td></tr>
<tr><td rowspan="2">Ⅰ</td><td>0.046</td><td>0.030</td><td>0.100</td><td>1.8 – 14.8</td><td>5.0</td><td>2 500</td><td>3 700</td></tr>
<tr><td>0.065</td><td>0.040</td><td>0.130</td><td>1.8 – 14.8</td><td>7.2</td><td>1 000</td><td>1 600</td></tr>
</table>

Remarks: 4. NSK support unit is recommended. Refer to Page B433 for details.
5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.

Compact FA PSS Type



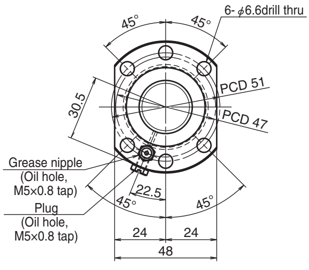
Ball screw No.	Screw shaft diameter d	Lead l	Basic load ratings (N) Dynamic C_a	Static C_{0a}	Stroke Nominal	Max. L_t-L	Nut length L	Screw shaft dimensions L_t	L_a	L_o	L_1
PSS2520N1D0729	25	20	7 650	14 800	500	550	54	604	630	729	26
PSS2520N1D0829					600	650		704	730	829	
PSS2520N1D0929					700	750		804	830	929	
PSS2520N1D1029					800	850		904	930	1 029	
PSS2520N1D1263					1 000	1 050		1 104	1 130	1 263	
PSS2520N1D1463					1 200	1 250		1 304	1 330	1 463	
PSS2520N1D1863					1 600	1 650		1 704	1 730	1 863	
PSS2520N1D2263					2 000	2 050		2 104	2 130	2 263	
PSS2525N1D0779		25	7 490	14 600	500	587	63	650	680	779	30
PSS2525N1D0879					600	687		750	780	879	
PSS2525N1D0979					700	787		850	880	979	
PSS2525N1D1079					800	887		950	980	1 079	
PSS2525N1D1313					1 000	1 087		1 150	1 180	1 313	
PSS2525N1D1513					1 200	1 287		1 350	1 380	1 513	
PSS2525N1D1913					1 600	1 687		1 750	1 780	1 913	
PSS2525N1D2313					2 000	2 087		2 150	2 180	2 313	

Remarks: 1. Indicates ball screw preload control value. About 2.0 N·cm of torque is added due to thin plastic seal.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0˚C to 80˚C.

Screw shaft ø25

Lead 20, 25

Unit: mm



Cross-section *X-X*

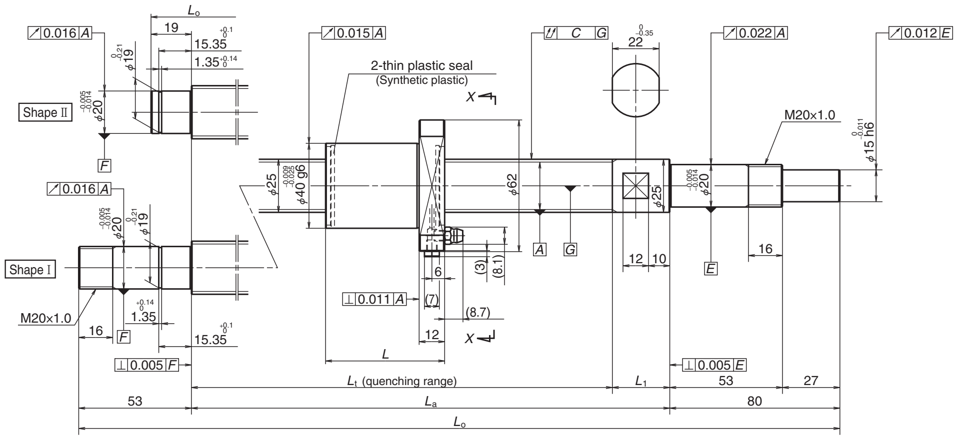
Ball screw specification	
Preload type	Oversize ball preload (P-preload)
Ball diameter/screw shaft root diameter	3.175 / 22.2
Ball circle dia.	25.5
Accuracy grade/axial play	C5 / 0
Factory pre-packed grease	NSK grease LR3

Recommended support unit	For drive side	For opposite to drive side
WBK20-01 (square)	○	○
WBK20S-01 (square)		○
WBK20-11 (round)	○	○

Unit: mm

Left shaft end (opposite driven side)	Lead accuracy			Shaft runout	Dynamic preload torque	Mass	Permissible rotational speed (min^{-1}) *2		Internal spatial volume of nut	Standard volume of grease replenishing
	Target value T	Error e_p	Variation υ_u	C	(N·cm) *1	(kg)	Fixed-Simple	Fixed-Fixed	(cm^3)	(cm^3)
Ⅱ	0	0.030	0.023	0.055	2.2 – 12.8	3.1	5 000	—	3.9	2.0
		0.035	0.025	0.065	2.2 – 12.8	3.4				
		0.040	0.027	0.065	2.2 – 12.8	3.8	4 800			
		0.040	0.027	0.080	2.2 – 12.8	4.2	3 800			
Ⅰ		0.046	0.030	0.100	1.8 – 14.8	5.0	2 600	3 800		
		0.054	0.035	0.100	1.8 – 14.8	5.8	1 800	2 700		
		0.065	0.040	0.130	1.8 – 14.8	7.3	1 100	1 600		
		0.077	0.046	0.170	1.8 – 14.8	8.8	700	1 000		
Ⅱ		0.035	0.025	0.055	2.7 – 13.8	3.3	5 000	—	4.3	2.2
		0.035	0.025	0.065	2.7 – 13.8	3.7				
		0.040	0.027	0.065	2.7 – 13.8	4.1	4 300			
		0.040	0.027	0.080	2.7 – 13.8	4.4	3 400			
Ⅰ		0.046	0.030	0.100	1.8 – 14.8	5.3	2 300	3 500		
		0.054	0.035	0.100	1.8 – 14.8	6.0	1 700	2 600		
		0.065	0.040	0.130	1.8 – 14.8	7.5	1 000	1 500		
		0.077	0.046	0.170	1.8 – 14.8	9.1	700	1 000		

Remarks: 4. NSK support unit is recommended. Refer to Page B433 for details.
5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.



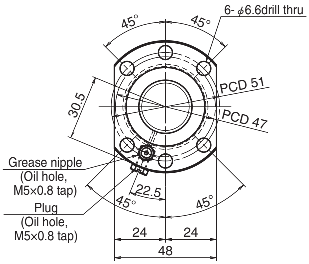
Ball screw No.	Screw shaft diameter *d*	Lead *l*	Basic load ratings (N) Dynamic C_a	Basic load ratings (N) Static C_{0a}	Stroke Nominal	Stroke Max. L_t-L	Nut length *L*	Screw shaft dimensions L_t	L_a	L_o	L_1
PSS2530N1D0779	25	30	7 490	14 600	500	576	74	650	680	779	30
PSS2530N1D0879					600	676		750	780	879	
PSS2530N1D0979					700	776		850	880	979	
PSS2530N1D1079					800	876		950	980	1 079	
PSS2530N1D1313					1 000	1 076		1 150	1 180	1 313	
PSS2530N1D1513					1 200	1 276		1 350	1 380	1 513	
PSS2530N1D1913					1 600	1 676		1 750	1 780	1 913	
PSS2530N1D2313					2 000	2 076		2 150	2 180	2 313	
PSS2550N1D0829		50	6 910	14 700	500	576	114	690	730	829	40
PSS2550N1D0929					600	676		790	830	929	
PSS2550N1D1029					700	776		890	930	1 029	
PSS2550N1D1129					800	876		990	1 030	1 129	
PSS2550N1D1363					1 000	1 076		1 190	1 230	1 363	
PSS2550N1D1563					1 200	1 276		1 390	1 430	1 563	
PSS2550N1D1963					1 600	1 676		1 790	1 830	1 963	
PSS2550N1D2363					2 000	2 076		2 190	2 230	2 363	

Remarks: 1. Indicates ball screw preload control value. About 2.0 N·cm of torque is added due to thin plastic seal.
2. Contact NSK if permissible rotational speed is to be exceeded.
3. Service temperature range is 0˚C to 80˚C.

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 pre-packed grease	NSK grease LR3

Recommended support unit		For drive side	For opposite to drive side
WBK20-01	(square)	○	○
WBK20S-01	(square)		○
WBK20-11	(round)	○	○

Unit: mm

Left shaft end (opposite driven side)	Lead accuracy Target value T	Error e_p	Variation υ_u	Shaft runout C	Dynamic preload torque (N·cm) *1	Mass (kg)	Permissible rotational speed (min^{-1}) *2 Fixed-Simple	Fixed-Fixed	Internal spatial volume of nut (cm^3)	Standard volume of grease replenishing (cm^3)
Ⅱ	0	0.035	0.025	0.055	2.7 – 13.8	3.4	5 000	—	5.5	2.8
		0.035	0.025	0.065	2.7 – 13.8	3.7				
		0.040	0.027	0.065	2.7 – 13.8	4.1	4 300			
		0.040	0.027	0.080	2.7 – 13.8	4.5	3 400			
Ⅰ		0.046	0.030	0.100	1.8 – 14.8	5.3	2 300	3 600		
		0.054	0.035	0.100	1.8 – 14.8	6.1	1 700	2 600		
		0.065	0.040	0.130	1.8 – 14.8	7.6	1 000	1 500		
		0.077	0.046	0.170	1.8 – 14.8	9.1	700	1 000		
Ⅱ		0.035	0.025	0.065	5.4 – 17.6	3.8	5 000	—	7.7	3.9
		0.035	0.025	0.065	5.4 – 17.6	4.1	4 800			
		0.040	0.027	0.080	5.4 – 17.6	4.5	3 800			
		0.040	0.027	0.080	5.4 – 17.6	4.9	3 100			
Ⅰ		0.046	0.030	0.100	4.1 – 19.6	5.8	2 200	3 400		
		0.054	0.035	0.100	4.1 – 19.6	6.5	1 600	2 500		
		0.065	0.040	0.130	4.1 – 19.6	8.0	900	1 500		
		0.077	0.046	0.170	4.1 – 19.6	9.6	600	1 000		

Remarks: 4. NSK support unit is recommended. Refer to Page B433 for details.
5. The amount for replenishing should be about 50% of nut internal space capacity. Refer to Page D16 for details.

B-3-2.2 Finished Shaft End MA type, FA type, SA type

◇Ball screw sizes are arranged in order of the page number.

The Table begins with the smallest shaft diameter of each MA, FA, and SA type ball screws, and proceeds to the larger sizes. If ball screws have the same shaft diameter, those with smaller leads appear first. Page numbers of shaft diameter and lead combinations are shown in Table 1.

◇Dimension tables

Dimension tables show shapes/sizes as well as specification factors of each shaft diameter/ lead combination. Tables also contain data as follows:

●Stroke

Nominal stroke: A reference for your use.

Maximum stroke: The limit stroke that the nut can move. The figure is obtained by subtracting the nut length from the effective threaded length (L_1).

●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"

Table 1 Combinations of screw shaft diameter and lead

Lead (mm) / Screw shaft diameter (mm)	1	1.5	2	2.5	4	5	6
4	B243						
6	B245						
8	B247	B249	B251				
10			B253	B255	B265		
12			B257	B259		B267	
14						B271	
15							
16			B261	B263		B279	
20					B301	B303	
25					B305	B307	B309
28						B313 B315	B317 B319
32						B321 B323	B325 B327
36							
40						B339	
45							
50							

(Page B41) for the details of the codes.

●Permissible rotational speed

d • n: Limited by the relative peripheral speed between the screw shaft and the nut.

Critical speed: Limited by the natural frequency of a ball screw shaft. Critical speed depends on the supporting condition of screw shaft.

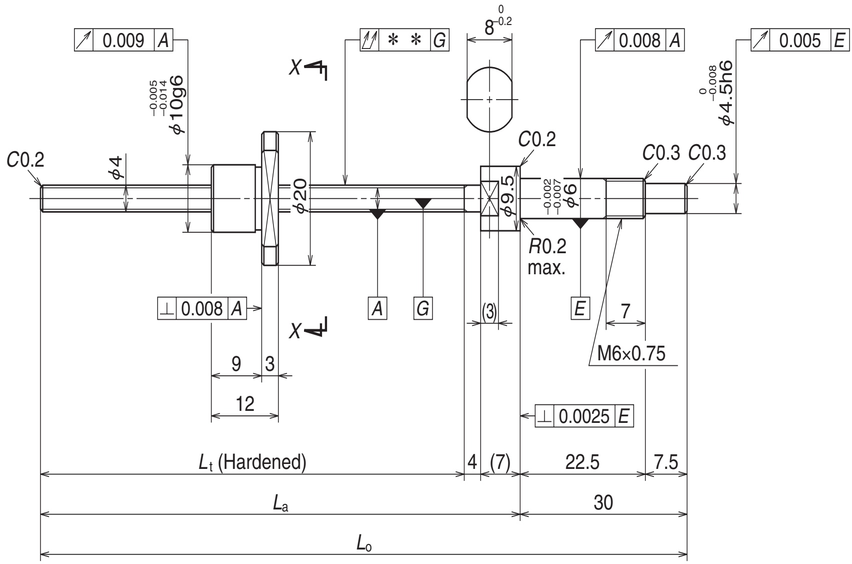
The lower of the two criteria, d·n and Critical Speed, will determine the overall Permissible Rotational Speed of the ball screw. For details, see "Technical description: Permissible rotational speed" (Page B51).

◇Other

The seal of the ball screw, ball recirculating deflector, and end cap are made of synthetic resin. Consult NSK when using our ball screws under extreme environments or in special environments, or if using special lubricant or oil. For special environments, refer to Pages B74 and D2. For lubricants, refer to Pages B71 and D13.

Note: For details of standard stock products, contack NSK.

8	10	12	16	20	25	32	40	50
	B269							
B273								
	B275			B277				
			B281			B283		
	B285			B287			B289	
	B311			B291	B293			B295
B329	B331 B333				B297	B299		
	B335 B337							
B341	B343 B345	B347 B349						
	B351							
	B353 B355							

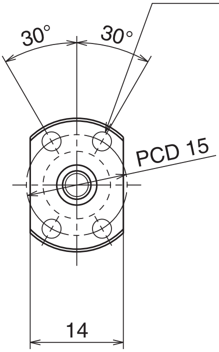


Ball screw No.		Stroke	
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum (L_t—Nut length)
W0400MA-1PY-C3Z1	**W0400MA-2Y-C3T1**	20	32
W0400MA-3PY-C3Z1	**W0400MA-4Y-C3T1**	40	52
W0401MA-1PY-C3Z1	**W0401MA-2Y-C3T1**	70	82

Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease PS2 is recommended. Apply to the screw shaft surface when replenishing. Refer to Page D16 for details.
3. Nut does not have a seal.
4. Contact NSK if permissible rotational speed is to be exceeded.

ø4×1

Unit: mm



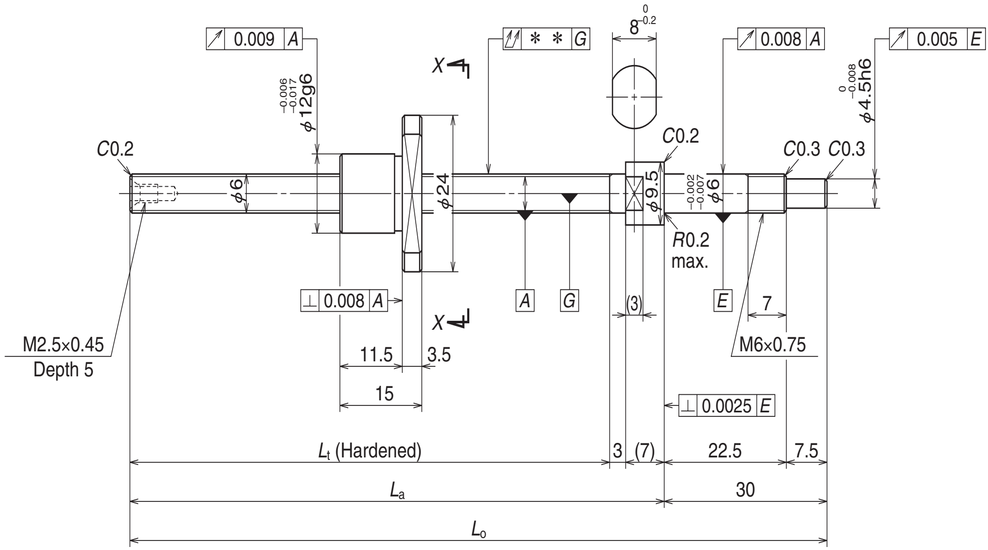
View *X-X*

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		4×1/Right	
Preload / Ball recirculation		P preload / Deflector	
Ball dia. / Ball circle dia.		0.800/4.2	
Screw shaft root diameter		3.2	
Effective turns of balls		1×2	
Accuracy grade / Preload / Axial play		C3/Z	C3/T
Basic load rating (N)	Dynamic C_a	370	
	Static C_{0a}	370	
Axial play		0	0.005 or less
Preload (N)		19.6	—
Dynamic friction torque, (N·cm)		1.0 or less	0.3 or less
Spacer ball		None	
Factory packed grease		NSK grease PS2	

Recommended support unit	
WBK06-01A	(square)
WBK06-11	(round)

Unit: mm

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 - Free
44	55	85	0	0.008	0.008	0.015	0.024	3000
64	75	105	0	0.008	0.008	0.020	0.026	3000
94	105	135	0	0.008	0.008	0.025	0.028	3000

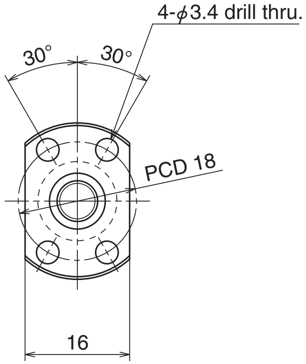


<table>
<tr><th colspan="2" rowspan="1">Ball screw No.</th><th colspan="2">Stroke</th></tr>
<tr><th>Preloaded (MPFD)</th><th>Precise clearance (MSFD)</th><th>Nominal</th><th>Maximum (L_t—Nut length)</th></tr>
<tr><td>W0600MA-1PY-C3Z1</td><td>W0600MA-2Y-C3T1</td><td>40</td><td>50</td></tr>
<tr><td>W0601MA-1PY-C3Z1</td><td>W0601MA-2Y-C3T1</td><td>70</td><td>80</td></tr>
<tr><td>W0601MA-3PY-C3Z1</td><td>W0601MA-4Y-C3T1</td><td>100</td><td>110</td></tr>
</table>

Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease PS2 is recommended. Apply to the screw shaft surface when replenishing. Refer to Page D16 for details.
3. Nut does not have a seal.
4. Contact NSK if permissible rotational speed is to be exceeded.

ø6×1

Unit: mm



View *X-X*

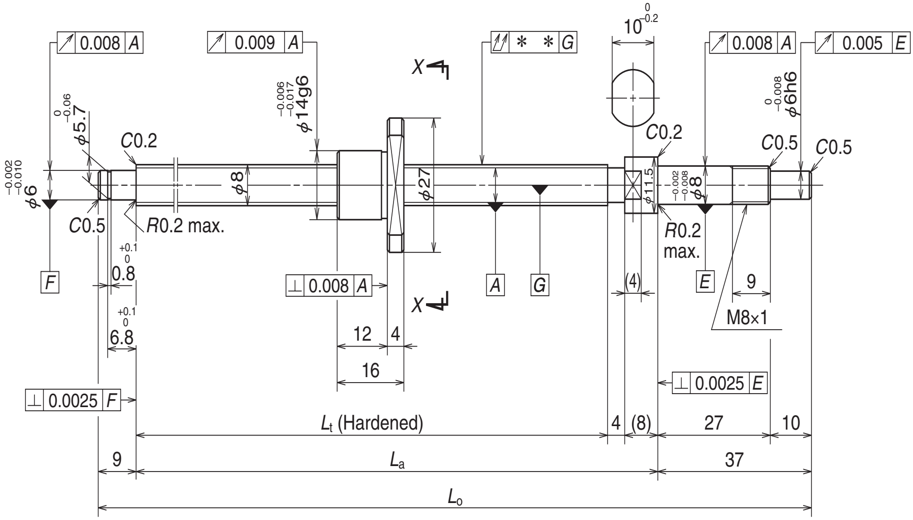
Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		6×1/Right	
Preload / Ball recirculation		P preload / Deflector	
Ball dia. / Ball circle dia.		0.800/6.2	
Screw shaft root diameter		5.2	
Effective turns of balls		1×3	
Accuracy grade / Preload / Axial play		C3/Z	C3/T
Basic load rating (N)	Dynamic C_a	680	
	Static C_{0a}	920	
Axial play		0	0.005 or less
Preload (N)		24.5	—
Dynamic friction torque, (N·cm)		1.3 or less	0.3 or less
Spacer ball		None	
Factory packed grease		NSK grease PS2	

Recommended support unit	
WBK06-01A	(square)
WBK06-11	(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 - Free
65	75	105	0	0.008	0.008	0.015	0.039	3000
95	105	135	0	0.008	0.008	0.020	0.045	3000
125	135	165	0	0.010	0.008	0.025	0.051	3000

B 246

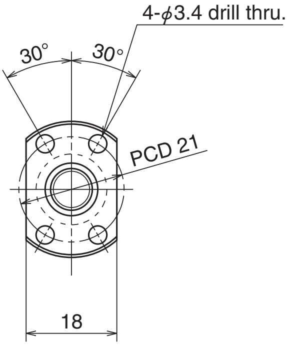


<table>
<tr><th colspan="2" rowspan="2">Ball screw No.</th><th colspan="2">Stroke</th></tr>
<tr><th rowspan="2">Nominal</th><th rowspan="2">Maximum
(L_t—Nut length)</th></tr>
<tr><th>Preloaded (MPFD)</th><th>Precise clearance (MSFD)</th></tr>
<tr><td>W0800MA-1PY-C3Z1</td><td>W0800MA-2Y-C3T1</td><td>40</td><td>64</td></tr>
<tr><td>W0801MA-1PY-C3Z1</td><td>W0801MA-2Y-C3T1</td><td>70</td><td>94</td></tr>
<tr><td>W0801MA-3PY-C3Z1</td><td>W0801MA-4Y-C3T1</td><td>100</td><td>124</td></tr>
<tr><td>W0802MA-1PY-C3Z1</td><td>W0802MA-2Y-C3T1</td><td>150</td><td>174</td></tr>
</table>

Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease PS2 is recommended. Apply to the screw shaft surface when replenishing. Refer to Page D16 for details.
3. Nut does not have a seal.
4. Contact NSK if permissible rotational speed is to be exceeded.

ø8×1

Unit: mm



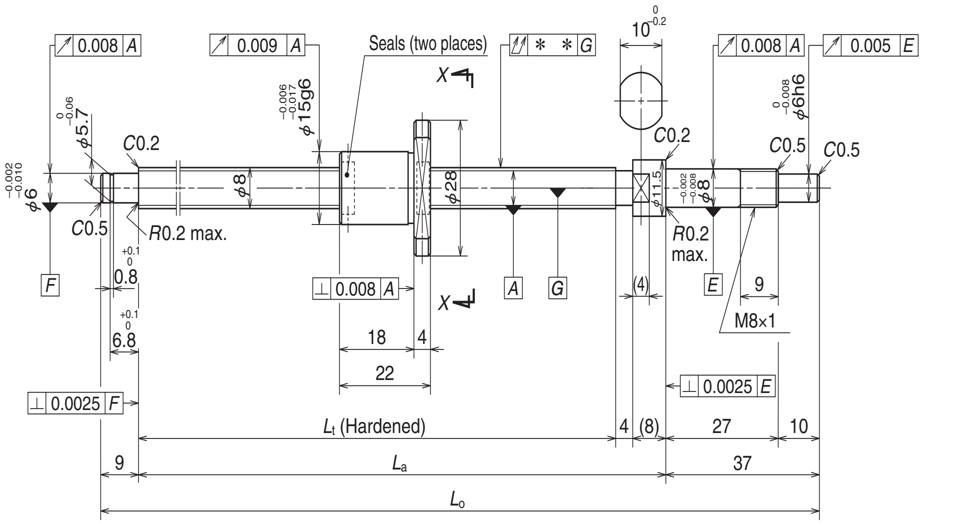
View *X-X*

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	790	
Basic load rating (N) Static C_{0a}	1290	
Axial play	0	0.005 or less
Preload (N)	29.4	—
Dynamic friction torque, (N·cm)	1.8 or less	0.5 or less
Spacer ball	None	
Factory packed grease	NSK grease PS2	

Recommended support unit	**For drive side**	**For opposite to drive side**
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
80	92	138	0	0.008	0.008	0.025	0.073	3000
110	122	168	0	0.010	0.008	0.030	0.084	3000
140	152	198	0	0.010	0.008	0.030	0.095	3000
190	202	248	0	0.010	0.008	0.035	0.11	3000

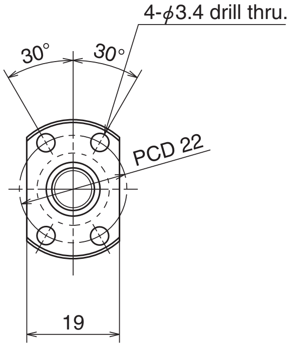


Ball screw No.		Stroke	
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum (L_t—Nut length)
W0800MA-3PY-C3Z1.5	**W0800MA-4Y-C3T1.5**	40	58
W0801MA-5PY-C3Z1.5	**W0801MA-6Y-C3T1.5**	70	88
W0801MA-7PY-C3Z1.5	**W0801MA-8Y-C3T1.5**	100	118
W0802MA-3PY-C3Z1.5	**W0802MA-4Y-C3T1.5**	150	168

Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease PS2 is recommended. Apply to the screw shaft surface when replenishing. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø8×1.5

Unit: mm



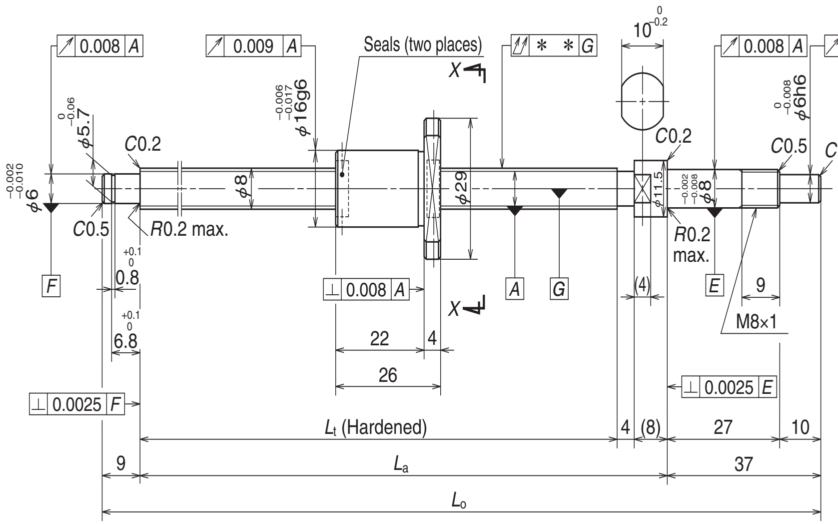
View *X*-*X*

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	1270	
	Static C_{0a}	1970	
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**	**For opposite to drive side**
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
80	92	138	0	0.008	0.008	0.025	0.082	3000
110	122	168	0	0.010	0.008	0.030	0.093	3000
140	152	198	0	0.010	0.008	0.030	0.10	3000
190	202	248	0	0.010	0.008	0.035	0.12	3000

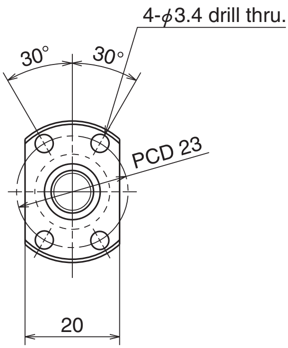


Ball screw No.		Stroke	
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum (L_t—Nut length)
W0800MA-5PY-C3Z2	**W0800MA-6Y-C3T2**	40	54
W0801MA-9PY-C3Z2	**W0801MA-10Y-C3T2**	70	84
W0801MA-11PY-C3Z2	**W0801MA-12Y-C3T2**	100	114
W0802MA-5PY-C3Z2	**W0802MA-6Y-C3T2**	150	164

Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease PS2 is recommended. Apply to the screw shaft surface when replenishing. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø8×2

Unit: mm



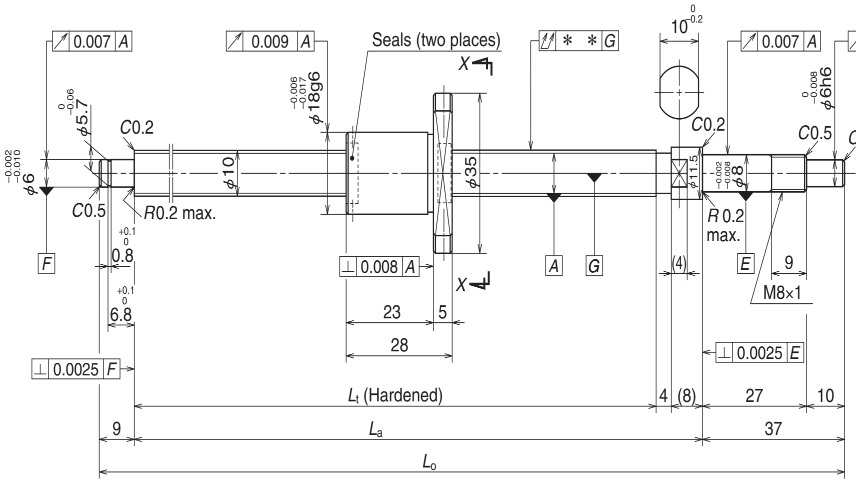
View *X-X*

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		8×2/Right	
Preload / Ball recirculation		P preload / Deflector	
Ball dia. / Ball circle dia.		1.200/8.3	
Screw shaft root diameter		6.9	
Effective turns of balls		1×3	
Accuracy grade / Preload / Axial play		C3/Z	C3/T
Basic load rating (N)	Dynamic C_a	1560	
	Static C_{0a}	2200	
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	For opposite to drive side
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
80	92	138	0	0.008	0.008	0.025	0.09	3000
110	122	168	0	0.010	0.008	0.030	0.10	3000
140	152	198	0	0.010	0.008	0.030	0.11	3000
190	202	248	0	0.010	0.008	0.035	0.13	3000



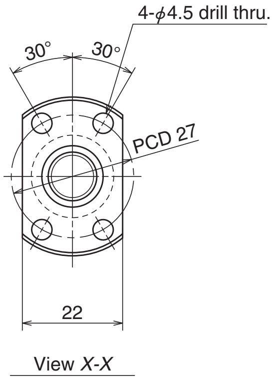
Ball screw No.		Stroke	
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum (L_t—Nut length)
W1001MA-1PY-C3Z2	**W1001MA-2Y-C3T2**	50	72
W1001MA-3PY-C3Z2	**W1001MA-4Y-C3T2**	100	122
W1002MA-1PY-C3Z2	**W1002MA-2Y-C3T2**	150	172
W1002MA-3PY-C3Z2	**W1002MA-4Y-C3T2**	200	222

Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease PS2 is recommended. Apply to the screw shaft surface when replenishing. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

NSK

ø10×2

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	1800	
	Static C_{0a}	2970	
Axial play		0	0.005 or less
Preload (N)		58.8	—
Dynamic friction torque, (N·cm)		0.1 – 2.4	0.5 or less
Spacer ball		None	
Factory packed grease		NSK grease PS2	

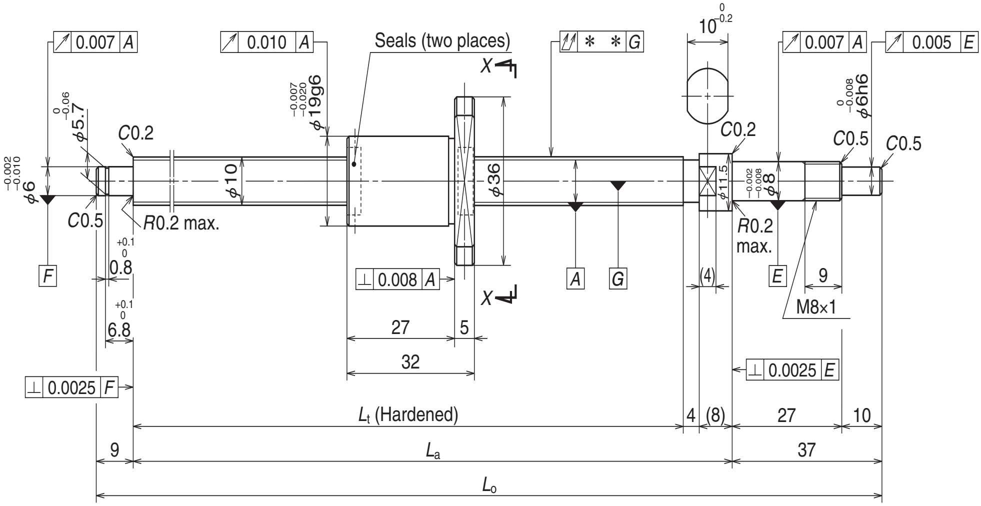
Recommended support unit	For drive side	For opposite to drive side
WBK08-01A (square)	○	
WBK08S-01 (square)		○
WBK08-11 (round)	○	

Unit: mm

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	3000
150	162	208	0	0.010	0.008	0.030	0.16	3000
200	212	258	0	0.010	0.008	0.030	0.19	3000
250	262	308	0	0.012	0.008	0.030	0.22	3000

Finished shaft end MA Type

(Fine lead) Dia. 10, Lead 2.5

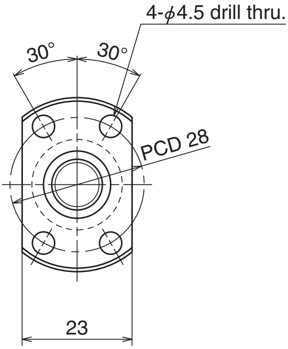


Ball screw No.		Stroke	
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum (L_t—Nut length)
W1001MA-5PY-C3Z2.5	**W1001MA-6Y-C3T2.5**	50	68
W1001MA-7PY-C3Z2.5	**W1001MA-8Y-C3T2.5**	100	118
W1002MA-5PY-C3Z2.5	**W1002MA-6Y-C3T2.5**	150	168
W1002MA-7PY-C3Z2.5	**W1002MA-8Y-C3T2.5**	200	218

Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease PS2 is recommended. Apply to the screw shaft surface when replenishing. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø10×2.5

Unit: mm



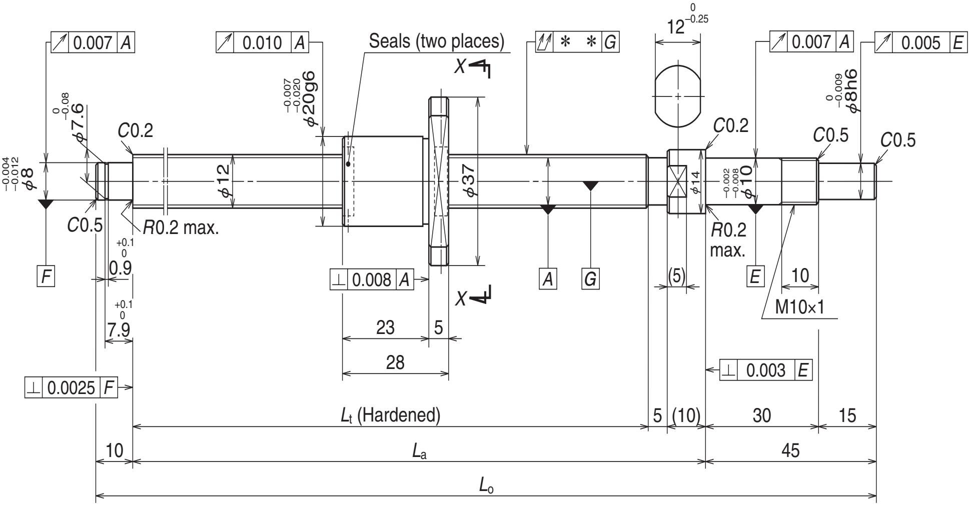
View *X-X*

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	2500	
Basic load rating (N) Static C_{0a}	3630	
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	For opposite to drive side
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: Fixed - Simple support
L_t	L_a	L_o	T	e_p	υ_u			
100	112	158	0	0.008	0.008	0.020	0.14	3000
150	162	208	0	0.010	0.008	0.030	0.17	3000
200	212	258	0	0.010	0.008	0.030	0.20	3000
250	262	308	0	0.012	0.008	0.030	0.23	3000

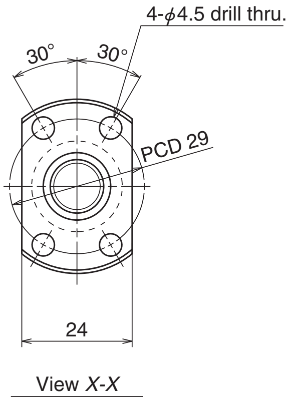


Ball screw No.		Stroke	
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum (L_t—Nut length)
W1201MA-1PY-C3Z2	**W1201MA-2Y-C3T2**	50	82
W1201MA-3PY-C3Z2	**W1201MA-4Y-C3T2**	100	132
W1202MA-1PY-C3Z2	**W1202MA-2Y-C3T2**	150	182
W1202MA-3PY-C3Z2	**W1202MA-4Y-C3T2**	200	232
W1203MA-1PY-C3Z2	**W1203MA-2Y-C3T2**	250	282

Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease PS2 is recommended. Apply to the screw shaft surface when replenishing. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø12×2

Unit: mm

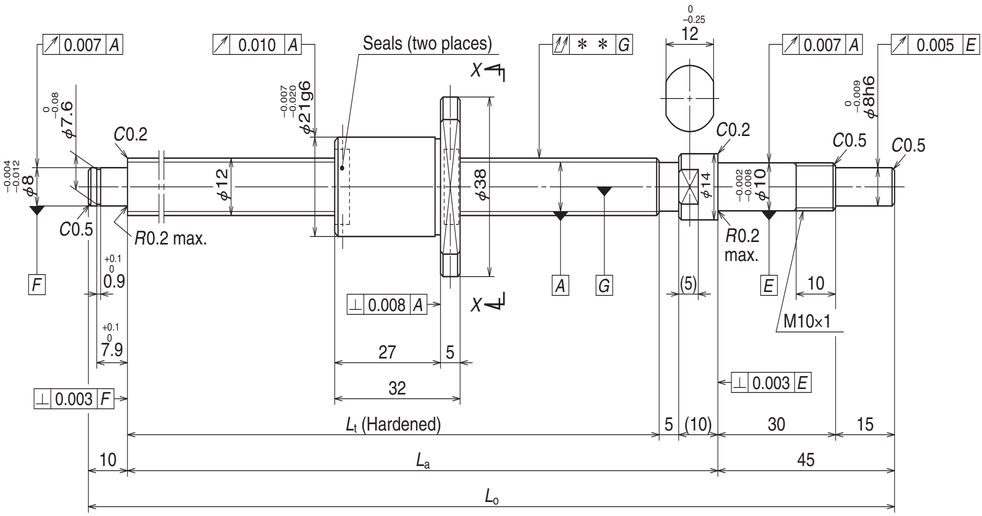


Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		12×2/Right	
Preload / Ball recirculation		P preload / Deflector	
Ball dia. / Ball circle dia.		1.200/12.3	
Screw shaft root diameter		10.9	
Effective turns of balls		1×3	
Accuracy grade / Preload / Axial play		C3/Z	C3/T
Basic load rating (N)	Dynamic C_a	1960	
	Static C_{0a}	3620	
Axial play		0	0.005 or less
Preload (N)		98.1	—
Dynamic friction torque, (N·cm)		0.4 – 3.4	1.0 or less
Spacer ball		None	
Factory packed grease		NSK grease PS2	

Recommended support unit		For drive side	For opposite to drive side
WBK10-01A	(square)	○	
WBK10S-01	(square)		○
WBK10-11	(round)	○	

Unit: mm

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
110	125	180	0	0.010	0.008	0.020	0.20	3000
160	175	230	0	0.010	0.008	0.030	0.24	3000
210	225	280	0	0.012	0.008	0.030	0.28	3000
260	275	330	0	0.012	0.008	0.040	0.32	3000
310	325	380	0	0.012	0.008	0.040	0.36	3000



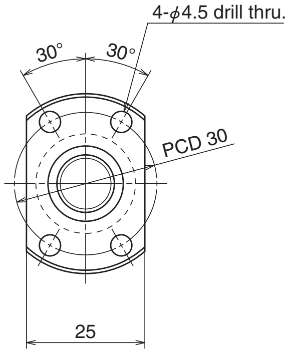
Ball screw No.		Stroke	
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum (L_t—Nut length)
W1201MA-5PY-C3Z2.5	**W1201MA-6Y-C3T2.5**	50	78
W1201MA-7PY-C3Z2.5	**W1201MA-8Y-C3T2.5**	100	128
W1202MA-5PY-C3Z2.5	**W1202MA-6Y-C3T2.5**	150	178
W1202MA-7PY-C3Z2.5	**W1202MA-8Y-C3T2.5**	200	228
W1203MA-3PY-C3Z2.5	**W1203MA-4Y-C3T2.5**	250	278

Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease PS2 is recommended. Apply to the screw shaft surface when replenishing. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

NSK

ø12×2.5

Unit: mm



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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	2790	
	Static C_{0a}	4530	
Axial play		0	0.005 or less
Preload (N)		98.1	—
Dynamic friction torque, (N·cm)		0.4 – 3.4	1.0 or less
Spacer ball		None	
Factory packed grease		NSK grease PS2	

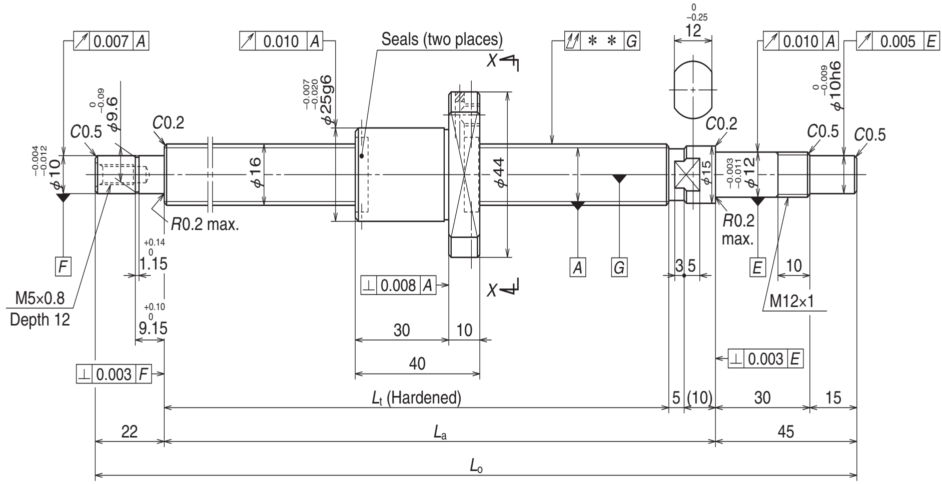
Recommended support unit	For drive side	For opposite to drive side
WBK10-01A (square)	○	
WBK10S-01 (square)		○
WBK10-11 (round)	○	

Unit: mm

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
110	125	180	0	0.010	0.008	0.020	0.21	3000
160	175	230	0	0.010	0.008	0.030	0.25	3000
210	225	280	0	0.012	0.008	0.030	0.29	3000
260	275	330	0	0.012	0.008	0.040	0.33	3000
310	325	380	0	0.012	0.008	0.040	0.37	3000

Finished shaft end MA Type

(Fine lead) Dia. 16, Lead 2

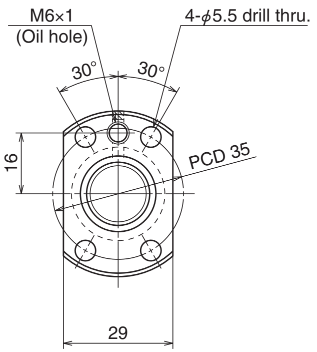


Ball screw No.		Stroke	
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum (L_t—Nut length)
W1601MA-1PY-C3Z2	**W1601MA-2Y-C3T2**	50	99
W1601MA-3PY-C3Z2	**W1601MA-4Y-C3T2**	100	149
W1602MA-1PY-C3Z2	**W1602MA-2Y-C3T2**	150	199
W1602MA-3PY-C3Z2	**W1602MA-4Y-C3T2**	200	249
W1603MA-1PY-C3Z2	**W1603MA-2Y-C3T2**	300	349

Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease PS2 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø16×2

Unit: mm



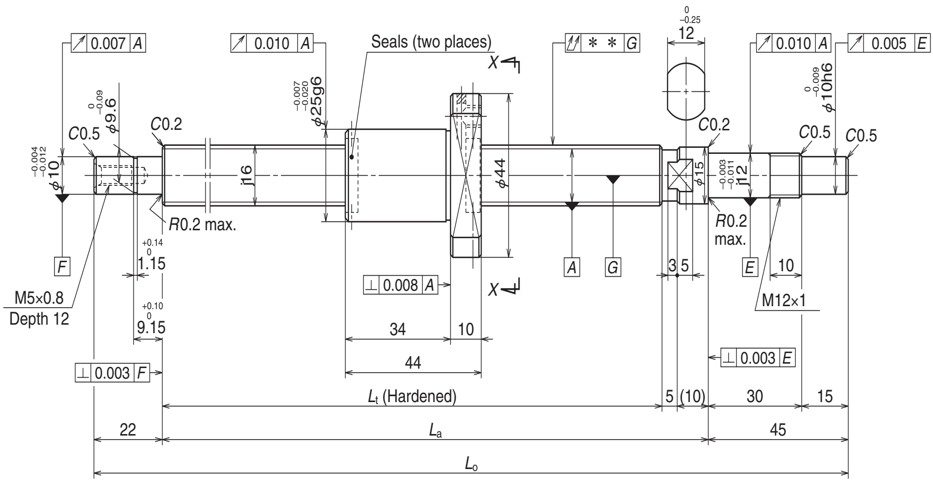
View *X-X*

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	4150	
Basic load rating (N) Static C_{0a}	8450	
Axial play	0	0.005 or less
Preload (N)	147	—
Dynamic friction torque, (N·cm)	0.5 – 4.9	1.5 or less
Spacer ball	None	
Factory packed grease	NSK grease PS2	
Internal spatial volume of nut (cm³)	1.6	
Standard volume of grease replenishing (cm³)	0.8	

Recommended support unit	For drive side	For opposite to drive side
WBK12-01A (square)	○	
WBK12S-01 (square)		○
WBK12-11 (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	Fixed - Fixed
139	154	221	0	0.010	0.008	0.020	0.41	3000	3000
189	204	271	0	0.010	0.008	0.020	0.48	3000	3000
239	254	321	0	0.012	0.008	0.030	0.55	3000	3000
289	304	371	0	0.012	0.008	0.030	0.62	3000	3000
389	404	471	0	0.013	0.010	0.035	0.77	3000	3000



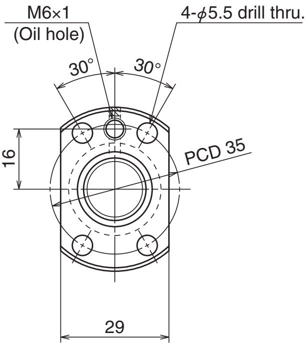
Ball screw No.		Stroke	
Preloaded (MPFD)	Precise clearance (MSFD)	Nominal	Maximum (L_t—Nut length)
W1601MA-5PY-C3Z2.5	**W1601MA-6Y-C3T2.5**	50	95
W1601MA-7PY-C3Z2.5	**W1601MA-8Y-C3T2.5**	100	145
W1602MA-5PY-C3Z2.5	**W1602MA-6Y-C3T2.5**	150	195
W1602MA-7PY-C3Z2.5	**W1602MA-8Y-C3T2.5**	200	245
W1603MA-3PY-C3Z2.5	**W1603MA-4Y-C3T2.5**	300	345

Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease PS2 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

NSK

ø16×2.5

Unit: mm



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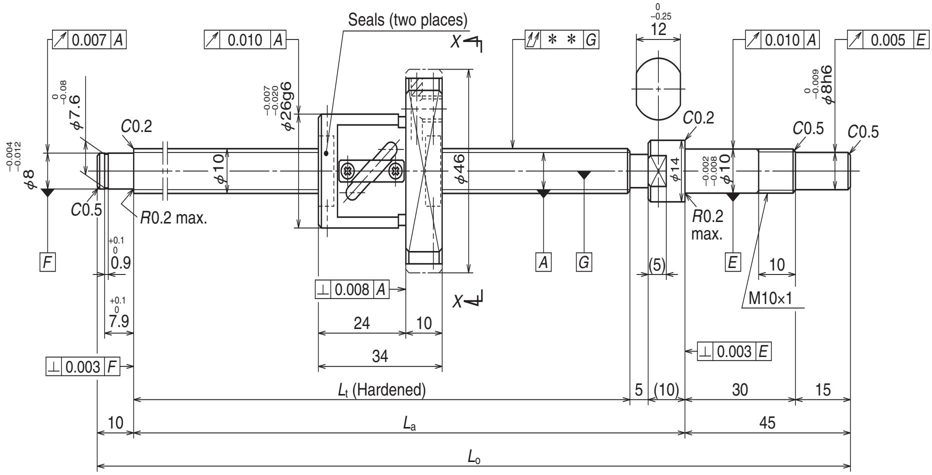
Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		16×2.5/Right	
Preload / Ball recirculation		P preload / Deflector	
Ball dia. / Ball circle dia.		1.588/16.4	
Screw shaft root diameter		14.6	
Effective turns of balls		1×4	
Accuracy grade / Preload / Axial play		C3/Z	C3/T
Basic load rating (N)	Dynamic C_a	4150	
	Static C_{0a}	8440	
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	For opposite to drive side
WBK12-01A (square)	○	
WBK12S-01 (square)		○
WBK12-11 (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	Fixed - Fixed
139	154	221	0	0.010	0.008	0.020	0.42	3000	3000
189	204	271	0	0.010	0.008	0.020	0.49	3000	3000
239	254	321	0	0.012	0.008	0.030	0.57	3000	3000
289	304	371	0	0.012	0.008	0.030	0.64	3000	3000
389	404	471	0	0.013	0.010	0.035	0.79	3000	3000

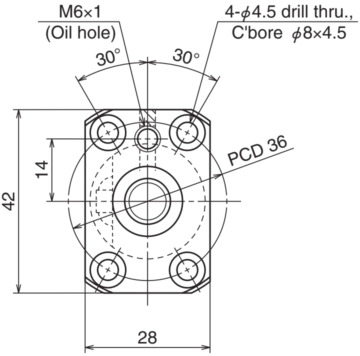


Ball screw No.		Stroke	
Preloaded (PFT)	Precise clearance (SFT)	Nominal	Maximum (L_t—Nut length)
W1001FA-1P-C3Z4	**W1001FA-2-C3T4**	50	76
W1001FA-3P-C3Z4	**W1001FA-4-C3T4**	100	126
W1002FA-1P-C3Z4	**W1002FA-2-C3T4**	150	176
W1002FA-3P-C3Z4	**W1002FA-4-C3T4**	200	226
W1003FA-1P-C3Z4	**W1003FA-2-C3T4**	250	276
W1003FA-3P-C3Z4	**W1003FA-4-C3T4**	300	326

Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease PS2 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø10×4

Unit: mm



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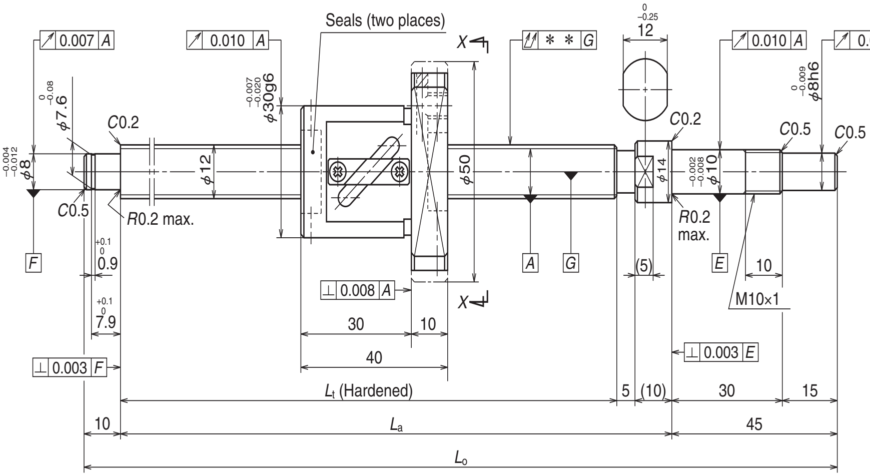
Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	10×4/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	2.000/10.3	
Screw shaft root diameter	8.2	
Effective turns of balls	2.5×1	
Accuracy grade / Preload / Axial play	C3/Z	C3/T
Basic load rating (N) Dynamic C_a	2020	3210
Basic load rating (N) Static C_{0a}	2210	4420
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 (cm³)	0.8	
Standard volume of grease replenishing (cm³)	0.4	

Recommended support unit	For drive side	For opposite to drive side
WBK10-01A (square)	○	
WBK10S-01 (square)		○
WBK10-11 (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
110	125	180	0	0.010	0.008	0.020	0.26	3000
160	175	230	0	0.010	0.008	0.030	0.28	3000
210	225	280	0	0.012	0.008	0.030	0.31	3000
260	275	330	0	0.012	0.008	0.040	0.34	3000
310	325	380	0	0.012	0.008	0.040	0.37	3000
360	375	430	0	0.013	0.010	0.050	0.39	3000

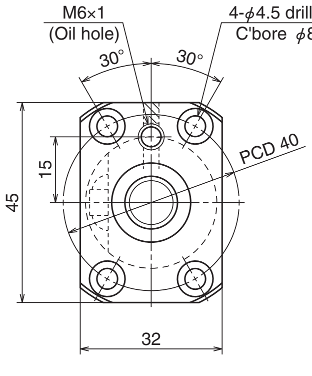


Ball screw No.		Stroke	
Preloaded (PFT)	Precise clearance (SFT)	Nominal	Maximum (L_t—Nut length)
W1201FA-1P-C3Z5	**W1201FA-2-C3T5**	50	70
W1201FA-3P-C3Z5	**W1201FA-4-C3T5**	100	120
W1202FA-1P-C3Z5	**W1202FA-2-C3T5**	150	170
W1202FA-3P-C3Z5	**W1202FA-4-C3T5**	200	220
W1203FA-1P-C3Z5	**W1203FA-2-C3T5**	250	270
W1204FA-1P-C3Z5	**W1204FA-2-C3T5**	350	370
W1205FA-1P-C3Z5	**W1205FA-2-C3T5**	450	470

Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease PS2 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø12×5

Unit: mm



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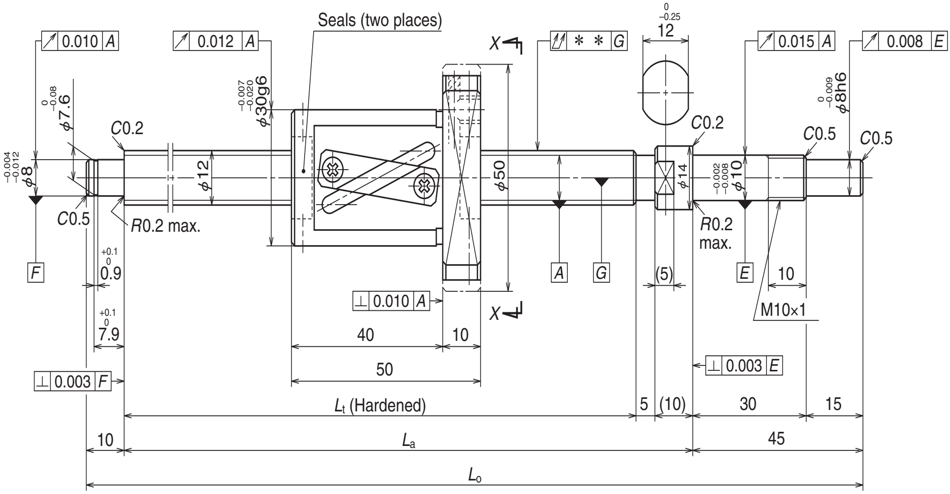
Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		12×5/Right	
Preload / Ball recirculation		P preload / Return tube	
Ball dia. / Ball circle dia.		2.381/12.3	
Screw shaft root diameter		9.8	
Effective turns of balls		2.5×1	
Accuracy grade / Preload / Axial play		C3/Z	C3/T
Basic load rating (N)	Dynamic C_a	2770	4390
	Static C_{0a}	3130	6260
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 (cm³)		1.2	
Standard volume of grease replenishing (cm³)		0.6	

Recommended support unit	For drive side	For opposite to drive side
WBK10-01A (square)	○	
WBK10S-01 (square)		○
WBK10-11 (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
110	125	180	0	0.010	0.008	0.020	0.35	3000
160	175	230	0	0.010	0.008	0.030	0.38	3000
210	225	280	0	0.012	0.008	0.030	0.42	3000
260	275	330	0	0.012	0.008	0.040	0.46	3000
310	325	380	0	0.012	0.008	0.040	0.50	3000
410	425	480	0	0.015	0.010	0.050	0.58	3000
510	525	580	0	0.016	0.012	0.065	0.66	3000

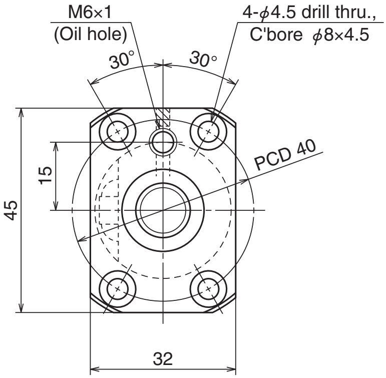


Ball screw No.		Stroke	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L_t—Nut length)
W1201FA-5P-C5Z10	**W1201FA-6-C5T10**	100	110
W1202FA-5P-C5Z10	**W1202FA-6-C5T10**	150	160
W1203FA-3P-C5Z10	**W1203FA-4-C5T10**	250	260
W1204FA-3P-C5Z10	**W1204FA-4-C5T10**	350	360
W1205FA-3P-C5Z10	**W1205FA-4-C5T10**	450	460

Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø12×10

Unit: mm



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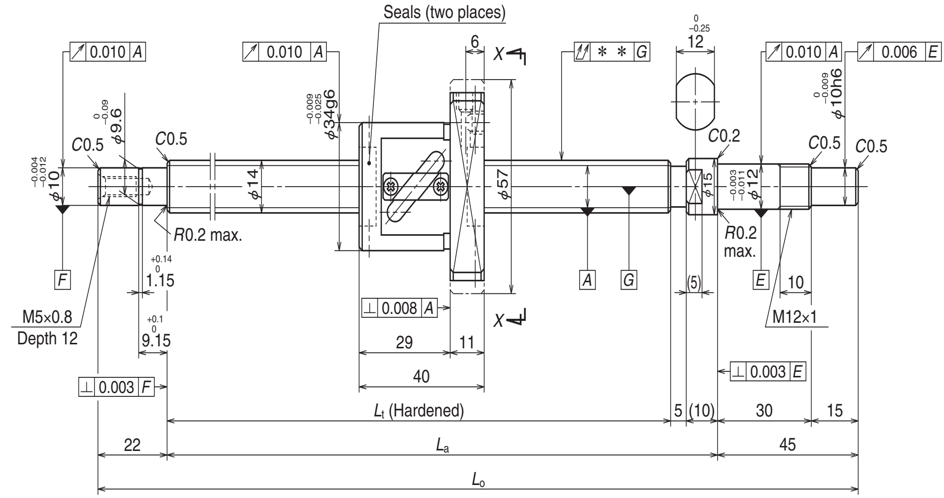
Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		12×10/Right	
Preload / Ball recirculation		P preload / Return tube	
Ball dia. / Ball circle dia.		2.381/12.5	
Screw shaft root diameter		10.0	
Effective turns of balls		2.5×1	
Accuracy grade / Preload / Axial play		C5/Z	C5/T
Basic load rating (N)	Dynamic C_a	2790	4430
	Static C_{0a}	3220	6430
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	For opposite to drive side
WBK10-01A (square)	○	
WBK10S-01 (square)		○
WBK10-11 (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
160	175	230	0	0.020	0.018	0.035	0.43	3000
210	225	280	0	0.023	0.018	0.035	0.47	3000
310	325	380	0	0.023	0.018	0.050	0.56	3000
410	425	480	0	0.027	0.020	0.060	0.64	3000
510	525	580	0	0.030	0.023	0.075	0.72	3000



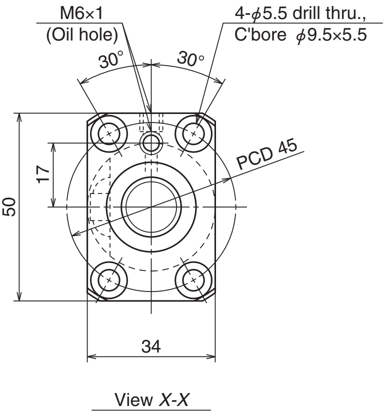
Ball screw No.		Stroke	
Preloaded (PFT)	Precise clearance (SFT)	Nominal	Maximum (L_t—Nut length)
W1401FA-1P-C3Z5	**W1401FA-2-C3T5**	100	149
W1402FA-1P-C3Z5	**W1402FA-2-C3T5**	150	199
W1403FA-1P-C3Z5	**W1403FA-2-C3T5**	250	299
W1404FA-1P-C3Z5	**W1404FA-2-C3T5**	350	399
W1405FA-1P-C3Z5	**W1405FA-2-C3T5**	450	499
W1406FA-1P-C3Z5	**W1406FA-2-C3T5**	600	649

Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

NSK

ø14×5

Unit: mm

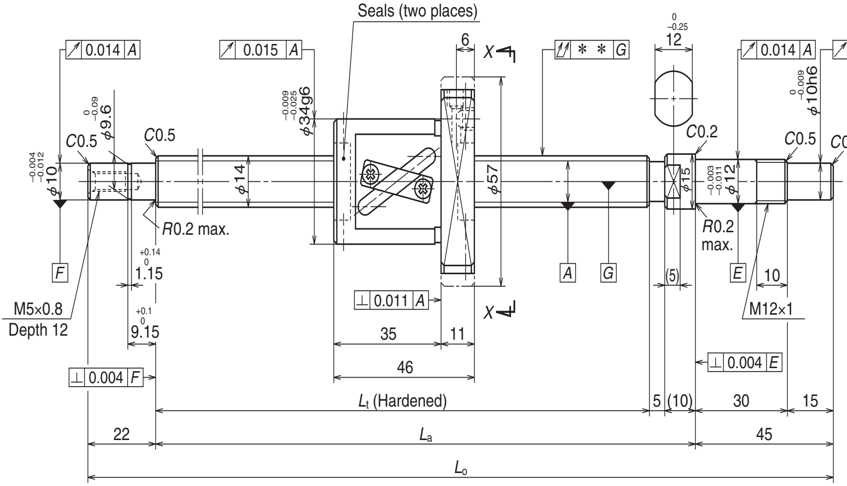


Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		14×5/Right	
Preload / Ball recirculation		P preload / Return tube	
Ball dia. / Ball circle dia.		3.175/14.5	
Screw shaft root diameter		11.2	
Effective turns of balls		2.5×1	
Accuracy grade / Preload / Axial play		C3/Z	C3/T
Basic load rating (N)	Dynamic C_a	5020	7970
	Static C_{0a}	5970	11900
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	For opposite to drive side
WBK12-01A (square)	○	
WBK12S-01 (square)		○
WBK12-11 (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	Fixed - Fixed
189	204	271	0	0.010	0.008	0.020	0.52	3000	3000
239	254	321	0	0.012	0.008	0.030	0.57	3000	3000
339	354	421	0	0.013	0.010	0.035	0.67	3000	3000
439	454	521	0	0.015	0.010	0.045	0.77	3000	3000
539	554	621	0	0.016	0.012	0.045	0.87	3000	3000
689	704	771	0	0.018	0.013	0.055	1.0	3000	3000

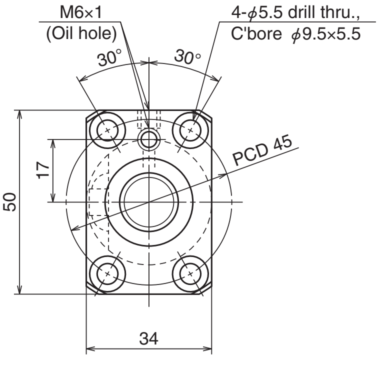


Ball screw No.		Stroke	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L_t—Nut length)
W1401FA-3P-C5Z8	**W1401FA-4-C5T8**	100	143
W1402FA-3P-C5Z8	**W1402FA-4-C5T8**	150	193
W1402FA-5P-C5Z8	**W1402FA-6-C5T8**	200	243
W1403FA-3P-C5Z8	**W1403FA-4-C5T8**	250	293
W1403FA-5P-C5Z8	**W1403FA-6-C5T8**	300	343
W1404FA-3P-C5Z8	**W1404FA-4-C5T8**	350	393
W1404FA-5P-C5Z8	**W1404FA-6-C5T8**	400	443
W1405FA-3P-C5Z8	**W1405FA-4-C5T8**	450	493
W1405FA-5P-C5Z8	**W1405FA-6-C5T8**	500	543
W1406FA-3P-C5Z8	**W1406FA-4-C5T8**	550	593
W1406FA-5P-C5Z8	**W1406FA-6-C5T8**	600	643
W1407FA-1P-C5Z8	**W1407FA-2-C5T8**	700	743

Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø14×8

Unit: mm



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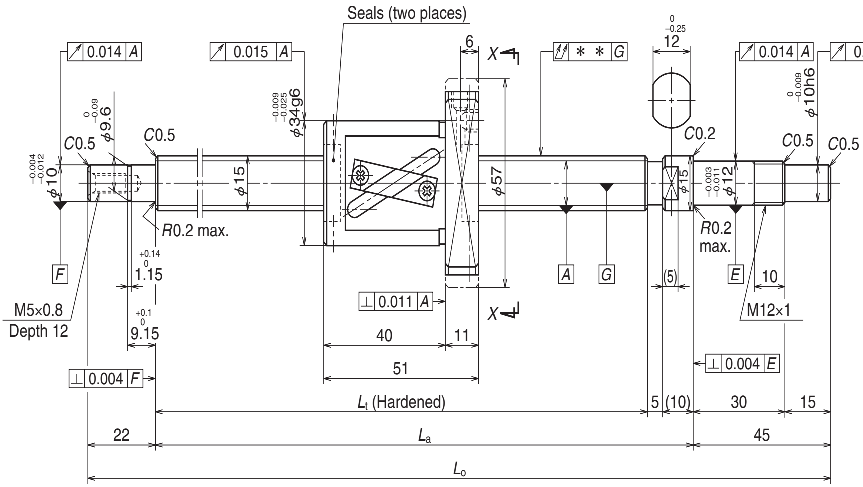
Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	14×8/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	3.175/14.5	
Screw shaft root diameter	11.2	
Effective turns of balls	2.5×1	
Accuracy grade / Preload / Axial play	C5/Z	C5/T
Basic load rating (N) Dynamic C_a	4960	7780
Basic load rating (N) Static C_{0a}	5920	11800
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	For opposite to drive side
WBK12-01A (square)	○	
WBK12S-01 (square)		○
WBK12-11 (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	Fixed - Fixed
189	204	271	0	0.020	0.018	0.025	0.56	3000	3000
239	254	321	0	0.023	0.018	0.035	0.61	3000	3000
289	304	371	0	0.023	0.018	0.035	0.67	3000	3000
339	354	421	0	0.025	0.020	0.040	0.72	3000	3000
389	404	471	0	0.025	0.020	0.040	0.78	3000	3000
439	454	521	0	0.027	0.020	0.050	0.83	3000	3000
489	504	571	0	0.027	0.020	0.050	0.88	3000	3000
539	554	621	0	0.030	0.023	0.050	0.94	3000	3000
589	604	671	0	0.030	0.023	0.065	0.99	3000	3000
639	654	721	0	0.035	0.025	0.065	1.0	3000	3000
689	704	771	0	0.035	0.025	0.065	1.1	3000	3000
789	804	871	0	0.035	0.025	0.085	1.2	2800	3000

Finished shaft end FA Type (Medium lead) Dia. 15, Lead 10

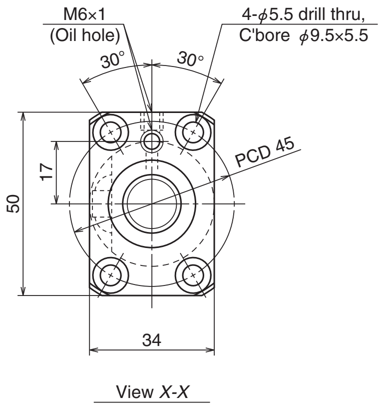


Ball screw No.		Stroke	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L_t—Nut length)
W1501FA-1P-C5Z10	**W1501FA-2-C5T10**	100	138
W1502FA-1P-C5Z10	**W1502FA-2-C5T10**	150	188
W1502FA-3P-C5Z10	**W1502FA-4-C5T10**	200	238
W1503FA-1P-C5Z10	**W1503FA-2-C5T10**	250	288
W1503FA-3P-C5Z10	**W1503FA-4-C5T10**	300	338
W1504FA-1P-C5Z10	**W1504FA-2-C5T10**	350	388
W1504FA-3P-C5Z10	**W1504FA-4-C5T10**	400	438
W1505FA-1P-C5Z10	**W1505FA-2-C5T10**	450	488
W1505FA-3P-C5Z10	**W1505FA-4-C5T10**	500	538
W1506FA-1P-C5Z10	**W1506FA-2-C5T10**	550	588
W1506FA-3P-C5Z10	**W1506FA-4-C5T10**	600	638
W1507FA-1P-C5Z10	**W1507FA-2-C5T10**	700	738
W1508FA-1P-C5Z10	**W1508FA-2-C5T10**	800	838
W1510FA-1P-C5Z10	**W1510FA-2-C5T10**	1000	1038

Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø15×10

Unit: mm



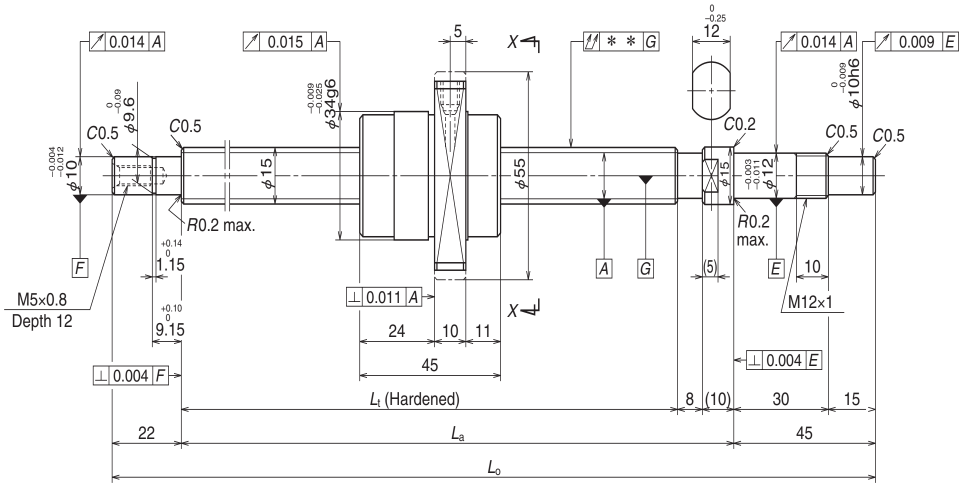
View *X-X*

Recommended support unit	For drive side	For opposite to drive side
WBK12-01A (square)	○	
WBK12S-01 (square)		○
WBK12-11 (round)	○	

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		15×10/Right	
Preload / Ball recirculation		P preload / Return tube	
Ball dia. / Ball circle dia.		3.175/15.5	
Screw shaft root diameter		12.2	
Effective turns of balls		2.5×1	
Accuracy grade / Preload / Axial play		C5/Z	C5/T
Basic load rating (N)	Dynamic C_a	5130	8140
	Static C_{0a}	6420	12800
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)		2.3	
Standard volume of grease replenishing (cm³)		1.2	

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	Fixed - Fixed
189	204	271	0	0.020	0.018	0.025	0.61	3000	3000
239	254	321	0	0.023	0.018	0.035	0.67	3000	3000
289	304	371	0	0.023	0.018	0.035	0.74	3000	3000
339	354	421	0	0.025	0.020	0.040	0.80	3000	3000
389	404	471	0	0.025	0.020	0.040	0.86	3000	3000
439	454	521	0	0.027	0.020	0.050	0.93	3000	3000
489	504	571	0	0.027	0.020	0.050	1.0	3000	3000
539	554	621	0	0.030	0.023	0.050	1.1	3000	3000
589	604	671	0	0.030	0.023	0.065	1.1	3000	3000
639	654	721	0	0.035	0.025	0.065	1.2	3000	3000
689	704	771	0	0.035	0.025	0.065	1.2	3000	3000
789	804	871	0	0.035	0.025	0.085	1.4	3000	3000
889	904	971	0	0.040	0.027	0.085	1.5	2400	3000
1089	1104	1171	0	0.046	0.030	0.110	1.8	1590	2250

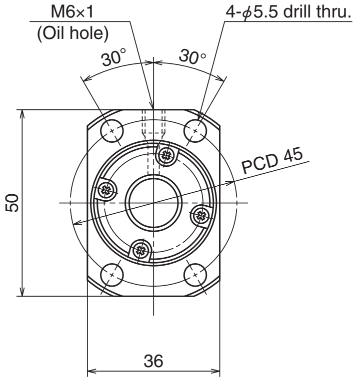


Ball screw No.		Stroke	
Preloaded (UPFC)	Precise clearance (USFC)	Nominal	Maximum (L_t—Nut length)
W1501FA-3PG-C5Z20	**W1501FA-4G-C5T20**	100	141
W1502FA-5PG-C5Z20	**W1502FA-6G-C5T20**	150	191
W1502FA-7PG-C5Z20	**W1502FA-8G-C5T20**	200	241
W1503FA-5PG-C5Z20	**W1503FA-6G-C5T20**	250	291
W1503FA-7PG-C5Z20	**W1503FA-8G-C5T20**	300	341
W1504FA-5PG-C5Z20	**W1504FA-6G-C5T20**	350	391
W1504FA-7PG-C5Z20	**W1504FA-8G-C5T20**	400	441
W1505FA-5PG-C5Z20	**W1505FA-6G-C5T20**	450	491
W1505FA-7PG-C5Z20	**W1505FA-8G-C5T20**	500	541
W1506FA-5PG-C5Z20	**W1506FA-6G-C5T20**	550	591
W1506FA-7PG-C5Z20	**W1506FA-8G-C5T20**	600	641
W1507FA-3PG-C5Z20	**W1507FA-4G-C5T20**	700	741
W1508FA-3PG-C5Z20	**W1508FA-4G-C5T20**	800	841
W1510FA-3PG-C5Z20	**W1510FA-4G-C5T20**	1000	1041

Remarks: 1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø15×20

Unit: mm



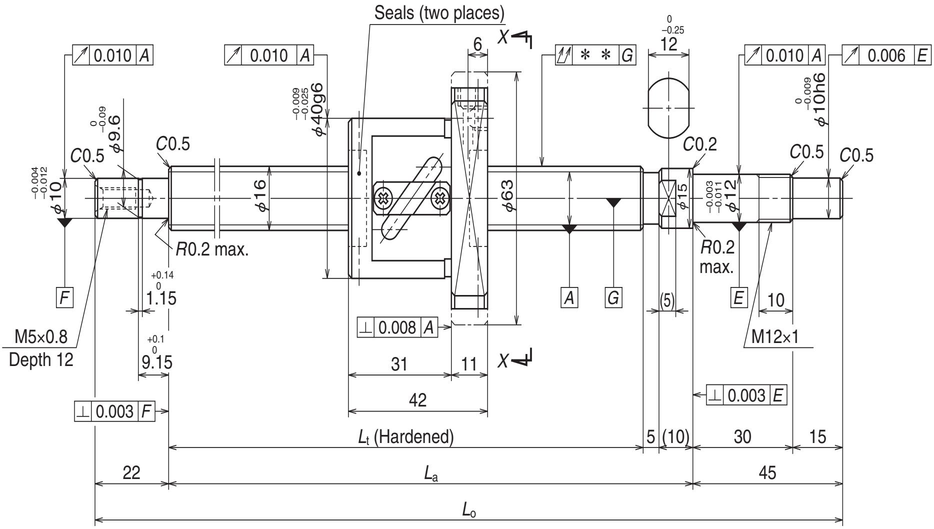
View *X-X*

Recommended support unit	For drive side	For opposite to drive side
WBK12-01A (square)	○	
WBK12S-01 (square)		○
WBK12-11 (round)	○	

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		15×20/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	4320	5660
	Static C_{0a}	5800	8700
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)		1.9	
Standard volume of grease replenishing (cm^3)		1.0	

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	Fixed - Fixed
186	204	271	0	0.020	0.018	0.025	0.61	3000	3000
236	254	321	0	0.023	0.018	0.035	0.68	3000	3000
286	304	371	0	0.023	0.018	0.035	0.75	3000	3000
336	354	421	0	0.025	0.020	0.040	0.81	3000	3000
386	404	471	0	0.025	0.020	0.040	0.88	3000	3000
436	454	521	0	0.027	0.020	0.050	0.95	3000	3000
486	504	571	0	0.027	0.020	0.050	1.0	3000	3000
536	554	621	0	0.030	0.023	0.050	1.1	3000	3000
586	604	671	0	0.030	0.023	0.065	1.1	3000	3000
636	654	721	0	0.035	0.025	0.065	1.2	3000	3000
686	704	771	0	0.035	0.025	0.065	1.3	3000	3000
786	804	871	0	0.035	0.025	0.085	1.4	3000	3000
886	904	971	0	0.040	0.027	0.085	1.5	2400	3000
1086	1104	1171	0	0.046	0.030	0.110	1.8	1590	2240

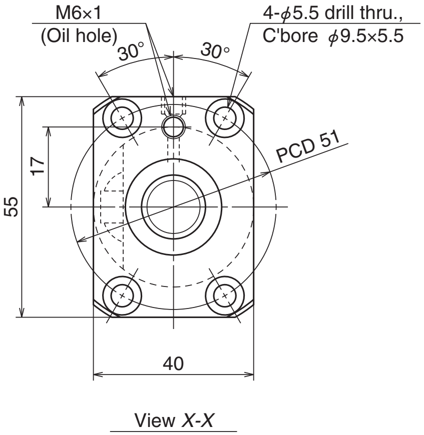


<table>
<tr><th colspan="2">Ball screw No.</th><th colspan="2">Stroke</th></tr>
<tr><th>Preloaded (PFT)</th><th>Precise clearance (SFT)</th><th>Nominal</th><th>Maximum (L_t—Nut length)</th></tr>
<tr><td>W1601FA-1P-C3Z5</td><td>W1601FA-2-C3T5</td><td>100</td><td>147</td></tr>
<tr><td>W1602FA-1P-C3Z5</td><td>W1602FA-2-C3T5</td><td>200</td><td>247</td></tr>
<tr><td>W1603FA-1P-C3Z5</td><td>W1603FA-2-C3T5</td><td>300</td><td>347</td></tr>
<tr><td>W1604FA-1P-C3Z5</td><td>W1604FA-2-C3T5</td><td>400</td><td>447</td></tr>
<tr><td>W1606FA-1P-C3Z5</td><td>W1606FA-2-C3T5</td><td>600</td><td>647</td></tr>
<tr><td>W1608FA-1P-C3Z5</td><td>W1608FA-2-C3T5</td><td>800</td><td>847</td></tr>
</table>

Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø16×5

Unit: mm

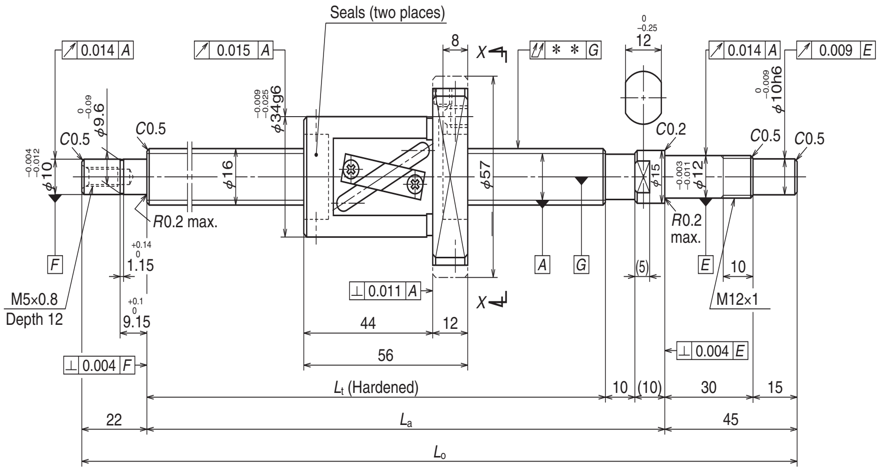


Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		16×5/Right	
Preload / Ball recirculation		P preload / Return tube	
Ball dia. / Ball circle dia.		3.175/16.5	
Screw shaft root diameter		13.2	
Effective turns of balls		2.5×1	
Accuracy grade / Preload / Axial play		C3/Z	C3/T
Basic load rating (N)	Dynamic C_a	5430	8620
	Static C_{0a}	6890	13800
Axial play		0	0.005 or less
Preload (N)		147	—
Dynamic friction torque, (N·cm)		1.5 – 7.8	2.0 or less
Spacer ball		Yes	None
Factory packed grease		NSK grease LR3	
Internal spatial volume of nut (cm^3)		2.6	
Standard volume of grease replenishing (cm^3)		1.3	

Recommended support unit	For drive side	For opposite to drive side
WBK12-01A (square)	○	
WBK12S-01 (square)		○
WBK12-11 (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	Fixed - Fixed
189	204	271	0	0.010	0.008	0.020	0.70	3000	3000
289	304	371	0	0.012	0.008	0.030	0.83	3000	3000
389	404	471	0	0.013	0.010	0.035	0.97	3000	3000
489	504	571	0	0.015	0.010	0.045	1.1	3000	3000
689	704	771	0	0.018	0.013	0.055	1.4	3000	3000
889	904	971	0	0.021	0.015	0.075	1.6	2570	3000

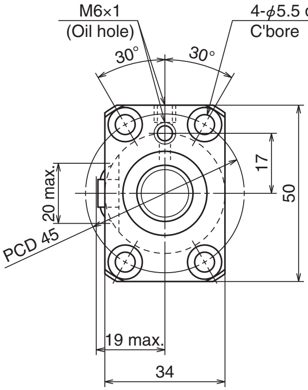


Ball screw No.		Stroke	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L_t—Nut length)
W1601FA-3P-C5Z16	**W1601FA-4-C5T16**	100	128
W1602FA-3P-C5Z16	**W1602FA-4-C5T16**	150	178
W1602FA-5P-C5Z16	**W1602FA-6-C5T16**	200	228
W1603FA-3P-C5Z16	**W1603FA-4-C5T16**	250	278
W1603FA-5P-C5Z16	**W1603FA-6-C5T16**	300	328
W1604FA-3P-C5Z16	**W1604FA-4-C5T16**	350	378
W1604FA-5P-C5Z16	**W1604FA-6-C5T16**	400	428
W1605FA-1P-C5Z16	**W1605FA-2-C5T16**	450	478
W1605FA-3P-C5Z16	**W1605FA-4-C5T16**	500	528
W1606FA-3P-C5Z16	**W1606FA-4-C5T16**	550	578
W1606FA-5P-C5Z16	**W1606FA-6-C5T16**	600	628
W1607FA-1P-C5Z16	**W1607FA-2-C5T16**	700	728
W1608FA-3P-C5Z16	**W1608FA-4-C5T16**	800	828
W1610FA-1P-C5Z16	**W1610FA-2-C5T16**	1000	1028

Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø16×16

Unit: mm



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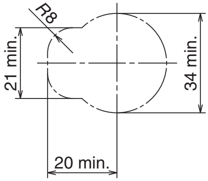


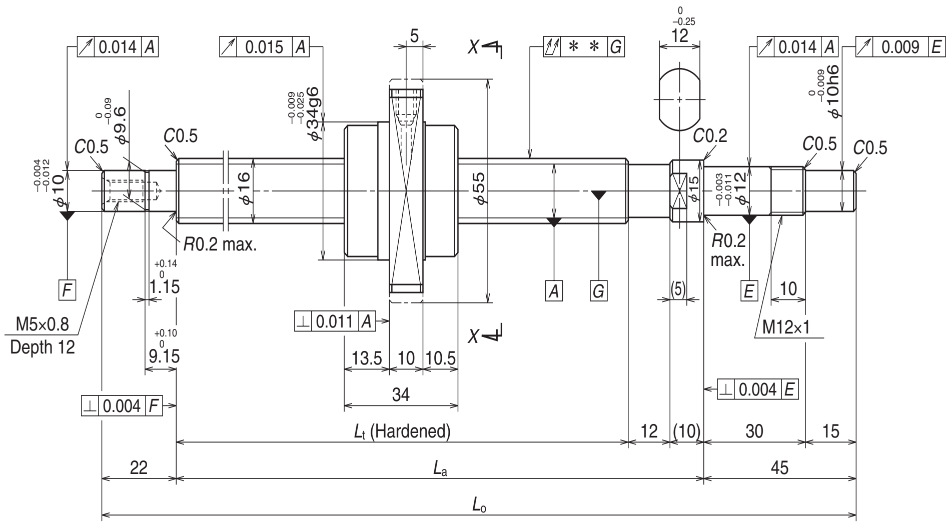
Housing hole and its clearance

Recommended support unit	For drive side	For opposite to drive side
WBK12-01A (square)	○	
WBK12S-01 (square)		○
WBK12-11 (round)	○	

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		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	4180	5480
	Static C_{0a}	5390	8080
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

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	Fixed - Fixed
184	204	271	0	0.020	0.018	0.025	0.69	3000	3000
234	254	321	0	0.023	0.018	0.035	0.77	3000	3000
284	304	371	0	0.023	0.018	0.035	0.84	3000	3000
334	354	421	0	0.025	0.020	0.040	0.92	3000	3000
384	404	471	0	0.025	0.020	0.040	0.99	3000	3000
434	454	521	0	0.027	0.020	0.050	1.1	3000	3000
484	504	571	0	0.027	0.020	0.050	1.1	3000	3000
534	554	621	0	0.030	0.023	0.050	1.2	3000	3000
584	604	671	0	0.030	0.023	0.065	1.3	3000	3000
634	654	721	0	0.035	0.025	0.065	1.4	3000	3000
684	704	771	0	0.035	0.025	0.065	1.4	3000	3000
784	804	871	0	0.035	0.025	0.085	1.6	3000	3000
884	904	971	0	0.040	0.027	0.085	1.7	2690	3000
1084	1104	1171	0	0.046	0.030	0.110	2.0	1770	2480

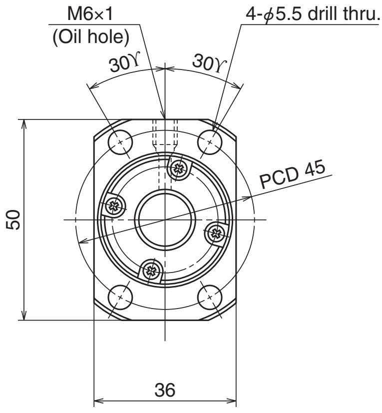


Ball screw No.		Stroke	
Preloaded (UPFC)	Precise clearance (USFC)	Nominal	Maximum (L_t—Nut length)
W1603FA-7PGX-C5Z32	**W1603FA-8GX-C5T32**	300	348
W1605FA-5PGX-C5Z32	**W1605FA-6GX-C5T32**	500	548
W1608FA-5PGX-C5Z32	**W1608FA-6GX-C5T32**	800	848
W1612FA-1PGX-C5Z32	**W1612FA-2GX-C5T32**	1200	1248

Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Nut does not have a seal.
4. Contact NSK if permissible rotational speed is to be exceeded.

ø16×32

Unit: mm



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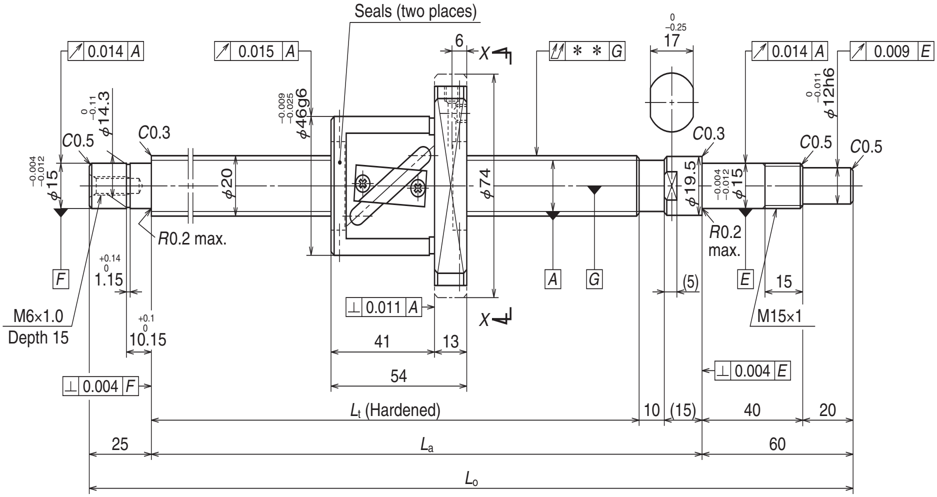
Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		16×32/Right	
Preload / Ball recirculation		P preload / End cap	
Ball dia. / Ball circle dia.		3.175/16.75	
Screw shaft root diameter		13.4	
Effective turns of balls		0.7×2	
Accuracy grade / Preload / Axial play		C5/Z	C5/T
Basic load rating (N)	Dynamic C_a	4320	
	Static C_{0a}	6760	
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	For opposite to drive side
WBK12-01A (square)	○	
WBK12S-01 (square)		○
WBK12-11 (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	Fixed - Fixed
382	404	471	0	0.025	0.020	0.040	0.90	3000	3000
582	604	671	0	0.030	0.023	0.065	1.2	3000	3000
882	904	971	0	0.040	0.027	0.085	1.7	2630	3000
1282	1304	1371	0	0.054	0.035	0.150	2.3	1240	1740

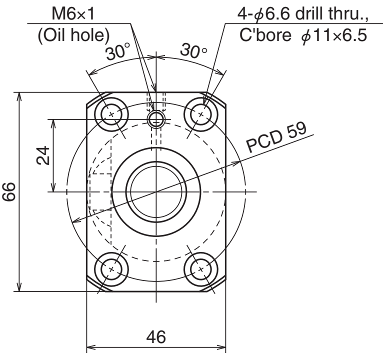


Ball screw No.		Stroke	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L_t—Nut length)
W2002FA-1P-C5Z10	**W2002FA-2-C5T10**	200	235
W2003FA-1P-C5Z10	**W2003FA-2-C5T10**	300	335
W2004FA-1P-C5Z10	**W2004FA-2-C5T10**	400	435
W2005FA-1P-C5Z10	**W2005FA-2-C5T10**	500	535
W2006FA-1P-C5Z10	**W2006FA-2-C5T10**	600	635
W2007FA-1P-C5Z10	**W2007FA-2-C5T10**	700	735
W2008FA-1P-C5Z10	**W2008FA-2-C5T10**	800	835
W2009FA-1P-C5Z10	**W2009FA-2-C5T10**	900	935
W2010FA-1P-C5Z10	**W2010FA-2-C5T10**	1000	1035
W2011FA-1P-C5Z10	**W2011FA-2-C5T10**	1100	1135
W2012FA-1P-C5Z10	**W2012FA-2-C5T10**	1200	1235

Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø20×10

Unit: mm



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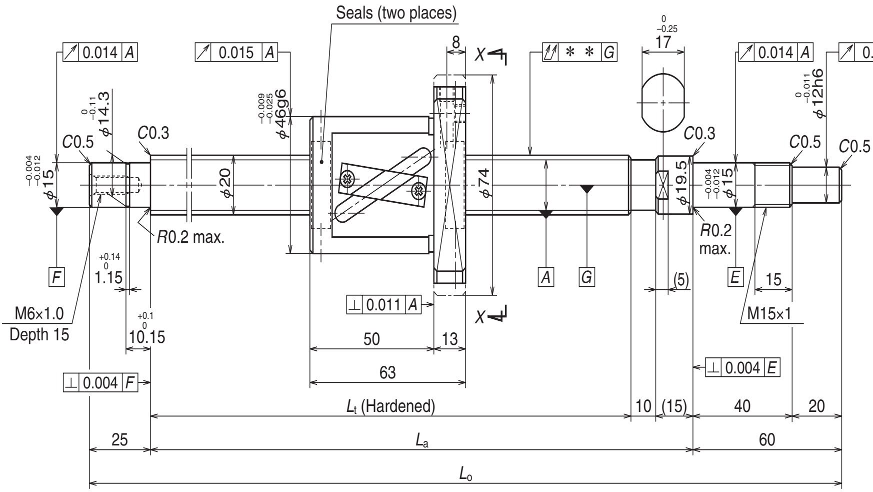
Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		20×10/Right	
Preload / Ball recirculation		P preload / Return tube	
Ball dia. / Ball circle dia.		3.969/21	
Screw shaft root diameter		16.9	
Effective turns of balls		2.5×1	
Accuracy grade / Preload / Axial play		C5/Z	C5/T
Basic load rating (N)	Dynamic C_a	8350	13300
	Static C_{0a}	11000	21900
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	

Recommended support unit		For drive side	For opposite to drive side
WBK15-01A	(square)	○	
WBK15S-01	(square)		○
WBK15-11	(round)	○	

Unit: mm

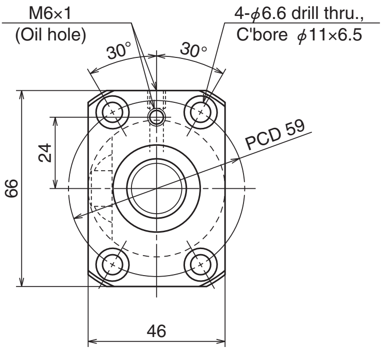
Screw shaft length			Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
L_t	L_a	L_o	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
289	314	399	0	0.023	0.018	0.035	1.4	3000	3000
389	414	499	0	0.025	0.020	0.040	1.6	3000	3000
489	514	599	0	0.027	0.020	0.050	1.9	3000	3000
589	614	699	0	0.030	0.023	0.065	2.1	3000	3000
689	714	799	0	0.035	0.025	0.065	2.3	3000	3000
789	814	899	0	0.035	0.025	0.085	2.5	3000	3000
889	914	999	0	0.040	0.027	0.085	2.8	3000	3000
989	1014	1099	0	0.040	0.027	0.110	3.0	2680	3000
1089	1114	1199	0	0.046	0.030	0.110	3.2	2210	3000
1189	1214	1299	0	0.046	0.030	0.150	3.4	1840	2570
1289	1314	1399	0	0.054	0.035	0.150	3.7	1570	2190



Ball screw No.		Stroke	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L_t—Nut length)
W2003FA-3P-C5Z20	**W2003FA-4-C5T20**	200	247
W2004FA-3P-C5Z20	**W2004FA-4-C5T20**	300	347
W2005FA-3P-C5Z20	**W2005FA-4-C5T20**	400	447
W2006FA-3P-C5Z20	**W2006FA-4-C5T20**	500	547
W2007FA-3P-C5Z20	**W2007FA-4-C5T20**	600	647
W2008FA-3P-C5Z20	**W2008FA-4-C5T20**	700	747
W2009FA-3P-C5Z20	**W2009FA-4-C5T20**	800	847
W2010FA-3P-C5Z20	**W2010FA-4-C5T20**	900	947
W2011FA-3P-C5Z20	**W2011FA-4-C5T20**	1000	1047
W2012FA-3P-C5Z20	**W2012FA-4-C5T20**	1100	1147
W2015FA-1P-C5Z20	**W2015FA-2-C5T20**	1400	1447

Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

Unit: mm



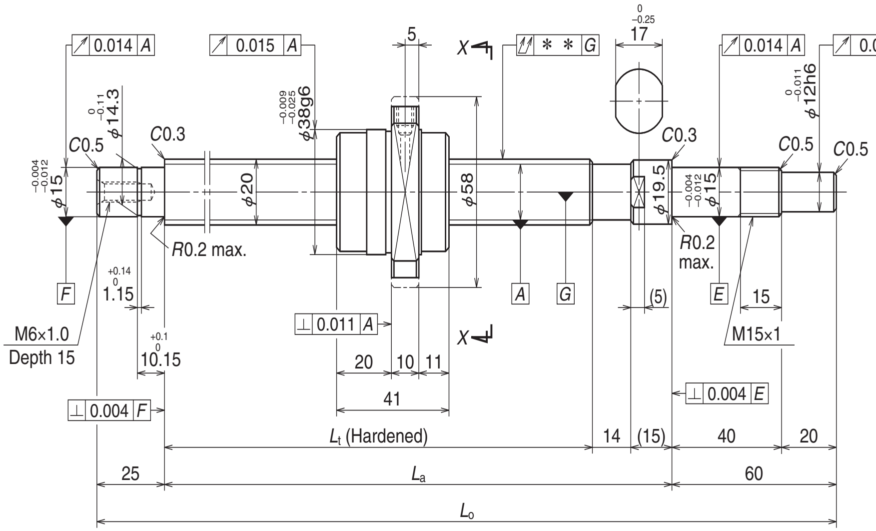
View *X-X*

Recommended support unit	For drive side	For opposite to drive side
WBK15-01A (square)	○	
WBK15S-01 (square)		○
WBK15-11 (round)	○	

Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		20×20/Right	
Preload / Ball recirculation		P preload / Return tube	
Ball dia. / Ball circle dia.		3.969/21	
Screw shaft root diameter		16.9	
Effective turns of balls		1.5×1	
Accuracy grade / Preload / Axial play		C5/Z	C5/T
Basic load rating (N)	Dynamic C_a	6250	8190
	Static C_{0a}	8760	13100
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

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	Fixed - Fixed
310	335	420	0	0.023	0.018	0.040	1.6	3000	3000
410	435	520	0	0.027	0.020	0.050	1.8	3000	3000
510	535	620	0	0.030	0.023	0.050	2.0	3000	3000
610	635	720	0	0.030	0.023	0.065	2.3	3000	3000
710	735	820	0	0.035	0.025	0.085	2.5	3000	3000
810	835	920	0	0.040	0.027	0.085	2.7	3000	3000
910	935	1020	0	0.040	0.027	0.110	3.0	3000	3000
1010	1035	1120	0	0.046	0.030	0.110	3.2	2590	3000
1110	1135	1220	0	0.046	0.030	0.110	3.4	2140	2970
1210	1235	1320	0	0.046	0.030	0.150	3.7	1790	2500
1510	1535	1620	0	0.054	0.035	0.180	4.4	1140	1610

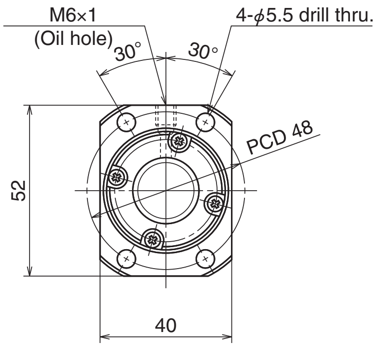


Ball screw No.		Stroke	
Preloaded (UPFC)	Precise clearance (USFC)	Nominal	Maximum (L_t—Nut length)
W2005FA-5PGX-C5Z40	**W2005FA-6GX-C5T40**	400	465
W2007FA-5PGX-C5Z40	**W2007FA-6GX-C5T40**	600	665
W2009FA-5PGX-C5Z40	**W2009FA-6GX-C5T40**	800	865
W2011FA-5PGX-C5Z40	**W2011FA-6GX-C5T40**	1000	1065
W2013FA-1PGX-C5Z40	**W2013FA-2GX-C5T40**	1200	1265
W2017FA-1PGX-C5Z40	**W2017FA-2GX-C5T40**	1600	1665

Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Nut does not have a seal.
4. Contact NSK if permissible rotational speed is to be exceeded.

ø20×40

Unit: mm



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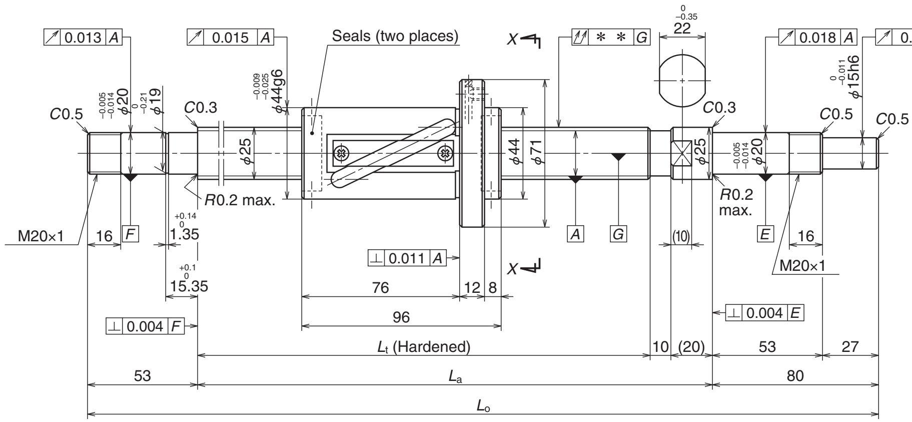
Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		20×40/Right	
Preload / Ball recirculation		P preload / End cap	
Ball dia. / Ball circle dia.		3.175/20.75	
Screw shaft root diameter		17.4	
Effective turns of balls		0.7×2	
Accuracy grade / Preload / Axial play		C5/Z	C5/T
Basic load rating (N)	Dynamic C_a	4870	
	Static C_{0a}	8420	
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	For opposite to drive side
WBK15-01A (square)	○	
WBK15S-01 (square)		○
WBK15-11 (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	Fixed - Fixed
506	535	620	0	0.030	0.023	0.050	1.7	3000	3000
706	735	820	0	0.035	0.025	0.085	2.2	3000	3000
906	935	1020	0	0.040	0.027	0.110	2.7	3000	3000
1106	1135	1220	0	0.046	0.030	0.110	3.1	2170	3000
1306	1335	1420	0	0.054	0.035	0.150	3.6	1550	2160
1706	1735	1820	0	0.065	0.040	0.230	4.6	910	1270

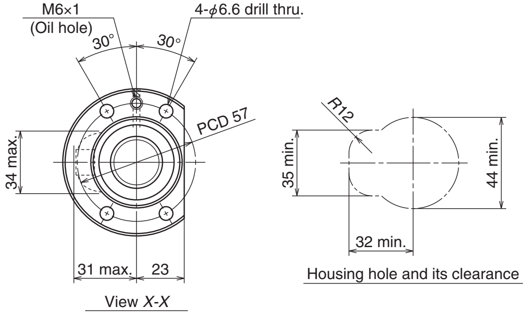


Ball screw No.		Stroke	
		Nominal	Maximum (L_t—Nut length)
Preloaded (LPFT)	Precise clearance (LSFT)		
W2507FA-1P-C5Z20	**W2507FA-2-C5T20**	600	654
W2509FA-1P-C5Z20	**W2509FA-2-C5T20**	800	854
W2511FA-1P-C5Z20	**W2511FA-2-C5T20**	1000	1054
W2513FA-1P-C5Z20	**W2513FA-2-C5T20**	1200	1254
W2515FA-1P-C5Z20	**W2515FA-2-C5T20**	1400	1454
W2517FA-1P-C5Z20	**W2517FA-2-C5T20**	1600	1654
W2521FA-1P-C5Z20	**W2521FA-2-C5T20**	2000	2054

Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø25×20

Unit: mm

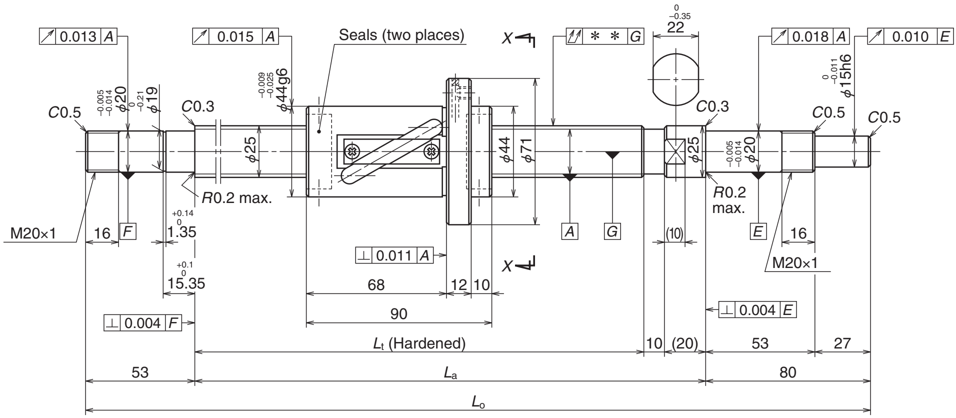


Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		25×20/Right	
Preload / Ball recirculation		P preload / Return tube	
Ball dia. / Ball circle dia.		4.762/26.25	
Screw shaft root diameter		21.3	
Effective turns of balls		2.5×1	
Accuracy grade / Preload / Axial play		C5/Z	C5/T
Basic load rating (N)	Dynamic C_a	11700	18600
	Static C_{0a}	16300	32600
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	For opposite to drive side
WBK20-01 (square)	○	○
WBK20S-01 (square)		○
WBK20-11 (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	Fixed - Fixed
750	780	913	0	0.035	0.025	0.055	4.0	2800	2800
950	980	1113	0	0.040	0.027	0.070	4.7	2800	2800
1150	1180	1313	0	0.046	0.030	0.090	5.4	2560	2800
1350	1380	1513	0	0.054	0.035	0.090	6.2	1840	2550
1550	1580	1713	0	0.054	0.035	0.120	6.9	1390	1940
1750	1780	1913	0	0.065	0.040	0.120	7.6	1080	1520
2150	2180	2313	0	0.077	0.046	0.160	9.1	710	1000

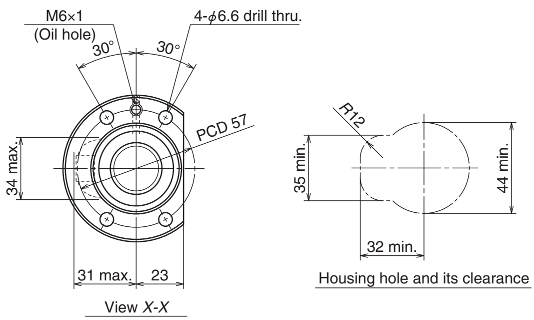


Ball screw No.		Stroke	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L_t—Nut length)
W2507FA-3P-C5Z25	**W2507FA-4-C5T25**	600	660
W2509FA-3P-C5Z25	**W2509FA-4-C5T25**	800	860
W2511FA-3P-C5Z25	**W2511FA-4-C5T25**	1000	1060
W2513FA-3P-C5Z25	**W2513FA-4-C5T25**	1200	1260
W2515FA-3P-C5Z25	**W2515FA-4-C5T25**	1400	1460
W2517FA-3P-C5Z25	**W2517FA-4-C5T25**	1600	1660
W2521FA-3P-C5Z25	**W2521FA-4-C5T25**	2000	2060

Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø25×25

Unit: mm

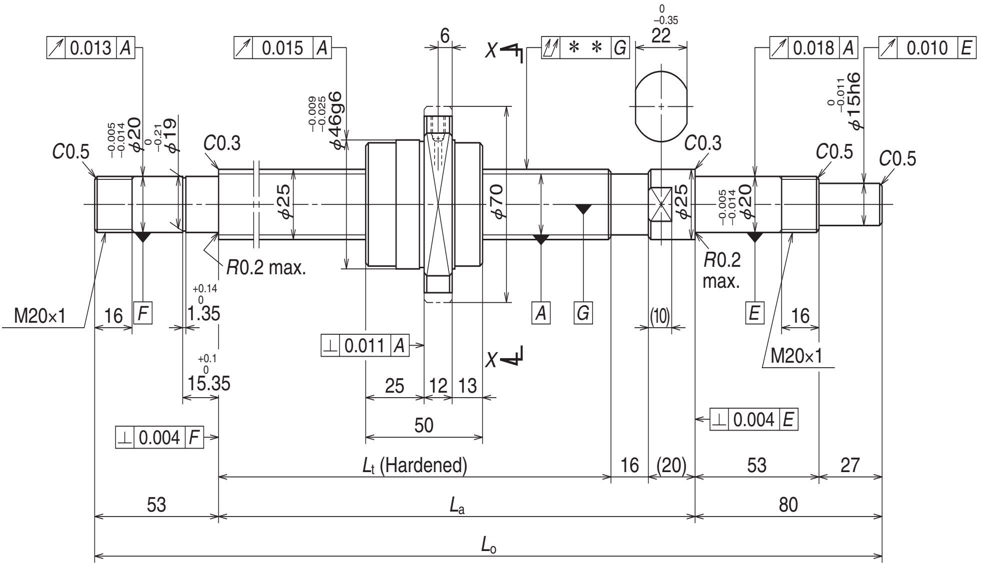


Ball screw specifications		
Product classification	Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn	25×25/Right	
Preload / Ball recirculation	P preload / Return tube	
Ball dia. / Ball circle dia.	4.762/26.25	
Screw shaft root diameter	21.3	
Effective turns of balls	1.5×1	
Accuracy grade / Preload / Axial play	C5/Z	C5/T
Basic load rating (N) Dynamic C_a	8970	11700
Basic load rating (N) Static C_{0a}	13100	19700
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	For opposite to drive side
WBK20-01 (square)	○	○
WBK20S-01 (square)		○
WBK20-11 (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	Fixed - Fixed
750	780	913	0	0.035	0.025	0.055	4.0	2800	2800
950	980	1113	0	0.040	0.027	0.070	4.7	2800	2800
1150	1180	1313	0	0.046	0.030	0.090	5.4	2540	2800
1350	1380	1513	0	0.054	0.035	0.090	6.2	1830	2540
1550	1580	1713	0	0.054	0.035	0.120	7.0	1380	1930
1750	1780	1913	0	0.065	0.040	0.120	7.7	1080	1510
2150	2180	2313	0	0.077	0.046	0.160	9.1	710	1000



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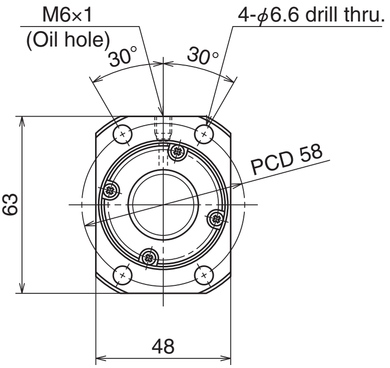
<tr><th colspan="2" rowspan="2">Ball screw No.</th><th colspan="2">Stroke</th></tr>
<tr><th rowspan="2">Nominal</th><th rowspan="2">Maximum
(L_t—Nut length)</th></tr>
<tr><th>Preloaded (UPFC)</th><th>Precise clearance (USFC)</th></tr>
<tr><td>**W2508FA-1PGX-C5Z50**</td><td>**W2508FA-2GX-C5T50**</td><td>700</td><td>794</td></tr>
<tr><td>**W2511FA-5PGX-C5Z50**</td><td>**W2511FA-6GX-C5T50**</td><td>1000</td><td>1094</td></tr>
<tr><td>**W2516FA-1PGX-C5Z50**</td><td>**W2516FA-2GX-C5T50**</td><td>1500</td><td>1594</td></tr>
<tr><td>**W2521FA-5PGX-C5Z50**</td><td>**W2521FA-6GX-C5T50**</td><td>2000</td><td>2094</td></tr>
</table>

Remarks:
1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Nut does not have a seal.
4. Contact NSK if permissible rotational speed is to be exceeded.

ø25×50

Unit: mm



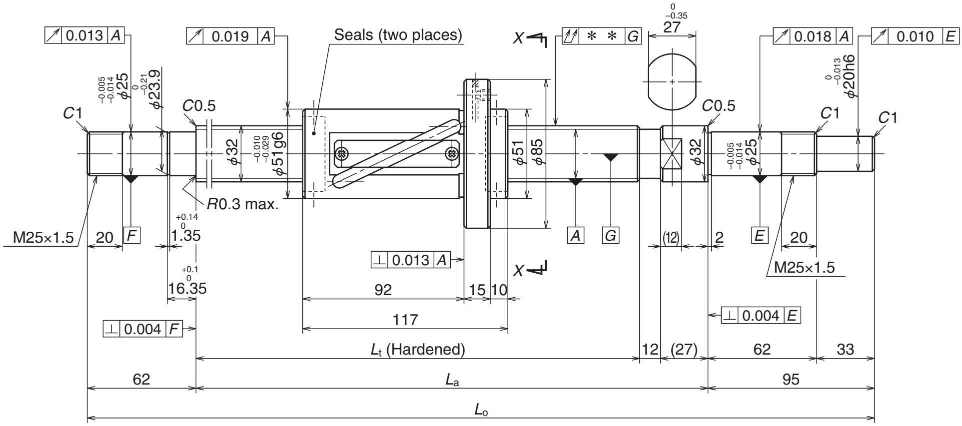
View *X-X*

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	7280	
	Static C_{0a}	13200	
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
WBK20-01 (square)	○	○
WBK20S-01 (square)		○
WBK20-11 (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	Fixed - Fixed
844	880	1013	0	0.040	0.027	0.070	4.1	2800	2800
1144	1180	1313	0	0.046	0.030	0.090	5.3	2550	2800
1644	1680	1813	0	0.065	0.040	0.120	7.2	1230	1710
2144	2180	2313	0	0.077	0.046	0.160	9.1	720	1010



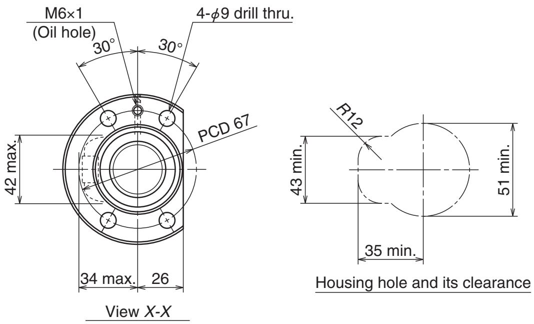
Ball screw No.		Stroke	
Preloaded (LPFT)	Precise clearance (LSFT)	Nominal	Maximum (L_t—Nut length)
W3211FA-1P-C5Z25	**W3211FA-2-C5T25**	1000	1063
W3216FA-1P-C5Z25	**W3216FA-2-C5T25**	1500	1563
W3221FA-1P-C5Z25	**W3221FA-2-C5T25**	2000	2063
W3227FA-1P-C5Z25	**W3227FA-2-C5T25**	2600	2663

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

NSK

ø32×25

Unit: mm



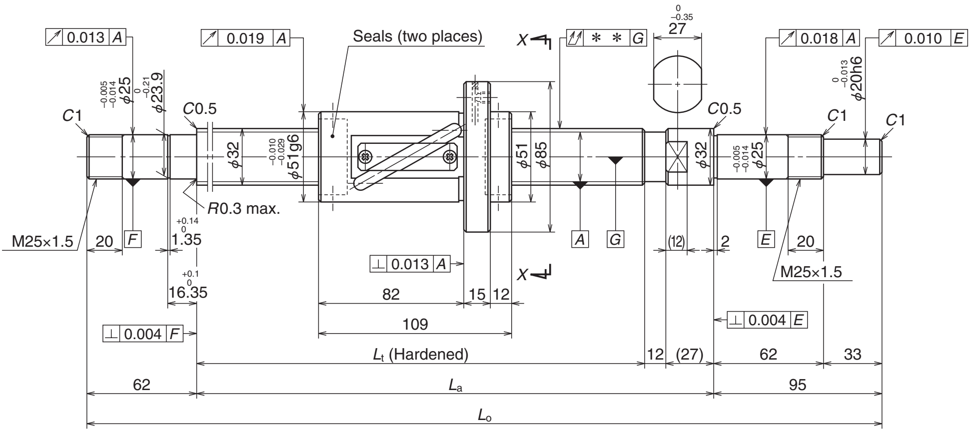
Housing hole and its clearance

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	12900	20400
	Static C_{0a}	21100	42200
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	For opposite to drive side
WBK25-01 (square)	○	○
WBK25S-01 (square)		○
WBK25-11 (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	Fixed - Fixed
1180	1219	1376	0	0.046	0.030	0.090	9.3	2180	2180
1680	1719	1876	0	0.065	0.040	0.120	12.3	1580	2180
2180	2219	2376	0	0.077	0.046	0.160	15.4	930	1300
2780	2819	2976	0	0.093	0.054	0.200	19.1	560	800



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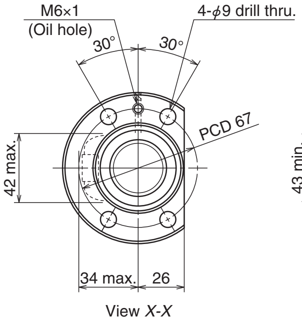
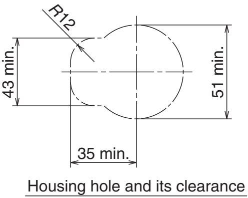
<tr><th colspan="2" rowspan="2">Ball screw No.</th><th colspan="2">Stroke</th></tr>
<tr><th rowspan="2">Nominal</th><th rowspan="2">Maximum
(L_t—Nut length)</th></tr>
<tr><th>Preloaded (LPFT)</th><th>Precise clearance (LSFT)</th></tr>
<tr><td>W3211FA-3P-C5Z32</td><td>W3211FA-4-C5T32</td><td>1000</td><td>1071</td></tr>
<tr><td>W3216FA-3P-C5Z32</td><td>W3216FA-4-C5T32</td><td>1500</td><td>1571</td></tr>
<tr><td>W3221FA-3P-C5Z32</td><td>W3221FA-4-C5T32</td><td>2000</td><td>2071</td></tr>
<tr><td>W3227FA-3P-C5Z32</td><td>W3227FA-4-C5T32</td><td>2600</td><td>2671</td></tr>
</table>

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. NSK grease LR3 is recommended. The amount for replenishing should be about 50% of the nut internal space capacity. Refer to Page D16 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø32×32

Unit: mm



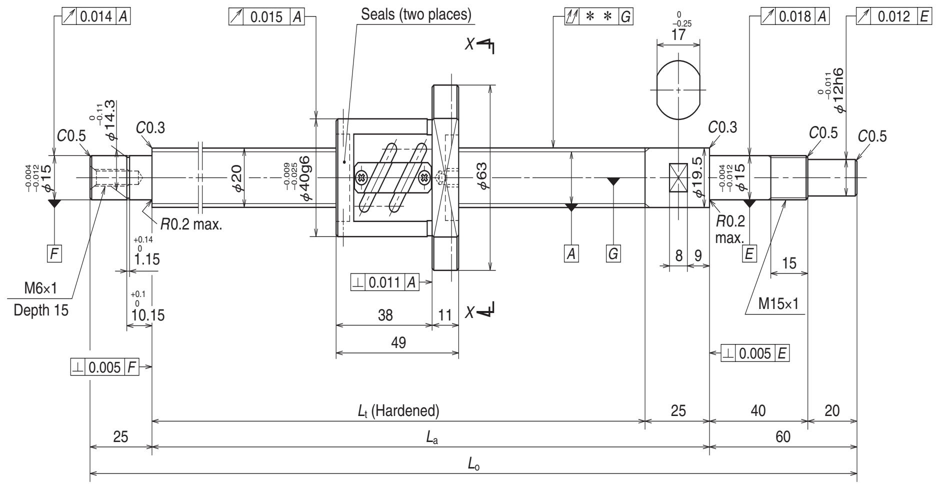


Ball screw specifications			
Product classification		Preloaded	Precise clearance
Shaft dia. x Lead / Direction of turn		32×32/Right	
Preload / Ball recirculation		P preload / Return tube	
Ball dia. / Ball circle dia.		4.762/33.25	
Screw shaft root diameter		28.3	
Effective turns of balls		1.5×1	
Accuracy grade / Preload / Axial play		C5/Z	C5/T
Basic load rating (N)	Dynamic C_a	10100	13300
	Static C_{0a}	16800	25200
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	For opposite to drive side
WBK25-01	(square)	○	○
WBK25S-01	(square)		○
WBK25-11	(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	Fixed - Fixed
1180	1219	1376	0	0.046	0.030	0.090	9.3	2180	2180
1680	1719	1876	0	0.065	0.040	0.120	12.3	1570	2180
2180	2219	2376	0	0.077	0.046	0.160	15.4	920	1290
2780	2819	2976	0	0.093	0.054	0.200	19.1	560	790

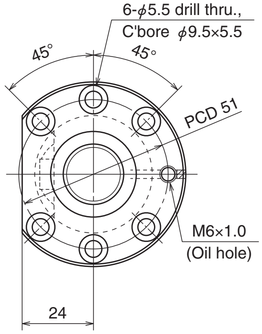


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W2002SA-1P-C5Z4	150	176	225	250	335
W2002SA-2P-C5Z4	200	226	275	300	385
W2003SA-1P-C5Z4	300	326	375	400	485
W2004SA-1P-C5Z4	400	426	475	500	585
W2005SA-1P-C5Z4	500	526	575	600	685
W2006SA-1P-C5Z4	600	626	675	700	785

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø20×4

Unit: mm



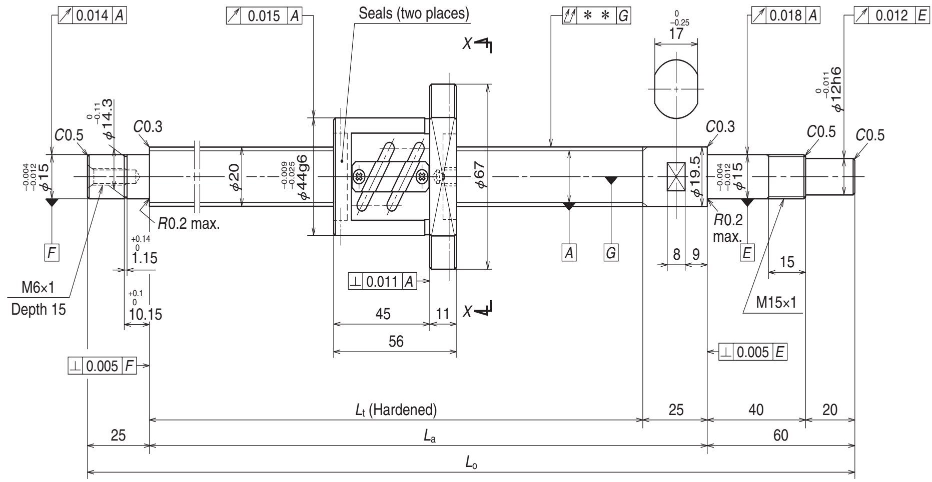
View *X-X*

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	6550
	Static C_{0a}	10900
Preload (N)		294
Dynamic friction torque, median, (N·cm)		3.9
Spacer ball		Yes
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		2.7
Standard volume of grease replenishing (cm^3)		1.4

Recommended support unit	For drive side	For opposite to drive side
WBK15-01A (square)	○	
WBK15S-01 (square)		○
WBK15-11 (round)	○	

Unit: mm

Lead accuracy			Shaft run-out ** ↗↗	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
–0.005	0.023	0.018	0.045	1.1	3000	3000
–0.007	0.023	0.018	0.045	1.2	3000	3000
–0.009	0.025	0.020	0.055	1.5	3000	3000
–0.011	0.027	0.020	0.070	1.7	3000	3000
–0.014	0.030	0.023	0.085	1.9	3000	3000
–0.016	0.035	0.025	0.085	2.1	3000	3000

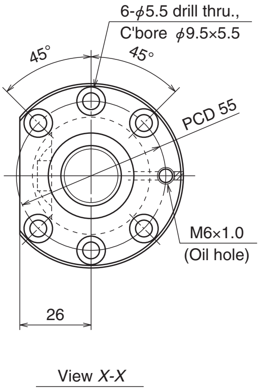


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W2002SA-3P-C5Z5	150	169	225	250	335
W2002SA-4P-C5Z5	200	219	275	300	385
W2003SA-2P-C5Z5	300	319	375	400	485
W2004SA-2P-C5Z5	400	419	475	500	585
W2005SA-2P-C5Z5	500	519	575	600	685
W2007SA-1P-C5Z5	700	719	775	800	885

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø20×5

Unit: mm

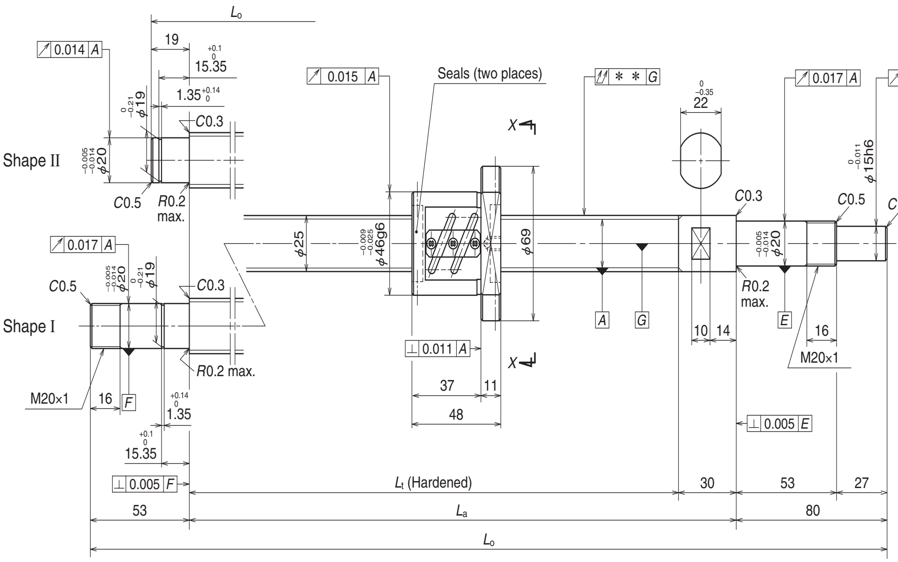


Ball screw specifications		
Shaft dia. x Lead / Direction of turn		20×5/Right
Preload / Ball recirculation		P preload / Return tube
Ball dia. / Ball circle dia.		3.175/20.5
Screw shaft root diameter		17.2
Effective turns of balls		2.5×2
Accuracy grade / Preload		C5/Z
Basic load rating (N)	Dynamic C_a	11100
	Static C_{0a}	17100
Preload (N)		490
Dynamic friction torque, median, (N·cm)		7.8
Spacer ball		Yes
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		4.3
Standard volume of grease replenishing (cm^3)		2.2

Recommended support unit		For drive side	For opposite to drive side
WBK15-01A	(square)	○	
WBK15S-01	(square)		○
WBK15-11	(round)	○	

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
-0.005	0.023	0.018	0.045	1.3	3000	3000
-0.007	0.023	0.018	0.045	1.4	3000	3000
-0.009	0.025	0.020	0.055	1.6	3000	3000
-0.011	0.027	0.020	0.070	1.8	3000	3000
-0.014	0.030	0.023	0.085	2.0	3000	3000
-0.019	0.035	0.025	0.110	2.5	3000	3000

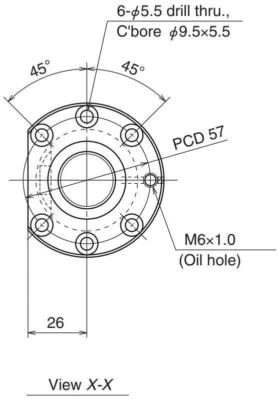


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W2502SA-1P-C5Z4	150	172	220	250	349
W2502SA-2P-C5Z4	200	222	270	300	399
W2503SA-1P-C5Z4	300	322	370	400	499
W2504SA-1P-C5Z4	400	422	470	500	599
W2505SA-1P-C5Z4	500	522	570	600	733
W2507SA-1P-C5Z4	700	722	770	800	933

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø25×4

Unit: mm

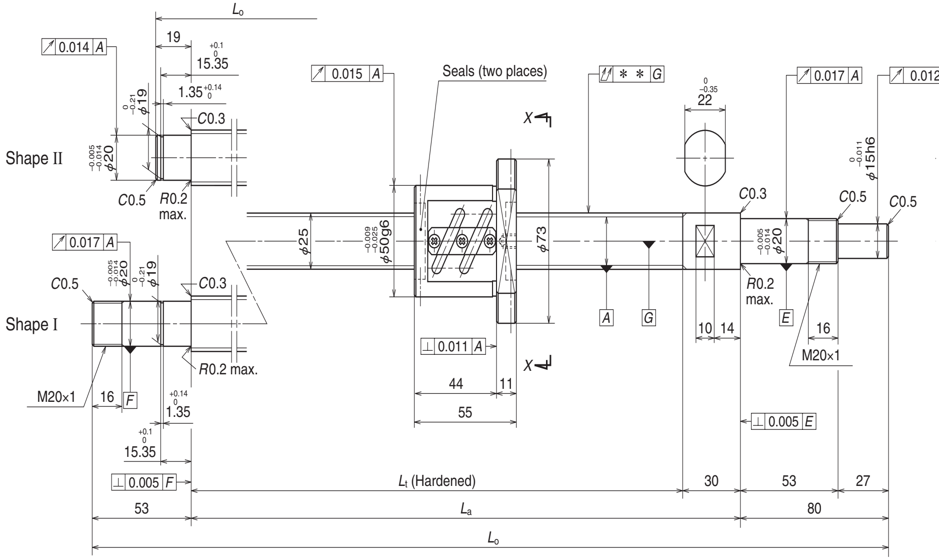


Ball screw specifications		
Shaft dia. x Lead / Direction of turn		25×4/Right
Preload / Ball recirculation		P preload / Return tube
Ball dia. / Ball circle dia.		2.381/25.3
Screw shaft root diameter		22.8
Effective turns of balls		2.5×2
Accuracy grade / Preload		C5/Z
Basic load rating (N)	Dynamic C_a	7110
	Static C_{0a}	13600
Preload (N)		290
Dynamic friction torque, median, (N·cm)		4.9
Spacer ball		Yes
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		3.2
Standard volume of grease replenishing (cm^3)		1.6

Recommended support unit		For drive side	For opposite to drive side
WBK20-01	(square)	○	○
WBK20S-01	(square)		○
WBK20-11	(round)	○	○

Unit: mm

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
II	–0.005	0.023	0.018	0.035	1.6	2800	—
II	–0.006	0.023	0.018	0.035	1.8	2800	—
II	–0.009	0.025	0.020	0.040	2.2	2800	—
II	–0.011	0.027	0.020	0.050	2.5	2800	—
I	–0.014	0.030	0.023	0.060	3.0	2800	2800
I	–0.018	0.035	0.025	0.075	3.7	2800	2800

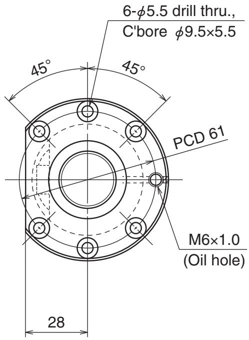


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W2502SA-3P-C5Z5	150	165	220	250	349
W2502SA-4P-C5Z5	200	215	270	300	399
W2503SA-2P-C5Z5	300	315	370	400	499
W2504SA-2P-C5Z5	400	415	470	500	599
W2505SA-2P-C5Z5	500	515	570	600	733
W2506SA-1P-C5Z5	600	615	670	700	833
W2507SA-2P-C5Z5	700	715	770	800	933
W2509SA-1P-C5Z5	900	915	970	1000	1133
W2511SA-1P-C5Z5	1000	1115	1170	1200	1333

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø25×5

Unit: mm



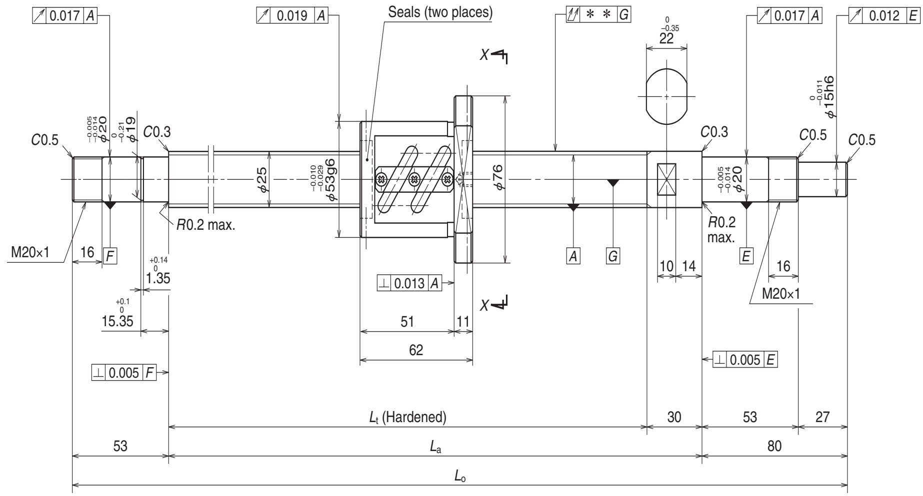
View *X-X*

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	12300
	Static C_{0a}	21800
Preload (N)		540
Dynamic friction torque, median, (N·cm)		8.8
Spacer ball		Yes
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		5.0
Standard volume of grease replenishing (cm^3)		2.5

Recommended support unit		For drive side	For opposite to drive side
WBK20-01	(square)	○	○
WBK20S-01	(square)		○
WBK20-11	(round)	○	○

Unit: mm

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
II	–0.005	0.023	0.018	0.035	1.8	2800	—
II	–0.006	0.023	0.018	0.035	2.0	2800	—
II	–0.009	0.025	0.020	0.040	2.3	2800	—
II	–0.011	0.027	0.020	0.050	2.7	2800	—
I	–0.014	0.030	0.023	0.060	3.1	2800	2800
I	–0.016	0.035	0.025	0.075	3.4	2800	2800
I	–0.018	0.035	0.025	0.075	3.8	2800	2800
I	–0.023	0.040	0.027	0.090	4.5	2800	2800
I	–0.028	0.046	0.030	0.120	5.2	2480	2800

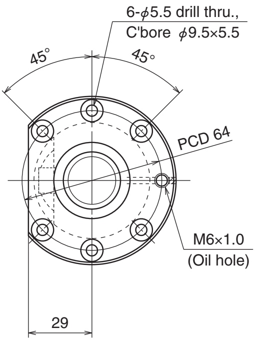


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W2503SA-3P-C5Z6	250	308	370	400	533
W2505SA-3P-C5Z6	450	508	570	600	733
W2507SA-3P-C5Z6	650	708	770	800	933
W2511SA-2P-C5Z6	1050	1108	1170	1200	1333

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø25×6

Unit: mm



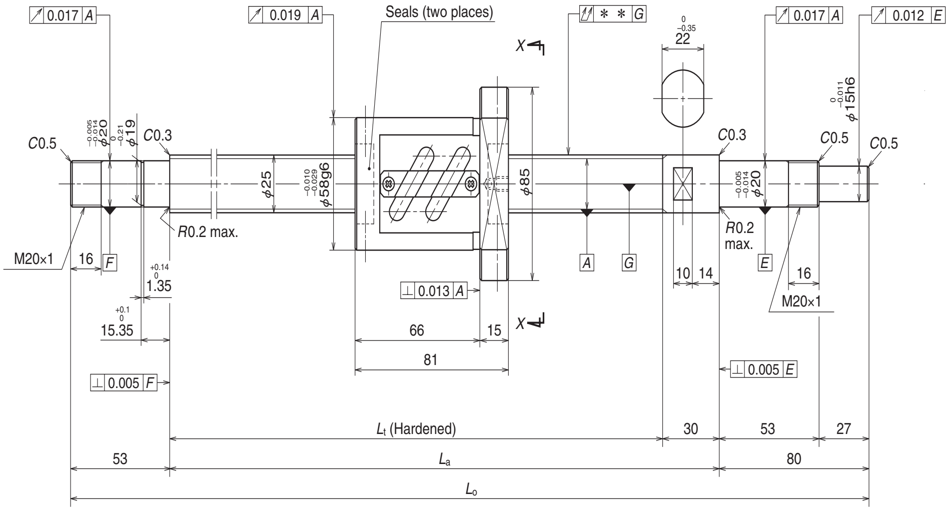
View *X-X*

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	16600
	Static C_{0a}	26700
Preload (N)		685
Dynamic friction torque, median, (N·cm)		13.8
Spacer ball		Yes
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		7.0
Standard volume of grease replenishing (cm^3)		3.5

Recommended support unit	For drive side	For opposite to drive side
WBK20-01 (square)	○	○
WBK20S-01 (square)		○
WBK20-11 (round)	○	○

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
–0.009	0.025	0.020	0.050	2.5	2800	2800
–0.014	0.030	0.023	0.060	3.2	2800	2800
–0.018	0.035	0.025	0.075	3.9	2800	2800
–0.028	0.046	0.030	0.120	5.2	2410	2800

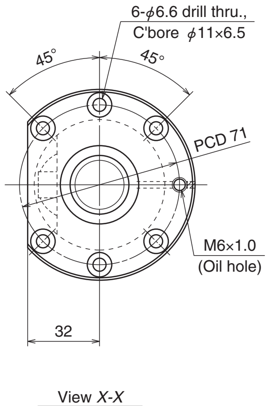


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W2503SA-4P-C5Z10	250	289	370	400	533
W2505SA-4P-C5Z10	450	489	570	600	733
W2507SA-4P-C5Z10	650	689	770	800	933
W2509SA-2P-C5Z10	850	889	970	1000	1133
W2511SA-3P-C5Z10	1050	1089	1170	1200	1333
W2514SA-1P-C5Z10	1350	1389	1470	1500	1633

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø25×10

Unit: mm

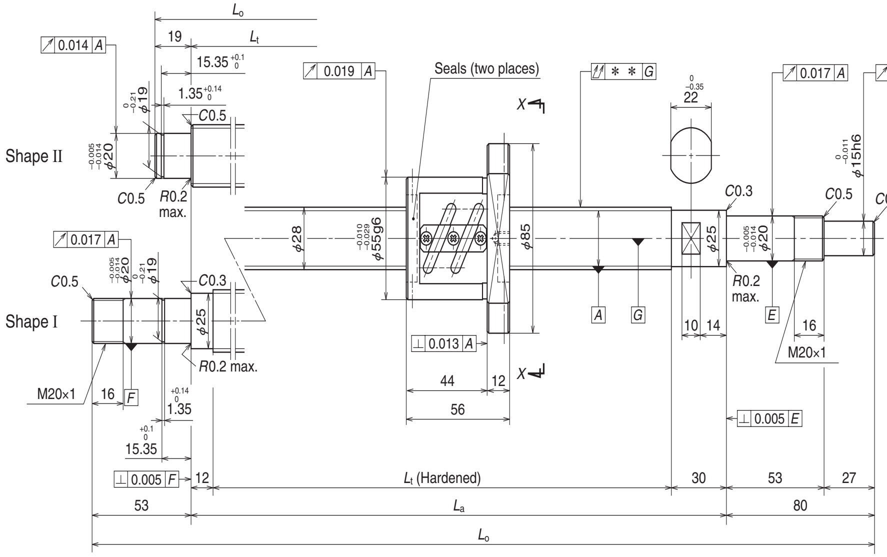


Ball screw specifications		
Shaft dia. x Lead / Direction of turn		25×10/Right
Preload / Ball recirculation		P preload / Return tube
Ball dia. / Ball circle dia.		4.762/25.5
Screw shaft root diameter		20.5
Effective turns of balls		1.5×2
Accuracy grade / Preload		C5/Z
Basic load rating (N)	Dynamic C_a	13600
	Static C_{0a}	18900
Preload (N)		585
Dynamic friction torque, median, (N·cm)		13.8
Spacer ball		Yes
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm³)		9.5
Standard volume of grease replenishing (cm³)		4.8

Recommended support unit		For drive side	For opposite to drive side
WBK20-01	(square)	○	○
WBK20S-01	(square)		○
WBK20-11	(round)	○	○

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
–0.009	0.025	0.020	0.050	3.2	2800	2800
–0.014	0.030	0.023	0.060	3.8	2800	2800
–0.018	0.035	0.025	0.075	4.5	2800	2800
–0.023	0.040	0.027	0.090	5.2	2800	2800
–0.028	0.046	0.030	0.120	5.9	2340	2800
–0.035	0.054	0.035	0.150	6.9	1470	2050

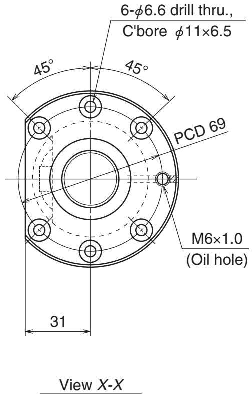


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W2802SA-1P-C5Z5	200	214	270	300	399
W2803SA-1P-C5Z5	300	314	370	400	499
W2804SA-1P-C5Z5	400	414	470	500	599
W2805SA-1P-C5Z5	450	502	558	600	733
W2807SA-1P-C5Z5	650	702	758	800	933
W2809SA-1P-C5Z5	850	902	958	1000	1133
W2811SA-1P-C5Z5	1050	1102	1158	1200	1333

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø28×5

Unit: mm



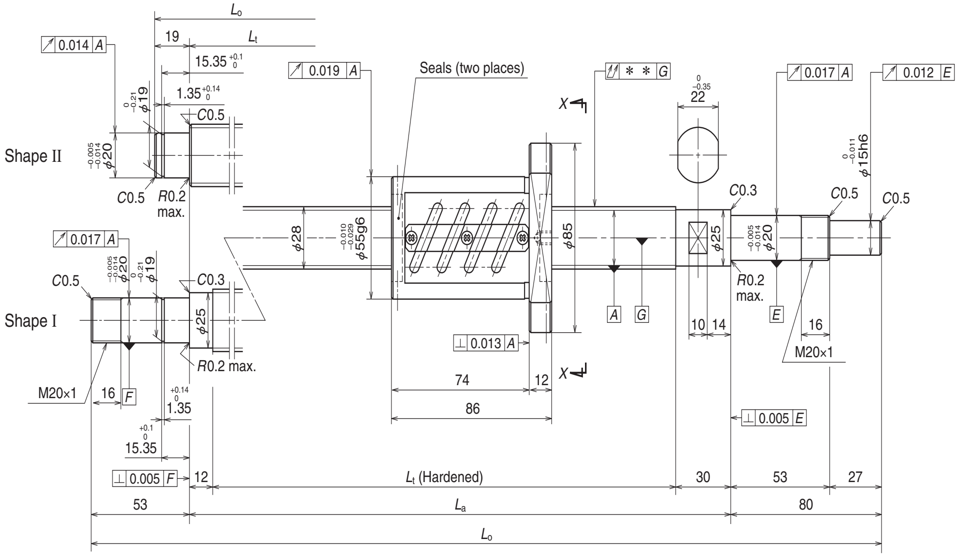
View *X-X*

Ball screw specifications		
Shaft dia. x 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	13000
	Static C_{0a}	24400
Preload (N)		540
Dynamic friction torque, median, (N·cm)		9.8
Spacer ball		Yes
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm³)		6.0
Standard volume of grease replenishing (cm³)		3.0

Recommended support unit	For drive side	For opposite to drive side
WBK20-01 (square)	○	○
WBK20S-01 (square)		○
WBK20-11 (round)	○	○

Unit: mm

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
Ⅱ	–0.006	0.023	0.018	0.035	2.5	2500	—
Ⅱ	–0.009	0.025	0.020	0.040	2.9	2500	—
Ⅱ	–0.011	0.027	0.020	0.050	3.3	2500	—
Ⅰ	–0.014	0.030	0.023	0.060	3.8	2500	2500
Ⅰ	–0.018	0.035	0.025	0.075	4.7	2500	2500
Ⅰ	–0.024	0.040	0.027	0.090	5.6	2500	2500
Ⅰ	–0.028	0.046	0.030	0.120	6.5	2500	2500

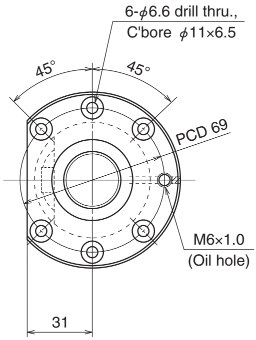


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W2802SA-2Z-C5Z5	150	184	270	300	399
W2803SA-2Z-C5Z5	250	284	370	400	499
W2804SA-2Z-C5Z5	350	384	470	500	599
W2805SA-2Z-C5Z5	450	472	558	600	733
W2807SA-2Z-C5Z5	650	672	758	800	933
W2809SA-2Z-C5Z5	850	872	958	1000	1133
W2811SA-2Z-C5Z5	1050	1072	1158	1200	1333

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø28×5

Unit: mm



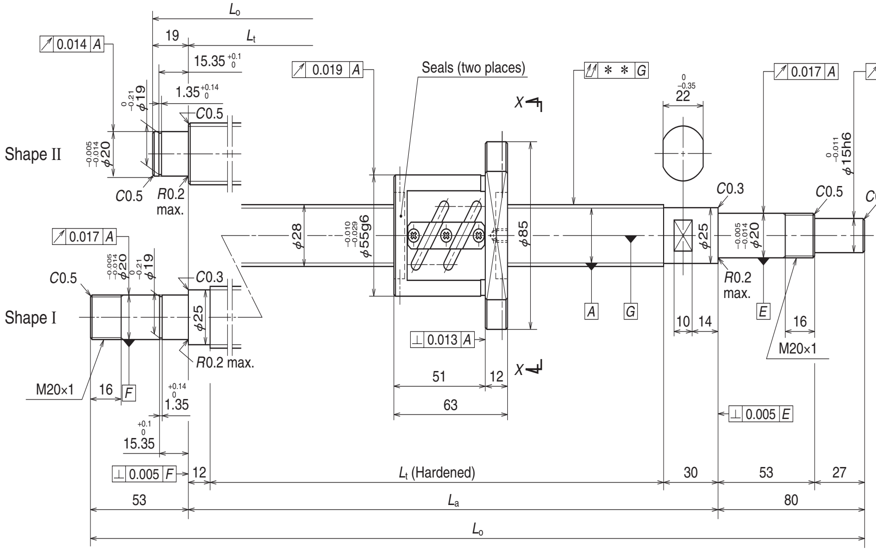
View *X-X*

Ball screw specifications		
Shaft dia. x 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	20600
	Static C_{0a}	48700
Preload (N)		1220
Dynamic friction torque, median, (N·cm)		21.5
Spacer ball		None
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		9.0
Standard volume of grease replenishing (cm^3)		4.5

Recommended support unit		For drive side	For opposite to drive side
WBK20-01	(square)	○	○
WBK20S-01	(square)		○
WBK20-11	(round)	○	○

Unit: mm

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
Ⅱ	–0.006	0.023	0.018	0.035	2.8	2500	—
Ⅱ	–0.009	0.025	0.020	0.040	3.2	2500	—
Ⅱ	–0.011	0.027	0.020	0.050	3.7	2500	—
Ⅰ	–0.013	0.030	0.023	0.060	4.2	2500	2500
Ⅰ	–0.018	0.035	0.025	0.075	5.1	2500	2500
Ⅰ	–0.023	0.040	0.027	0.090	5.9	2500	2500
Ⅰ	–0.028	0.046	0.030	0.120	6.8	2500	2500

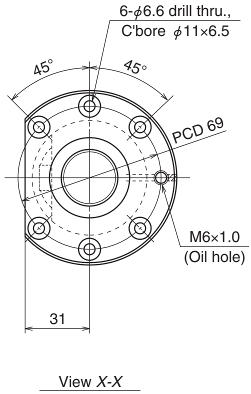


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W2803SA-3P-C5Z6	250	307	370	400	499
W2805SA-3P-C5Z6	450	507	570	600	699
W2807SA-3P-C5Z6	650	695	758	800	933
W2809SA-3P-C5Z6	850	895	958	1000	1133
W2811SA-3P-C5Z6	1050	1095	1158	1200	1333

Remarks 1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø28×6

Unit: mm

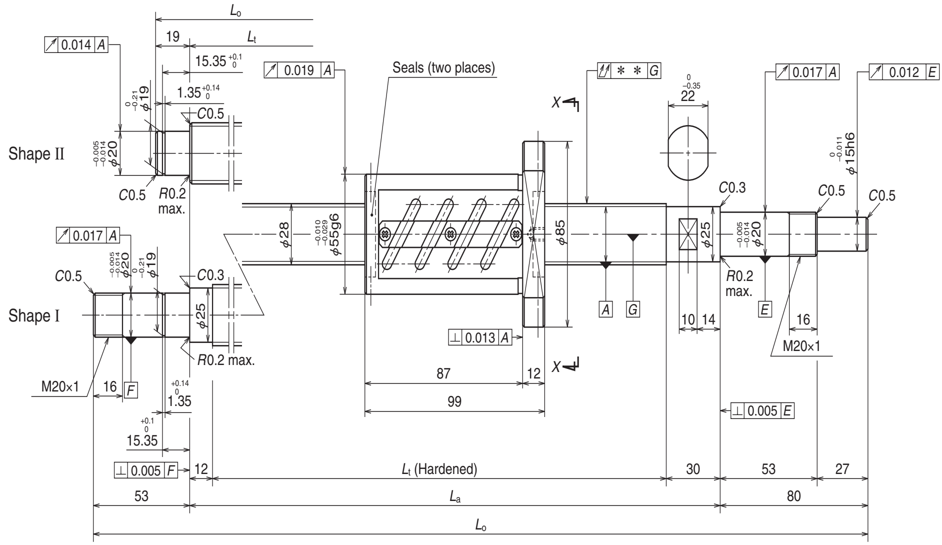


Ball screw specifications		
Shaft dia. x Lead / Direction of turn		28×6/Right
Preload / Ball recirculation		P preload / Return tube
Ball dia. / Ball circle dia.		3.175/28.5
Screw shaft root diameter		25.2
Effective turns of balls		2.5×2
Accuracy grade / Preload		C5/Z
Basic load rating (N)	Dynamic C_a	12900
	Static C_{0a}	24300
Preload (N)		540
Dynamic friction torque, median, (N·cm)		11.8
Spacer ball		Yes
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		6.0
Standard volume of grease replenishing (cm^3)		3.0

Recommended support unit		For drive side	For opposite to drive side
WBK20-01	(square)	○	○
WBK20S-01	(square)		○
WBK20-11	(round)	○	○

Unit: mm

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
II	–0.009	0.025	0.020	0.040	3.0	2500	—
II	–0.014	0.030	0.023	0.060	3.9	2500	—
I	–0.018	0.035	0.025	0.075	4.9	2500	2500
I	–0.023	0.040	0.027	0.090	5.8	2500	2500
I	–0.028	0.046	0.030	0.120	6.6	2500	2500

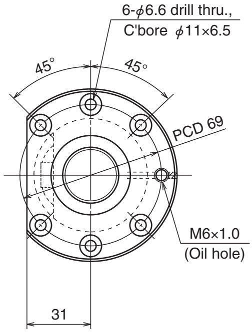


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W2803SA-4Z-C5Z6	250	271	370	400	499
W2805SA-4Z-C5Z6	450	471	570	600	699
W2807SA-4Z-C5Z6	650	659	758	800	933
W2809SA-4Z-C5Z6	850	859	958	1000	1133
W2811SA-4Z-C5Z6	1050	1059	1158	1200	1333

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø28×6

Unit: mm



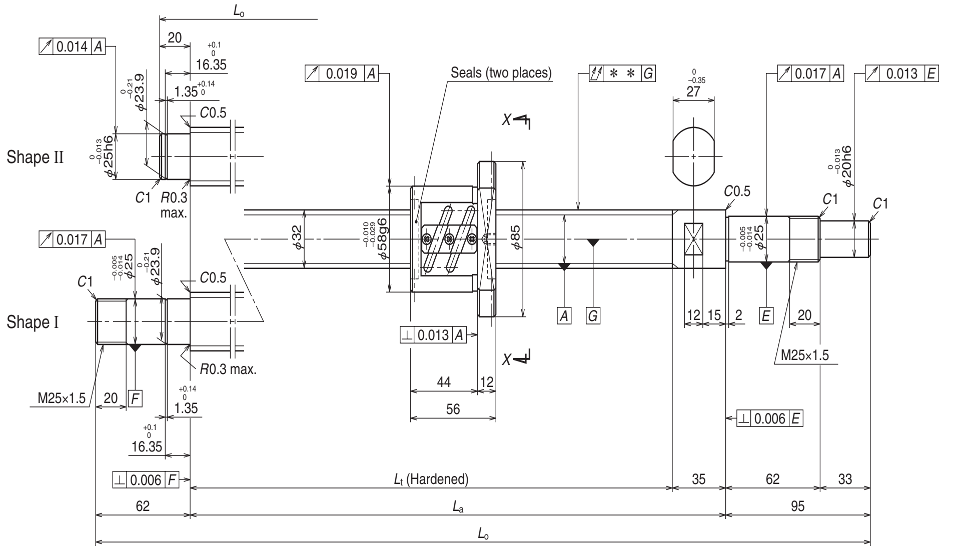
View *X-X*

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		28×6/Right
Preload / Ball recirculation		Z preload / Return tube
Ball dia. / Ball circle dia.		3.175/28.5
Screw shaft root diameter		25.2
Effective turns of balls		2.5×2
Accuracy grade / Preload		C5/Z
Basic load rating (N)	Dynamic C_a	20600
	Static C_{0a}	48700
Preload (N)		1220
Dynamic friction torque, median, (N·cm)		23.5
Spacer ball		None
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		9.5
Standard volume of grease replenishing (cm^3)		4.8

Recommended support unit		For drive side	For opposite to drive side
WBK20-01	(square)	○	○
WBK20S-01	(square)		○
WBK20-11	(round)	○	○

Unit: mm

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
II	–0.009	0.025	0.020	0.040	3.4	2500	—
II	–0.014	0.030	0.023	0.060	4.3	2500	—
I	–0.018	0.035	0.025	0.075	5.3	2500	2500
I	–0.023	0.040	0.027	0.090	6.2	2500	2500
I	–0.028	0.046	0.030	0.120	7.1	2500	2500

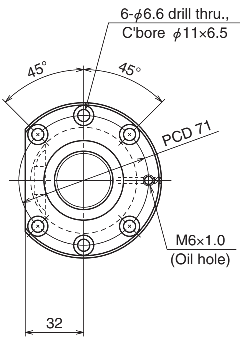


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W3202SA-1P-C5Z5	150	209	265	300	415
W3203SA-1P-C5Z5	250	309	365	400	515
W3204SA-1P-C5Z5	350	409	465	500	615
W3205SA-1P-C5Z5	450	509	565	600	715
W3206SA-1P-C5Z5	550	609	665	700	857
W3207SA-1P-C5Z5	650	709	765	800	957
W3209SA-1P-C5Z5	850	909	965	1000	1157
W3211SA-1P-C5Z5	1050	1109	1165	1200	1357
W3214SA-1P-C5Z5	1350	1409	1465	1500	1657

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø32×5

Unit: mm



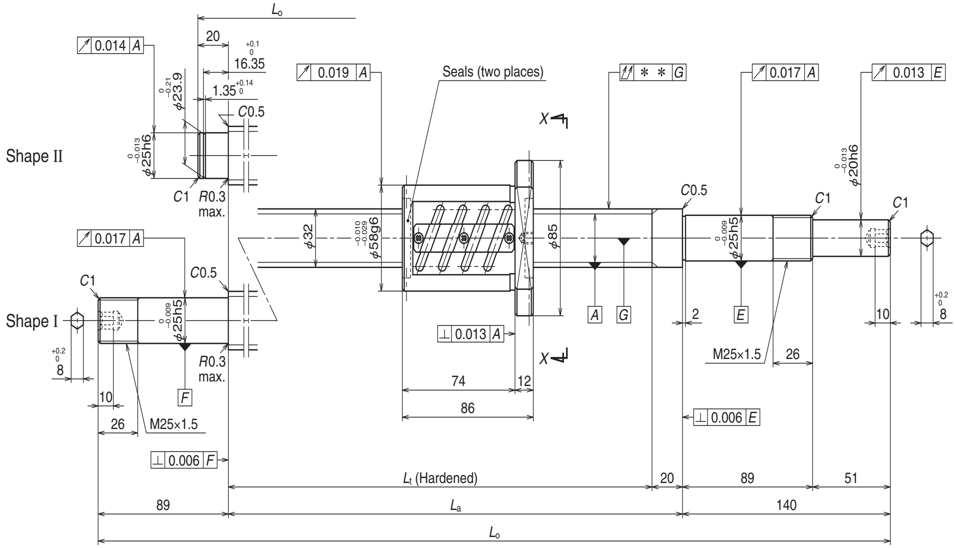
View *X-X*

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	13700
	Static C_{0a}	28000
Preload (N)		590
Dynamic friction torque, median, (N·cm)		11.8
Spacer ball		Yes
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		7.0
Standard volume of grease replenishing (cm^3)		3.5

Recommended support unit		**For drive side**	**For opposite to drive side**
WBK25-01	(square)	○	○
WBK25S-01	(square)		○
WBK25-11	(round)	○	○

Unit: mm

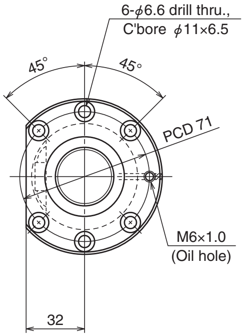
Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
II	–0.006	0.023	0.018	0.040	3.1	2180	—
II	–0.009	0.025	0.020	0.050	3.7	2180	—
II	–0.011	0.027	0.020	0.050	4.2	2180	—
II	–0.014	0.030	0.023	0.060	4.8	2180	—
I	–0.016	0.035	0.025	0.075	5.6	2180	2180
I	–0.018	0.035	0.025	0.075	6.1	2180	2180
I	–0.023	0.040	0.027	0.090	7.3	2180	2180
I	–0.028	0.046	0.030	0.120	8.5	2180	2180
I	–0.035	0.054	0.035	0.150	10.2	2070	2180



Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W3202SA-2Z-C5Z5	150	194	280	300	460
W3203SA-2Z-C5Z5	250	294	380	400	560
W3204SA-2Z-C5Z5	350	394	480	500	660
W3205SA-2Z-C5Z5	450	494	580	600	760
W3206SA-2Z-C5Z5	550	594	680	700	929
W3207SA-2Z-C5Z5	650	694	780	800	1029
W3209SA-2Z-C5Z5	850	894	980	1000	1229
W3211SA-2Z-C5Z5	1050	1094	1180	1200	1429
W3214SA-2Z-C5Z5	1350	1394	1480	1500	1729

Remarks 1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø32×5



View *X-X*

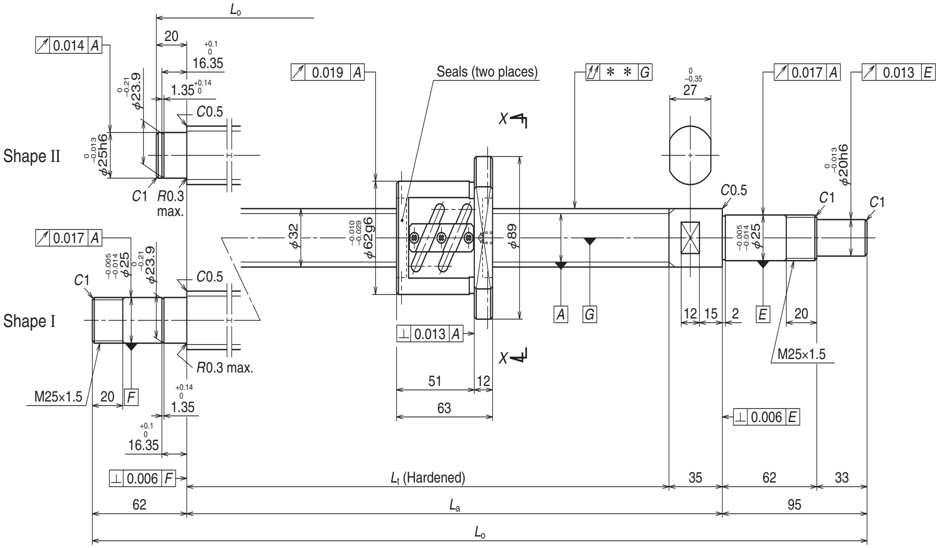
Unit: mm

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	21800
	Static C_{0a}	56000
Preload (N)		1270
Dynamic friction torque, median, (N·cm)		23.5
Spacer ball		None
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		10
Standard volume of grease replenishing (cm^3)		5

Recommended support unit	
WBK25DF-31	(round)

Unit: mm

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
Ⅱ	–0.007	0.023	0.018	0.040	3.5	2180	—
Ⅱ	–0.009	0.025	0.020	0.050	4.1	2180	—
Ⅱ	–0.012	0.027	0.020	0.060	4.7	2180	—
Ⅱ	–0.014	0.030	0.023	0.060	5.3	2180	—
Ⅰ	–0.016	0.035	0.025	0.075	6.1	2180	2180
Ⅰ	–0.019	0.035	0.025	0.090	6.7	2180	2180
Ⅰ	–0.024	0.040	0.027	0.090	7.9	2180	2180
Ⅰ	–0.028	0.046	0.030	0.120	9.0	2180	2180
Ⅰ	–0.036	0.054	0.035	0.150	10.8	2040	2180

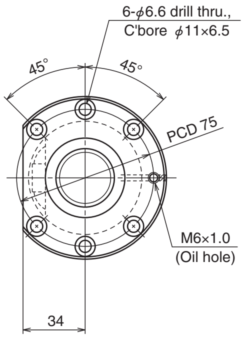


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W3203SA-3P-C5Z6	250	302	365	400	515
W3205SA-3P-C5Z6	450	502	565	600	715
W3207SA-3P-C5Z6	650	702	765	800	957
W3209SA-3P-C5Z6	850	902	965	1000	1157
W3211SA-3P-C5Z6	1050	1102	1165	1200	1357
W3214SA-3P-C5Z6	1350	1402	1465	1500	1657

Remarks 1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø32×6

Unit: mm



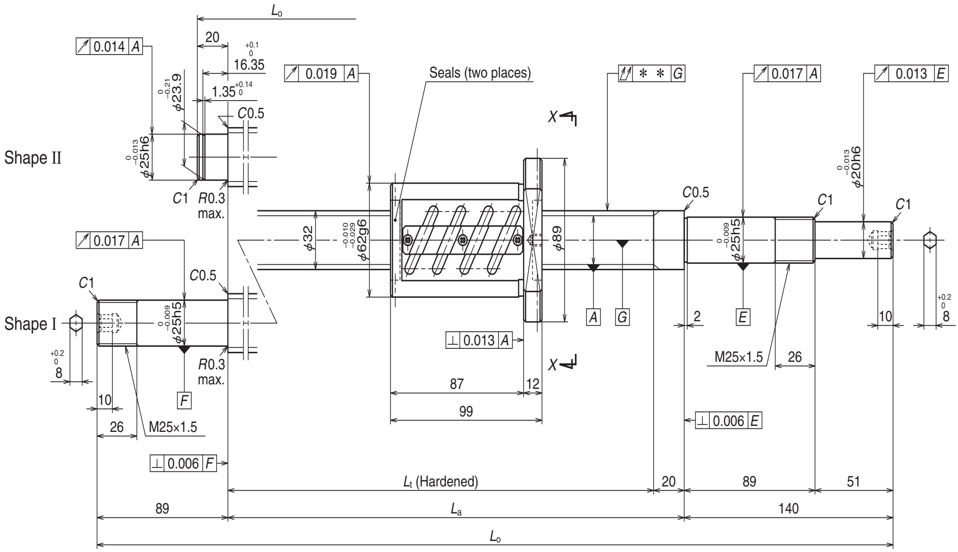
View *X-X*

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	18300
	Static C_{0a}	34700
Preload (N)		780
Dynamic friction torque, median, (N·cm)		15.7
Spacer ball		Yes
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		9.5
Standard volume of grease replenishing (cm^3)		4.8

Recommended support unit		For drive side	For opposite to drive side
WBK25-01	(square)	○	○
WBK25S-01	(square)		○
WBK25-11	(round)	○	○

Unit: mm

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
II	–0.009	0.025	0.020	0.050	3.8	2180	—
II	–0.014	0.030	0.023	0.060	5.0	2180	—
I	–0.018	0.035	0.025	0.075	6.3	2180	2180
I	–0.023	0.040	0.027	0.090	7.4	2180	2180
I	–0.028	0.046	0.030	0.120	8.5	2180	2180
I	–0.035	0.054	0.035	0.150	10.2	2020	2180

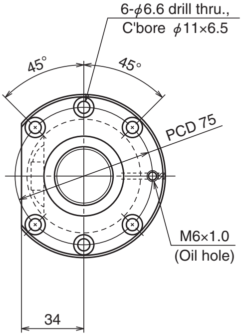


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W3203SA-4Z-C5Z6	250	281	380	400	560
W3205SA-4Z-C5Z6	450	481	580	600	760
W3207SA-4Z-C5Z6	650	681	780	800	1029
W3209SA-4Z-C5Z6	850	881	980	1000	1229
W3211SA-4Z-C5Z6	1050	1081	1180	1200	1429
W3214SA-4Z-C5Z6	1350	1381	1480	1500	1729

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø32×6

Unit: mm



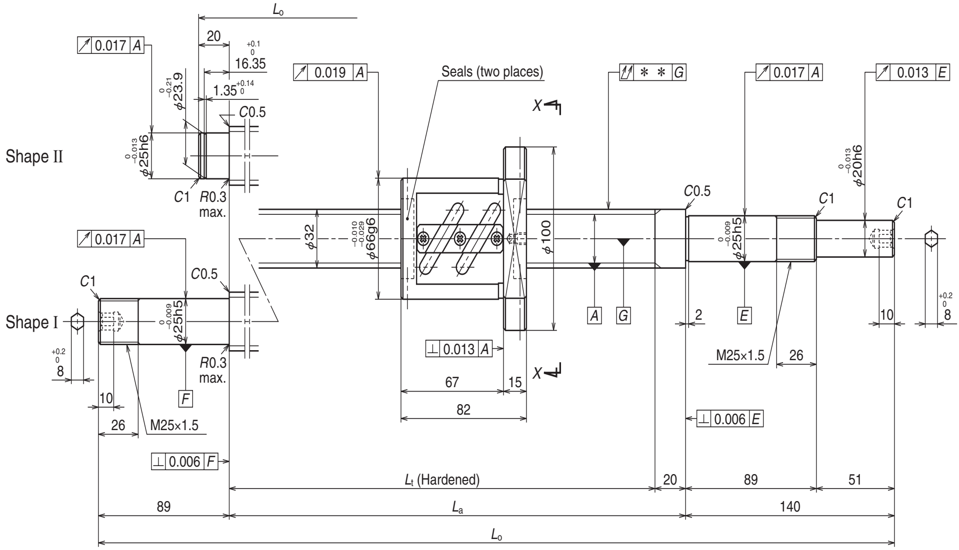
View *X-X*

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	29100
	Static C_{0a}	69300
Preload (N)		1710
Dynamic friction torque, median, (N·cm)		35.0
Spacer ball		None
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		14
Standard volume of grease replenishing (cm^3)		7

Recommended support unit	
WBK25DF-31	(round)

Unit: mm

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
Ⅱ	–0.009	0.025	0.020	0.050	4.5	2180	—
Ⅱ	–0.014	0.030	0.023	0.060	5.6	2180	—
Ⅰ	–0.019	0.035	0.025	0.090	7.0	2180	2180
Ⅰ	–0.024	0.040	0.027	0.090	8.1	2180	2180
Ⅰ	–0.028	0.046	0.030	0.120	9.3	2180	2180
Ⅰ	–0.036	0.054	0.035	0.150	11.0	2000	2180

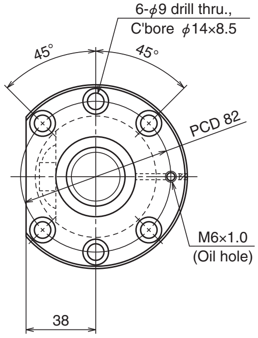


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W3203SA-5Z-C5Z8	250	298	380	400	560
W3205SA-5Z-C5Z8	450	498	580	600	760
W3207SA-5Z-C5Z8	650	698	780	800	1029
W3209SA-5Z-C5Z8	850	898	980	1000	1229
W3214SA-5Z-C5Z8	1350	1398	1480	1500	1729

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø32×8

Unit: mm



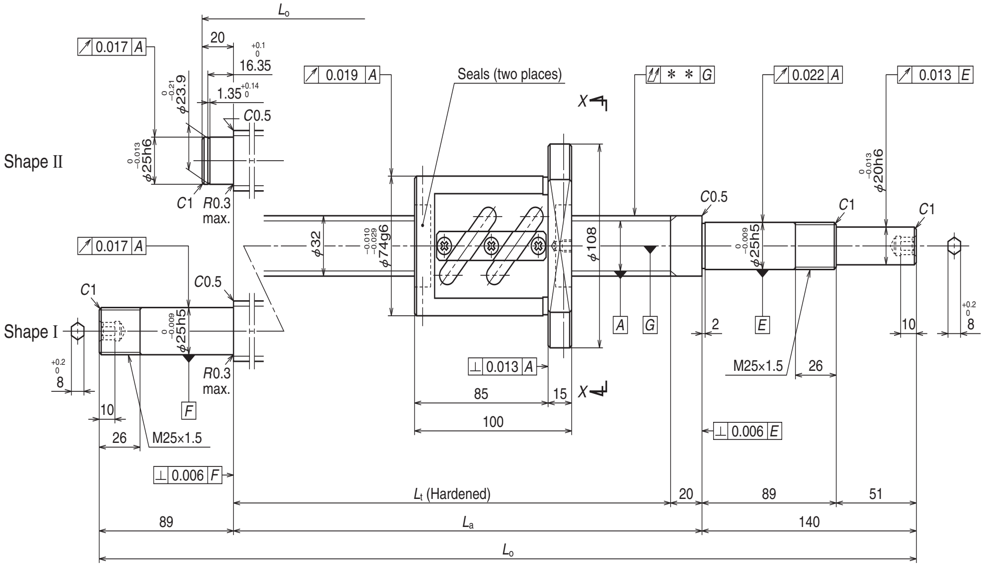
View *X-X*

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	20600
	Static C_{0a}	40900
Preload (N)		1320
Dynamic friction torque, median, (N·cm)		31.0
Spacer ball		None
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		13
Standard volume of grease replenishing (cm^3)		6.5

Recommended support unit	
WBK25DF-31	(round)

Unit: mm

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
Ⅱ	–0.009	0.025	0.020	0.050	4.7	2180	—
Ⅱ	–0.014	0.030	0.023	0.060	5.8	2180	—
Ⅰ	–0.019	0.035	0.025	0.090	7.2	2180	2180
Ⅰ	–0.024	0.040	0.027	0.090	8.3	2180	2180
Ⅰ	–0.036	0.054	0.035	0.150	11.1	1920	2180

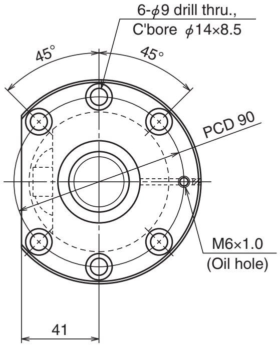


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W3203SA-6Z-C5Z10	250	280	380	400	560
W3204SA-3Z-C5Z10	350	380	480	500	660
W3205SA-6Z-C5Z10	450	480	580	600	760
W3206SA-3Z-C5Z10	550	580	680	700	929
W3207SA-6Z-C5Z10	650	680	780	800	1029
W3209SA-6Z-C5Z10	850	880	980	1000	1229
W3211SA-5Z-C5Z10	1050	1080	1180	1200	1429
W3214SA-6Z-C5Z10	1350	1380	1480	1500	1729
W3217SA-1Z-C5Z10	1650	1680	1780	1800	2029

Remarks 1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø32×10

Unit: mm



View *X-X*

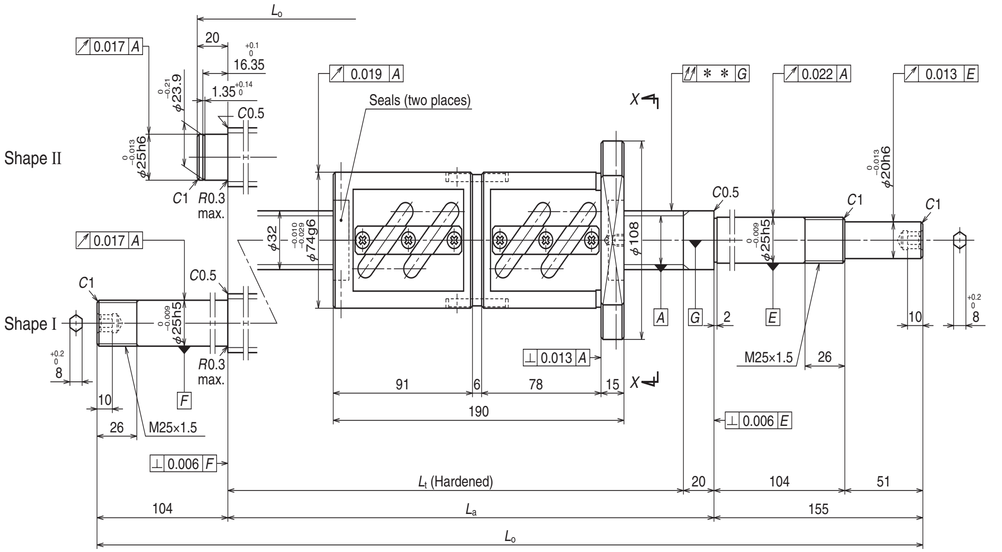
Ball screw specifications		
Shaft dia. x Lead / Direction of turn		32×10/Right
Preload / Ball recirculation		Z preload / Return tube
Ball dia. / Ball circle dia.		6.35/33
Screw shaft root diameter		26.4
Effective turns of balls		2.5×1
Accuracy grade / Preload		C5/Z
Basic load rating (N)	Dynamic C_a	30000
	Static C_{0a}	55100
Preload (N)		1960
Dynamic friction torque, median, (N·cm)		54.0
Spacer ball		None
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		22
Standard volume of grease replenishing (cm^3)		11

Recommended support unit	
WBK25DF-31	(round)

Unit: mm

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
Ⅱ	–0.009	0.025	0.020	0.050	5.5	2180	—
Ⅱ	–0.012	0.027	0.020	0.060	6.0	2180	—
Ⅱ	–0.014	0.030	0.023	0.060	6.6	2180	—
Ⅰ	–0.016	0.035	0.025	0.075	7.4	2180	2180
Ⅰ	–0.019	0.035	0.025	0.090	7.9	2180	2180
Ⅰ	–0.024	0.040	0.027	0.090	9.0	2180	2180
Ⅰ	–0.028	0.046	0.030	0.120	10.1	2180	2180
Ⅰ	–0.036	0.054	0.035	0.150	11.7	1860	2180
Ⅰ	–0.043	0.065	0.040	0.200	13.3	1280	1820

Finished shaft end SA Type (Fine lead) Dia. 32, Lead 10

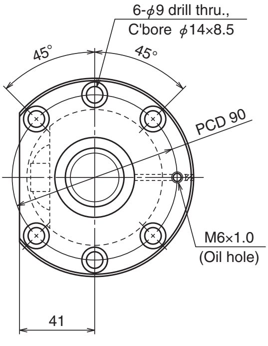


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W3203SA-7D-C5Z10	150	190	380	400	575
W3204SA-4D-C5Z10	250	290	480	500	675
W3205SA-7D-C5Z10	350	390	580	600	775
W3206SA-4D-C5Z10	450	490	680	700	959
W3207SA-7D-C5Z10	550	590	780	800	1059
W3209SA-7D-C5Z10	750	790	980	1000	1259
W3211SA-6D-C5Z10	950	990	1180	1200	1459
W3214SA-7D-C5Z10	1250	1290	1480	1500	1759
W3217SA-2D-C5Z10	1550	1590	1780	1800	2059

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø32×10

Unit: mm



View *X-X*

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	54500
	Static C_{0a}	110000
Preload (N)		3230
Dynamic friction torque, median, (N·cm)		83.0
Spacer ball		None
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		44
Standard volume of grease replenishing (cm^3)		22

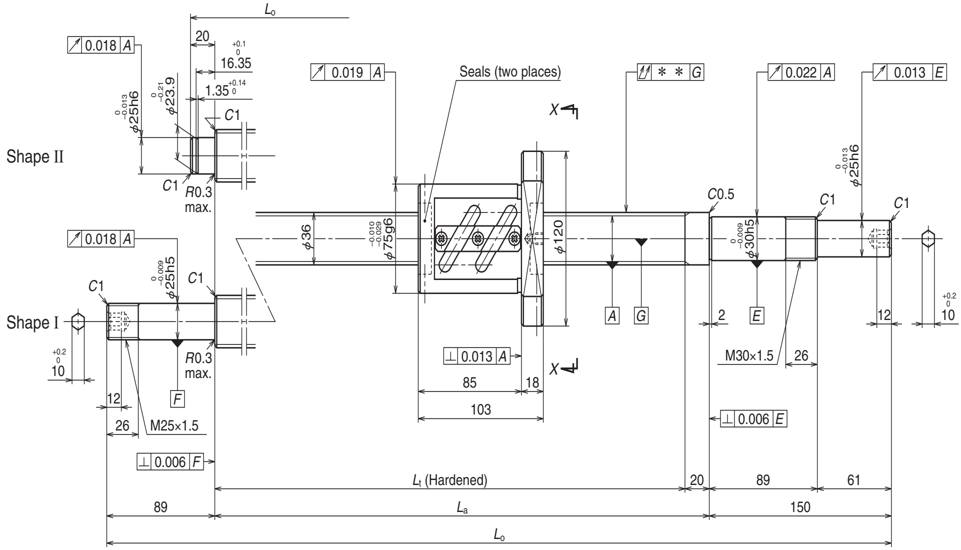
Recommended support unit	
WBK25DFD-31	(round)

Unit: mm

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
Ⅱ	–0.009	0.025	0.020	0.050	7.5	2180	—
Ⅱ	–0.012	0.027	0.020	0.060	8.1	2180	—
Ⅱ	–0.014	0.030	0.023	0.060	8.6	2180	—
Ⅰ	–0.016	0.035	0.025	0.075	9.5	2180	2180
Ⅰ	–0.019	0.035	0.025	0.090	10.0	2180	2180
Ⅰ	–0.024	0.040	0.027	0.120	11.1	2180	2180
Ⅰ	–0.028	0.046	0.030	0.120	12.2	2180	2180
Ⅰ	–0.036	0.054	0.035	0.150	13.8	1980	2180
Ⅰ	–0.043	0.065	0.040	0.200	15.4	1350	1910

Finished shaft end SA Type

(Fine lead) Dia. 36, Lead 10

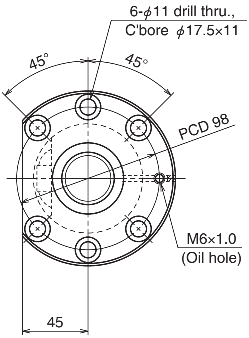


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W3604SA-1Z-C5Z10	350	377	480	500	670
W3606SA-1Z-C5Z10	550	577	680	700	870
W3609SA-1Z-C5Z10	850	877	980	1000	1239
W3613SA-1Z-C5Z10	1250	1277	1380	1400	1639
W3617SA-1Z-C5Z10	1650	1677	1780	1800	2039

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø36×10

Unit: mm



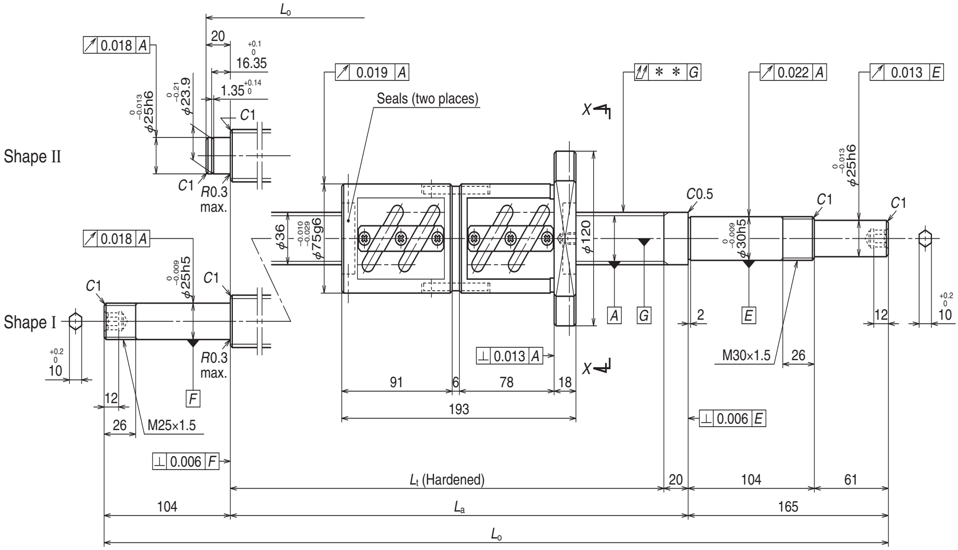
View *X-X*

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	32000
	Static C_{0a}	61100
Preload (N)		2060
Dynamic friction torque, median, (N·cm)		59.0
Spacer ball		None
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm³)		32
Standard volume of grease replenishing (cm³)		16

Recommended support unit	For drive side	For opposite to drive side
WBK30DF-31 (round)	○	
WBK25DF-31 (round)		○

Unit: mm

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
Ⅱ	–0.012	0.027	0.020	0.040	7.4	1940	—
Ⅱ	–0.016	0.035	0.025	0.050	8.8	1940	—
Ⅰ	–0.024	0.040	0.027	0.065	11.1	1940	1940
Ⅰ	–0.033	0.054	0.035	0.100	13.9	1940	1940
Ⅰ	–0.043	0.065	0.040	0.130	16.6	1480	1940

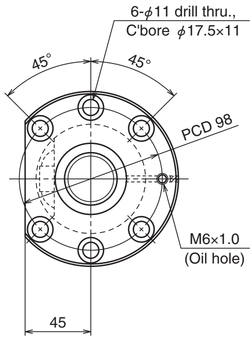


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W3604SA-2D-C5Z10	250	287	480	500	685
W3606SA-2D-C5Z10	450	487	680	700	885
W3609SA-2D-C5Z10	750	787	980	1000	1269
W3613SA-2D-C5Z10	1150	1187	1380	1400	1669
W3617SA-2D-C5Z10	1550	1587	1780	1800	2069

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø36×10

Unit: mm



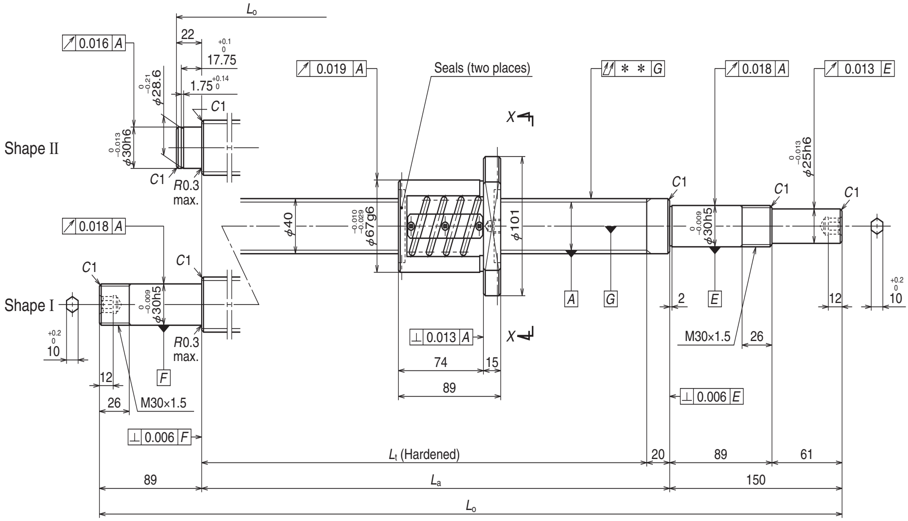
View *X-X*

Ball screw specifications		
Shaft dia. x 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	58000
	Static C_{0a}	122000
Preload (N)		3430
Dynamic friction torque, median, (N·cm)		93.0
Spacer ball		None
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		64
Standard volume of grease replenishing (cm^3)		27

Recommended support unit	For drive side	For opposite to drive side
WBK30DFD-31 (round)	○	
WBK25DFD-31 (round)		○

Unit: mm

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
Ⅱ	–0.012	0.027	0.020	0.040	9.3	1940	—
Ⅱ	–0.016	0.035	0.025	0.050	10.7	1940	—
Ⅰ	–0.024	0.040	0.027	0.080	13.1	1940	1940
Ⅰ	–0.033	0.054	0.035	0.100	15.9	1940	1940
Ⅰ	–0.043	0.065	0.040	0.130	18.6	1540	1940

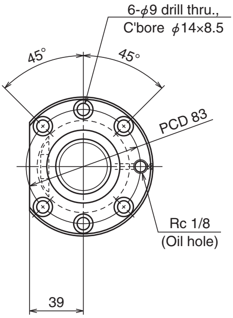


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W4003SA-1Z-C5Z5	250	291	380	400	572
W4005SA-1Z-C5Z5	450	491	580	600	772
W4007SA-1Z-C5Z5	650	691	780	800	1039
W4009SA-1Z-C5Z5	850	891	980	1000	1239
W4011SA-1Z-C5Z5	1050	1091	1180	1200	1439
W4015SA-1Z-C5Z5	1450	1491	1580	1600	1839

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø40×5

Unit: mm



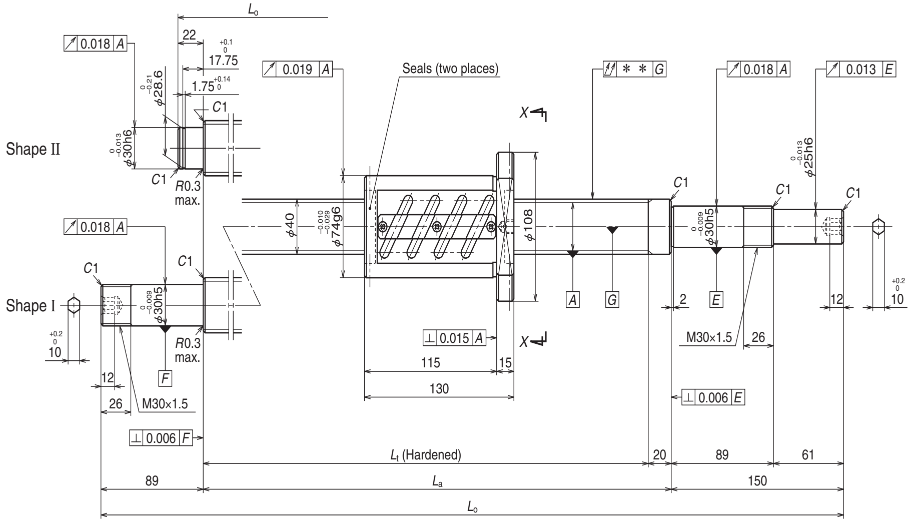
View *X-X*

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	23900
	Static C_{0a}	70500
Preload (N)		1420
Dynamic friction torque, median, (N·cm)		29.5
Spacer ball		None
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm³)		14
Standard volume of grease replenishing (cm³)		7

Recommended support unit	
WBK30DF-31	(round)

Unit: mm

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
Ⅱ	–0.009	0.025	0.020	0.035	6.3	1750	—
Ⅱ	–0.014	0.030	0.023	0.040	8.1	1750	—
Ⅰ	–0.019	0.035	0.025	0.065	10.3	1750	1750
Ⅰ	–0.024	0.040	0.027	0.065	12.2	1750	1750
Ⅰ	–0.028	0.046	0.030	0.080	14.0	1750	1750
Ⅰ	–0.038	0.054	0.035	0.100	17.7	1750	1750

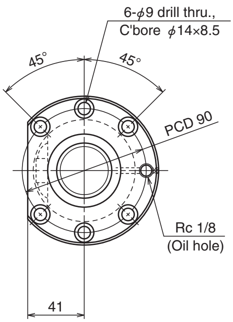


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W4003SA-2Z-C5Z8	200	250	380	400	572
W4005SA-2Z-C5Z8	400	450	580	600	772
W4007SA-2Z-C5Z8	600	650	780	800	1039
W4009SA-2Z-C5Z8	800	850	980	1000	1239
W4011SA-2Z-C5Z8	1000	1050	1180	1200	1439
W4015SA-2Z-C5Z8	1400	1450	1580	1600	1839

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø40×8

Unit: mm



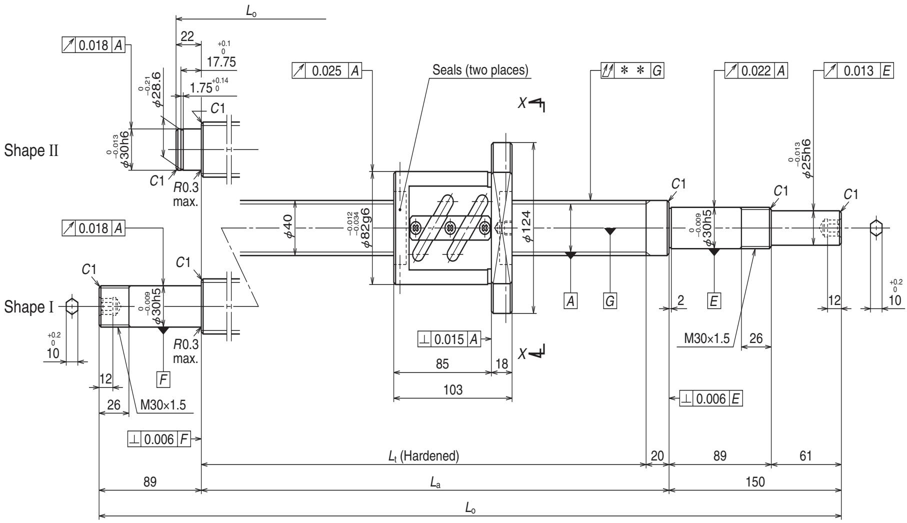
View *X-X*

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	41100
	Static C_{0a}	103000
Preload (N)		2450
Dynamic friction torque, median, (N·cm)		64.0
Spacer ball		None
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		27
Standard volume of grease replenishing (cm^3)		14

Recommended support unit	
WBK30DF-31	(round)

Unit: mm

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
II	–0.009	0.025	0.020	0.035	7.4	1750	—
II	–0.014	0.030	0.023	0.040	9.2	1750	—
I	–0.019	0.035	0.025	0.065	11.3	1750	1750
I	–0.024	0.040	0.027	0.065	13.1	1750	1750
I	–0.028	0.046	0.030	0.080	14.9	1750	1750
I	–0.038	0.054	0.035	0.100	18.5	1750	1750

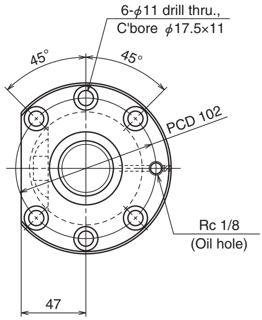


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W4004SA-1Z-C5Z10	350	377	480	500	672
W4005SA-3Z-C5Z10	450	477	580	600	772
W4006SA-1Z-C5Z10	550	577	680	700	872
W4007SA-3Z-C5Z10	650	677	780	800	1039
W4009SA-3Z-C5Z10	850	877	980	1000	1239
W4011SA-3Z-C5Z10	1050	1077	1180	1200	1439
W4013SA-1Z-C5Z10	1250	1277	1380	1400	1639
W4015SA-3Z-C5Z10	1450	1477	1580	1600	1839
W4017SA-1Z-C5Z10	1650	1677	1780	1800	2039
W4023SA-1Z-C5Z10	2250	2277	2380	2400	2639

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø40×10

Unit: mm



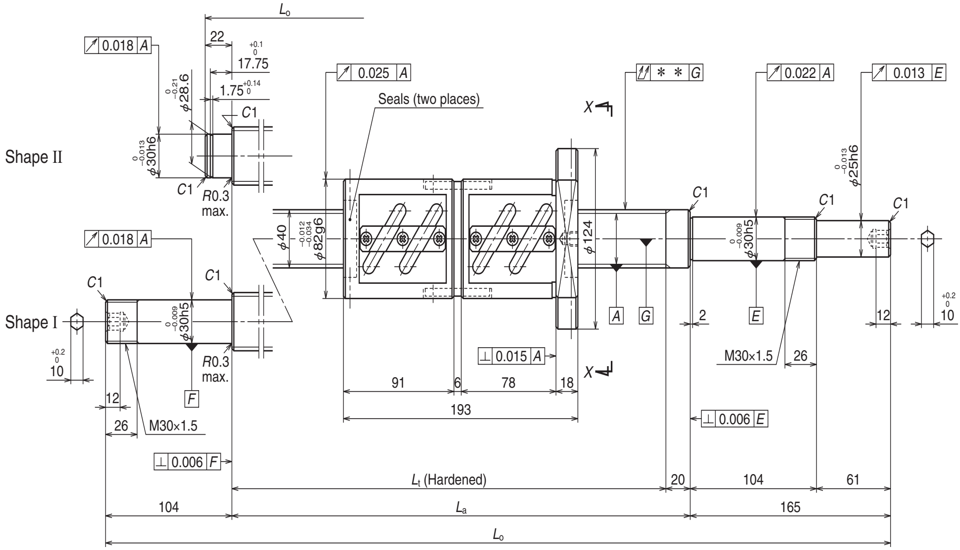
View *X-X*

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	33700
	Static C_{0a}	68300
Preload (N)		2160
Dynamic friction torque, median, (N·cm)		64.0
Spacer ball		None
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm³)		30
Standard volume of grease replenishing (cm³)		15

Recommended support unit	
WBK30DF-31	(round)

Unit: mm

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
Ⅱ	–0.012	0.027	0.020	0.040	8.7	1750	—
Ⅱ	–0.014	0.030	0.023	0.040	9.6	1750	—
Ⅱ	–0.016	0.035	0.025	0.050	10.4	1750	—
Ⅰ	–0.019	0.035	0.025	0.065	11.7	1750	1750
Ⅰ	–0.024	0.040	0.027	0.065	13.4	1750	1750
Ⅰ	–0.028	0.046	0.030	0.080	15.1	1750	1750
Ⅰ	–0.033	0.054	0.035	0.100	16.9	1750	1750
Ⅰ	–0.038	0.054	0.035	0.100	18.6	1750	1750
Ⅰ	–0.043	0.065	0.040	0.130	20.3	1670	1750
Ⅰ	–0.057	0.077	0.046	0.170	25.5	930	1320

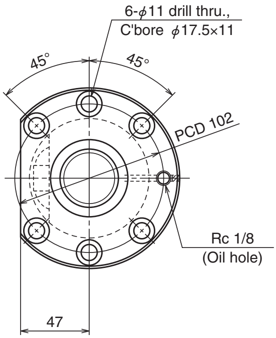


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W4004SA-2D-C5Z10	250	287	480	500	687
W4005SA-4D-C5Z10	350	387	580	600	787
W4006SA-2D-C5Z10	450	487	680	700	887
W4007SA-4D-C5Z10	550	587	780	800	1069
W4009SA-4D-C5Z10	750	787	980	1000	1269
W4011SA-4D-C5Z10	950	987	1180	1200	1469
W4013SA-2D-C5Z10	1150	1187	1380	1400	1669
W4015SA-4D-C5Z10	1350	1387	1580	1600	1869
W4017SA-2D-C5Z10	1550	1587	1780	1800	2069
W4023SA-2D-C5Z10	2150	2187	2380	2400	2669

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø40×10

Unit: mm



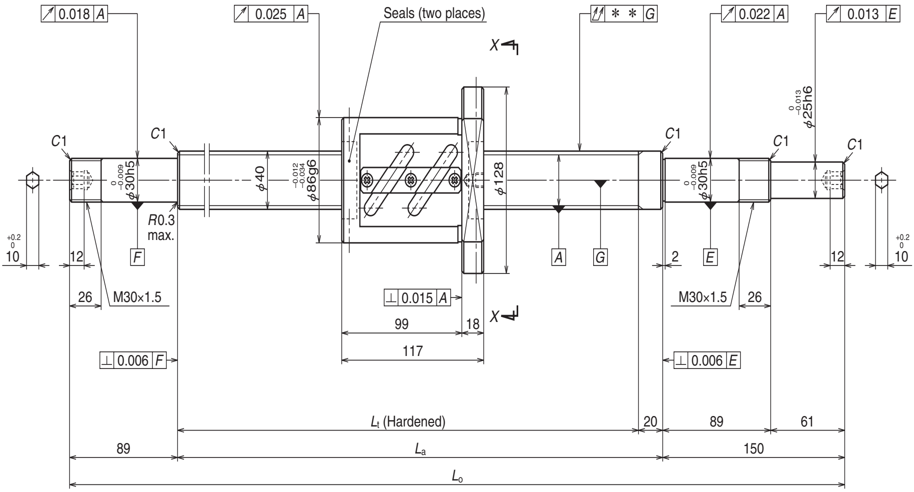
View *X-X*

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	61200
	Static C_{0a}	137000
Preload (N)		3630
Dynamic friction torque, median, (N·cm)		108
Spacer ball		None
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		59
Standard volume of grease replenishing (cm^3)		30

Recommended support unit	
WBK30DFD-31	(round)

Unit: mm

Left side shaft end	Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
	T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
Ⅱ	–0.012	0.027	0.020	0.040	11.0	1750	—
Ⅱ	–0.014	0.030	0.023	0.040	11.9	1750	—
Ⅱ	–0.016	0.035	0.025	0.050	12.7	1750	—
Ⅰ	–0.019	0.035	0.025	0.065	14.1	1750	1750
Ⅰ	–0.024	0.040	0.027	0.080	15.8	1750	1750
Ⅰ	–0.028	0.046	0.030	0.080	17.5	1750	1750
Ⅰ	–0.033	0.054	0.035	0.100	19.3	1750	1750
Ⅰ	–0.038	0.054	0.035	0.100	21.0	1750	1750
Ⅰ	–0.043	0.065	0.040	0.130	22.7	1750	1750
Ⅰ	–0.057	0.077	0.046	0.170	27.9	960	1370

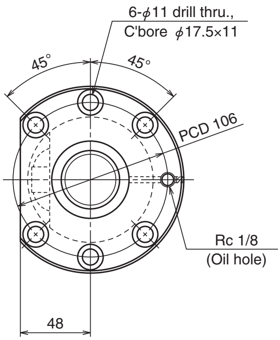


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W4006SA-3Z-C5Z12	500	563	680	700	939
W4009SA-5Z-C5Z12	800	863	980	1000	1239
W4013SA-3Z-C5Z12	1200	1263	1380	1400	1639
W4017SA-3Z-C5Z12	1600	1663	1780	1800	2039
W4024SA-1Z-C5Z12	2300	2363	2480	2500	2739

Remarks 1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø40×12

Unit: mm



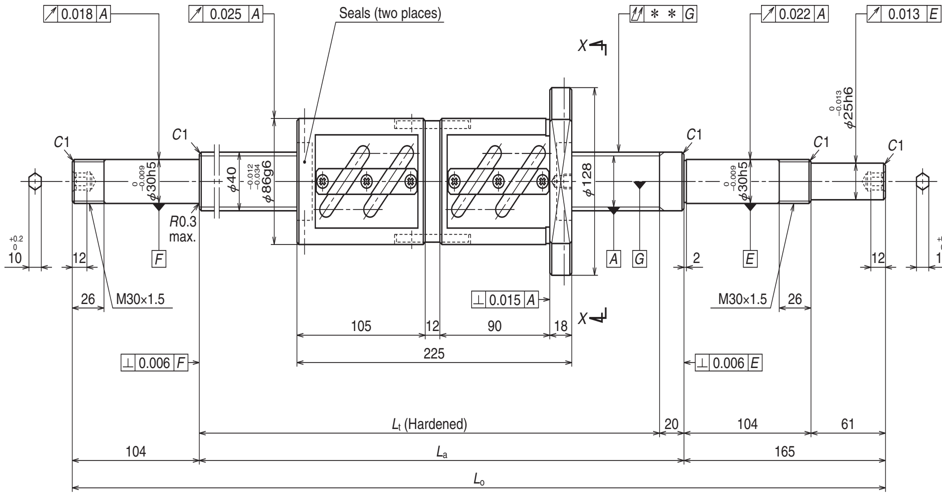
View *X-X*

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		40×12/Right
Preload / Ball recirculation		Z preload / Return tube
Ball dia. / Ball circle dia.		7.144/41.5
Screw shaft root diameter		34.1
Effective turns of balls		2.5×1
Accuracy grade / Preload		C5/Z
Basic load rating (N)	Dynamic C_a	39500
	Static C_{0a}	77200
Preload (N)		2550
Dynamic friction torque, median, (N·cm)		83.0
Spacer ball		None
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		33
Standard volume of grease replenishing (cm^3)		17

Recommended support unit	
WBK30DF-31	(round)

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
–0.016	0.035	0.025	0.050	11.6	1750	1750
–0.024	0.040	0.027	0.065	14.2	1750	1750
–0.033	0.054	0.035	0.100	17.7	1750	1750
–0.043	0.065	0.040	0.130	21.2	1670	1750
–0.060	0.077	0.046	0.170	27.2	850	1220

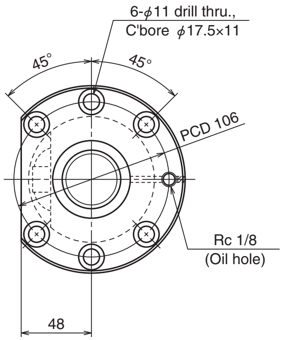


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W4006SA-4D-C5Z12	400	455	680	700	969
W4009SA-6D-C5Z12	700	755	980	1000	1269
W4013SA-4D-C5Z12	1100	1155	1380	1400	1669
W4017SA-4D-C5Z12	1500	1555	1780	1800	2069
W4024SA-2D-C5Z12	2200	2255	2480	2500	2769

Remarks 1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø40×12

Unit: mm



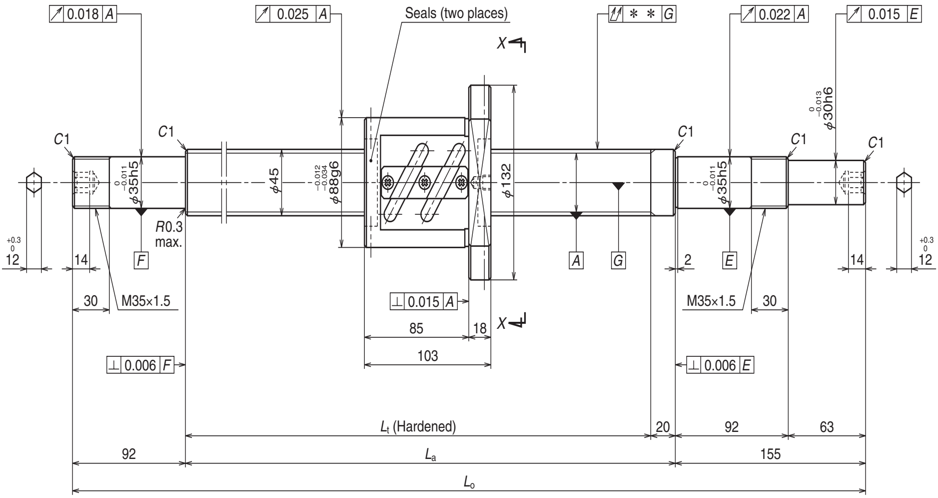
View *X-X*

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		40×12/Right
Preload / Ball recirculation		D preload / Return tube
Ball dia. / Ball circle dia.		7.144/41.5
Screw shaft root diameter		34.1
Effective turns of balls		2.5×2
Accuracy grade / Preload		C5/Z
Basic load rating (N)	Dynamic C_a	71700
	Static C_{0a}	154000
Preload (N)		4310
Dynamic friction torque, median, (N·cm)		137
Spacer ball		None
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		76
Standard volume of grease replenishing (cm^3)		38

Recommended support unit	
WBK30DFD-31	(round)

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
–0.016	0.035	0.025	0.050	14.8	1750	1750
–0.024	0.040	0.027	0.080	17.4	1750	1750
–0.033	0.054	0.035	0.100	20.9	1750	1750
–0.043	0.065	0.040	0.130	24.3	1750	1750
–0.060	0.077	0.046	0.170	30.4	880	1260

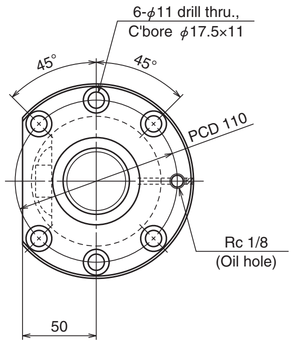


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W4506SA-1Z-C5Z10	550	577	680	700	947
W4509SA-1Z-C5Z10	850	877	980	1000	1247
W4513SA-1Z-C5Z10	1250	1277	1380	1400	1647
W4517SA-1Z-C5Z10	1650	1677	1780	1800	2047
W4524SA-1Z-C5Z10	2350	2377	2480	2500	2747

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø45×10

Unit: mm



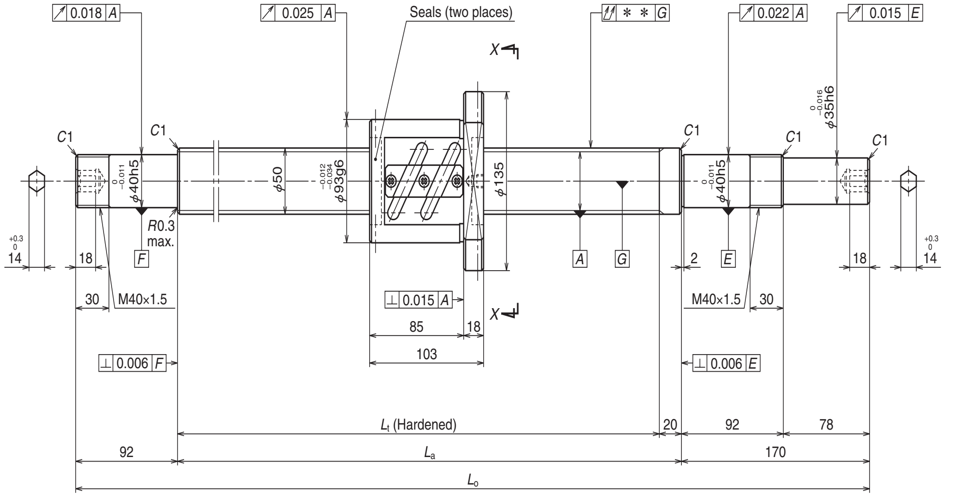
View *X-X*

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		45×10/Right
Preload / Ball recirculation		Z preload / Return tube
Ball dia. / Ball circle dia.		6.35/46
Screw shaft root diameter		39.4
Effective turns of balls		2.5×1
Accuracy grade / Preload		C5/Z
Basic load rating (N)	Dynamic C_a	36300
	Static C_{0a}	78500
Preload (N)		2260
Dynamic friction torque, median, (N·cm)		69.0
Spacer ball		None
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		33
Standard volume of grease replenishing (cm^3)		17

Recommended support unit	
WBK35DF-31	(round)

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
–0.016	0.035	0.025	0.050	13.4	1550	1550
–0.024	0.040	0.027	0.065	16.7	1550	1550
–0.033	0.054	0.035	0.100	21.2	1550	1550
–0.043	0.065	0.040	0.130	25.6	1550	1550
–0.060	0.077	0.046	0.170	33.4	980	1400



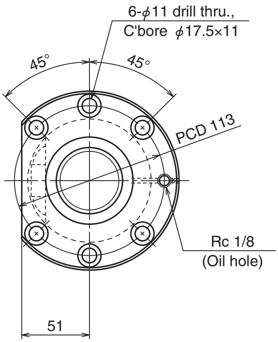
Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W5005SA-1Z-C5Z10	450	477	580	600	862
W5007SA-1Z-C5Z10	650	677	780	800	1062
W5009SA-1Z-C5Z10	850	877	980	1000	1262
W5011SA-1Z-C5Z10	1050	1077	1180	1200	1462
W5014SA-1Z-C5Z10	1350	1377	1480	1500	1762
W5019SA-1Z-C5Z10	1850	1877	1980	2000	2262
W5025SA-1Z-C5Z10	2450	2477	2580	2600	2862

Remarks 1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

NSK

ø50×10

Unit: mm



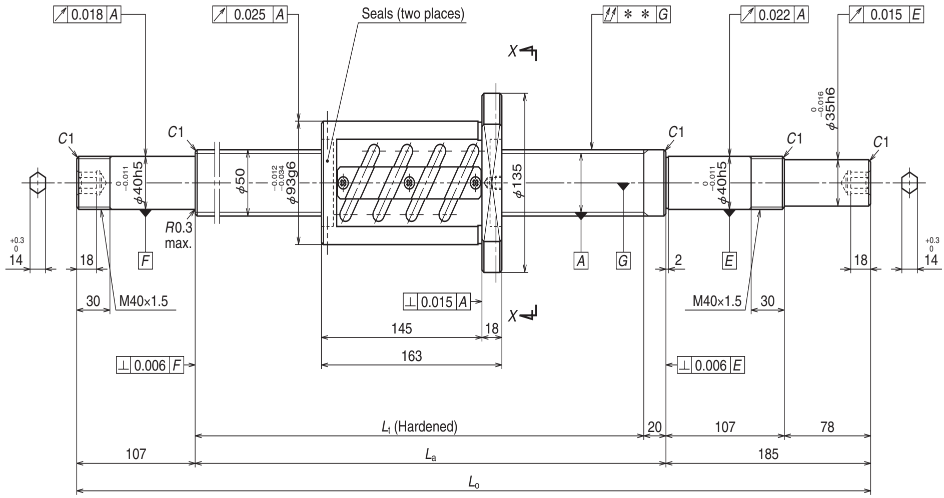
View *X-X*

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		50×10/Right
Preload / Ball recirculation		Z preload / Return tube
Ball dia. / Ball circle dia.		6.35/51
Screw shaft root diameter		44.4
Effective turns of balls		2.5×1
Accuracy grade / Preload		C5/Z
Basic load rating (N)	Dynamic C_a	37500
	Static C_{0a}	87200
Preload (N)		2450
Dynamic friction torque, median, (N·cm)		79.0
Spacer ball		None
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm^3)		37
Standard volume of grease replenishing (cm^3)		19

Recommended support unit	
WBK40DF-31	(round)

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition	
T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
–0.014	0.030	0.023	0.050	14.8	1400	1400
–0.019	0.035	0.025	0.065	17.6	1400	1400
–0.024	0.040	0.027	0.080	20.3	1400	1400
–0.028	0.046	0.030	0.080	23.1	1400	1400
–0.036	0.054	0.035	0.100	27.3	1400	1400
–0.048	0.065	0.040	0.130	34.2	1400	1400
–0.062	0.093	0.054	0.170	42.5	1020	1400

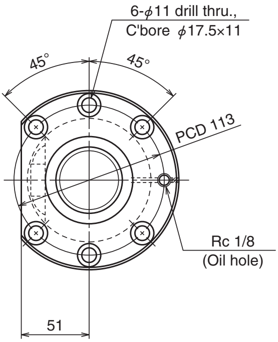


Ball screw No.	Stroke		Screw shaft length		
	Nominal	Maximum (L_t—Nut length)	L_t	L_a	L_o
W5005SA-2Z-C5Z10	350	417	580	600	892
W5007SA-2Z-C5Z10	550	617	780	800	1092
W5009SA-2Z-C5Z10	750	817	980	1000	1292
W5011SA-2Z-C5Z10	950	1017	1180	1200	1492
W5014SA-2Z-C5Z10	1250	1317	1480	1500	1792
W5019SA-2Z-C5Z10	1750	1817	1980	2000	2292
W5025SA-2Z-C5Z10	2350	2417	2580	2600	2892

Remarks
1. We recommend NSK support unit. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Contact NSK if permissible rotational speed is to be exceeded.

ø50×10

Unit: mm



View *X-X*

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	68100
	Static C_{0a}	174000
Preload (N)		4020
Dynamic friction torque, median, (N·cm)		137
Spacer ball		None
Factory packed grease		**Refer to Remarks 2.**
Internal spatial volume of nut (cm³)		59
Standard volume of grease replenishing (cm³)		30

Recommended support unit	
WBK40DFD-31	(round)

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition	
T	e_p	υ_u			Fixed - Simple support	Fixed - Fixed
–0.014	0.030	0.023	0.050	16.8	1400	1400
–0.019	0.035	0.025	0.065	19.6	1400	1400
–0.024	0.040	0.027	0.080	22.3	1400	1400
–0.028	0.046	0.030	0.080	25.1	1400	1400
–0.036	0.054	0.035	0.100	29.3	1400	1400
–0.048	0.065	0.040	0.130	36.2	1400	1400
–0.062	0.093	0.054	0.170	44.6	1040	1400

B-3-2.3 Finished Shaft End Ball Screws Made of Stainless Steel KA Type

◇ **Ball screw sizes are arranged in the order of the page number.**

The table begins with the smallest shaft diameter ball screw, and proceeds to larger sizes. If ball screws have the same shaft diameter, those with smaller leads appear first. Page numbers of shaft diameter and lead combinations are shown in Table 1.

◇ **Dimension tables**

The dimension tables show shapes/sizes as well as specification factors of each shaft diameter/lead combination. Tables also contain data as follows:

●Stroke

Nominal stroke : A reference for your use.

Maximum stroke : The stroke limit that the nut can move. The figure is obtained by subtracting the nut length (plus some allowance) from the screw threaded length (L_t).

●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 error" (Page B41) for details of the codes.

●Permissible rotational speed

d • n : Limited by the relative peripheral speed between screw shaft and nut.

Critical speed : Limited by the natural frequency of a ball screw shaft. Critical speed depends on the supporting condition of screw shaft.

The lower of the two criteria, d·n and Critical Speed, will determine the overall Permissible Rotational Speed of the ball screw. For details, see "Technical Description: Permissible rotational speed" (Page B51).

Table 1 Combinations of screw shaft diameter and lead

Screw shaft diameter (mm) \ Lead (mm)	1	2
6	B359	
8	B361	B363
10		B365
12		B369
15		
16		B379
20		

◇ **Material**

A martensitic stainless steel is used. A special heat treatment technology provides the ball groove section with sufficient hardness which produces high load carrying capacity and durability.

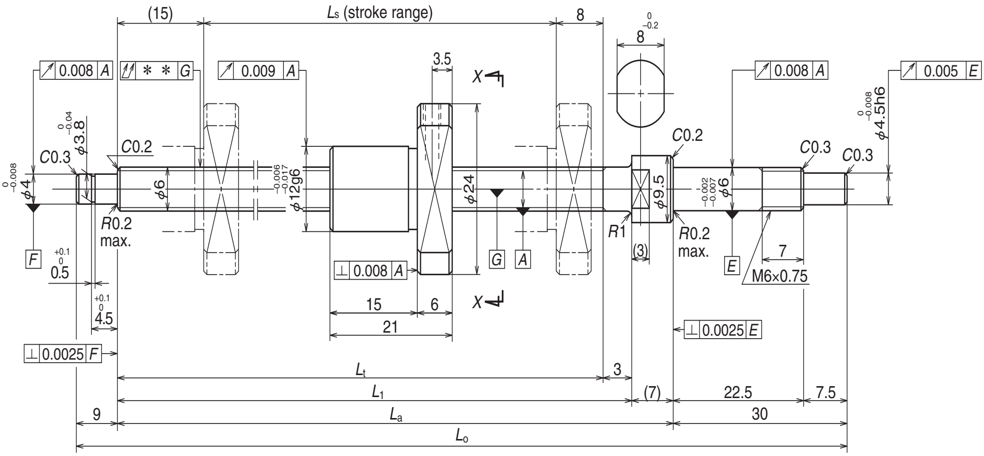
◇ **Other**

Seal of the ball screw, ball recirculating deflector, and end cap are made of synthetic resin. Consult NSK when using the ball screws under extreme environments or special environments, or using special lubricant or oil.

For special environments, refer to Pages B74 and D2. Refer to Pages B71 and D13 for lubricants.

Note: For details of standard stock products, contack NSK.

4	5	10	20
B367			
	B371	B373	
		B375	B377
			B381

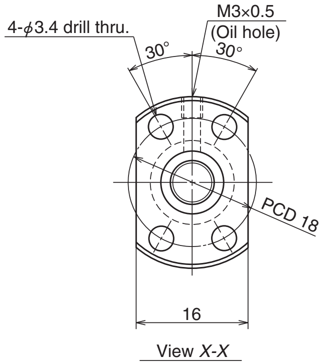


Ball screw No.	Stroke		Thread length			
	Nominal	Maximum	L_t	L_1	L_a	L_o
W0601KA-3PY-C3Z1	100	102	125	128	135	174

Remarks **1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
Refer to Page D13 for details.
NSK Clean Grease LG2 is recommended.
2. Nut does not have a seal.
3. Contact NSK if permissible rotational speed is to be exceeded.

Stainless ø6×1

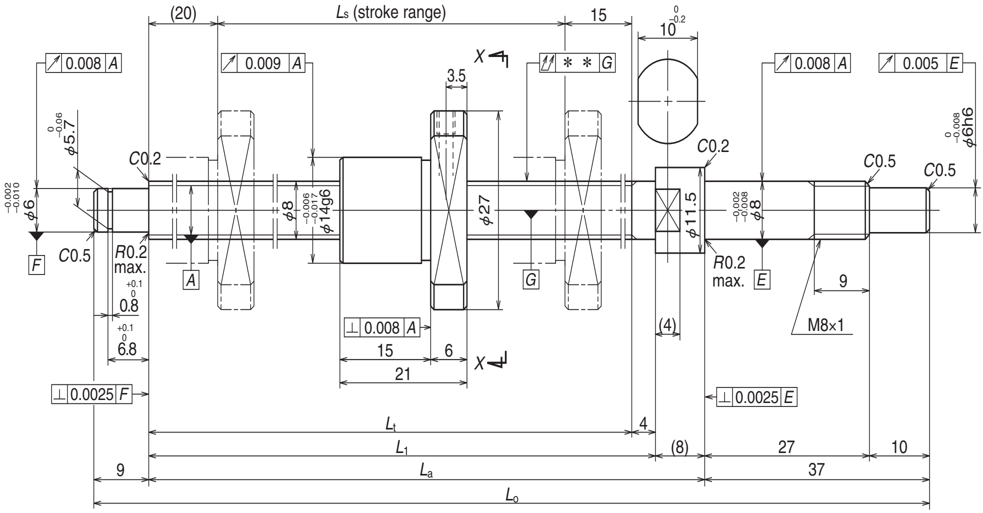
Unit: mm



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	555
	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 the remarks 1. below.

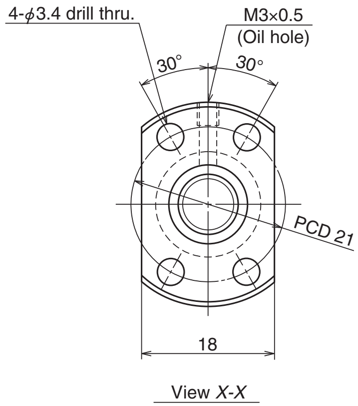
Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition
T	e_p	υ_u			Fixed - Simple support
0	0.010	0.008	0.025	0.06	3000



Ball screw No.	Stroke		Thread length			
	Nominal	Maximum	L_t	L_1	L_a	L_o
W0802KA-1PY-C3Z1	150	155	190	194	202	248

Remarks **1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
Refer to Page D13 for details.
NSK Clean Grease LG2 is recommended.
2. Nut does not have a seal.
3. Contact NSK if permissible rotational speed is to be exceeded.



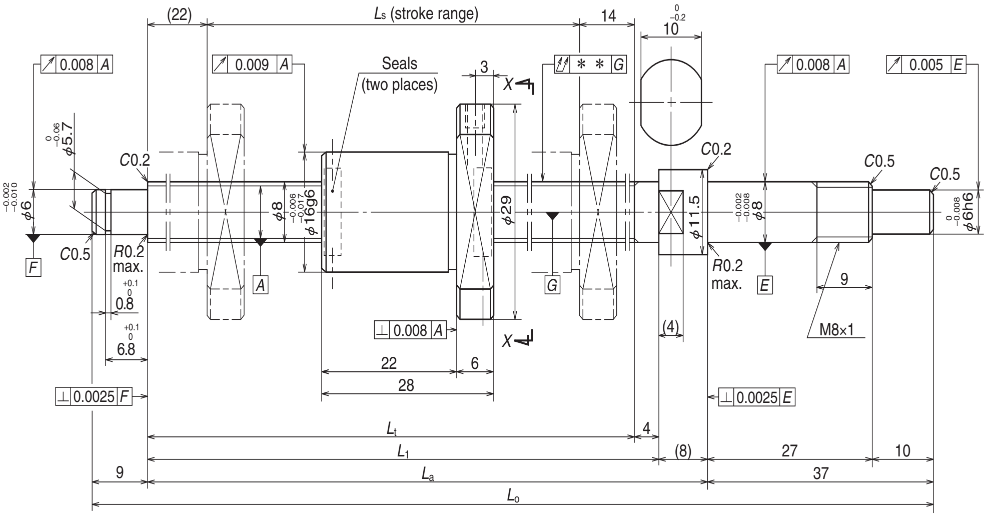
Unit: mm

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		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	645
	Static C_{0a}	955
Axial play		0
Preload (N)		29.4
Dynamic friction torque, (N·cm)		1.8 or less
Spacer ball		None
Factory packed grease		Refer to the remarks 1. below.

Clean support unit	For drive side	For opposite of drive side
WBK08-01C (square)	○	
WBK08-11C (round)	○	
WBK08S-01C (square)		○

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition Fixed - Simple support
T	e_p	υ_u			
0	0.010	0.008	0.035	0.12	3000

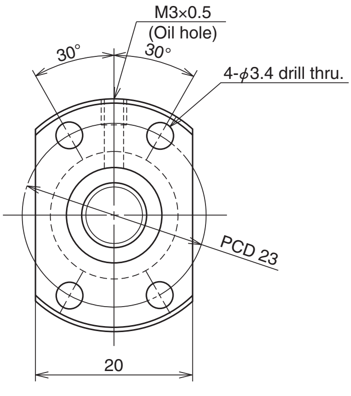


Ball screw No.	Stroke		Thread length			
	Nominal	Maximum	L_t	L_1	L_a	L_o
W0802KA-5PY-C3Z2	150	154	190	194	202	248

Remarks **1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
Refer to Page D13 for details.
NSK Clean Grease LG2 is recommended.
2. Contact NSK if permissible rotational speed is to be exceeded.

Stainless ø8×2

Unit: mm



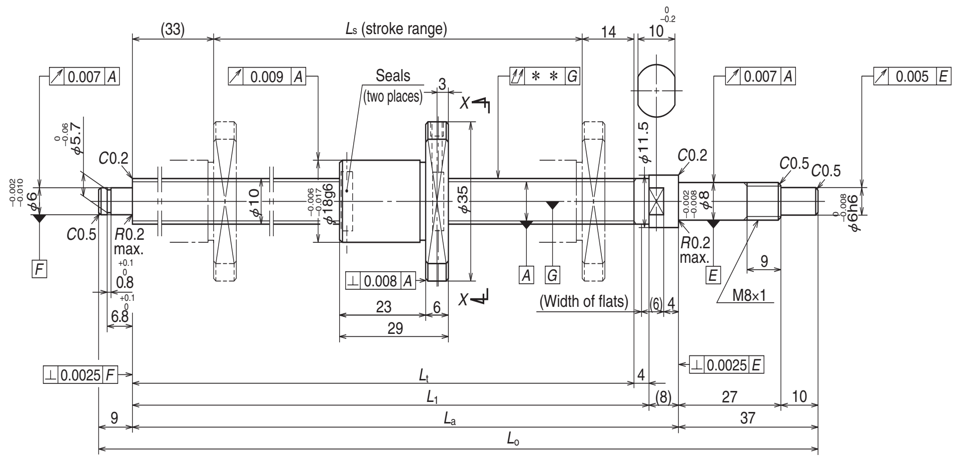
View *X-X*

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		8×2/Right
Preload / Ball recirculation		P preload / Deflector
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	1270
	Static C_{0a}	1630
Axial play		0
Preload (N)		49.0
Dynamic friction torque, (N·cm)		2.0 or less
Spacer ball		None
Factory packed grease		Refer to the remarks 1. below.
Internal spatial volume of nut (cm^3)		0.34
Standard volume of grease replenishing (cm^3)		0.17

Clean support unit	For drive side	For opposite of drive side
WBK08-01C (square)	○	
WBK08-11C (round)	○	
WBK08S-01C (square)		○

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition
T	e_p	υ_u			Fixed - Simple support
0	0.010	0.008	0.035	0.13	3000

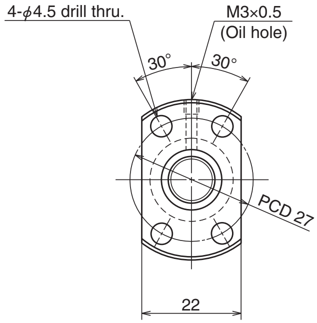


Ball screw No.	Stroke		Thread length			
	Nominal	Maximum	L_t	L_1	L_a	L_o
W1002KA-3PY-C3Z2	200	203	250	254	262	308

Remarks **1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
Refer to Page D13 for details.
NSK Clean Grease LG2 is recommended.
2. Contact NSK if permissible rotational speed is to be exceeded.

Stainless ø10×2

Unit: mm



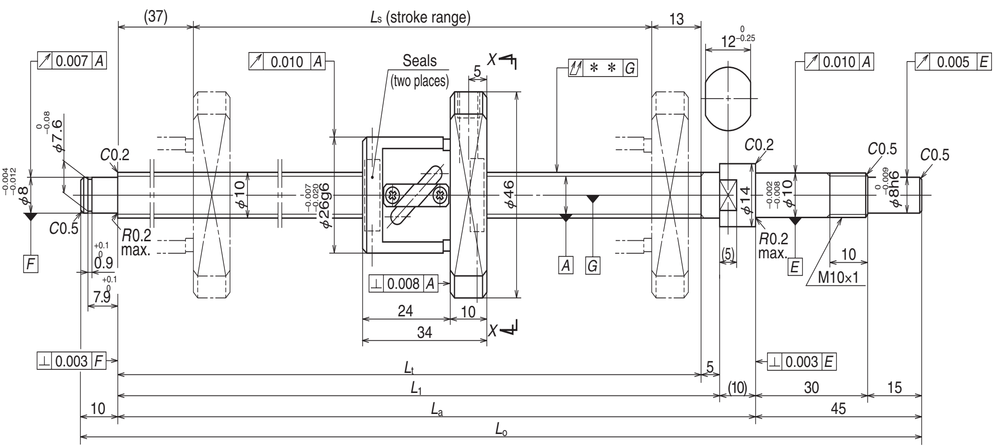
View *X-X*

Ball screw specifications		
Shaft dia. x Lead / Direction of turn		10x2/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		1x3
Accuracy grade / Preload		C3/Z
Basic load rating (N)	Dynamic C_a	1470
	Static C_{0a}	2190
Axial play		0
Preload (N)		58.8
Dynamic friction torque, (N·cm)		0.10 – 2.5
Spacer ball		None
Factory packed grease		Refer to the remarks 1. below.
Internal spatial volume of nut (cm^3)		0.44
Standard volume of grease replenishing (cm^3)		0.22

Clean support unit	For drive side	For opposite of drive side
WBK08-01C (square)	○	
WBK08-11C (round)	○	
WBK08S-01C (square)		○

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1})
					Supporting condition
T	e_p	υ_u			Fixed - Simple support
0	0.012	0.008	0.030	0.22	3000

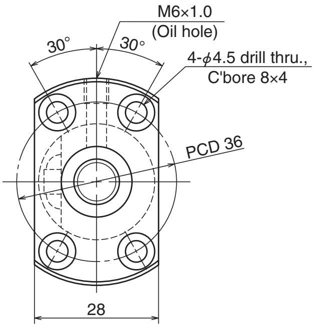


Ball screw No.	Stroke		Thread length			
	Nominal	Maximum	L_t	L_1	L_a	L_o
W1001KA-3P-C3Z4	100	110	160	165	175	230
W1003KA-3P-C3Z4	300	310	360	365	375	430

Remarks **1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
Refer to Page D13 for details.
NSK Clean Grease LG2 is recommended.
2. Contact NSK if permissible rotational speed is to be exceeded.

Stainless ø10×4

Unit: mm



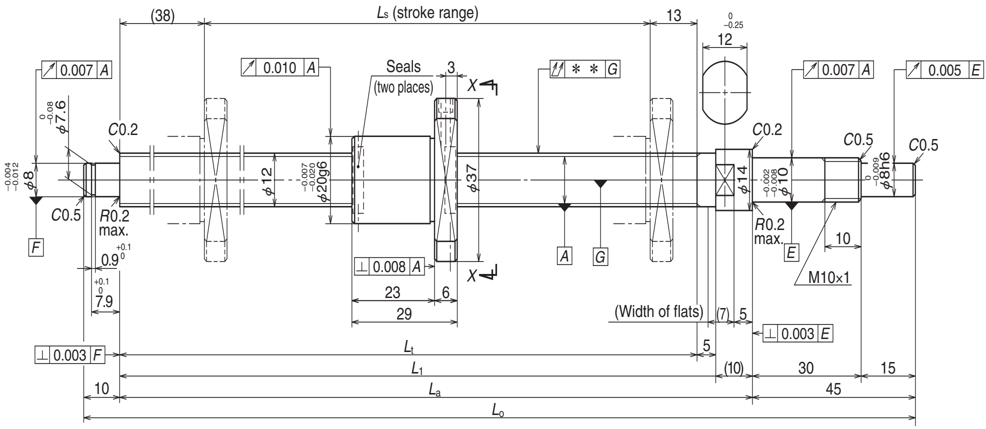
View *X-X*

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	2630
	Static C_{0a}	3270
Axial play		0
Preload (N)		98.1
Dynamic friction torque, (N·cm)		0.5 – 3.9
Spacer ball		None
Factory packed grease		Refer to the remarks 1. below.
Internal spatial volume of nut (cm^3)		0.8
Standard volume of grease replenishing (cm^3)		0.4

Clean support unit	For drive side	For opposite of drive side
WBK10-01C (square)	○	
WBK10-11C (round)	○	
WBK10S-01C (square)		○

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition
T	e_p	υ_u			Fixed - Simple support
0	0.010	0.008	0.030	0.29	3000
0	0.013	0.008	0.050	0.39	3000

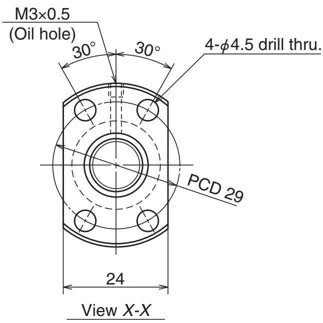


Ball screw No.	Stroke		Thread length			
	Nominal	Maximum	L_t	L_1	L_a	L_o
W1201KA-3PY-C3Z2	100	109	160	165	175	230
W1203KA-1PY-C3Z2	250	259	310	315	325	380

Remarks **1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
Refer to Page D13 for details.
NSK Clean Grease LG2 is recommended.
2. Contact NSK if permissible rotational speed is to be exceeded.

Stainless ø12×2

Unit: mm



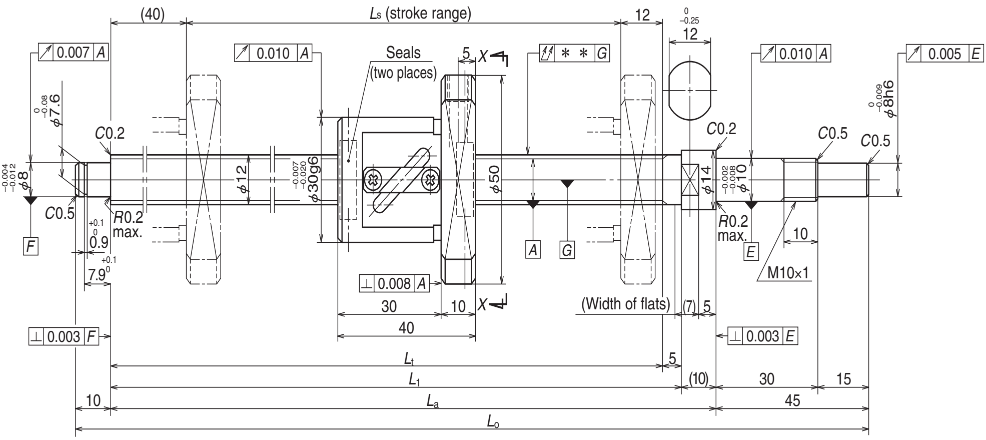
Ball screw specifications		
Shaft dia. x Lead / Direction of turn		12×2/Right
Preload / Ball recirculation		P preload / Deflector
Ball dia. / Ball circle dia.		1.200/12.3
Screw shaft root diameter		10.9
Effective turns of balls		1×3
Accuracy grade / Preload		C3/Z
Basic load rating (N)	Dynamic C_a	1600
	Static C_{0a}	2670
Axial play		0
Preload (N)		98.1
Dynamic friction torque, (N·cm)		0.4 – 3.4
Spacer ball		None
Factory packed grease		Refer to the remarks 1. below.
Internal spatial volume of nut (cm³)		0.53
Standard volume of grease replenishing (cm³)		0.27

Clean support unit	For drive side	For opposite of drive side
WBK10-01C (square)	○	
WBK10-11C (round)	○	
WBK10S-01C (square)		○

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition
T	e_p	υ_u			Fixed - Simple support
0	0.010	0.008	0.030	0.24	3000
0	0.012	0.008	0.040	0.36	3000

Finished shaft end Stainless steel product KA Type (Fine lead) Dia. 12, Lead 5



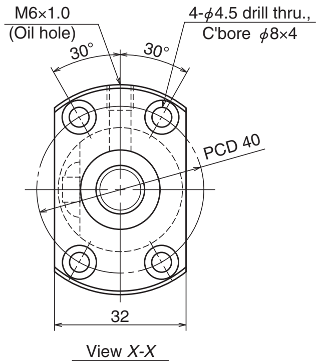
Ball screw No.	Stroke		Thread length			
	Nominal	Maximum	L_t	L_1	L_a	L_o
W1202KA-3P-C3Z5	200	208	260	265	275	330
W1205KA-1P-C3Z5	450	458	510	515	525	580

Remarks **1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
Refer to Page D13 for details.
NSK Clean Grease LG2 is recommended.
2. Contact NSK if permissible rotational speed is to be exceeded.

NSK

Stainless ø12×5

Unit: mm

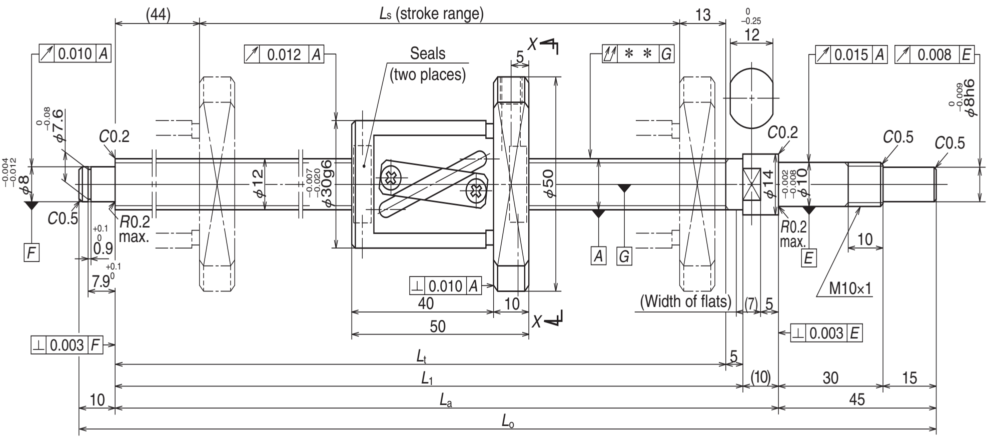


Ball screw specifications		
Shaft dia. x Lead / Direction of turn		12×5/Right
Preload / Ball recirculation		P preload / Return tube
Ball dia. / Ball circle dia.		2.381/12.3
Screw shaft root diameter		9.8
Effective turns of balls		2.5×1
Accuracy grade / Preload		C3/Z
Basic load rating (N)	Dynamic C_a	3590
	Static C_{0a}	4630
Axial play		0
Preload (N)		98.1
Dynamic friction torque, (N·cm)		1.0 – 4.4
Spacer ball		None
Factory packed grease		Refer to the remarks 1. below.
Internal spatial volume of nut (cm³)		1.2
Standard volume of grease replenishing (cm³)		0.6

Clean support unit	For drive side	For opposite of drive side
WBK10-01C (square)	○	
WBK10-11C (round)	○	
WBK10S-01C (square)		○

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition
T	e_p	υ_u			Fixed - Simple support
0	0.012	0.008	0.040	0.47	3000
0	0.016	0.012	0.065	0.66	3000

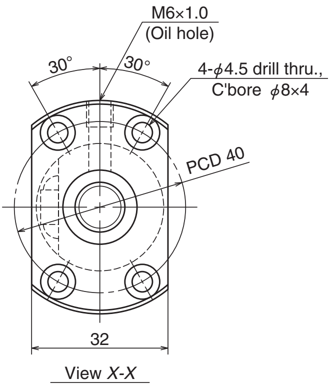


Ball screw No.	Stroke		Thread length			
	Nominal	Maximum	L_t	L_1	L_a	L_o
W1203KA-3P-C5Z10	250	253	310	315	325	380
W1205KA-3P-C5Z10	450	453	510	515	525	580

Remarks **1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
Refer to Page D13 for details.
NSK Clean Grease LG2 is recommended.
2. Contact NSK if permissible rotational speed is to be exceeded.

Stainless ø12×10

Unit: mm



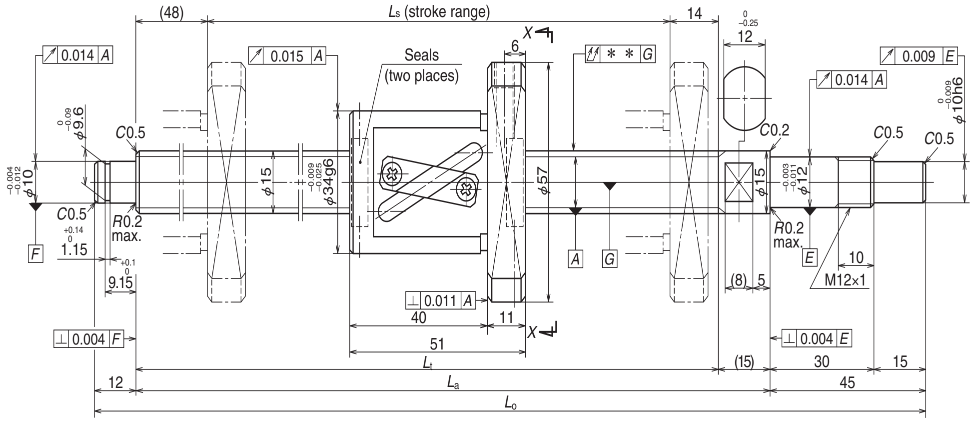
Ball screw specifications		
Shaft dia. x Lead / Direction of turn		12×10/Right
Preload / Ball recirculation		P preload / Return tube
Ball dia. / Ball circle dia.		2.381/12.5
Screw shaft root diameter		10.0
Effective turns of balls		2.5×1
Accuracy grade / Preload		C5/Z
Basic load rating (N)	Dynamic C_a	3620
	Static C_{0a}	4750
Axial play		0
Preload (N)		98.1
Dynamic friction torque, (N·cm)		1.0 – 4.9
Spacer ball		None
Factory packed grease		Refer to the remarks 1. below.
Internal spatial volume of nut (cm³)		1.4
Standard volume of grease replenishing (cm³)		0.7

Clean support unit	For drive side	For opposite of drive side
WBK10-01C (square)	○	
WBK10-11C (round)	○	
WBK10S-01C (square)		○

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min⁻¹) Supporting condition
T	e_p	υ_u			Fixed - Simple support
0	0.023	0.018	0.050	0.56	3000
0	0.030	0.023	0.075	0.72	3000

Finished shaft end Stainless steel product KA Type (Medium lead) Dia. 15, Lead 10

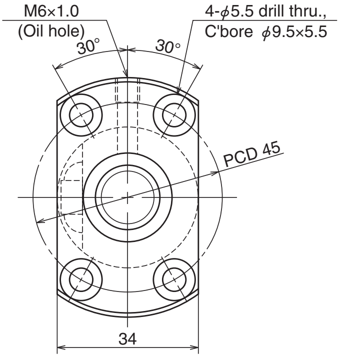


Ball screw No.	Stroke		Thread length		
	Nominal	Maximum	L_t	L_a	L_o
W1504KA-3P-C5Z10	400	427	489	504	561
W1506KA-3P-C5Z10	600	627	689	704	761
W1510KA-1P-C5Z10	1000	1027	1089	1104	1161

Remarks **1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
Refer to Page D13 for details.
NSK Clean Grease LG2 is recommended.
2. Contact NSK if permissible rotational speed is to be exceeded.

Stainless ø15×10

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	6660
	Static C_{0a}	9480
Axial play		0
Preload (N)		147
Dynamic friction torque, (N·cm)		1.5 – 7.9
Spacer ball		None
Factory packed grease		Refer to the remarks 1. below.
Internal spatial volume of nut (cm^3)		2.3
Standard volume of grease replenishing (cm^3)		1.4

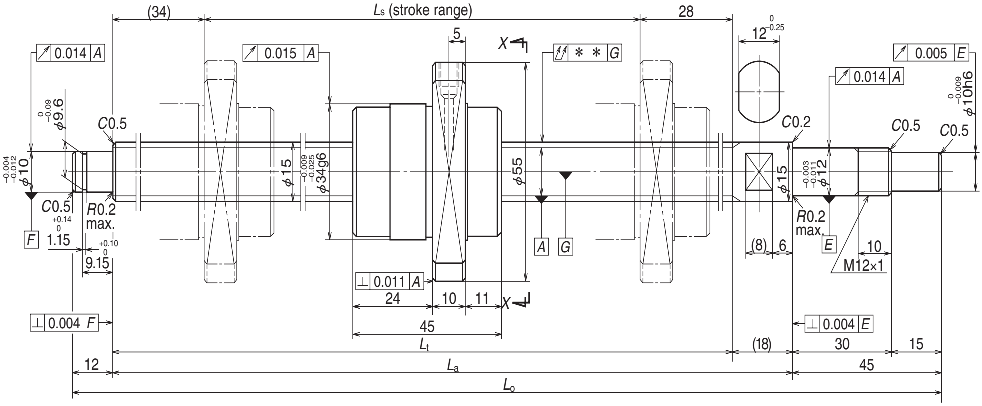
Clean support unit	For drive side	For opposite of drive side
WBK12-01C (square)	○	
WBK12-11C (round)	○	
WBK12S-01C (square)		○

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition
T	e_p	υ_u			Fixed - Simple support
0	0.027	0.020	0.050	0.99	3000
0	0.035	0.025	0.065	1.2	3000
0	0.046	0.030	0.110	1.7	1610

B 376

Finished shaft end Stainless steel product KA Type (Ultra high helix lead) Dia. 15, Lead 20

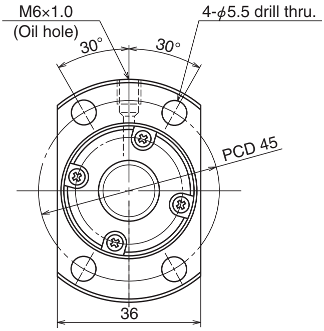


Ball screw No.	Stroke		Thread length		
	Nominal	Maximum	L_t	L_a	L_o
W1504KA-7PG-C5Z20	400	424	486	504	561
W1506KA-7PG-C5Z20	600	624	686	704	761
W1510KA-3PG-C5Z20	1000	1024	1086	1104	1161

Remarks **1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
Refer to Page D13 for details.
NSK Clean Grease LG2 is recommended.
2. Contact NSK if permissible rotational speed is to be exceeded.

Stainless ø15×20

Unit: mm



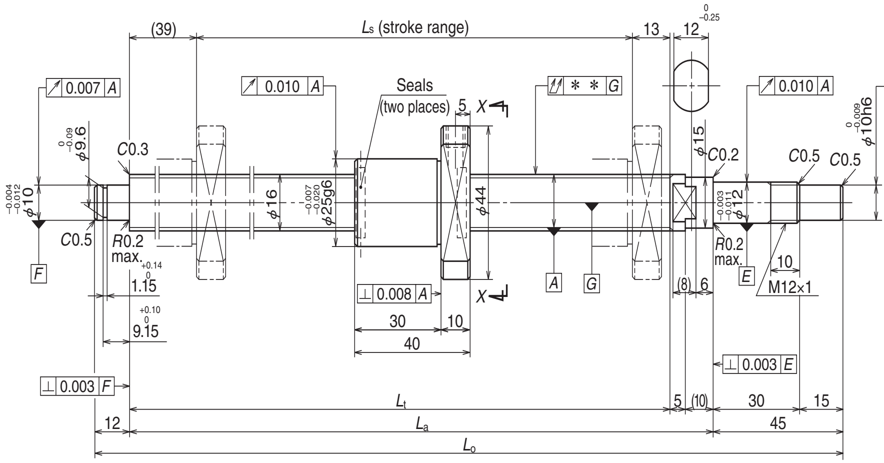
View *X-X*

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	4630
	Static C_{0a}	6430
Axial play		0
Preload (N)		147
Dynamic friction torque, (N·cm)		1.5 – 7.9
Spacer ball		None
Factory packed grease		Refer to the remarks 1. below.
Internal spatial volume of nut (cm^3)		1.9
Standard volume of grease replenishing (cm^3)		1.0

Clean support unit	For drive side	For opposite of drive side
WBK12-01C (square)	○	
WBK12-11C (round)	○	
WBK12S-01C (square)		○

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition
T	e_P	υ_u			Fixed - Simple support
0	0.027	0.020	0.050	1.0	3000
0	0.035	0.025	0.065	1.3	3000
0	0.046	0.030	0.110	1.8	1610

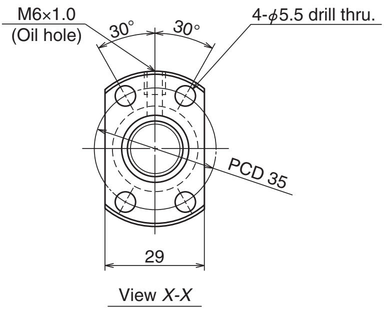


Ball screw No.	Stroke		Thread length		
	Nominal	Maximum	L_t	L_a	L_o
W1601KA-3PY-C3Z2	100	137	189	204	261
W1603KA-1PY-C3Z2	300	337	389	404	461

Remarks **1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
Refer to Page D13 for details.
NSK Clean Grease LG2 is recommended.
2. Contact NSK if permissible rotational speed is to be exceeded.

Stainless ø16×2

Unit: mm



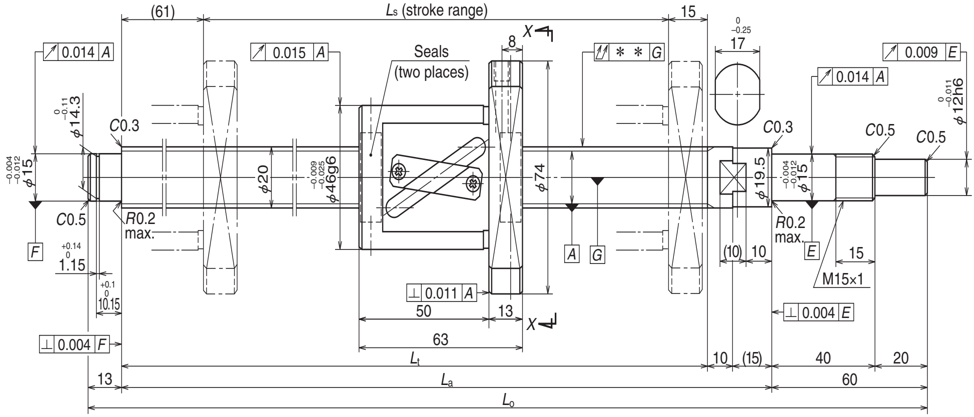
Ball screw specifications		
Shaft dia. x Lead / Direction of turn		16×2/Right
Preload / Ball recirculation		P preload / Deflector
Ball dia. / Ball circle dia.		1.588/16.4
Screw shaft root diameter		14.6
Effective turns of balls		1×4
Accuracy grade / Preload		C3/Z
Basic load rating (N)	Dynamic C_a	3400
	Static C_{0a}	6240
Axial play		0
Preload (N)		147
Dynamic friction torque, (N·cm)		0.5 – 4.9
Spacer ball		None
Factory packed grease		Refer to the remarks 1. below.
Internal spatial volume of nut (cm^3)		1.6
Standard volume of grease replenishing (cm^3)		0.8

Clean support unit	For drive side	For opposite of drive side
WBK12-01C (square)	○	
WBK12-11C (round)	○	
WBK12S-01C (square)		○

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition
T	e_p	υ_u			Fixed - Simple support
0	0.010	0.008	0.020	0.46	3000
0	0.013	0.010	0.035	0.75	3000

Finished shaft end Stainless steel product KA Type (Medium lead) Dia. 20, Lead 20

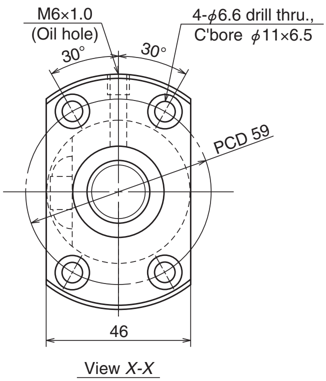


Ball screw No.	Stroke		Thread length		
	Nominal	Maximum	L_t	L_a	L_o
W2005KA-3P-C5Z20	400	434	510	535	608
W2007KA-3P-C5Z20	600	634	710	735	808
W2011KA-3P-C5Z20	1000	1034	1110	1135	1208

Remarks **1. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.**
Refer to Page D13 for details.
NSK Clean Grease LG2 is recommended.
2. Contact NSK if permissible rotational speed is to be exceeded.

Stainless ø2020

Unit: mm



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	6700
	Static C_{0a}	9710
Axial play		0
Preload (N)		196
Dynamic friction torque, (N·cm)		2.0 – 11.8
Spacer ball		None
Factory packed grease		Refer to the remarks 1. below.
Internal spatial volume of nut (cm^3)		4.2
Standard volume of grease replenishing (cm^3)		2.1

Clean support unit	For drive side	For opposite of drive side
WBK15-01C (square)	○	
WBK15-11C (round)	○	
WBK15S-01C (square)		○

Unit: mm

Lead accuracy			Shaft run-out **	Mass (kg)	Permissible rotational speed N (min^{-1}) Supporting condition
T	e_p	υ_u			Fixed - Simple support
0	0.030	0.023	0.050	2.0	3000
0	0.035	0.025	0.085	2.5	3000
0	0.046	0.030	0.110	3.4	2160

B-3-2.4 Blank Shaft End MS Type, FS Type, SS Type

◇ **Ball screw sizes are arranged in order of the page number.**

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.

◇ **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 C3 and C5 grades.

T : Travel compensation;

e_p: Tolerance of specified travel;

υ_u: Travel variation

See "Technical description: Lead accuracy" (Page B41) 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.

Table 1 Cambinations of screw shaft diameter and lead

Screw shaft diameter(mm) \ Lead(mm)	1	1.5	2	2.5	4	5	6
4	B385						
6	B385						
8	B385	B387	B387				
10			B387	B389	B393		
12			B389	B389		B393	
14						B395	
15							
16			B391	B391		B399	
20					B405	B405	
25					B407	B407 B409	B407
28						B411 B413	B411 B413
32						B415 B417 B419	B415 B417
36							
40						B421	
45							
50							

Criterion of maximum rotational speed
: 3000 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 B51).

◇ **Shaft end processing**

MS, FS, and SS types require shaft end processing to your specification. An exclusive support unit (Page B433) is available to design the shaft end support section. See "Configuration of shaft end" (Page B27 and following pages) when using a support unit. See "Technical Description: Shaft end processing" (Page B83) for procedures of shaft end processing and precautions.

◇ **Other**

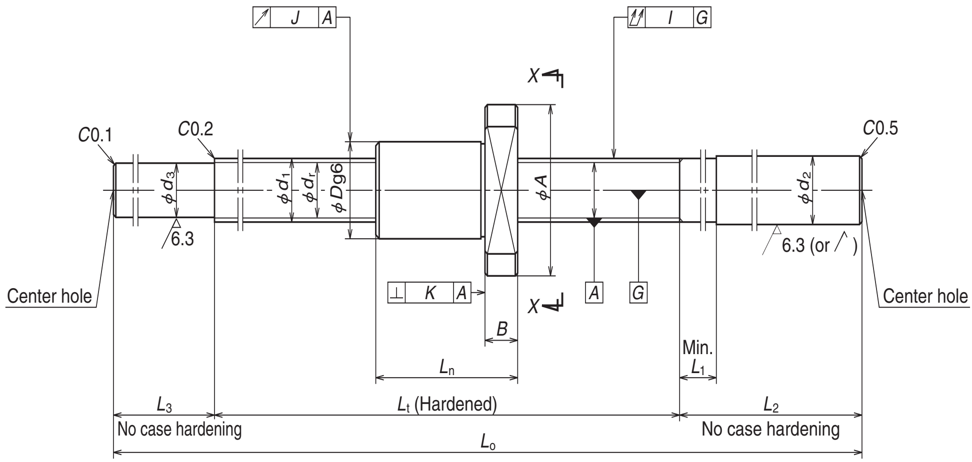
Seal of the ball screw, ball recirculating deflector and end cap are made of synthetic resin. Consult NSK when using the ball screws under extreme environments or special environments, or using special lubricant or oil.

For special environments, refer to Pages B74 and D2. Refer to Pages B71 and D13 for lubricants.

Note: For details of standard stock products, contack NSK.

8	10	12	16	20	25	32	40	50
	B393							
B395								
	B395			B397				
			B399			B397		
	B399			B399			B397	
	B409 B411			B401	B401			B401
B417	B419 B421 B423				B403	B403		
	B421 B423							
B425	B425 B427 B429	B425 B427						
	B431							
	B429 B431							

Blank shaft end MS Type (Fine lead: Deflector type)

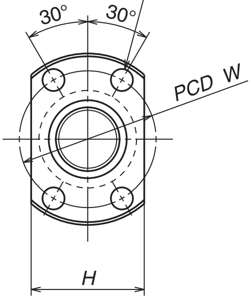


Nut type code: MSFD

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns	Basic load rating (N) Dynamic C_a	Static C_{0a}	Axial play Max.	Nut Outside dia. D	Flange A	H	B
W0400MS-1Y-C3T1	68	4	1	0.8	4.2	3.2	2	370	370	0.005	10	20	14	3
W0601MS-1Y-C3T1	110	6	1	0.8	6.2	5.2	3	680	920	0.005	12	24	16	3.5
W0801MS-1Y-C3T1	94	8	1	0.8	8.2	7.2	3	790	1290	0.005	14	27	18	4
W0802MS-1Y-C3T1	174													

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
3. Nut does not have a seal.
4. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

ø4×1, ø6×1, ø8×1

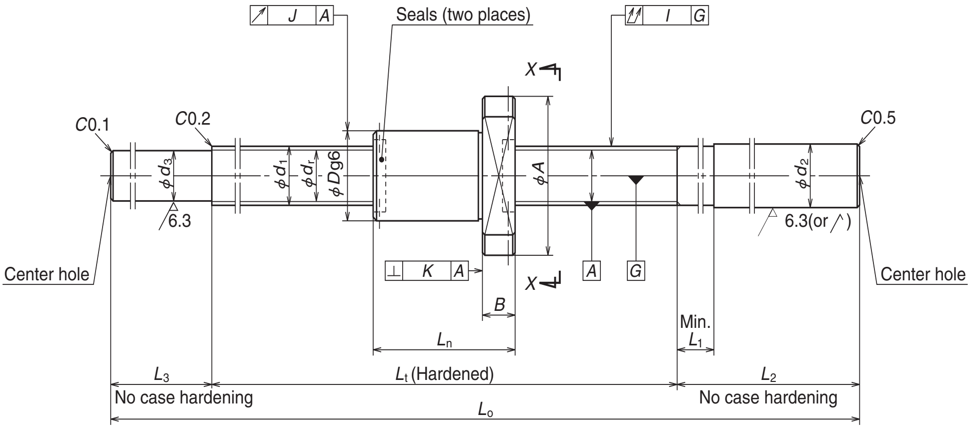


View *X-X*

Unit: mm

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		
12	15	2.9	80	6.0	4	40	3.3	10	130	0	0.008	0.008	0.030	0.009	0.008	0.026	3000
15	18	3.4	125	8.0	4	50	5.3	15	190	0	0.010	0.008	0.030	0.009	0.008	0.063	3000
16	21	3.4	110	10.2	4	60	7.3	25	195	0	0.010	0.008	0.030	0.009	0.008	0.11	3000
			190						275				0.050			0.14	

Blank shaft end MS Type

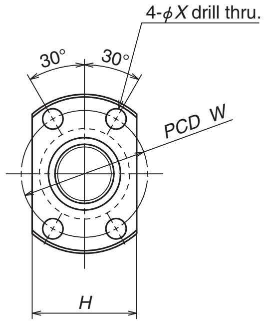


Nut type code: MSFD

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns	Basic load rating (N) Dynamic C_a	Basic load rating (N) Static C_{0a}	Axial play Max.	Nut Outside dia. D	Nut Flange A	Nut Flange H	Nut Flange B
W0801MS-2Y-C3T1.5	88	8	1.5	1.0	8.3	7.0	3	1270	1970	0.005	15	28	19	4
W0802MS-2Y-C3T1.5	168													
W0801MS-3Y-C3T2	84	8	2	1.2	8.3	6.9	3	1560	2200	0.005	16	29	20	4
W0802MS-3Y-C3T2	164													
W1001MS-1Y-C3T2	122	10	2	1.2	10.3	8.9	3	1800	2970	0.005	18	35	22	5
W1002MS-1Y-C3T2	222													

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

ø8×1.5, ø8×2, ø10×2

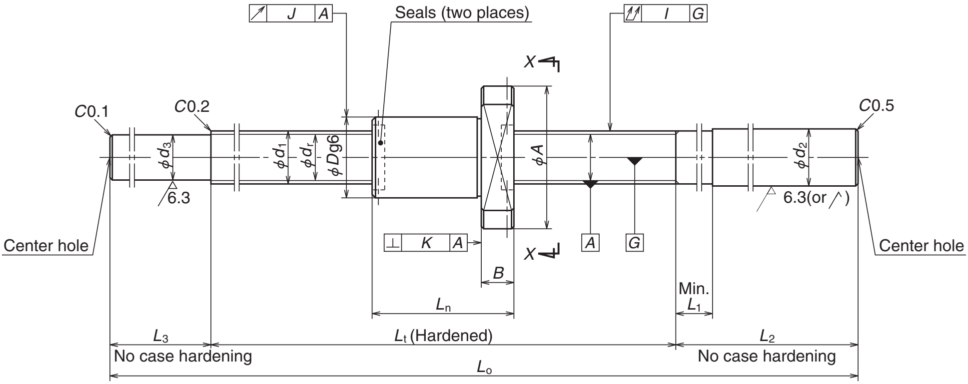


View X-X

Unit: mm

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		
22	22	3.4	110 190	10.2	4	60	7.2	25	195 275	0	0.010	0.008	0.030 0.050	0.009	0.008	0.12 0.15	3000
26	23	3.4	110 190	10.2	4	60	7.0	25	195 275	0	0.010	0.008	0.030 0.050	0.009	0.008	0.12 0.15	3000
28	27	4.5	150 250	12.2	4	70	9.0	30	250 350	0	0.010 0.012	0.008	0.035 0.050	0.009	0.008	0.22 0.27	3000

Blank shaft end MS Type

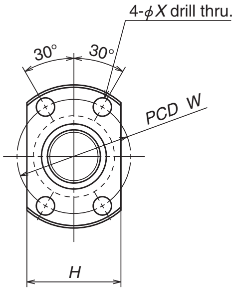


Nut type code: MSFD

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	2500	3630	0.005	19	36	23	5
W1002MS-2Y-C3T2.5	218													
W1202MS-1Y-C3T2	182	12	2	1.200	12.3	10.9	3	1960	3620	0.005	20	37	24	5
W1203MS-1Y-C3T2	282													
W1202MS-2Y-C3T2.5	178	12	2.5	1.588	12.4	10.6	3	2790	4530	0.005	21	38	25	5
W1203MS-2Y-C3T2.5	278													

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.
Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

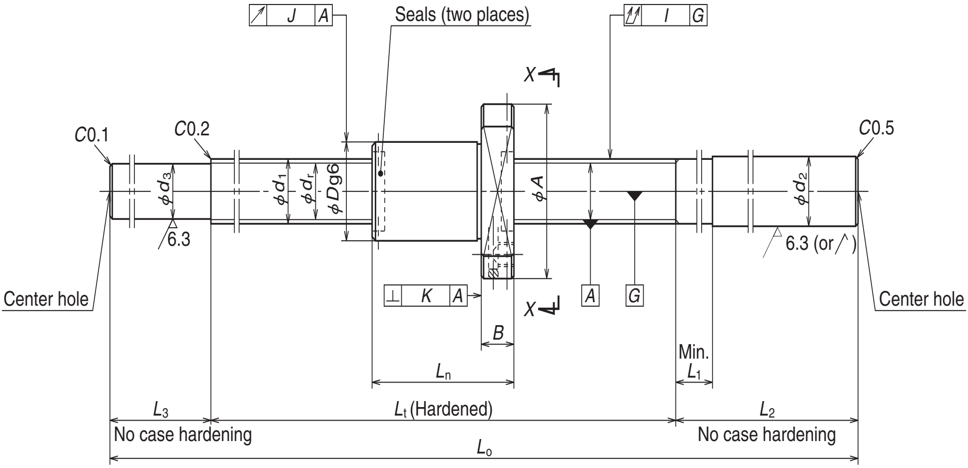
ø10×2.5, ø12×2, ø12×2.5



View *X-X*

Unit: mm

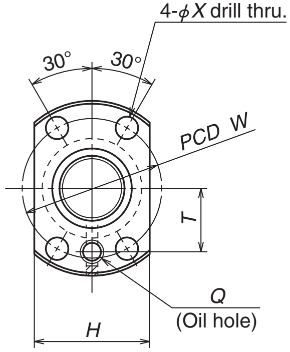
dimensions			Screw shaft dimensions							Lead accuracy			Run out			Mass (kg)	Permissible rotational speed N(min^{-1})
Overall length	Bolt hole		Threaded length	Shaft end, right			Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity		
L_n	W	X	L_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K		
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	3000
			250						350		0.012		0.050			0.28	
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	3000
			310						425				0.060			0.44	
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	3000
			310						425				0.060			0.45	



Nut type code: MSFD

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns	Basic load rating (N) Dynamic C_a	Basic load rating (N) Static C_{0a}	Axial play Max.	Nut Outside dia. D	Nut Flange A	Nut Flange H	Nut Flange B	Nut Overall length L_n	Nut Bolt hole W	Nut Bolt hole X
W1602MS-1Y-C3T2	210	16	2	1.588	16.4	14.6	4	4150	8450	0.005	25	44	29	10	40	35	5.5
W1604MS-1Y-C3T2	360																
W1602MS-2Y-C3T2.5	206	16	2.5	1.588	16.4	14.6	4	4150	8440	0.005	25	44	29	10	44	35	5.5
W1604MS-2Y-C3T2.5	356																

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.



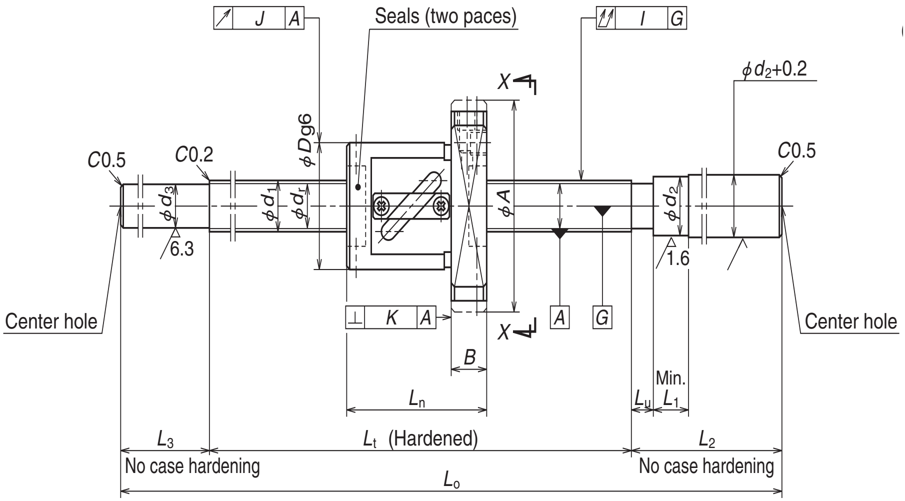
View X-X

Unit: mm

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)
Oil hole		Threaded length	Shaft end, right			Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity				
Q	T	L_t	d_2	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
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	3000	1.5	0.8
		400						540		0.013	0.010	0.050			0.93			
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	3000	1.5	0.8
		400						540		0.013	0.010	0.050			0.95			

Blank shaft end FS Type

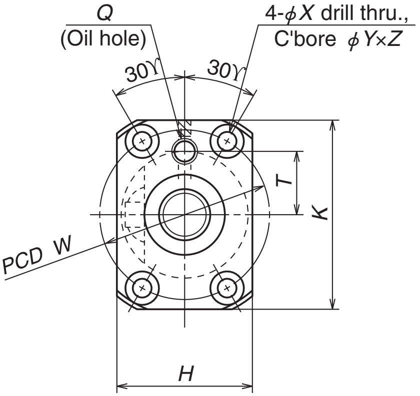
(Fine • medium lead: Tube type)



Nut type code: SFT, LSFT

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns: Turns x Circuits	Basic load rating (N): Dynamic C_a	Basic load rating (N): Static C_{0a}	Axial play Max.	Nut: Outside dia. D	Nut: Flange A	Nut: Flange H	Nut: Flange K	Nut: Flange B	Nut: Overall length L_n	Nut: Bolt hole W	Nut: Bolt hole X	Nut: Bolt hole Y	Nut: Bolt hole Z
W1001FS-1-C3T4	126	10	4	2.000	10.3	8.2	2.5×1	3210	4420	0.005	26	46	28	42	10	34	36	4.5	8	4.5
W1002FS-1-C3T4	226																			
W1003FS-1-C3T4	326																			
W1201FS-1-C3T5	110	12	5	2.381	12.3	9.8	2.5×1	4390	6260	0.005	30	50	32	45	10	40	40	4.5	8	4.5
W1202FS-1-C3T5	210																			
W1204FS-1-C3T5	410																			
W1202FS-2-C5T10	200	12	10	2.381	12.5	10.0	2.5×1	4430	6430	0.005	30	50	32	45	10	50	40	4.5	8	4.5
W1204FS-2-C5T10	400																			

Remarks:
1. NSK support unit is recommended. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

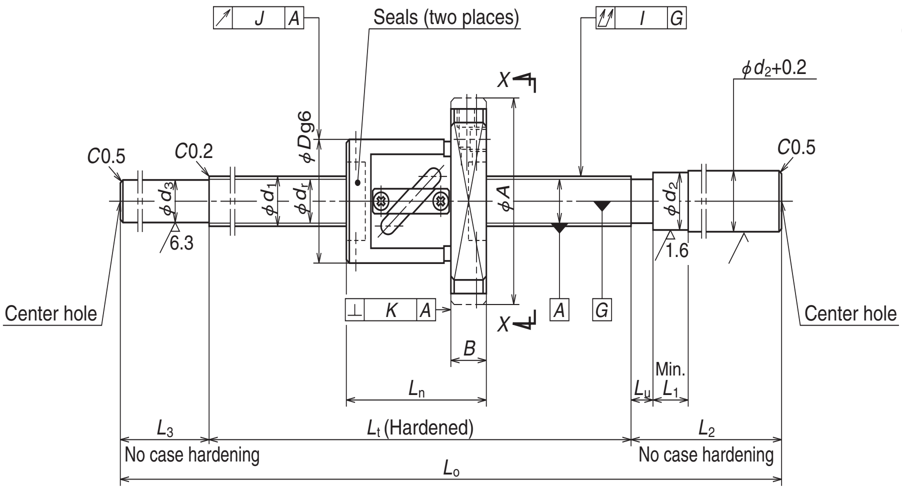


View X-X

Unit: mm

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)
Oil hole		Threaded length	Shaft end, right				Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity				
Q	T	L_t	d_2	L_u	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
		160							265		0.010	0.008	0.030			0.34			
M6×1	14	260	14	5	40	70	8.2	35	365	0	0.012	0.008	0.040	0.010	0.008	0.39	3000	0.86	0.43
		360							465		0.013	0.010	0.050			0.45			
		150							255		0.010	0.008	0.030			0.44			
M6×1	15	250	14	5	40	70	9.8	35	355	0	0.012	0.008	0.040	0.010	0.008	0.52	3000	1.2	0.6
		450							555		0.015	0.010	0.065			0.67			
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	3000	1.4	0.7
		450							555		0.027	0.020	0.075			0.74			

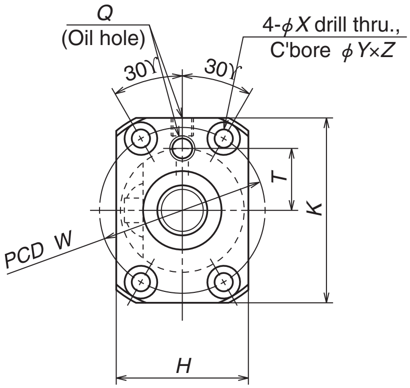
B
394



Nut type code: SFT, LSFT

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns: Turns x Circuits	Basic load rating (N): Dynamic C_a	Basic load rating (N): Static C_{0a}	Axial play Max.	Nut: Outside dia. D	Nut: Flange A	Nut: Flange H	Nut: Flange K	Nut: Flange B	Nut: Overall length L_n	Nut: Bolt hole W	Nut: Bolt hole X	Nut: Bolt hole Y	Nut: Bolt hole Z
W1403FS-1-C3T5	310	14	5	3.175	14.5	11.2	2.5×1	7970	11900	0.005	34	57	34	50	11	40	45	5.5	9.5	5.5
W1406FS-1-C3T5	560																			
W1405FS-1-C5T8	454	14	8	3.175	14.5	11.2	2.5×1	7880	11800	0.005	34	57	34	50	11	46	45	5.5	9.5	5.5
W1408FS-1-C5T8	754																			
W1504FS-1-C5T10	349	15	10	3.175	15.5	12.2	2.5×1	8140	12800	0.005	34	57	34	50	11	51	45	5.5	9.5	5.5
W1506FS-1-C5T10	549																			
W1509FS-1-C5T10	849																			
W1511FS-1-C5T10	1049																			

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.



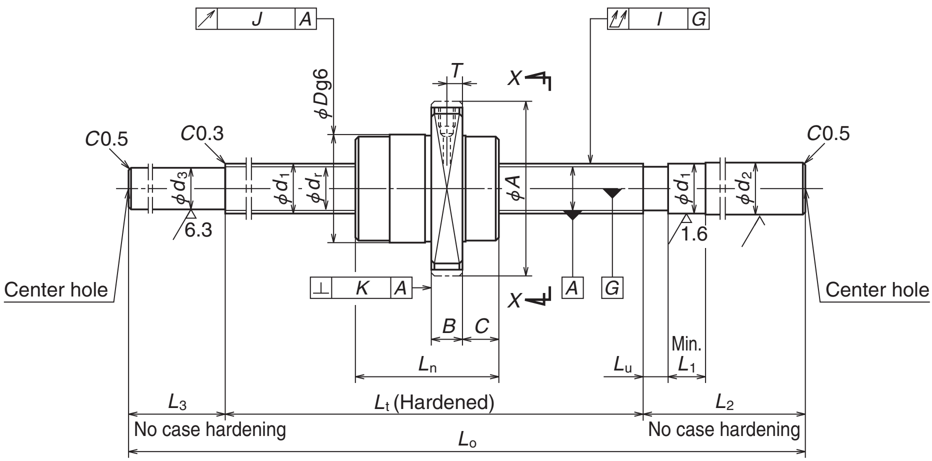
View X-X

Unit: mm

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)
Oil hole		Threaded length	Shaft end, right				Shaft end, left		Overall length		Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity				
Q	T	L_t	d_2	L_u	L_1	L_2	d_3	L_3	L_o	T	e_p	υ_u	I	J	K				
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	3000	2.0	1.0
		600							740		0.016	0.012	0.055			1.0			
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	3000	2.0	1.0
		800							940		0.035	0.025	0.085			1.3			
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	3000	2.3	1.2
		600							770		0.030	0.023	0.065			1.3			
		900							1070		0.040	0.027	0.110			1.7			
		1100							1270		0.046	0.030	0.150			1.9			

Blank shaft end FS Type

(Ultra high helix lead: End cap type)

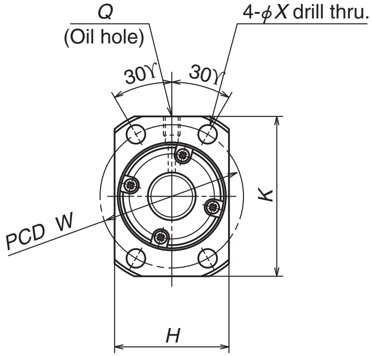


Nut type code: USFC

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns: Turns x Circuits	Basic load rating (N) Dynamic C_a	Basic load rating (N) Static C_{0a}	Axial play Max.	Nut: Outside dia. D	Flange A	Flange H	Flange K	Flange B	Flange C	Overall length L_o	Bolt hole W	Bolt hole X
W1504FS-2G-C5T20	355	15	20	3.175	15.5	12.2	1.7×1	5660	8700	0.005	34	55	36	50	10	11	45	45	5.5
W1506FS-2G-C5T20	555																		
W1509FS-2G-C5T20	855																		
W1511FS-2G-C5T20	1055																		
W1609FS-2GX-C5T32	866	16	32	3.175	16.75	13.4	0.7×2	4320	6760	0.005	34	55	36	50	10	10.5	34	45	5.5
W1613FS-1GX-C5T32	1266																		
W2011FS-1GX-C5T40	1059	20	40	3.175	20.75	17.4	0.7×2	4870	8420	0.005	38	58	40	52	10	11	41	48	5.5
W2017FS-1GX-C5T40	1659																		

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.
Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

ø15×20, ø16×32, ø20×40

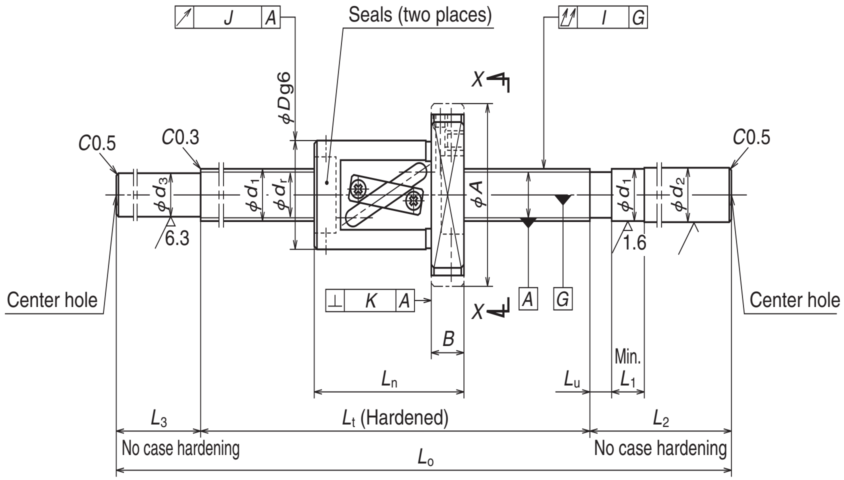


View *X-X*

Unit: mm

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)
Oil hole		Threaded length	Shaft end, right				Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity				
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*				
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	3000	1.9	1.0
		600							770		0.030	0.023	0.065			1.3			
		900							1070		0.040	0.027	0.110			1.7			
		1100							1270		0.046	0.030	0.150			2.0			
M6×1	5	900	16.2	19	40	150	13.4	60	1110	0	0.040	0.027	0.110	0.015	0.011	1.9	3000	2.0	1.0
		1300							1510		0.054	0.035	0.150			2.5			
M6×1	5	1100	20.2	22	60	150	17.4	80	1330	0	0.046	0.030	0.150	0.015	0.011	3.5	3000	2.7	1.4
		1700							1930		0.065	0.040	0.200			4.9			

Blank shaft end FS Type **(Fine, medium, high helix lead: Tube type)**

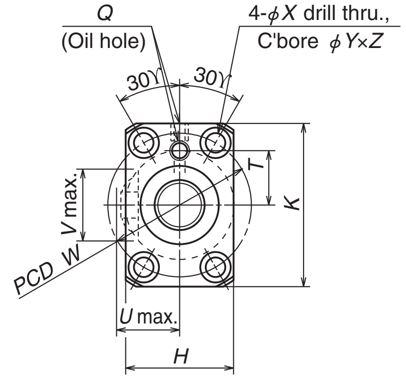


Nut type code: SFT, LSFT

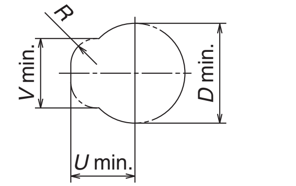
Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns x Circuits	Basic load rating (N) Dynamic C_a	Static C_{0a}	Axial play Max.	Nut Outside dia. D	Flange A	H	K	B	Overall length L_n	Bolt W	hole X	Y	Z
W1605FS-1-C3T5	458	16	5	3.175	16.5	13.2	2.5×1	8620	13800	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	5480	8080	0.005	34	57	34	50	12	56	45	5.5	9.5	5.5
W1611FS-1-C5T16	1044																			
W2009FS-1-C5T10	846	20	10	3.969	21	16.9	2.5×1	13300	21900	0.005	46	74	46	66	13	54	59	6.6	11	6.5
W2013FS-1-C5T10	1246																			
W2010FS-1-C5T20	937	20	20	3.969	21	16.9	1.5×1	8190	13100	0.005	46	74	46	66	13	63	59	6.6	11	6.5
W2015FS-1-C5T20	1437																			

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.
Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

ø16×5, ø16×16, ø20×10, ø20×20



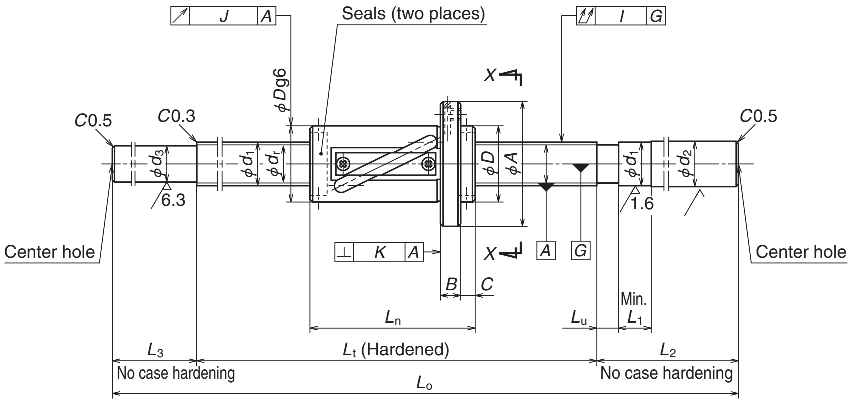
View *X-X*



Housing hole and its clearance
(Only applicable to shaft dia. φ16×lead 16)

Unit: mm

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*				
—	—	—	M6×1	17	500	16.2	5	40	150	13.2	60	710	0	0.015	0.010	0.055	0.012	0.008	1.4	3000	2.6	1.3
					900							1110		0.021	0.015	0.095			1.9			
19	20	8	M6×1	17	600	16.2	10	40	150	13.4	60	810	0	0.030	0.023	0.085	0.015	0.011	1.5	3000	2.1	1.1
					1100							1310		0.046	0.030	0.150			2.3			
—	—	—	M6×1	24	900	20.2	10	60	150	16.9	80	1130	0	0.040	0.027	0.110	0.015	0.011	3.2	3000	4.7	2.4
					1300							1530		0.054	0.035	0.150			4.1			
—	—	—	M6×1	24	1000	20.2	13	60	150	16.9	80	1230	0	0.040	0.027	0.110	0.015	0.011	3.6	3000	4.2	2.1
					1500							1730		0.054	0.035	0.200			4.8			

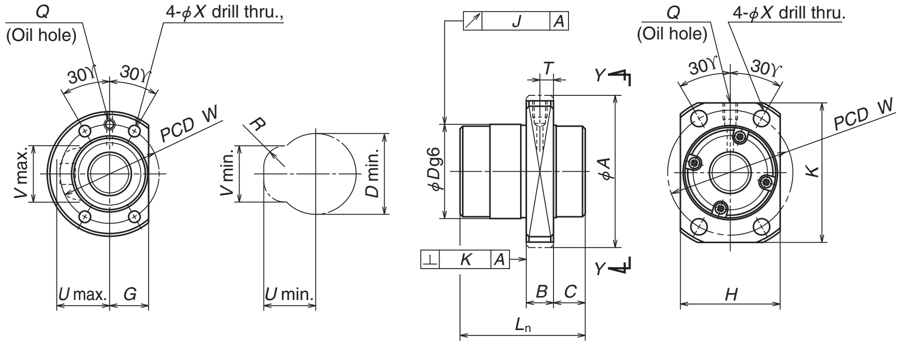


Nut type code: LSFT

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns: Turns x Circuits	Basic load rating (N) Dynamic C_a	Static C_{0a}	Axial play Max.	Nut: Nut type code	Outside dia. D	Flange A	G	H	K	B	C	Overall length L_o	Bolt hole W	X
W2513FS-1-C5T20	1254	25	20	4.762	26.25	21.3	2.5x1	18600	32600	0.005	LSFT	44	71	23	—	—	12	8	96	57	6.6
W2521FS-1-C5T20	2054																				
W2513FS-2-C5T25	1260	25	25	4.762	26.25	21.3	1.5x1	11700	19700	0.005	LSFT	44	71	23	—	—	12	10	90	57	6.6
W2521FS-2-C5T25	2060																				
W2515FS-1GX-C5T50	1450	25	50	3.969	26	21.9	0.7x2	7280	13200	0.005	USFC	46	70	—	48	63	12	13	50	58	6.6
W2521FS-3GX-C5T50	2100																				

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

ø25×20, ø25×25, ø25×50



View X-X

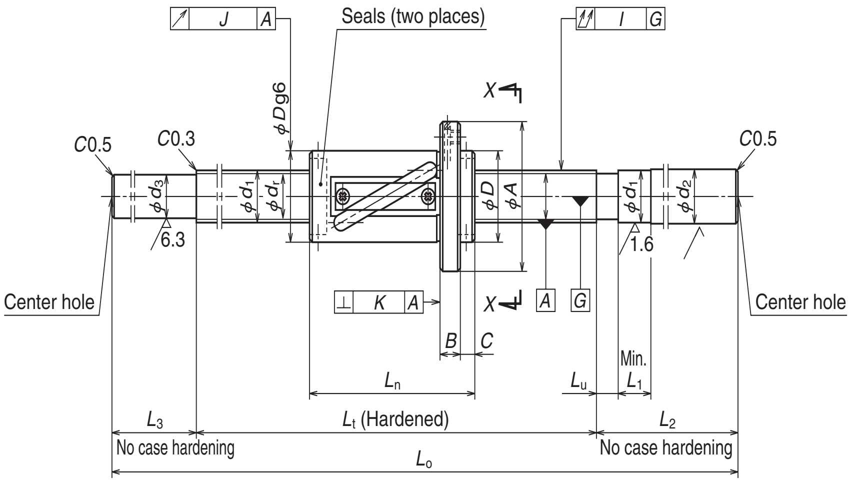
Housing hole and its clearance

View Y-Y

Nut type code: USFC

Unit: mm

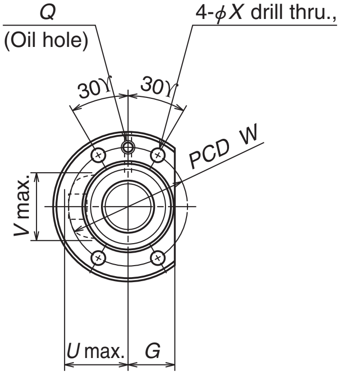
dimensions					Screw shaft dimensions								Lead accuracy			Run out			Mass (kg)	Permissible rotational speed N(min⁻¹)	Internal spatial volume of nut (cm³)	Standard volume of grease replenishing (cm³)
Projecting tube			Oil hole		Threaded length	Shaft end, right				Shaft end, left		Overall length		Deviation	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				
31	35	12	M6×1	—	1350	25.2	13	70	200	21.3	100	1650	0	0.054	0.035	0.120	0.015	0.011	6.8	2800	12	6.0
					2150							2450		0.077	0.046	0.160			9.8			
32	34	12	M6×1	—	1350	25.2	15	70	200	21.3	100	1650	0	0.054	0.035	0.120	0.015	0.011	6.8	2800	10	5.0
					2150							2450		0.077	0.046	0.160			9.8			
—	—	—	M6×1	6	1500	25.2	26	70	200	21.9	100	1800	0	0.054	0.035	0.120	0.015	0.011	7.3	2800	5.3	2.7
					2150							2450		0.077	0.046	0.160			9.8			



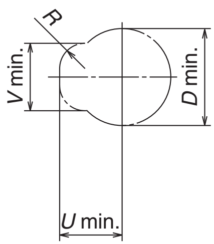
Nut type code: LSFT

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns x Circuits	Basic load rating (N) Dynamic C_a	Static C_{0a}	Axial play Max.	Nut Outside dia. D	Flange A	G	B	C	Overall length L_n	Bolt hole W	X
W3217FS-1-C5T25	1583	32	25	4.762	33.25	28.3	2.5×1	20400	42200	0.005	51	85	26	15	10	117	67	9
W3227FS-1-C5T25	2583																	
W3217FS-2-C5T32	1591	32	32	4.762	33.25	28.3	1.5×1	13300	25200	0.005	51	85	26	15	12	109	67	9
W3227FS-2-C5T32	2591																	

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.



View *X-X*



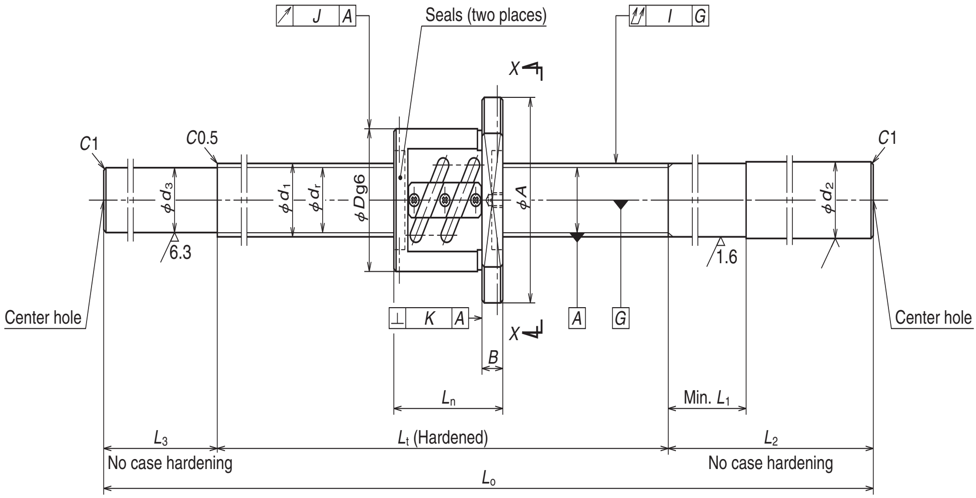
Housing hole and its clearance

Unit: mm

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	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				
34	42	12	M6×1	1700	32.3	15	70	250	28.3	120	2070	0	0.065	0.040	0.160	0.019	0.013	13.8	2180	17	8.5
				2700							3070		0.093	0.054	0.210			20.0			
34	42	12	M6×1	1700	32.3	19	70	250	28.3	120	2070	0	0.065	0.040	0.160	0.019	0.013	13.9	2180	15	7.5
				2700							3070		0.093	0.054	0.210			20.0			

Blank shaft end SS Type

(Fine lead: Tube type)

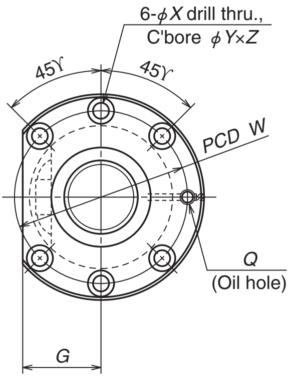


Nut type code: PFT

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns x Circuits	Basic load rating (N) Dynamic C_a	Basic load rating (N) Static C_{0a}	Preload (N)	Dynamic friction torque, median (N·cm)	Nut Outside dia. D	Nut Flange A	Nut Flange G	Nut Flange B	Nut Overall length L_n	Nut Bolt hole W	Nut Bolt hole X
W2003SS-1P-C5Z4	251	20	4	2.381	20.3	17.8	2.5×2	6550	10900	290	3.9	40	63	24	11	49	51	5.5
W2005SS-1P-C5Z4	451																	
W2008SS-1P-C5Z4	751																	
W2003SS-2P-C5Z5	244	20	5	3.175	20.5	17.2	2.5×2	11100	17100	490	7.8	44	67	26	11	56	55	5.5
W2005SS-2P-C5Z5	444																	
W2007SS-1P-C5Z5	644																	
W2010SS-1P-C5Z5	944																	

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

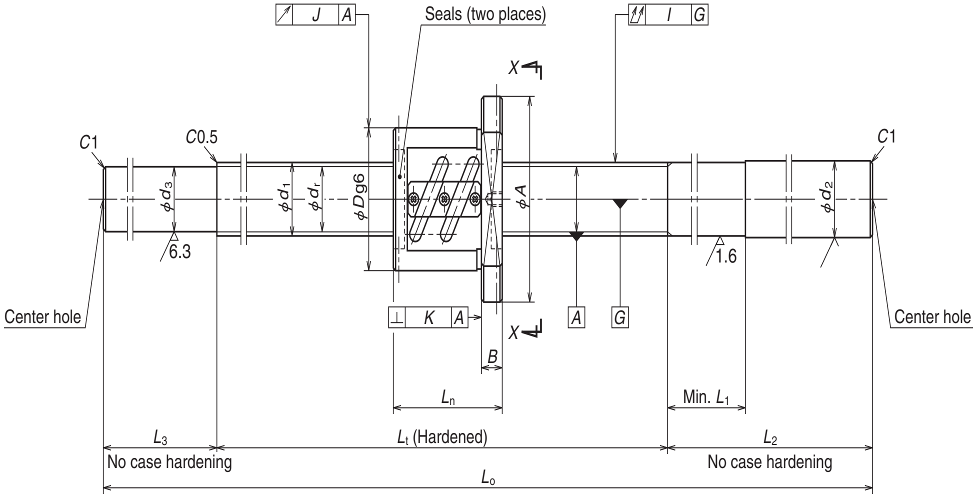
ø20×4, ø20×5



View *X-X*

Unit: mm

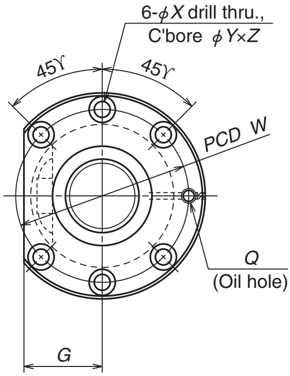
dimensions			Screw shaft dimensions							Lead accuracy			Run out			Mass (kg)	Permissible rotational speed N(min^{-1})	Internal spatial volume of nut (cm^3)	Standard volume of grease replenishing (cm^3)
Bolt hole		Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	Deviation	Variation	Shaft straightness	Nut O.D. eccentricity	Flange perpendicularity				
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				
9.5	5.5	M6×1	300	20.2	40	150	17.8	—	450	-0.007	0.023	0.018	0.055	0.015	0.011	1.5	3000	2.7	1.4
			500			150		50	700	-0.012	0.027	0.020	0.085			2.0			
			800			200		100	1100	-0.019	0.035	0.025	0.140			2.9			
9.5	5.5	M6×1	300	20.2	40	150	17.2	—	450	-0.007	0.023	0.018	0.055	0.015	0.011	1.6	3000	4.3	2.2
			500			150		50	700	-0.012	0.027	0.020	0.085			2.2			
			700			200		100	1000	-0.017	0.035	0.025	0.110			2.8			
			1000			200		100	1300	-0.024	0.040	0.027	0.180			3.5			



Nut type code: PFT

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns x Circuits	Basic load rating (N) Dynamic C_a	Basic load rating (N) Static C_{0a}	Preload (N)	Dynamic friction torque, median (N·cm)	Nut Outside dia. D	Nut Flange A	Nut Flange G	Nut Flange B	Nut Overall length L_n	Nut Bolt hole W	Nut Bolt hole X
W2503SS-1P-C5Z4	252	25	4	2.381	25.3	22.8	2.5×2	7110	13600	290	4.9	46	69	26	11	48	57	5.5
W2506SS-1P-C5Z4	552																	
W2510SS-1P-C5Z4	952																	
W2503SS-2P-C5Z5	245	25	5	3.175	25.5	22.2	2.5×2	12300	21800	540	8.8	50	73	28	11	55	61	5.5
W2505SS-1P-C5Z5	445																	
W2508SS-1P-C5Z5	745																	
W2512SS-1P-C5Z5	1145																	
W2504SS-1P-C5Z6	338	25	6	3.969	25.5	21.4	2.5×2	16600	26700	690	13.8	53	76	29	11	62	64	5.5
W2508SS-2P-C5Z6	738																	
W2512SS-2P-C5Z6	1138																	

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

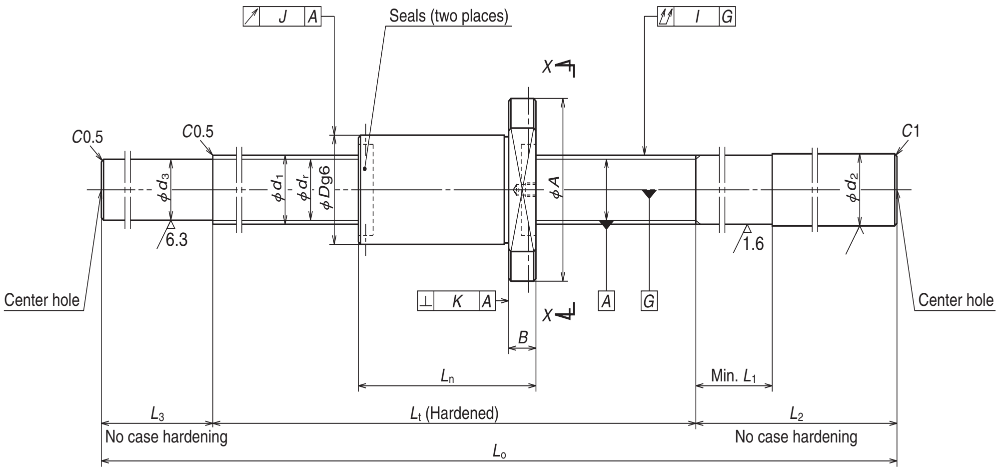


View *X-X*

Unit: mm

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				
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				
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	2800	3.2	1.6
			600			200		100	900	-0.014	0.030	0.023	0.075			3.8			
			1000			200		100	1300	-0.024	0.040	0.027	0.120			5.2			
9.5	5.5	M6×1	300	25.2	40	200	22.2	—	500	-0.007	0.023	0.018	0.040	0.015	0.011	2.5	2800	5.2	2.6
			500			200		50	750	-0.012	0.027	0.020	0.060			3.4			
			800			250		100	1150	-0.019	0.035	0.025	0.090			4.8			
			1200			300		100	1600	-0.029	0.046	0.030	0.120			6.3			
9.5	5.5	M6×1	400	25.2	40	200	21.4	—	600	-0.010	0.025	0.020	0.050	0.019	0.013	3.0	2800	7.0	3.5
			800			250		100	1150	-0.019	0.035	0.025	0.090			4.8			
			1200			300		100	1600	-0.029	0.046	0.030	0.120			6.3			

Blank shaft end SS Type (Fine lead: Deflector type)

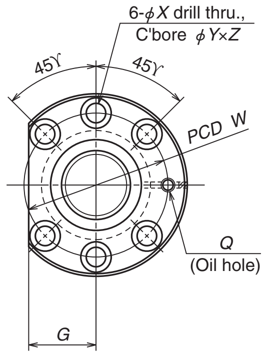


Nut type code: ZFD

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns x Circuits	Basic load rating (N) Dynamic C_a	Static C_{0a}	Preload (N)	Dynamic friction torque, median (N·cm)	Nut Outside dia. D	Flange A	G	B	Overall length L_n	Bolt hole W	X
W2502SS-1ZY-C5Z5	184	25	5	3.175	25.75	22.4	1x3	11600	22900	740	13.8	40	63	24	11	66	51	5.5
W2504SS-3ZY-C5Z5	334																	
W2506SS-2ZY-C5Z5	534																	
W2509SS-1ZY-C5Z5	834																	
W2512SS-3ZY-C5Z5	1134																	
W2504SS-4ZY-C5Z10	312	25	10	4.762	26.25	21.3	1x2	13300	21200	880	21.5	42	69	26	15	88	55	6.6
W2506SS-3ZY-C5Z10	512																	
W2508SS-3ZY-C5Z10	712																	
W2511SS-1ZY-C5Z10	1012																	
W2515SS-2ZY-C5Z10	1412																	

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

ø25×5, ø25×10



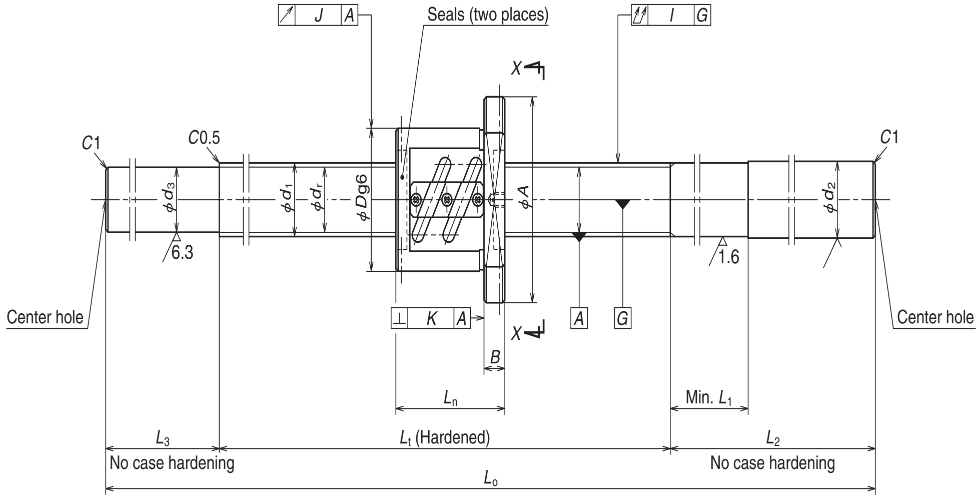
View *X*-*X*

Unit: mm

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				
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				
			250			200		—	450	-0.005	0.023	0.018	0.040			2.1			
			400			200		50	650	-0.009	0.025	0.020	0.060			2.8			
9.5	5.5	M6×1	600	25.2	40	250	22.4	100	950	-0.013	0.030	0.023	0.075	0.015	0.011	3.9	2800	5.4	2.7
			900			250		100	1250	-0.021	0.040	0.027	0.090			4.9			
			1200			300		100	1600	-0.028	0.046	0.030	0.120			6.2			
			400			200		50	650	-0.008	0.025	0.020	0.060			3.0			
			600			250		100	950	-0.012	0.030	0.023	0.075			4.1			
11	6.5	M6×1	800	25.2	60	250	21.3	100	1150	-0.017	0.035	0.025	0.090	0.015	0.011	4.8	2800	9.0	4.5
			1100			300		100	1500	-0.024	0.046	0.030	0.120			6.0			
			1500			300		100	1900	-0.034	0.054	0.035	0.150			7.4			

Blank shaft end SS Type

(Fine lead: Tube type)

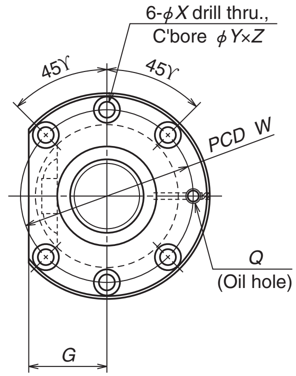


Nut type code: PFT

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns x Circuits	Basic load rating (N) Dynamic C_a	Basic load rating (N) Static C_{0a}	Preload (N)	Dynamic friction torque, median (N·cm)	Nut Outside dia. D	Nut Flange A	Nut Flange G	Nut Flange B	Nut Overall length L_n	Nut Bolt hole W	Nut Bolt hole X
W2504SS-2P-C5Z10	319	25	10	4.762	25.5	20.5	1.5×2	13600	18900	590	13.8	58	85	32	15	81	71	6.6
W2507SS-1P-C5Z10	619																	
W2510SS-2P-C5Z10	919																	
W2515SS-1P-C5Z10	1419																	
W2804SS-1P-C5Z5	344	28	5	3.175	28.5	25.2	2.5×2	13000	24400	540	9.8	55	85	31	12	56	69	6.6
W2806SS-1P-C5Z5	544																	
W2808SS-1P-C5Z5	744																	
W2812SS-1P-C5Z5	1144																	
W2804SS-3P-C5Z6	337	28	6	3.175	28.5	25.2	2.5×2	12900	24300	540	10.8	55	85	31	12	63	69	6.6
W2806SS-3P-C5Z6	537																	
W2808SS-3P-C5Z6	737																	
W2812SS-3P-C5Z6	1137																	

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.
Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

ø25×10, ø28×5, ø28×6

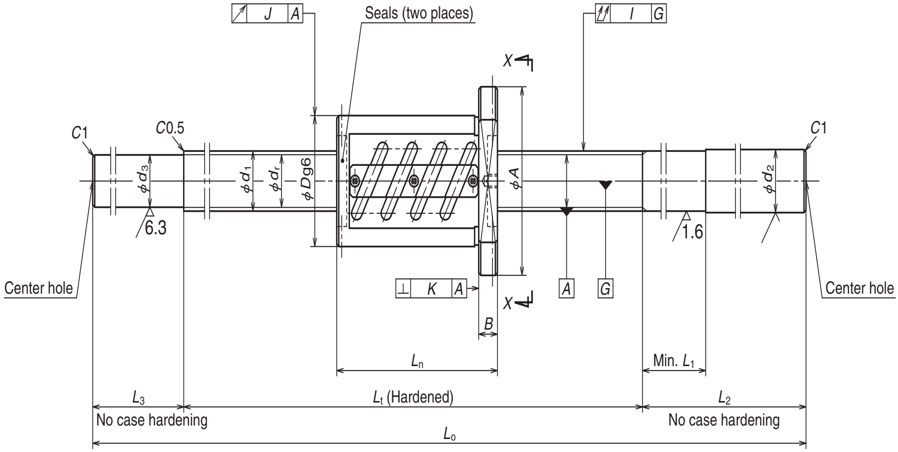


View *X*-*X*

Unit: mm

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				
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				
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	2800	9.7	4.9
			700			250		100	1050	–0.017	0.035	0.025	0.090			5.1			
			1000			250		100	1350	–0.024	0.040	0.027	0.120			6.1			
			1500			300		100	1900	–0.036	0.054	0.035	0.150			8.0			
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	2500	6.1	3.1
			600			250		100	950	–0.014	0.030	0.023	0.075			5.2			
			800			250		100	1150	–0.019	0.035	0.025	0.090			6.1			
			1200			300		100	1600	–0.029	0.046	0.030	0.120			8.1			
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	2500	6.1	3.1
			600			250		100	950	–0.014	0.030	0.023	0.075			5.3			
			800			250		100	1150	–0.019	0.035	0.025	0.090			6.2			
			1200			300		100	1600	–0.029	0.046	0.030	0.120			8.2			

Blank shaft end SS Type **(Fine lead: Tube type)**

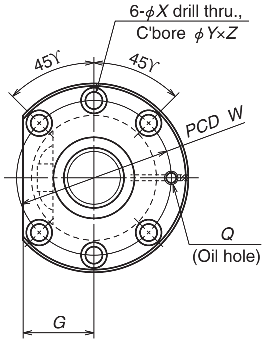


Nut type code: ZFT

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns: Turns x Circuits	Basic load rating (N): Dynamic C_a	Basic load rating (N): Static C_{0a}	Preload (N)	Dynamic friction torque, median (N·cm)	Nut: Outside dia. D	Nut: Flange A	Nut: Flange G	Nut: Flange B	Nut: Overall length L_n	Nut: Bolt hole W	Nut: Bolt hole X
W2804SS-2Z-C5Z5	314	28	5	3.175	28.5	25.2	2.5×2	20600	48700	1225	21.5	55	85	31	12	86	69	6.6
W2806SS-2Z-C5Z5	514																	
W2808SS-2Z-C5Z5	714																	
W2812SS-2Z-C5Z5	1114																	
W2804SS-4Z-C5Z6	301	28	6	3.175	28.5	25.2	2.5×2	20600	48700	1225	22.5	55	85	31	12	99	69	6.6
W2806SS-4Z-C5Z6	501																	
W2808SS-4Z-C5Z6	701																	
W2812SS-4Z-C5Z6	1101																	

Remarks:
1. NSK support unit is recommended. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

ø28×5, ø28×6



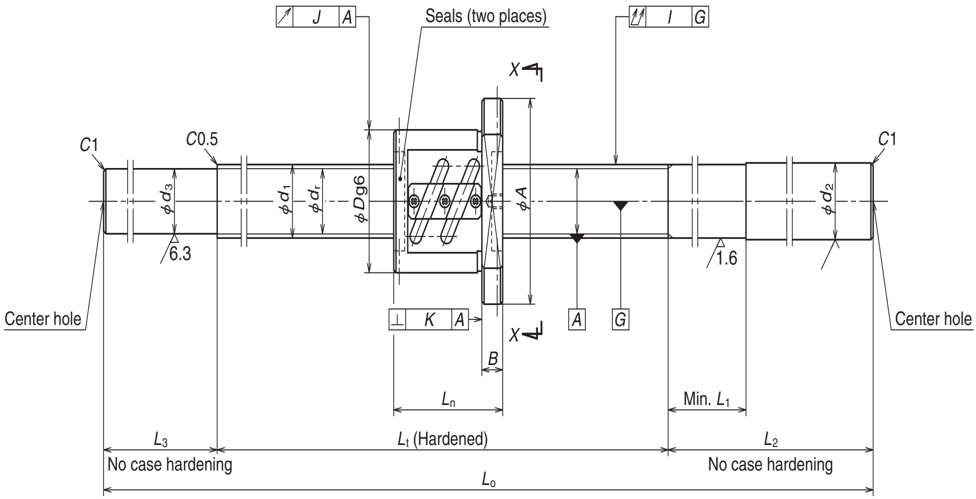
View *X-X*

Unit: mm

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				
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				
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	2500	9.2	4.6
			600			250		100	950	–0.014	0.030	0.023	0.075			5.5			
			800			250		100	1150	–0.019	0.035	0.025	0.090			6.4			
			1200			300		100	1600	–0.029	0.046	0.030	0.120			8.4			
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	2500	9.5	4.8
			600			250		100	950	–0.014	0.030	0.023	0.075			5.7			
			800			250		100	1150	–0.019	0.035	0.025	0.090			6.6			
			1200			300		100	1600	–0.029	0.046	0.030	0.120			8.6			

Blank shaft end SS Type

(Fine lead: Tube type)

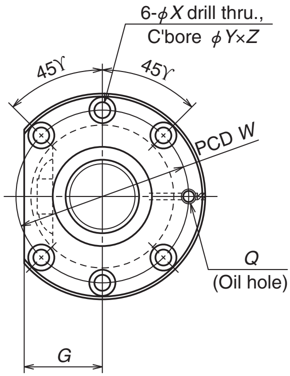


Nut type code: PFT

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load rating (N) Dynamic C_a	Basic load rating (N) Static C_{0a}	Preload (N)	Dynamic friction torque, median (N·cm)	Nut Outside dia. D	Nut Flange A	Nut Flange G	Nut Flange B	Nut Overall length L_n
W3204SS-1P-C5Z5	344	32	5	3.175	32.5	29.2	2.5×2	13700	28000	590	10.8	58	85	32	12	56
W3206SS-1P-C5Z5	544															
W3208SS-1P-C5Z5	744															
W3212SS-1P-C5Z5	1144															
W3215SS-1P-C5Z5	1444															
W3206SS-3P-C5Z6	537	32	6	3.969	32.5	28.4	2.5×2	18300	34700	780	15.6	62	89	34	12	63
W3210SS-1P-C5Z6	937															
W3215SS-3P-C5Z6	1437															

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

ø32×5, ø32×6

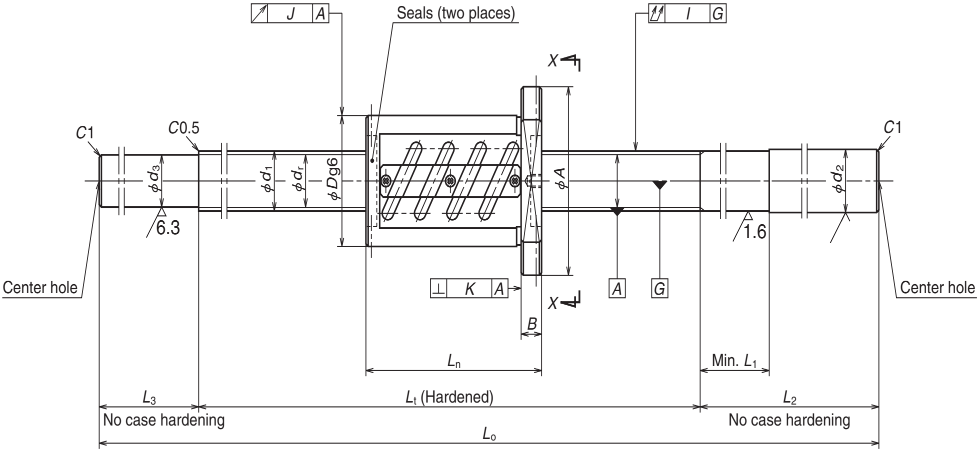


View X-X

Unit: mm

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				
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	2180	6.9	3.5
					600			250		100	950	-0.014	0.030	0.023	0.075			6.5			
					800			250		100	1150	-0.019	0.035	0.025	0.090			7.7			
					1200			300		100	1600	-0.029	0.046	0.030	0.120			10.3			
					1500			300		100	1900	-0.036	0.054	0.035	0.150			12.1			
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	2180	9.4	4.7
					1000			300			1400	-0.024	0.040	0.027	0.120			9.2			
					1500			300			1900	-0.036	0.054	0.035	0.150			12.1			

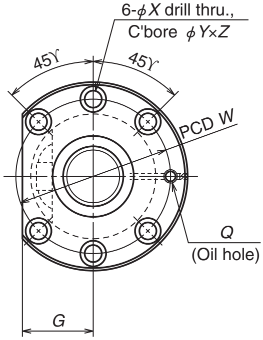
B 416



Nut type code: ZFT

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load rating (N) Dynamic C_a	Static C_{0a}	Preload (N)	Dynamic friction torque, median (N·cm)	Nut Outside dia. D	Flange A	G	B	Overall length L_n
W3204SS-2Z-C5Z5	314	32	5	3.175	32.5	29.2	2.5×2	21800	56000	1270	22.5	58	85	32	12	86
W3206SS-2Z-C5Z5	514															
W3208SS-2Z-C5Z5	714															
W3212SS-2Z-C5Z5	1114															
W3215SS-2Z-C5Z5	1414															
W3206SS-4Z-C5Z6	501	32	6	3.969	32.5	28.4	2.5×2	29100	69300	1720	34.5	62	89	34	12	99
W3210SS-2Z-C5Z6	901															
W3215SS-4Z-C5Z6	1401															
W3206SS-5Z-C5Z8	518	32	8	4.762	32.5	27.5	2.5×1	20600	40900	1320	30.5	66	100	38	15	82
W3210SS-3Z-C5Z8	918															
W3215SS-5Z-C5Z8	1418															

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

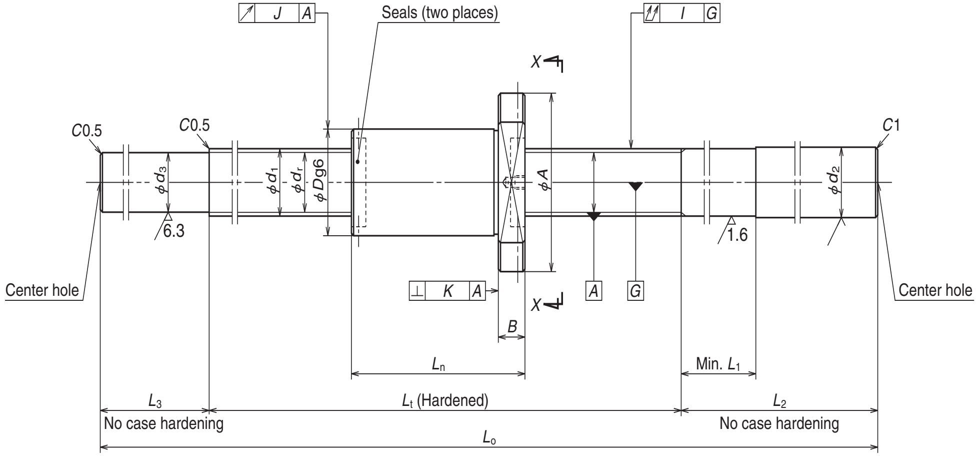


View *X-X*

Unit: mm

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				
					400			200		50	650	-0.010	0.025	0.020	0.060			5.1			
					600			250		100	950	-0.014	0.030	0.023	0.075			6.9			
71	6.6	11	6.5	M6×1	800	32.3	40	250	29.2	100	1150	-0.019	0.035	0.025	0.090	0.019	0.013	8.0	2180	10	5.0
					1200			300		100	1600	-0.029	0.046	0.030	0.120			10.1			
					1500			300		100	1900	-0.036	0.054	0.035	0.150			12.4			
					600			250			950	-0.014	0.030	0.023	0.075			7.1			
75	6.6	11	6.5	M6×1	1000	32.3	40	300	28.4	100	1400	-0.024	0.040	0.027	0.120	0.019	0.013	9.7	2180	15	7.5
					1500			300			1900	-0.036	0.054	0.035	0.150			12.6			
					600			250			950	-0.014	0.030	0.023	0.075			7.3			
82	9	14	8.5	M6×1	1000	32.3	50	300	27.5	100	1400	-0.024	0.040	0.027	0.120	0.019	0.013	9.8	2180	7.9	4.0
					1500			300			1900	-0.036	0.054	0.035	0.150			12.6			

Blank shaft end SS Type **(Fine lead: Deflector type)**

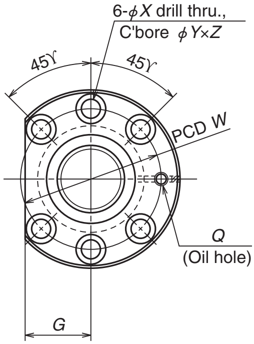


Nut type code: ZFD

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns: Turns × Circuits	Basic load rating (N): Dynamic C_a	Basic load rating (N): Static C_{0a}	Preload (N)	Dynamic friction torque, median (N·cm)	Nut: Outside dia. D	Nut: Flange A	Nut: Flange G	Nut: Flange B	Nut: Overall length L_n
W3204SS-3ZY-C5Z5	323	32	5	3.175	32.75	29.4	4	16800	40600	1080	19.6	48	75	29	12	77
W3206SS-6ZY-C5Z5	523															
W3209SS-1ZY-C5Z5	823															
W3212SS-3ZY-C5Z5	1123															
W3216SS-1ZY-C5Z5	1523															
W3205SS-3ZY-C5Z10	380	32	10	6.35	33.75	27.1	3	30500	52500	1860	49.0	54	88	34	15	120
W3207SS-3ZY-C5Z10	580															
W3210SS-6ZY-C5Z10	880															
W3214SS-3ZY-C5Z10	1280															
W3218SS-3ZY-C5Z10	1680															

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use. Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

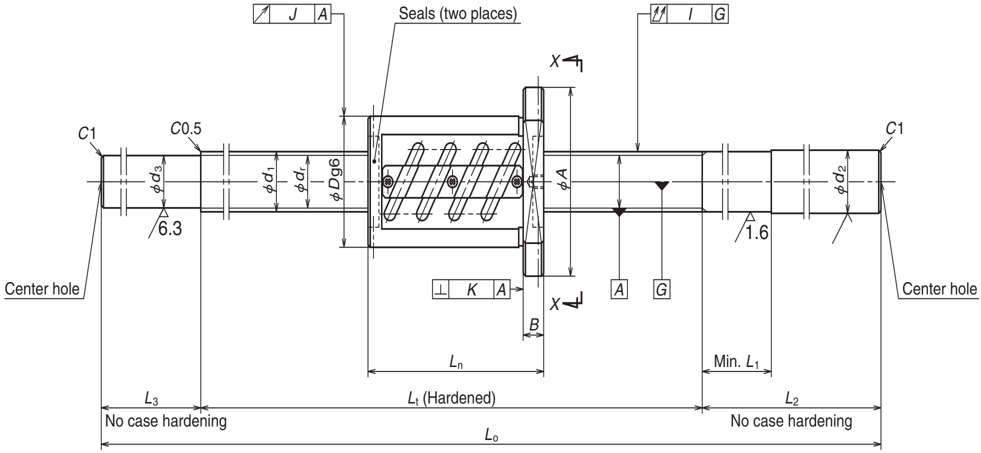
ø32×5, ø32×10



View *X-X*

Unit: mm

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				
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	2180	22	11
					600			250		100	950	-0.013	0.030	0.023	0.075			6.4			
					900			250		100	1250	-0.021	0.040	0.027	0.090			8.1			
					1200			300		100	1600	-0.028	0.046	0.030	0.120			10.2			
					1600			300		100	2000	-0.037	0.054	0.035	0.150			12.6			
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	2180	23	12
					700			250		100	1050	-0.015	0.035	0.025	0.090			7.3			
					1000			300		100	1400	-0.022	0.040	0.027	0.120			9.3			
					1400			350		120	1870	-0.032	0.054	0.035	0.150			11.9			
					1800			350		120	2270	-0.041	0.065	0.040	0.200			14.1			

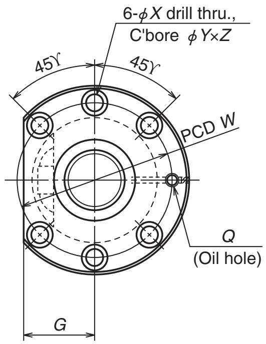


Nut type code: ZFT

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns: Turns × Circuits	Basic load rating (N): Dynamic C_a	Basic load rating (N): Static C_{0a}	Preload (N)	Dynamic friction torque, median (N·cm)	Nut: Outside dia. D	Nut: Flange A	Nut: Flange G	Nut: Flange B	Nut: Overall length L_n
W3205SS-1Z-C5Z10	400	32	10	6.350	33	26.4	2.5×1	30000	55100	1960	50	74	108	41	15	100
W3207SS-1Z-C5Z10	600															
W3210SS-4Z-C5Z10	900															
W3214SS-1Z-C5Z10	1300															
W3218SS-1Z-C5Z10	1700															
W3607SS-1Z-C5Z10	597	36	10	6.350	37	30.4	2.5×1	32000	61100	2060	56	75	120	45	18	103
W3612SS-1Z-C5Z10	1097															
W3620SS-1Z-C5Z10	1897															
W4006SS-1Z-C5Z5	511	40	5	3.175	40.5	37.2	2.5×2	23900	70500	1420	28.5	67	101	39	15	89
W4010SS-1Z-C5Z5	911															
W4016SS-1Z-C5Z5	1511															

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

ø32×10, ø36×10, ø40×5

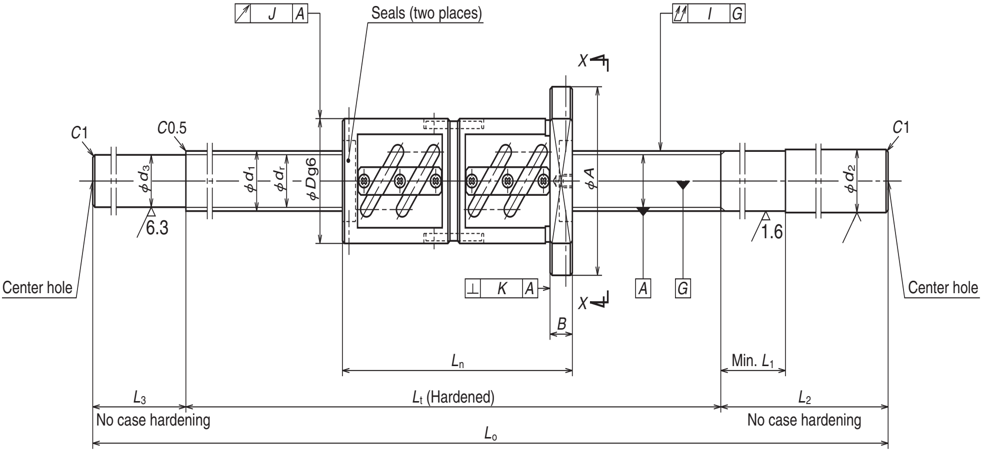


View X-X

Unit: mm

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				
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	2180	22	11
					700			250		100	1050	-0.017	0.035	0.025	0.090			8.5			
					1000			300		100	1400	-0.024	0.040	0.027	0.120			10.5			
					1400			350		120	1870	-0.034	0.054	0.035	0.150			13.1			
					1800			350		120	2270	-0.043	0.065	0.040	0.200			15.2			
98	11	17.5	11	M6×1	700	36.3	60	300	30.4	100	1100	-0.017	0.035	0.025	0.065	0.019	0.013	10.9	1940	27	14
					1200			350		120	1670	-0.029	0.046	0.030	0.100			14.9			
					2000			350		120	2470	-0.048	0.065	0.040	0.130			20.4			
83	9	14	8.5	Rc1/8	600	40.3	50	300	37.2	100	1000	-0.014	0.030	0.023	0.050	0.019	0.013	11.1	1750	14	7.0
					1000			300			1400	-0.024	0.040	0.027	0.080			14.8			
					1600			350			2050	-0.038	0.054	0.035	0.130			20.8			

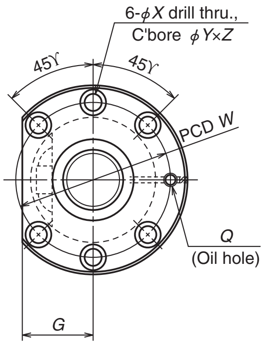
Blank shaft end SS Type **(Fine lead: Tube type)**



Nut type code: DFT

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns: Turns × Circuits	Basic load rating (N): Dynamic C_a	Basic load rating (N): Static C_{0a}	Preload (N)	Dynamic friction torque, median (N·cm)	Nut: Outside dia. D	Nut: Flange A	Nut: Flange G	Nut: Flange B	Nut: Overall length L_n
W3205SS-2D-C5Z10	310															
W3207SS-2D-C5Z10	510															
W3210SS-5D-C5Z10	810	32	10	6.350	33	26.4	2.5×2	54500	110000	3240	83	74	108	41	15	190
W3214SS-2D-C5Z10	1210															
W3218SS-2D-C5Z10	1610															
W3607SS-2D-C5Z10	507															
W3612SS-2D-C5Z10	1007	36	10	6.350	37	30.4	2.5×2	58000	122000	3430	93	75	120	45	18	193
W3620SS-2D-C5Z10	1807															

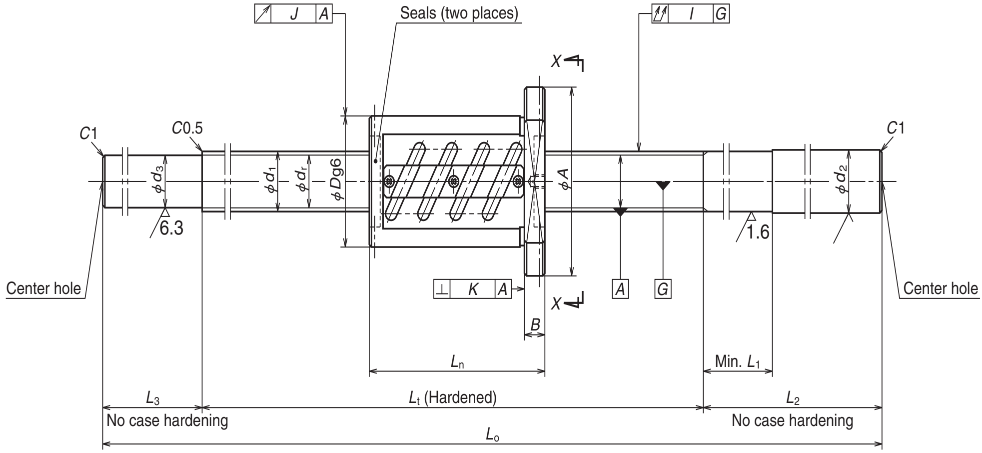
Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.
Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.



View *X-X*

Unit: mm

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				
					500			250		100	850	-0.012	0.027	0.020	0.075			9.5			
					700			250		100	1050	-0.017	0.035	0.025	0.090			10.6			
90	9	14	8.5	M6×1	1000	32.3	60	300	26.4	100	1400	-0.024	0.040	0.027	0.120	0.019	0.013	12.5	2180	57	29
					1400			350		120	1870	-0.034	0.054	0.035	0.150			15.1			
					1800			350		120	2270	-0.043	0.065	0.040	0.200			17.2			
					700			300		100	1100	-0.017	0.035	0.025	0.065			12.8			
98	11	17.5	11	M6×1	1200	36.3	60	350	30.4	120	1670	-0.029	0.046	0.030	0.100	0.019	0.013	16.8	1940	67	34
					2000			350		120	2470	-0.048	0.065	0.040	0.130			22.3			

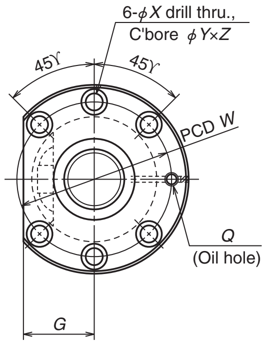


Nut type code: ZFT

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load rating (N) Dynamic C_a	Static C_{0a}	Preload (N)	Dynamic friction torque, median (N·cm)	Nut Outside dia. D	Flange A	G	B	Overall length L_n
W4007SS-1Z-C5Z8	570	40	8	4.762	40.5	35.5	2.5×2	41100	103000	2450	64	74	108	41	15	130
W4012SS-1Z-C5Z8	1070															
W4018SS-1Z-C5Z8	1670															
W4007SS-2Z-C5Z10	597	40	10	6.350	41	34.4	2.5×1	33700	68300	2160	64	82	124	47	18	103
W4010SS-2Z-C5Z10	897															
W4014SS-1Z-C5Z10	1297															
W4018SS-2Z-C5Z10	1697															
W4024SS-1Z-C5Z10	2297															
W4010SS-4Z-C5Z12	883	40	12	7.144	41.5	34.1	2.5×1	39500	77200	2550	83	86	128	48	18	117
W4016SS-2Z-C5Z12	1483															
W4025SS-1Z-C5Z12	2383															

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.
Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

ø40×8, ø40×10, ø40×12



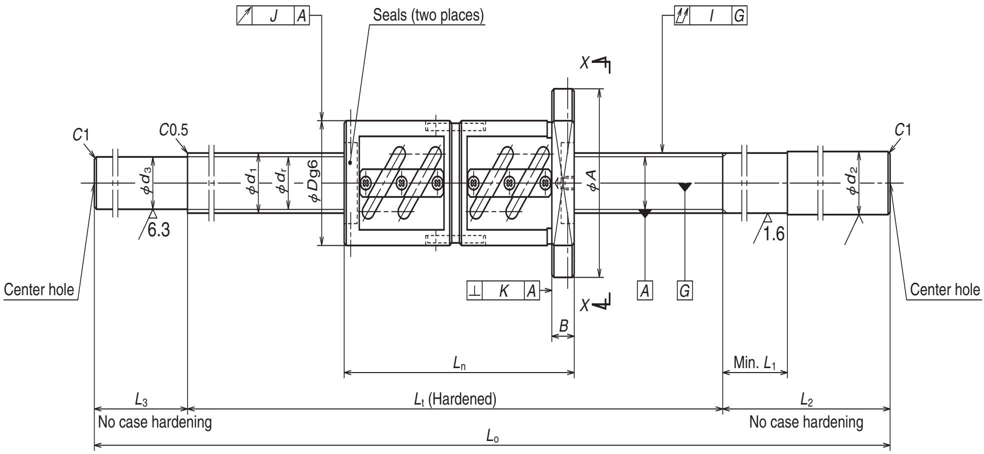
View X-X

Unit: mm

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				
90	9	14	8.5	Rc1/8	700	40.3	50	300	35.5	100	1100	–0.017	0.035	0.025	0.065	0.019	0.013	13.0	1750	27	14
					1200			350		100	1650	–0.029	0.046	0.030	0.100			18.0			
					1800			350		120	2270	–0.043	0.065	0.040	0.130			23.5			
102	11	17.5	11	Rc1/8	700	40.3	60	300	34.4	100	1100	–0.017	0.035	0.025	0.065	0.025	0.015	13.3	1750	30	15
					1000			300		100	1400	–0.024	0.040	0.027	0.080			15.9			
					1400			350		120	1870	–0.034	0.054	0.035	0.100			20.0			
					1800			350		120	2270	–0.043	0.065	0.040	0.130			23.4			
					2400			400		150	2950	–0.058	0.077	0.046	0.170			29.4			
106	11	17.5	11	Rc1/8	1000	40.3	70	300	34.1	100	1400	–0.024	0.040	0.027	0.080	0.025	0.015	16.7	1750	35	18
					1600			350		150	2100	–0.038	0.054	0.035	0.130			22.9			
					2500			400		150	3050	–0.060	0.077	0.046	0.170			31.1			

Blank shaft end SS Type

(Fine lead: Tube type)



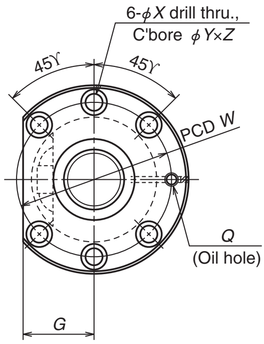
Nut type code: DFT

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load rating (N) Dynamic C_a	Static C_{0a}	Preload (N)	Dynamic friction torque, median (N·cm)	Nut Outside dia. D	Flange A	G	B	Overall length L_n
W4007SS-3D-C5Z10	507															
W4010SS-3D-C5Z10	807															
W4014SS-2D-C5Z10	1207	40	10	6.350	41	34.4	2.5×2	61200	137000	3630	108	82	124	47	18	193
W4018SS-3D-C5Z10	1607															
W4024SS-2D-C5Z10	2207															
W4010SS-5D-C5Z12	775															
W4016SS-3D-C5Z12	1375	40	12	7.144	41.5	34.1	2.5×2	71700	154000	4310	138	86	128	48	18	225
W4025SS-2D-C5Z12	2275															

Remarks: 1. NSK support unit is recommended. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.

NSK

ø40×10, ø40×12



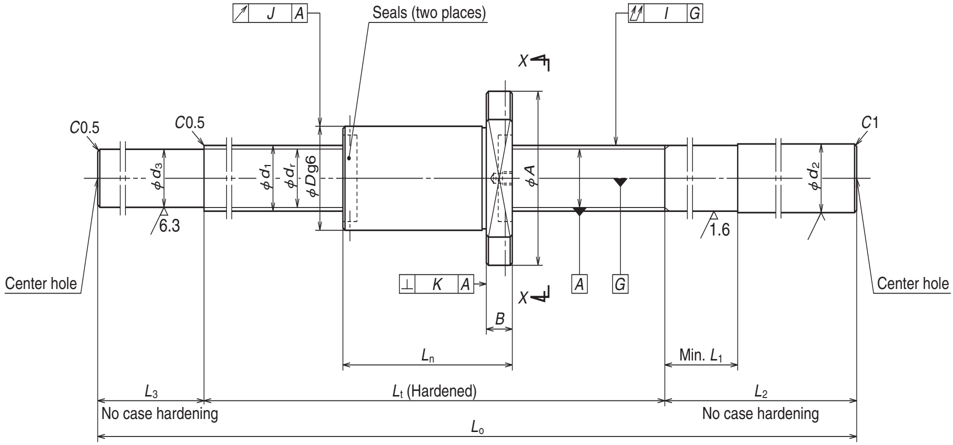
View *X-X*

Unit: mm

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				
102	11	17.5	11	Rc1/8	700	40.3	60	300	34.4	100	1100	–0.017	0.035	0.025	0.065	0.025	0.015	15.5	1750	74	37
					1000			300		100	1400	–0.024	0.040	0.027	0.080			18.1			
					1400			350		120	1870	–0.034	0.054	0.035	0.100			22.2			
					1800			350		120	2270	–0.043	0.065	0.040	0.130			25.6			
					2400			400		150	2950	–0.058	0.077	0.046	0.170			31.6			
106	11	17.5	11	Rc1/8	1000	40.3	70	300	34.1	100	1400	–0.024	0.040	0.027	0.080	0.025	0.015	19.7	1750	93	47
					1600			350		150	2100	–0.038	0.054	0.035	0.130			25.8			
					2500			400		150	3050	–0.060	0.077	0.046	0.170			34.0			

Blank shaft end SS Type

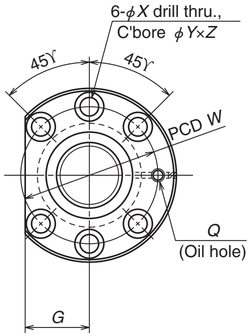
(Fine lead: Deflector type)



Nut type code: ZFD

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns	Basic load rating (N) Dynamic C_a	Static C_{0a}	Preload (N)	Dynamic friction torque, median (N·cm)	Nut Outside dia. D	Flange A	G	B	Overall length L_n
W4007SS-4ZY-C5Z10	557															
W4010SS-6ZY-C5Z10	857															
W4014SS-3ZY-C5Z10	1257	40	10	6.350	41.75	35.1	4	45200	93100	2840	83	62	104	40	18	143
W4018SS-4ZY-C5Z10	1657															
W4024SS-3ZY-C5Z10	2257															
W5007SS-1ZY-C5Z10	557															
W5010SS-3ZY-C5Z10	857															
W5015SS-3ZY-C5Z10	1357	50	10	6.350	51.75	45.1	4	51500	122000	3240	108	72	114	44	18	143
W5020SS-3ZY-C5Z10	1857															
W5026SS-3ZY-C5Z10	2457															

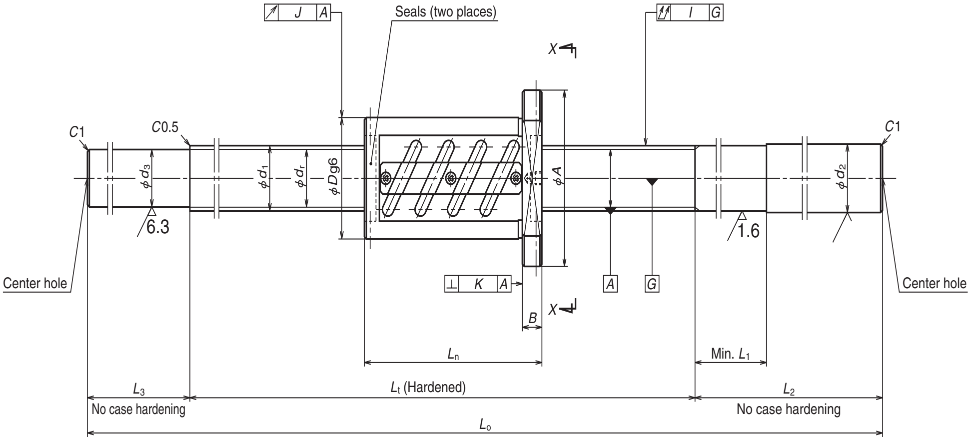
Remarks:
1. NSK support unit is recommended. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.



View *X-X*

Unit: mm

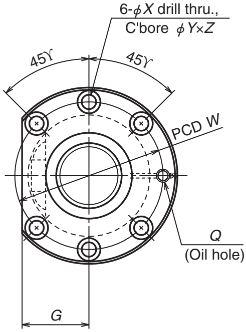
dimensions					Screw shaft dimensions							Lead accuracy			Run out			Mass (kg)	Permissible rotational speed N (min⁻¹)	Internal spatial volume of nut (cm³)	Standard volume of grease replenishing (cm³)
Bolt hole				Oil hole	Threaded length	Shaft end, right			Shaft end, left		Overall length	Travel compensation	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*				
82	11	17.5	11	Rc1/8	700	40.3	60	300	35.1	100	1100	–0.015	0.035	0.025	0.065	0.019	0.013	12.1	1750	32	16
					1000			300		100	1400	–0.022	0.040	0.027	0.080			14.7			
					1400			350		120	1870	–0.032	0.054	0.035	0.100			18.9			
					1800			350		120	2270	–0.041	0.065	0.040	0.130			22.5			
					2400			400		150	2950	–0.056	0.077	0.046	0.170			28.5			
92	11	17.5	11	Rc1/8	700	50.3	60	300	45.1	100	1100	–0.015	0.035	0.025	0.065	0.019	0.013	18.3	1400	39	20
					1000			300		100	1400	–0.022	0.040	0.027	0.080			22.5			
					1500			400		150	2050	–0.034	0.054	0.035	0.130			31.8			
					2000			400		150	2550	–0.046	0.065	0.040	0.170			38.9			
					2600			500		200	3300	–0.060	0.093	0.054	0.220			49.5			



Nut type code: ZFT

Ball screw No.	Stroke Max. L_t-L_n	Screw shaft dia. d_1	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective ball turns Turns × Circuits	Basic load rating (N) Dynamic C_a	Static C_{0a}	Preload (N)	Dynamic friction torque, median (N·cm)	Nut Outside dia. D	Flange A	G	B	Overall length L_n
W4510SS-1Z-C5Z10	897	45	10	6.350	46	39.4	2.5×1	36300	78500	2260	69	88	132	50	18	103
W4516SS-1Z-C5Z10	1497															
W4525SS-1Z-C5Z10	2397															
W5010SS-1Z-C5Z10	897	50	10	6.350	51	44.4	2.5×1	37500	87200	2450	78	93	135	51	18	103
W5015SS-1Z-C5Z10	1397															
W5020SS-1Z-C5Z10	1897															
W5026SS-1Z-C5Z10	2497															
W5010SS-2Z-C5Z10	837	50	10	6.350	51	44.4	2.5×2	68100	174000	4020	138	93	135	51	18	163
W5015SS-2Z-C5Z10	1337															
W5020SS-2Z-C5Z10	1837															
W5026SS-2Z-C5Z10	2437															

Remarks:
1. NSK support unit is recommended. Refer to Page B433 for details.
2. **Only rust preventive agent is applied at time of delivery. Please apply lubricant (oil or grease) before use.** Refer to Page D13 for details.
3. Permissible rotational speed is determined by a d·n value and a critical speed. See page B383 and B51.



View X-X

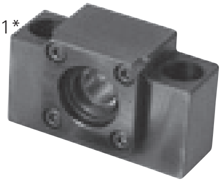
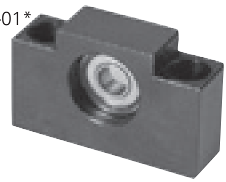
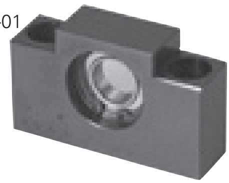
Unit: mm

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				
					1000			300		100	1400	-0.024	0.040	0.027	0.080			19.7			
110	11	17.5	11	Rc1/8	1600	45.3	60	400	39.4	150	2150	-0.038	0.054	0.035	0.130	0.025	0.015	28.1	1550	34	17
					2500			450		150	3100	-0.060	0.077	0.046	0.170			38.8			
					1000			300		100	1400	-0.024	0.040	0.027	0.080			23.8			
113	11	17.5	11	Rc1/8	1500	50.3	60	400	44.4	150	2050	-0.036	0.054	0.035	0.130	0.025	0.015	32.9	1400	37	19
					2000			400		150	2550	-0.048	0.065	0.040	0.170			39.8			
					2600			450		150	3200	-0.062	0.093	0.054	0.220			48.9			
					1000			300		100	1400	-0.024	0.040	0.027	0.080			25.5			
113	11	17.5	11	Rc1/8	1500	50.3	60	400	44.4	150	2050	-0.036	0.054	0.035	0.130	0.025	0.015	34.6	1400	59	30
					2000			400		150	2550	-0.048	0.065	0.040	0.170			41.5			
					2600			450		150	3200	-0.062	0.093	0.054	0.220			50.7			

B-3-2.5 Accessories

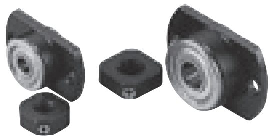
Accessories to use with ball screw are available in stock.

Table 1 Support unit categories

Application		Shape	Support side	Bearing in use	Bearing bore Bearing seat diameter	Page
Small equipment, light load	Square	WBK**-01* 	Fixed support side	Angular contact ball bearing	ϕ6 – ϕ25	B439 –
		WBK**S-01* 	Simple support side	Deep groove ball bearing	ϕ6 – ϕ25	B443 –
		WBK**SF-01 		Deep groove ball bearing	ϕ12, ϕ15 (Exclusive for VFA Type)	B446

① **Classification**

Ball screw support units are classified into categories by their shape (Table 1). Select the type that is appropriate for you to use.

Application		Shape	Support side	Bearing in use	Bearing bore Bearing seat diameter	Page
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 Type)	B445
		WBK**-11* 		Angular contact ball bearing	ϕ6 – ϕ25	B441 –
Machine tools, heavy load	Round	WBK**DF*-31 	Fixed support side	Thrust angular contact ball bearing	ϕ17 – ϕ40	B451 –

② **Features**

- Short delivery time: Standardized items in stock
- Bearings and seal

  On the fixed support side, the angular contact ball bearing is used. It has great rigidity and low friction torque which match the rigidity of the ball screw. The thrust angular contact ball bearing with high precision and great rigidity is another choice for the fixed support side.

  An oil seal is installed on fixed support side used with an angular contact ball bearing. The seal may have fine clearance.

  A deep-groove ball bearing with a shield on both sides is used on the simple support side.
- Lock nut is provided.

  A lock nut of fine grade finish is provided to fix the bearing with high precision.

③ **Reference number coding**

(For light load)

Example : WBK 08 S - 01 A

- 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 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 / C: For clean environment use

＊ In case of simple support unit, be careful that 12 or less size codes do not represent internal bores of bearing. Please refer to the dimensional table for internal bore of bearing.

(For heavy load)

Example : WBK 25 DF - 31

- 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 configuration of standard screw shaft ends for NSK standard ball screws with blank shaft ends. For transporting ball screws, you require optional spacers when mounting fixed support side support units.

①Features

●Prompt delivery

All support units are standard stocked items.

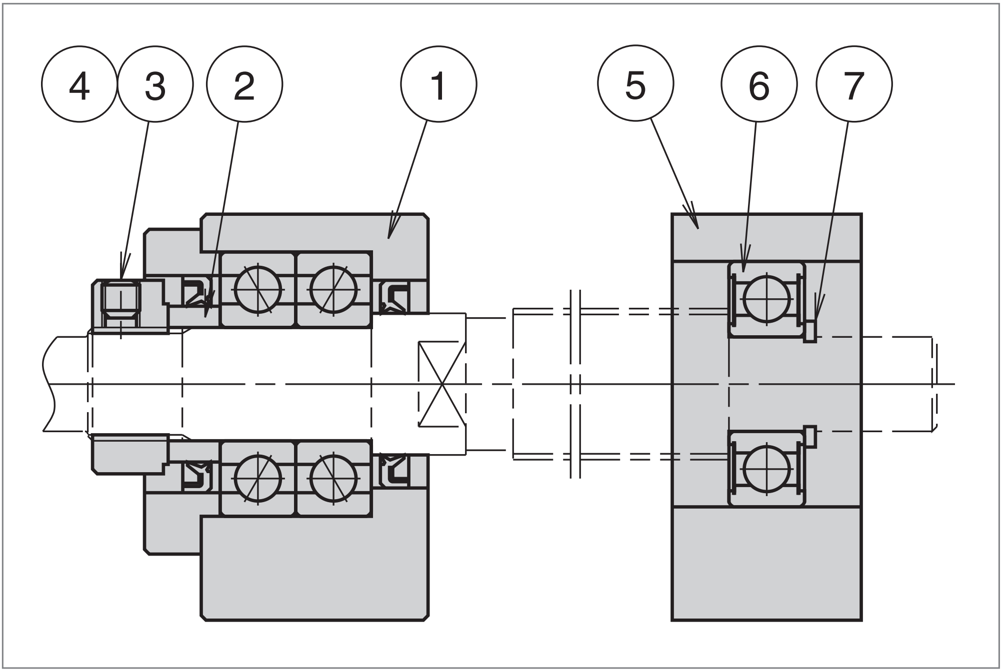
●Best selection of bearings for your application

General use support units for fixed support side are equipped with highly rigid angular contact ball bearings that have been assembled with proper preload, and packed with the appropriate volume of grease. On the other hand, clean support units for fixed support side uses low dust emission grease, and low torque special bearings. Sealed deep groove ball bearings are used for simple support side units for both general and clean environment use.

●Accessories

Support units provide everything necessary for mounting ball screws to machines. (Please refer to the table below.)

* Do not disassemble fixed support side units as they are equipped with bearings and oil seals.



●Antirust treatment

The table on the right shows the surface treatment for the bearing housing, and material of small parts.

Fixed support side		Simple support side	
Part no.	Name of parts	Part no.	Name of parts
①	Bearing housing	⑤	Bearing housing
②	Spacer	⑥	Bearing
③	Locknut	⑦	Snap ring
④	Set screw with set piece		

	General support unit
Bearings and grease	Angular contact ball bearings, PS2
Surface treatment	Black oxide
Screws and snap rings	Standard material

⑥Features of Clean Support Unit

●Outstanding low dust emission

Clean support unit uses “NSK clean grease LG2” which has a proven feature of low dust emission. It reduces dust emission to 1/10 of general support units.

●Low torque

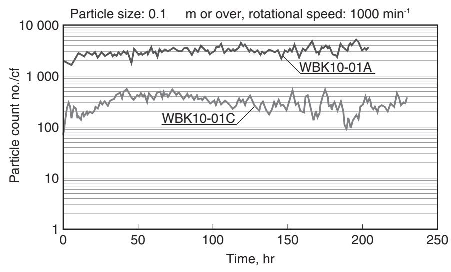
It features low torque characteristics because of special bearings. (50% lower than general support unit.)

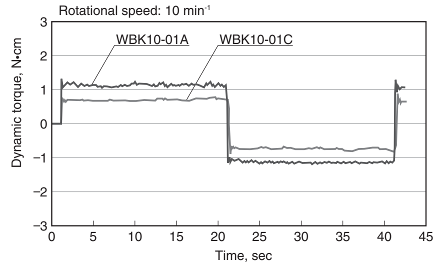
●High antirust specification

Low temperature chrome plating is applied to bearing housings, retaining plates, locknuts and spacers to improve antirust properties. Moreover, bolts and snap rings are made of stainless steel.

The table below shows the surface treatment of the bearing housing and material of small parts.

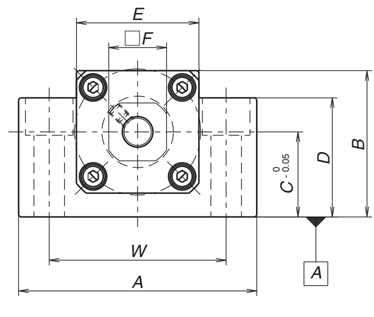
	Clean support unit
Bearing • grease	Special bearings, LG2
Surface treatment	Low temperature chrome plating
Set screw and snap ring material	Stainless steel

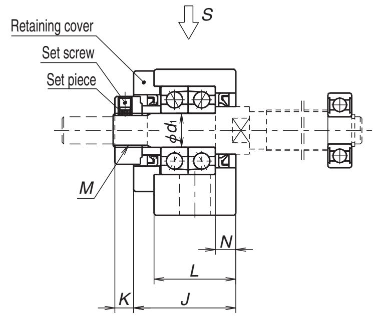




Accessories

Support Units for Light Load and Small Equipment

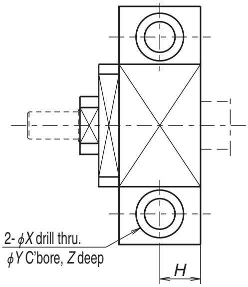




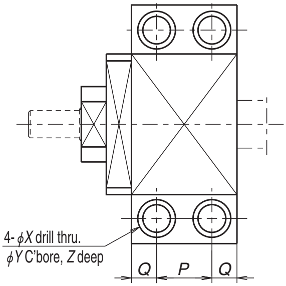
Fixed support side support unit (square type)

Reference no.	Use	d_1	A	B	C	D	E	F	L	J	K
WBK06-01A*	General	6	42	25	13	20	18	12	20	20	5.5
WBK08-01A*	General		52	32	17	26	25		23	23	7
WBK08-01B	Low type	8	62	31	15.5	31	—	14	21.5	25.5	4.5
WBK08-01C*	Clean environment		52	32	17	26	25		23	23	7
WBK10-01A	General			43	25	35	36				
WBK10-01B	Low type	10	70	38	20	38	—	17	24	30	5.5
WBK10-01C	Clean environment			43	25	35	36				
WBK12-01A	General			43	25	35	36				
WBK12-01B	Low type	12	70	38	20	38	—	19	24	30	5.5
WBK12-01C	Clean environment			43	25	35	36				
WBK15-01A	General			50	30	40	41				
WBK15-01B	Low type	15	80	42	22	42	—	22	25	31	12
WBK15-01C	Clean environment			50	30	40	41				
WBK17-01A	General	17	86	64	39	55	50	24	35	44	7
WBK20-01	General	20	95	58	30	45	56	30	42	52	10
WBK25-01	General	25	105	68	35	25	66	36	48	61	13

Notes: 1. Use datum face A for mounting to the machine base.
2. Tighten the set screw after the locknut has been adjusted and tightened.
3. The brass pad (set piece), provided with the unit, is inserted into locknut set screw hole, then set screw is inserted and tightened over it.
4. A deep groove ball bearing and a snap ring are attached.
*There are no seals for the retaining cover side of WBK06-01A, WBK08-01A, and WBK08-01C.



View S (WBK06 – 15)

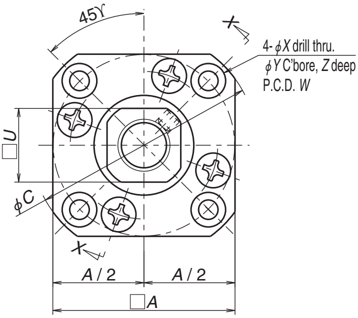


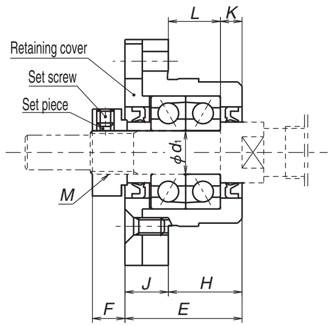
View S (WBK17 – 25)

Reference no.	Tightening torque (reference) [N · cm]	
	Locknut	Set screw
WBK06-**	190	69 (M3)
WBK08-**	230	69 (M3)
WBK10-**	280	147 (M4)
WBK12-**	630	147 (M4)
WBK15-**	790	147 (M4)
WBK17-**	910	147 (M4)
WBK20-**	1670	147 (M4)
WBK25-**	2060	490 (M6)

Units: mm

N	Counter bore dimensions							Mass (kg)	Locknut screw *M*	Attached bearing for support side
	H	*P*	*Q*	*W*	*X*	*Y*	*Z*			
3.5	10	—	—	30	5.5	9.5	11	0.15	M6×0.75	—
4	11.5	—	—	38	6.6	11	12	0.25	M8×1	606ZZ
3.5	11	—	—	46	9	14	18	0.3		606ZZ
4	11.5	—	—	38	6.6	11	12	0.25		606VV
6	12	—	—	52	9	14	11	0.5	M10×1	608ZZ
		—	—				19	0.45		608ZZ
		—	—				11	0.5		608VV
6	12	—	—	52	9	14	11	0.5	M12×1	6000ZZ
		—	—				19	0.4		6000ZZ
		—	—				11	0.5		6000VV
5	12.5	—	—	60	11	17	15	0.7	M15×1	6002ZZ
		—	—				23	0.6		6002ZZ
		—	—				15	0.7		6002VV
7	—	19	8	68	9	14	11	1.3	M17×1	6203ZZ
10	—	22	10	75	11	17	15	1.4	M20×1	6204ZZ
14	—	30	9	85	11	—	—	1.9	M25×1.5	6205ZZ



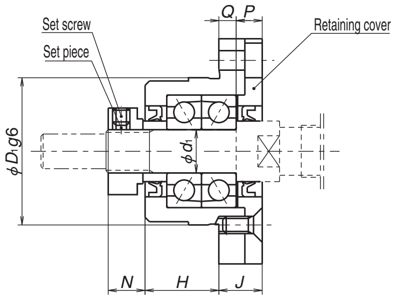


View X-X (Example 1)

Fixed support side support unit (round type)

Reference no.	Use	d_1	A	C	D_1	E	H	L	K	F	N
WBK06-11*	General	6	28	35	22	20	13	9.5	3.5	5.5	6.5
WBK08-11*	General	8	35	43	28	23	14	10	4	7	8
WBK08-11B	Low type		42	52	34	25.5	15.5	12	3.5	4.5	7
WBK08-11C*	Clean environment		35	43	28	23	14	10	4	7	8
WBK10-11	General	10	42	52	34	27	17	12	5	7.5	8.5
WBK10-11C	Clean environment										
WBK12-11	General	12	44	54	36	27	17	12	5	7.5	8.5
WBK12-11C	Clean environment										
WBK15-11	General	15	52	63	40	32	17	11	6	12	14
WBK15-11C	Clean environment										
WBK20-11	General	20	68	85	57	52	30	20	10	10	14
WBK25-11	General	25	79	98	63	57	30	20	10	13	20

Notes: 1. Tighten the set screw after the locknut has been adjusted and tightened.
2. The brass pad (set piece), provided with the unit, is inserted into locknut set screw hole, then set screw is inserted and tightened over it.
3. A deep groove ball bearing and a snap ring are attached.
*There are no seals for the retaining cover side of WBK06-01A, WBK08-01A, and WBK08-01C.

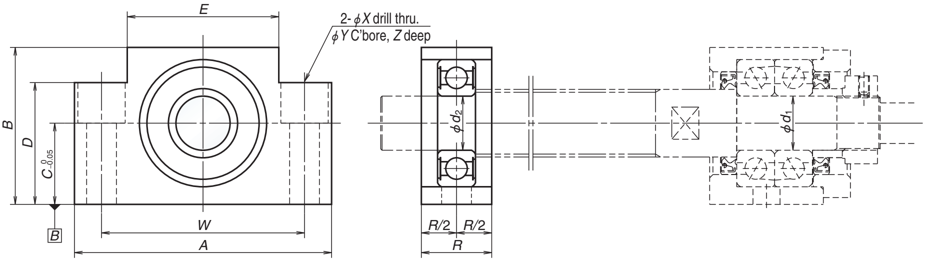


View X-X (Example 2)

Reference no.	Tightening torque (reference) [N · cm]	
	Locknut	Set screw
WBK06-**	190	69 (M3)
WBK08-**	230	69 (M3)
WBK10-**	280	147 (M4)
WBK12-**	630	147 (M4)
WBK15-**	790	147 (M4)
WBK17-**	910	147 (M4)
WBK20-**	1670	147 (M4)
WBK25-**	2060	490 (M6)

Units: mm

U	*P*	*Q*	Counter bore dimensions					Mass (kg)	Locknut screw *M*	Attached bearing for support side
			J	*W*	*X*	*Y*	*Z*			
12	4.5	2.5	7	28	2.9	5.5	3.5	0.1	M6×0.75	—
14	5	4	9	35	3.4	6.5	4	0.15	M8×1	606ZZ
	6		10	42	4.5	8	4	0.2		608ZZ
	5		9	35	3.4	6.5	4	0.15		606VV
17	6	4	10	42	4.5	8	4	0.2	M10×1	608ZZ
										608VV
19	6	4	10	44	4.5	8	4	0.25	M12×1	6000ZZ
										6000VV
22	8	7	15	50	5.5	9.5	6	0.4	M15×1	6002ZZ
										6002VV
30	14	8	22	70	6.6	11	10	1.1	M20×1	6204ZZ
36	17	10	27	80	9	15	13	1.5	M25×1.5	6205ZZ



Simple support side support unit (square type)

Units: mm

Reference no.	Use	d_2	A	B	C	D	E	R	Counter bore dimensions				Mass (kg)
									W	X	Y	Z	
WBK08S-01	General	6	52	32	17	26	25	15	38	6.6	11	12	0.15
WBK08S-01B	Low type		62	31	15.5	31	—	16	46	9	14	18	0.2
WBK08S-01C	Clean environment		52	32	17	26	25	15	38	6.6	11	12	0.15
WBK10S-01	General	8	70	43	25	35	36	20	52	9	14	11	0.4
WBK10S-01C	Clean environment												
WBK12S-01	General	10	70	43	25	35	36	20	52	9	14	11	0.35
WBK12S-01B	Low type			38	20	38	—					19	0.4
WBK12S-01C	Clean environment			43	25	35	36					11	0.35
WBK15S-01	General	15	80	50	30	40	41	20	60	9	14	11	0.45
WBK15S-01B	Low type			42	22	42	—					23	0.4
WBK15S-01C	Clean environment			50	30	40	41					11	0.45
WBK17S-01	General	17	86	64	39	55	50	23	68	9	14	11	0.8
WBK20S-01	General	20	95	58	30	45	56	26	75	11	17	15	0.8
WBK25S-01	General	25	105	68	35	25	66	30	85	11	—	—	0.9

Notes: 1. Use datum face B for mounting to the machine base.

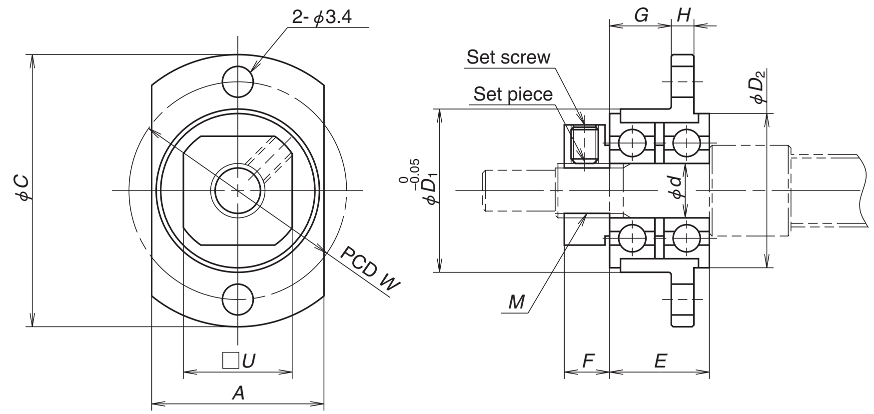
Specifications of support unit

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]	Stiffness [N / μm]				
WBK06-01A	General	2670	1040	28	0.49	—	—	—
WBK06-11	General	2670	1040	28	0.49	—	—	—
WBK08-01A	General	4400	1450	49	0.88	**WBK08S-01**	606ZZ	2260
WBK08-01B	Low type	6600	2730	94	1.9	**WBK08S-01B**	606ZZ	2260
WBK08-01C	Clean environment	3100	1100	36	0.52	**WBK08S-01C**	606VV	2260
WBK08-11	General	4400	1450	49	0.88	**WBK08S-01**	606ZZ	2260
WBK08-11B	Low type	6600	2730	94	1.9	—	606ZZ	2260
WBK08-11C	Clean environment	3100	1100	36	0.52	**WBK08S-01C**	606VV	2260
WBK10-01A	General	6600	2730	94	1.9	**WBK10S-01**	608ZZ	3300
WBK10-01B	Low type	6600	2730	94	1.9	—	608ZZ	3300
WBK10-01C	Clean environment	4250	1364	50	1.1	**WBK10S-01C**	608VV	3300
WBK10-11	General	6600	2730	94	1.9	**WBK10S-01**	608ZZ	3300
WBK10-11C	Clean environment	4250	1364	50	1.1	**WBK10S-01C**	608VV	3300
WBK12-01A	General	7100	3040	104	2.1	**WBK12S-01**	6000ZZ	4550
WBK12-01B	Low type	7100	3040	104	2.1	**WBK12S-01B**	6000ZZ	4550
WBK12-01C	Clean environment	4700	2443	57	1.2	**WBK12S-01C**	6000VV	4550
WBK12-11	General	7100	3040	104	2.1	**WBK12S-01**	6000ZZ	4550
WBK12-11C	Clean environment	4700	2443	57	1.2	**WBK12S-01C**	6000VV	4550
WBK15-01A	General	7600	3380	113	2.4	**WBK15S-01**	6002ZZ	5600
WBK15-01B	Low type	7600	3380	113	2.4	**WBK15S-01B**	6002ZZ	5600
WBK15-01C	Clean environment	5100	2757	63	1.3	**WBK15S-01C**	6002VV	5600
WBK15-11	General	7600	3380	113	2.4	**WBK15S-01**	6002ZZ	5600
WBK15-11C	Clean environment	5100	2757	63	1.3	**WBK15S-01C**	6002VV	5600
WBK17-01A	General	13400	5800	120	3.5	**WBK17S-01**	6203ZZ	9550
WBK20-01	General	17900	8240	155	6.2	**WBK20S-01**	6204ZZ	12800
WBK20-11	General	17900	8240	155	6.2	**WBK20S-01**	6204ZZ	12800
WBK25-01	General	20200	10000	192	7.2	**WBK25S-01**	6205ZZ	14000
WBK25-11	General	20200	10000	192	7.2	**WBK25S-01**	6205ZZ	14000
WBK04R-11	General	615	490	6.5	0.59	—	—	—
WBK06R-11	General	1280	930	9	0.59	—	—	—

Support kits for ball screws for transfer equipment

Support kits are for the RMS type ball screw.

However, please use support units for general use in case of RMA1002 or larger rolled ball screws.



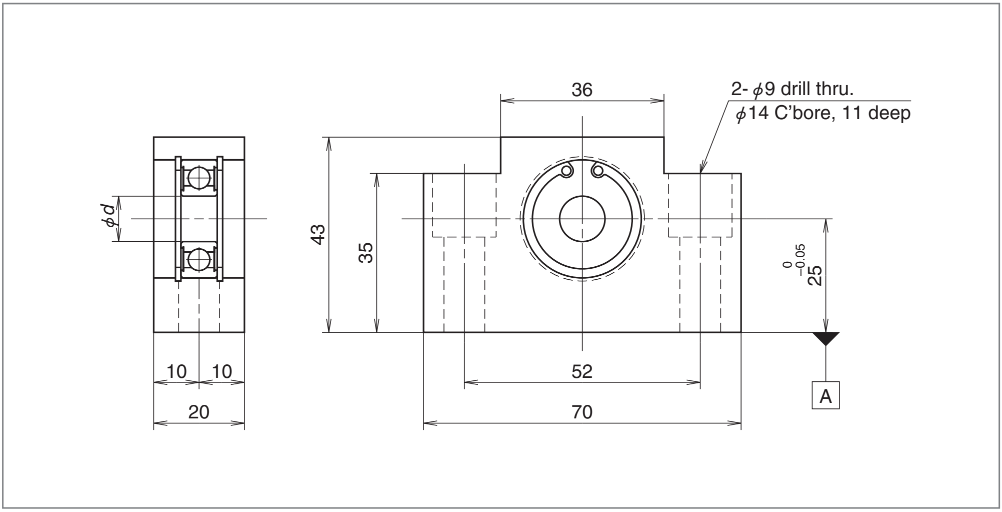
Units: mm

Reference no.	A	C	d	D_1	D_2	E	F	G	H	W	U	M
WBK04R-11	14	25	4	13	12.5	9	5	5	2.5	19	10	M4×0.5
WBK06R-11	19	30	6	18	17	11	5	6.8	2.5	24	12	M6×0.75

Reference no.	Applicable ball screw	Locknut tightening torque (reference) [N·cm]	Set screw tightening torque (reference) [N·cm]
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 a place to make run-out of mounting face minimal, and then tighten a locknut.
2. A support kit is put on a provisional shaft (bolt) for shipping.
3. When securing support unit on the shaft, insert the set piece (brass pad) that is provided with the support unit into the lock nut screw hole, and then tighten the set screw.

Simple support side support units for VFA type ball screws



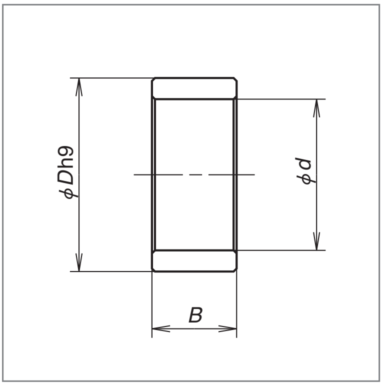
Units: mm

Reference no.	*d*	Applicable ball screw
WBK12SF-01	12	VFA1210
WBK15SF-01	15	VFA1510 VFA1520

Notes:
1. Use datum face A for mounting to the machine base.
2. This type of simple side support unit is made exclusively for NSK VFA ball screws. This unit supports the outer diameter of the screw shaft.

Spacer

The shaft requires an optional spacer on the journal where the ball thread is cut through the bearing shoulder. This is common for R series for transportation ball screw shaft, when mounting the support unit for fixed support side.

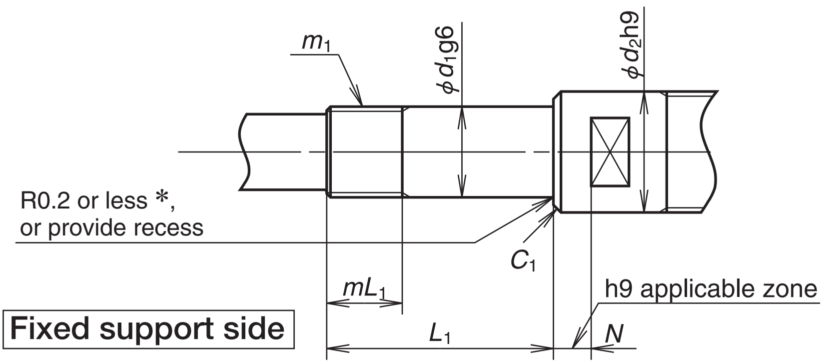


Units: mm

Reference no.	Internal diameter, *d*	Outside diameter, *D*	Width *B*	Applicable support unit
WBK06K	6	9.5	5.0	WBK06-∗∗
WBK08K	8	11.5	5.5	WBK08-∗∗
WBK10K	10	14.5	5.5	WBK10-∗∗
WBK12K	12	15.0	5.6	WBK12-∗∗
WBK15K	15	19.5	10.0	WBK15-∗∗
WBK17K	17	24.4	7.0	WBK17-∗∗
WBK20K	20	25.5	11.0	WBK20-∗∗
WBK25K	25	32.0	14.0	WBK25-∗∗

Screw shaft end configuration

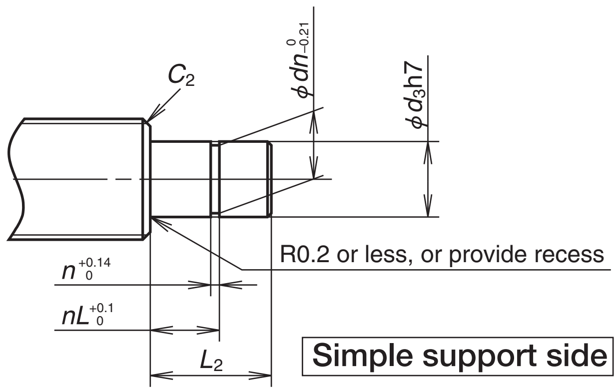
Dimensions of the shaft end configurations for the light load and small equipment support units, are shown in the table below. When using a spacer for a ball screw for transportation, add the width of the spacer (B from table of spacer dimensions on page B446) to the L_1 dimension below.



Radius marked with ∗ above is 0.15 or less for WBK04R-11 and WBK06R-11.

Units: mm

Reference no.	Fixed support side						
	Bearing journal		Locknut thread		Sealing part		Chamfer
	d_1	L_1	m_1	mL_1	d_2	N	C_1
WBK06-∗∗	6	22.5	M6×0.75	7	9.5	3.5	0.2
WBK08-∗∗	8	27	M8×1	9	11.5	4	0.2
WBK10-∗∗	10	30	M10×1	10	14	6	0.2
WBK12-∗∗	12	30	M12×1	10	15	6	0.2
WBK15-∗∗	15	40	M15×1	15	19.5	5	0.3
WBK17-∗∗	17	46	M17×1	17	24	7	0.3
WBK20-∗∗	20	53	M20×1	16	25	10	0.3
WBK25-∗∗	25	62	M25×1.5	20	32	14	0.5
WBK04R-11	4	15	M4×0.5	7.5	—	—	0.3
WBK06R-11	6	17	M6×0.75	7.5	—	—	0.3

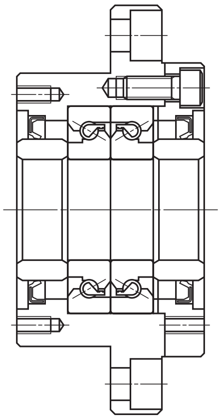


Units: mm

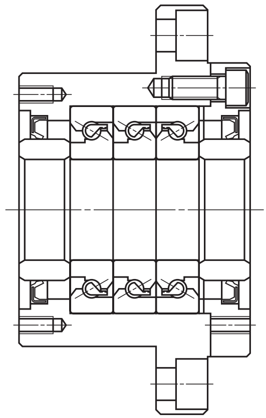
Reference no.	Simple support side					
	Bearing journal		Snap ring groove			Chamfer
	d_3	L_2	n	dn	nL	C_2
————	—	—	—	—	—	—
WBK08S-＊＊	6	9	0.8	5.7	6.8	0.2
WBK10S-＊＊	8	10	0.9	7.6	7.9	0.2
WBK12S-＊＊	10	22	1.15	9.6	9.15	0.5
WBK15S-＊＊	15	25	1.15	14.3	10.15	0.5
WBK17S-＊＊	17	16	1.15	16.2	13.15	0.5
WBK20S-＊＊	20	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

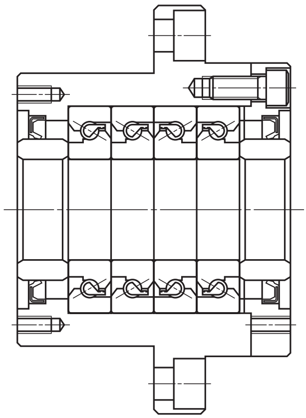
Support units for heavy-load/machine tools use a thrust angular contact ball bearing (TAC Series) with high rigidity and accuracy. The thrust angular contact ball bearing has very suitable functions and structure as a ball screw support bearing.
There are three combinations as shown below.



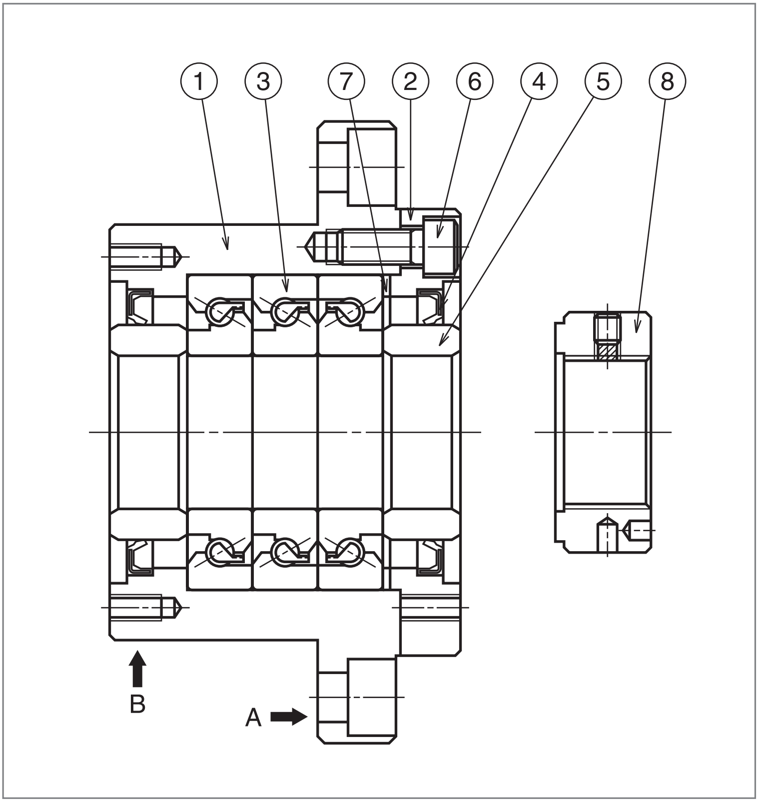
DF combination



DFD combination



DFF combination

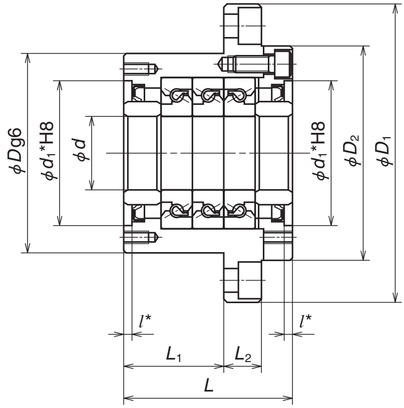


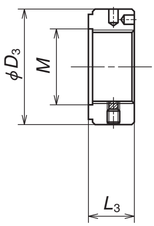
Parts list

Part number	Part name	Quantity
①	Housing	1
②	Retaining cover	1
③	High accuracy thrust angular contact ball bearing	One set
④	Dust seal	2
⑤	Collar	2
⑥	Preload bolt	6 or 8
⑦	Shim	One set
⑧	Lock nut	1

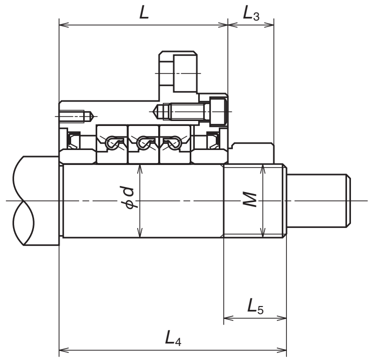
Remarks

1. Mount sections A and B to the machine base.
2. NSK support units are precisely preloaded and adjusted. Components ①, ②, ③, ④, ⑥, ⑦ are assembled into a unit. Do not disassemble.
3. Grease is packed into the bearings.
4. Lock nut ⑧ is exclusively prepared for ball screw. The end face of the nut is in strict control being precisely perpendicular to the V thread. Secure the lock nut using the set screw.
   Lock nut is also available as an accessory (See page B453). Refer to Page B457 as well for high-precision thrust angular contact ball bearing (TAC Series).





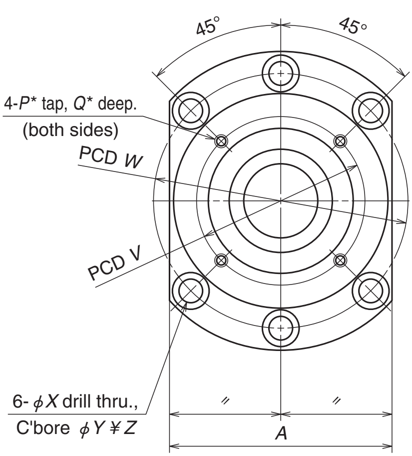
Lock nut



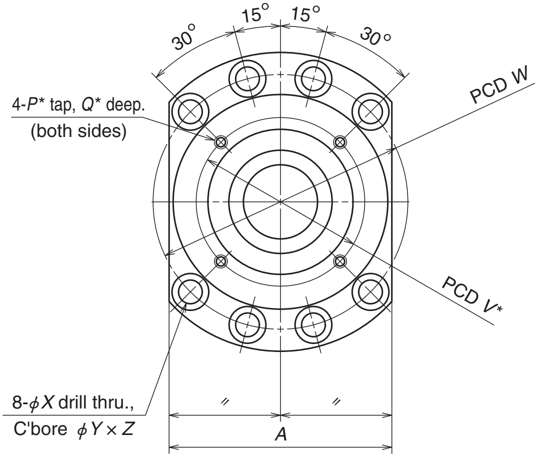
Dimensions of bearing seat

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											

Remarks 1. Rigidity
Values in the Table are theoretical values obtained from the elastic deformation between the groove and the balls.
2. Starting torque
Starting torque indicates torque due to the preload of the bearing. It does not include seal torque.
3. The tolerance of the shaft bearing seat
We recommend h5 class of the fits tolerance.



Bearing bore $d \leq 30$



Bearing bore $d \geq 35$

Unit: mm

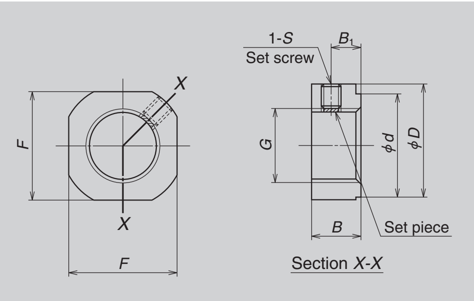
Basic dynamic load rating	Permissible axial load	Preload	Axial rigidity	Maximum Starting torque	Lock nut			Mass	Bearing seat for unit		
C_a (N)	(N)	(N)	(N/μm)	(N · cm)	M	D_3	L_3	(kg)	d	L_4	L_5
21900	26600	2150	750	19	M17×1	37	18	1.9	17	81	23
21900	26600	2150	750	19	M20×1	40	18	1.9	20	81	23
28500	40500	3150	1000	29	M25×1.5	45	20	3.1	25	89	26
46500	81500	4300	1470	39				3.4		104	
29200	43000	3350	1030	30	M30×1.5	50	20	3.0	30	89	26
47500	86000	4500	1520	40				3.3		104	
31000	50000	3800	1180	34	M35×1.5	55	22	3.4	35	92	30
50500	100000	5200	1710	45				4.3		107	
50500	100000	7650	2350	59				5.0		122	
31500	52000	3900	1230	36	M40×1.5	60	22	3.6	40	92	30
51500	104000	5300	1810	47				4.2		107	
51500	104000	7850	2400	61				4.7		122	

Remarks 4. Dimensions with * (asterisk) mark
*Pilot diameter and tapped screws marked with "asterisk *" are used for seal unit installation for NSK standard hollow shaft ball screws. They also can be used for dust cover and damper installation.
5. Grease is packed into the bearing. It is not necessary to apply grease before use.

In addition to the support units, NSK has other components for the ball screw as shown below.

(3) Lock nuts

Ball screw support bearing must be installed with minimum inclination. NSK lock nuts exclusive for ball screw help to reduce this inclination.



A Type Shapes and dimensions

A Type lock nuts

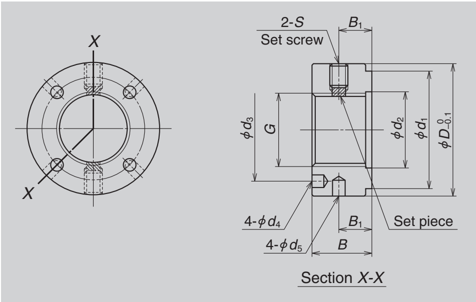
A Type lock nuts

Lock nut reference number	*G*	*D*	*F*	*B*	*d*
WBK06L-01	M6×0.75	14.5	12	5	10
WBK08L-01	M8×1	17	14	6.5	13
WBK10L-01	M10×1	20	17	8	16
WBK12L-01	M12×1	22	19	8	17
WBK15L-01	M15×1	25	22	10	21
WBK17L-01	M17×1	29	24	13	24
WBK20L-01	M20×1	35	30	13	26
WBK25L-01	M25×1.5	42	36	16	34

Remarks: Insert a set piece (brass pad) and tighten the securing set screw.

S Type lock nuts

Lock nut reference number	*G*	$D^{0}_{-0.1}$	*B*	d_1	d_2	d_3
WBK17L-31	M17×1	37	18	30	18	27
WBK20L-31	M20×1	40	18	30	21	30
WBK25L-31	M25×1.5	45	20	40	26	35
WBK30L-31	M30×1.5	50	20	40	31	40
WBK35L-31	M35×1.5	55	22	50	36	45
WBK40L-31	M40×1.5	60	22	50	41	50



S Type Shapes and dimensions

S Type lock nuts

Unit: mm

B_1	S	Tightening torque (N · cm) (for reference)	Set screw tightening torque (reference) [N · cm]
2.75	M3, with brass made set piece	190	69 (M3)
4	M3, with brass made set piece	230	69 (M3)
5	M4, with brass made set piece	280	147 (M4)
5	M4, with brass made set piece	630	147 (M4)
6	M4, with brass made set piece	790	147 (M4)
8	M4, with brass made set piece	910	147 (M4)
8	M4, with brass made set piece	1670	147 (M4)
10	M6, with brass made set piece	2060	490 (M6)

Unit: mm

d_4	d_5	B_1	S	Tightening torque (N · cm) (for reference)	Set screw tightening torque (reference) [N · cm]
4.3	4	10	M6	4100	490 (M6)
4.3	4	10	M6	4500	490 (M6)
4.3	4	11	M6	8500	490 (M6)
4.3	5	11	M6	10100	490 (M6)
4.3	5	12	M6	13800	490 (M6)
4.3	5	12	M6	15500	490 (M6)

(4) Grease unit

NSK has numerous grease types that are exclusive for ball screw lubrication. They come in bellows-shaped tubes, that can be attached to a grease gun quickly. For details of grease types, refer to Page D13 or for grease pump and nozzles, refer to Page D20.

NSK greases

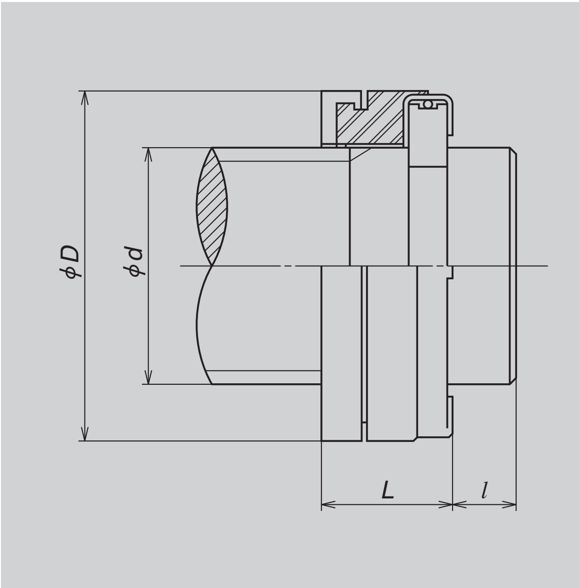
Lubricant greases

Name	Use	Base oil viscosity mm^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 (by order)

A travel stopper is installed in some cases to prevent the nut from overrunning due to the malfunction of the safety system of the equipment or by human error. NSK has several types of series of shock-absorbing travel stoppers. Please request NSK for installation.

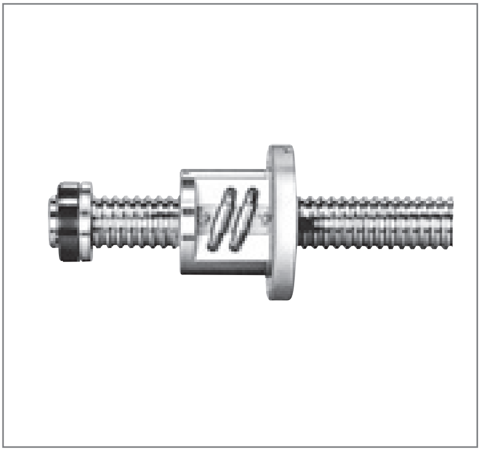
The travel stopper is not sold as a single item since it does not have a general use. Also, a travel stopper cannot be used for end cap type recirculation system, because the stopper would come directly into contact with the ball recirculating portion.



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

Remarks: This stopper is patented by NSK Ltd.



Shock-absorbing travel stopper

Thrust Angular Contact Ball Bearing for Ball Screw

(1) Features

This is highly rigid and accurate ball screw support bearing often used for the machine tool driving mechanism.

① High axial rigidity

Uses many balls, and set high contact angle at 60 degrees.

② Small friction torque

Friction torque is smaller than that of tapered or cylindrical roller bearing. This contributes to accurate rotation by a small driving power.

③ Axial play is pre-adjusted

Combination bearings are already adjusted to a suitable preload. Universal combination bearing (SU) furnishes certain preload for all combinations (DB, DF, and other).

④ Simple mounting structure

A duplex combination of bearings can receive axial and radial loads. Therefore, the installation structure is simpler than when both a thrust bearing and a radial bearing are used.

⑤ Easy handling

Inner and outer rings are inseparable, and are easy to handle.

⑥ Superb polyamide resin retainer

Uses polyamide resin retainer which is superb to friction and furnishes high precision rotations.

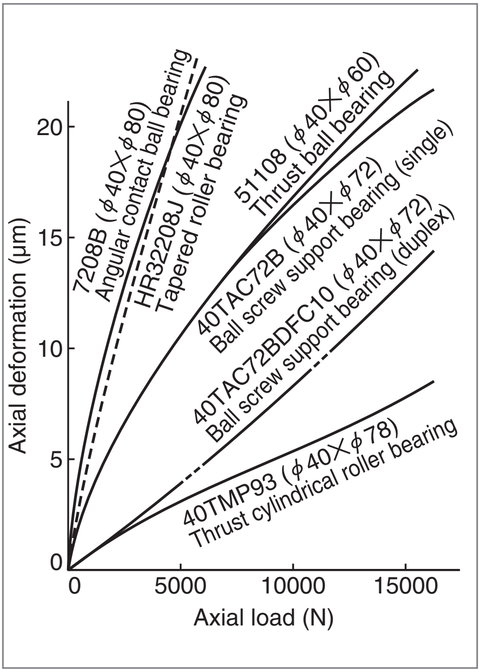


Fig. 1 Axial rigidity of various bearings

Table 2 Comparison with other types of bearings

Bearing type	Bearing rigidity (See Fig. 1)	Starting torque	Preload adjustment	Installation structure
Thrust angular contact ball bearing for NSK precision ball screw support unit	High	Low	Not required	Simple
Combined angular contact ball bearing	Low	Low	Not required	Simple
Combination of tapered roller bearings	Low	High	Complicated	Simple
Thrust ball bearing and radial bearing	High	Low	Complicated	Complicated
Thrust cylindrical roller bearing and radial bearing	Extremely high	Extremely high	Complicated	Complicated

Note : Consult NSK when you use these bearings other than the purpose of ball screw support.

(2) Composition of reference number

30 TAC 62 B DF C10 PN7A

- 30 — Bearing bore (mm)
- TAC — Bearing model code
- 62 — Bearing outside diameter (mm)
- B — Internal design code
- DF — Combination code
- C10 — Axial play code
- PN7A — Accuracy

Remark : As "30 TAC 62 B," any part of the first half of the reference number is referred to as "nominal size" in this catalog.

(3) Bearing combinations

Generally, a set uses more than two pieces (referred to as 'two rows') of bearings and, thus the preload is applied.
There are two types of combination:

● **Bearing combination**
Bearings are adjusted as a single combined set. Since the bearing alignment is pre-set, there is no interchangeability;

● **Universal combination bearing (SU)**
A combination of independent bearings, which is manufactured as a single bearing. Bearings are randomly-matched to obtain required preload by more than one of randomly picked up bearings.

① **Bearing combination**

- Figure 2 shows examples of combinations. There is "V" mark on the outside surface of the bearing to avoid misarrangement. A complete letter "V" should be formed when all bearings align correctly to form a set.
- DF combination which easily absorbs misalignment with the ball screw nut is used in general.

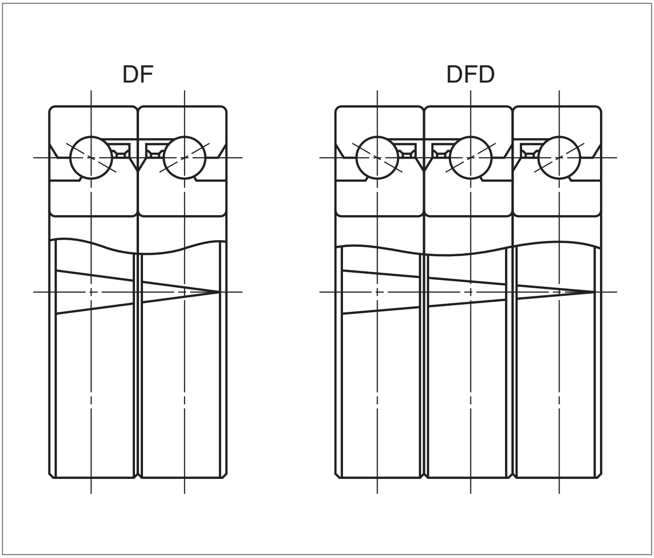


Fig. 2 Examples of combination and "V" mark

② **Universal combination bearing (SU)**

• Unlike the above case, marks on the bearing outside surface do not form a letter "V." The tip of the "V" on each bearing simply indicates the direction to which axial load can be applied.

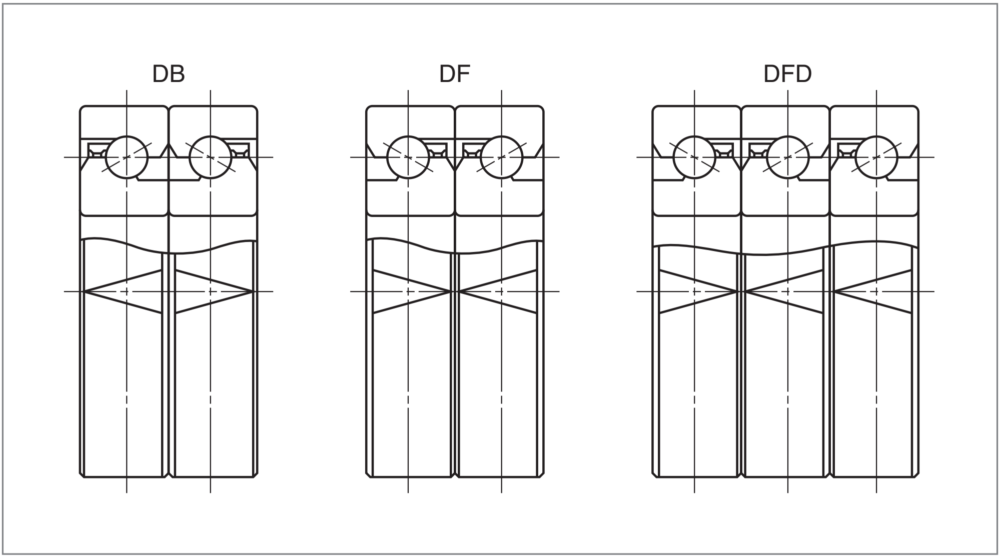


Fig. 3 Example of universal combination (SU) and "V" mark

(4) Preload, rigidity, and starting torque

The table 3 shows preload, rigidity (spring modulus), and starting torque with grease lubrication. (The starting torque should be 1.4 times higher when oil is used as a lubricant.)
Consult NSK for the bearing combinations not included in the Table below.

(5) Accuracy

① Accuracy grades

Uses NSK standard PN7A and PN7B which are equivalent to JIS4 grade of the radial ball bearing.
Combined bearing ———————— PN7A
Universal combination bearing —— PN7B
However, PN7A is stricter than JIS4 grade regarding axial run out of inner and outer rings. PN7B is stricter regarding the tolerance of the bore and outside diameter (Table 4).

Table 3 Preload, rigidity, and starting torque

Reference number	Duplex combination DF				Triplex combination DFD	
	Axial play code	Preload (N)	Rigidity (N/μm)	Starting torque (N · m)	Axial play code	Preload (N)
15TAC 47B	C10	2150	750	0.14	C10	2950
17TAC 47B	C10	2150	750	0.14	C10	2950
20TAC 47B	C10	2150	750	0.14	C10	2950
25TAC 62B	C10	3150	1000	0.23	C10	4300
30TAC 62B	C10	3350	1030	0.24	C10	4500
35TAC 72B	C10	3800	1180	0.28	C10	5200
40TAC 72B	C10	3900	1230	0.28	C10	5300
40TAC 90B	C10	5000	1320	0.48	C10	6750
45TAC 75B	C10	4100	1270	0.29	C10	5600
45TAC 100B	C10	5900	1520	0.58	C10	8050
50TAC 100B	C10	6100	1570	0.60	C10	8250
55TAC 100B	C10	6100	1570	0.60	C10	8250
55TAC 120B	C10	6650	1810	0.64	C10	9100
60TAC 120B	C10	6650	1810	0.64	C10	9100

Table 4 Tolerance: thrust angular contact ball bearing for ball screw support

Unit: μm

Nominal size of bearing bore or outside diameter (mm)		Tolerance of bore				Tolerance of outside diameter				Tolerance of inner ring width		Axial run out of inner or outer ring
		Accuracy grade				Accuracy grade				Accuracy grade		Accuracy grade
		PN7A		PN7B		PN7A		PN7B		PN7A PN7B		PN7A 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

Remarks : The tolerance of the outer ring width is the same as that of the inner ring width of the same bearing.

② **Fits**

Table 5 shows recommended values of the tolerance of shaft and housing bore.

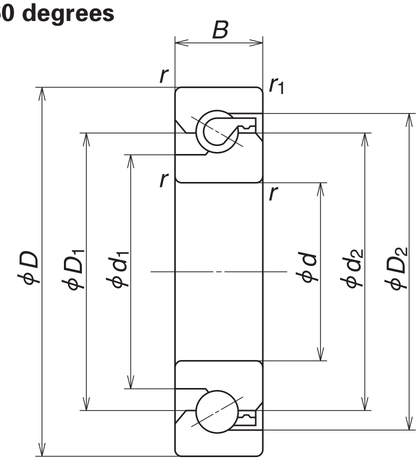
		Quadruplet combination DFF			
Rigidity (N/μm)	Starting torque (N · m)	Axial play code	Preload (N)	Rigidity (N/μm)	Starting torque (N · m)
1080	0.20	C10	4300	1470	0.29
1080	0.20	C10	4300	1470	0.29
1080	0.20	C10	4300	1470	0.29
1470	0.31	C10	6250	1960	0.46
1520	0.33	C10	6650	2010	0.49
1710	0.37	C10	7650	2350	0.55
1810	0.38	C10	7850	2400	0.57
1960	0.65	C10	10300	2650	0.96
1910	0.40	C10	8250	2550	0.59
2210	0.78	C10	11800	3000	1.16
2300	0.80	C10	12300	3100	1.18
2300	0.80	C10	12300	3100	1.18
2650	0.86	C10	13200	3550	1.27
2650	0.86	C10	13200	3550	1.27

Table 5 Tolerance of shaft bearing seat and housing bore

Unit: μm

Size of shaft or housing bore (mm)		Tolerance of shaft bearing seat h5		Tolerance of housing hole H6	
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



External dimensions (mm)					Dimensions (mm)				Permissible rotational speed (min^{-1})		
d	D	B	r Min.	r_1 Min.	d_1	d_2	D_1	D_2	Grease lubrication	Oil lubrication	Bearing No.
15	47	15	1	0.6	27.2	34	34	39.6	6000	8000	**15TAC 47B**
17	47	15	1	0.6	27.2	34	34	39.6	6000	8000	**17TAC 47B**
20	47	15	1	0.6	27.2	34	34	39.6	6000	8000	**20TAC 47B**
25	62	15	1	0.6	37	45	45	50.7	4500	6000	**25TAC 62B**
30	62	15	1	0.6	39.5	47	47	53.2	4300	5600	**30TAC 62B**
35	72	15	1	0.6	47	55	55	60.7	3600	5000	**35TAC 72B**
40	72	15	1	0.6	49	57	57	62.7	3600	4800	**40TAC 72B**
40	90	20	1	0.6	57	68	68	77.2	3000	4000	**40TAC 90B**
45	75	15	1	0.6	54	62	62	67.7	3200	4300	**45TAC 75B**
45	100	20	1	0.6	64	75	75	84.2	2600	3600	**45TAC 100B**
50	100	20	1	0.6	67.5	79	79	87.7	2600	3400	**50TAC 100B**
55	100	20	1	0.6	67.5	79	79	87.7	2600	3400	**55TAC 100B**
55	120	20	1	0.6	82	93	93	102.2	2200	3000	**55TAC 120B**
60	120	20	1	0.6	82	93	93	102.2	2200	3000	**60TAC 120B**

Note : (1) Values are based on a standard preload (C10).

Dynamic equivalent load $P_a = XF_r \times F_a$

Bearing configuration / Combination code / Number of the row that receives axial load		Duplex		Triplex			Quadruplet		
		DF	DT	DFD		DTD	DFT	DFF	DFT
e=2.17		One row	Two rows	One row	Two rows	Three rows	One row	Two rows	Three rows
$F_a/F_r \le e$	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

Basic dynamic load rating C_a			Permissible axial load			Mass
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)
21900	35500	47500	26600	53000	79500	0.144
21900	35500	47500	26600	53000	79500	0.144
21900	35500	47500	26600	53000	79500	0.135
28500	46500	61500	40500	81500	122000	0.252
29200	47500	63000	43000	86000	129000	0.224
31000	50500	67000	50000	100000	150000	0.310
31500	51500	68500	52000	104000	157000	0.275
59000	95500	127000	89500	179000	269000	0.674
33000	53500	71000	57000	114000	170000	0.270
61500	100000	133000	99000	198000	298000	0.842
63000	102000	136000	104000	208000	310000	0.778
63000	102000	136000	104000	208000	310000	0.714
67500	109000	145000	123000	246000	370000	1.23
67500	109000	145000	123000	246000	370000	1.16

* "Row" means the quantity of bearings that receive axial load.
"Two rows" means two bearings are receiving axial load.

B-3-3 Dimension Table and Reference Number of Standard Nut Ball Screws

B-3-3.1 End Deflector Type Ball Screw

NSK has a patent for this product.

1. Features

●Silent and high quality of sound

The average noise level is reduced by more than 6 dB compared with our conventional products. At low-speed rotation, the ball screws are nearly silent, while the lowest noise level is achieved at high-speed rotation.

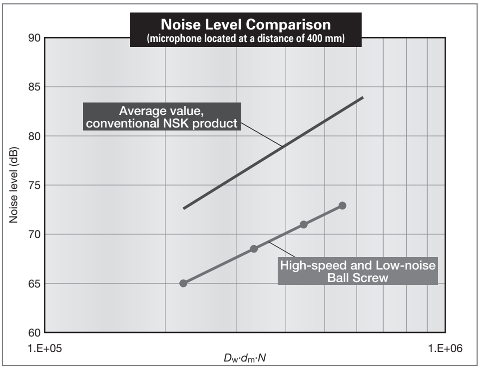


Fig. 1 Comparison of noise level

●High-speed operation

Realizes at d·n 180000 outstanding for ball screws and far surpassing the 100000 d·n performance of conventional return tube type products. For high lead ball screws, high-speed operation at over 200m/min is also possible.

●Compact

The external diameter of the ball nut is 30% smaller than our conventional models. Compact configurations are possible for low-profile XY tables as well as for other devices and equipment.

●Grease fitting provided as standard equipment

The ball screws with shaft diameters of less than ø25 are standardly equipped with a grease fitting (M5 × 0.8). Lubrication ports are provided in 2 places to facilitate maintenance. The ball screws can be easily connected to an integrated lubrication system.

2. Specifications

(1) Recirculation system

Fig. 2 shows the structure of the end-deflector recirculation system.

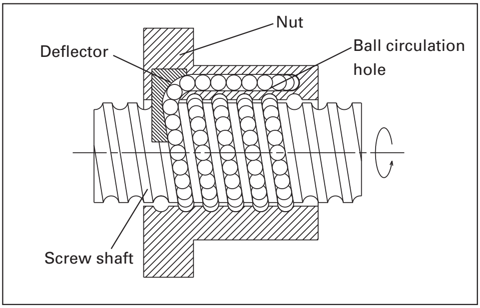


Fig. 2 Structure of end-deflector recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

Accuracy grade	C0, C1, C2, C3, C5, Ct7
Axial play	Z, 0 mm (Preload); T, 0.005 mm or less S, 0.020 mm or less; N, 0.050 mm or less

(3) Allowable d·n value and the criterion of maximum rotational speed

Allowable d·n value and the criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Allowable d·n value : 180000 or less
Standard of rotational speed : 5000 min^{-1}

Note: Please also review the critical speed. See "Technical Description: Permissible rotational speed" (Page B51) for details.

(4) Seal

Compact, thin plastic seal is available. Nut outside diameter is compact compare with the return tube recirculation system.

(5) Option

Optional NSK K1 lubrication unit, molded from resin and impregnated with lubrication oil, supplies fresh oil onto ball rolling surfaces, ensuring long-term, maintenance-free operation. Please contact NSK when using NSK K1.

3. Design precautions

When designing the shaft end of a ball screw which diameter is 25 mm or less, or 32 mm or over, and the lead is the same as its shaft diameter, one end of the screw must meet either one of the following conditions. If not, we cannot install the ball nut on the screw shaft.

- Cut the ball groove through to the shaft end.
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove "dr" specified on the dimension table.

For general precautions regarding ball screws, refer to "Design Precautions"(Page B84) and "Handling Precautions"(Page B103).

4. Product categories

End deflector type has a model as follows.

Table 2 End-deflector type ball screw product categories

Nut model	Shape	Flang shape	Nut shape	Preload system
BSS		Circular Ⅱ, Ⅲ	Circular	Non-preload, Slight axial play P preload (light preload)

5. Example of model number in dimension tables

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇Model number

BSS 10 10 - 2E

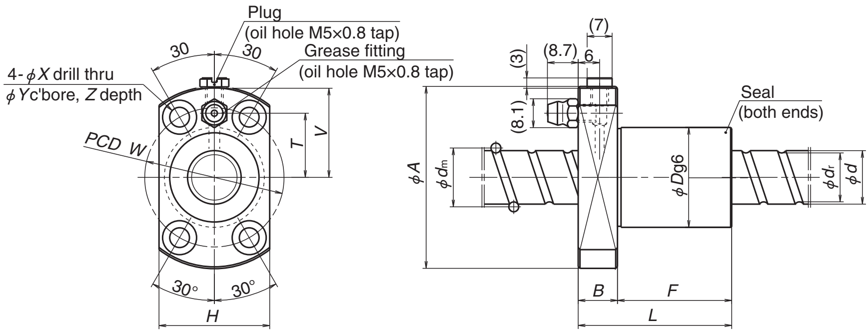
- Nut model: BSS
- Screw shaft diameter (mm)
- Lead (mm)
- Effective turns of balls

◇Reference number for ball screw

W 10 01 - ** P SS - C5 Z 10

- 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
- End-deflector recirculation system
- Accuracy grade: C0, C1, C2, C3, C5, C7 (Ct7)
- Axial play code: Z, T, S, N
- Lead (mm)

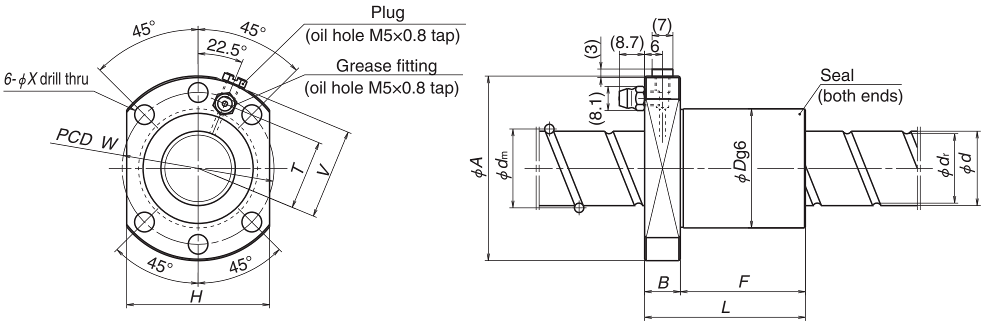
End deflector type



Flange TYPE I

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	Basic load rating (N) Static C_{0a}	Axial rigidity K (N/μm)
BSS1005-3E	10	5	2.000	10.3	8.2	3	3420	4840	126
BSS1010-2E		10				2	2290	2980	77
BSS1205-3E	12	5	2.000	12.3	10.2	3	3750	5810	146
BSS1210-3E		10				3	3760	5780	142
BSS1220-2E		20				2	2330	3600	83
BSS1230-2E		30				2	2190	3650	75
BSS1505-3E	15	5	2.778	15.5	12.6	3	6410	10100	183
BSS1510-3E		10				3	6530	10200	181
BSS1520-2E		20	3.175		12.2	2	5660	8700	127
BSS1530-2E		30				2	5500	8580	116
BSS2005-3E	20	5	3.175	20.5	17.2	3	10400	18500	268
BSS2010-3E		10				3	10200	18600	268
BSS2020-2E		20				2	6790	11800	167
BSS2030-2E		30				2	6550	11800	159
BSS2040-2E		40				2	6380	11600	147
BSS2060-2E		60				2	5680	11800	128
BSS2505-3E	25	5	3.175	25.5	22.2	3	11500	23500	325
BSS2510-4E		10				4	15000	32400	437
BSS2520-2E		20				2	7650	14800	203
BSS2525-2E		25				2	7490	14600	197
BSS2530-2E		30				2	7490	14600	194
BSS2550-2E		50				2	6910	14700	177

Note: The axial rigidity in the table above is a theoretical value derived from elastic displacement between screw grooves and balls when axial load is applied to a ball nut for which preload is set at 3% of the basic dynamic load rating (C_a).
For ball screws with shaft diameters less than ø25, the standard Compact FA PSS can be available.

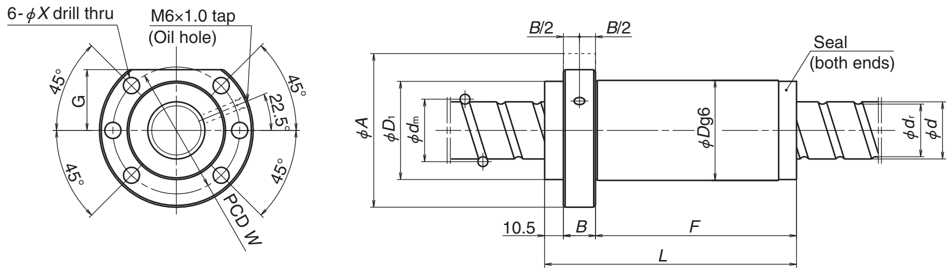


Flange TYPE Ⅱ

Unit: mm

Nut entire length	Nut diameter	Flange diameter	Flange width	Nut length	Flange dimension		Flange	Bolt hole PCD	Bolt hole dimension			Oil hole distance
L	*D*	*A*	*B*	*F*	*H*	*V*	*TYPE*	*W*	*X*	*Y*	*Z*	*T*
29	23	43	11	18	26	21	Ⅰ	33	4.5	8	4.5	14
32				21								
30	24	44	11	19	27	21.5	Ⅰ	34	4.5	8	4.5	14.5
43				32								
50				39								
70				59								
30	28	51	11	19	31	25	Ⅰ	39	5.5	9.5	5.5	18
43				32								
51	32	55		40	33	27		43				20
71				60								
31	36	62	13	18	38	30.5	Ⅰ	49	6.6	11	6.5	23.5
45				32								
54				41								
74				61								
92				79								
129				116								
32	40	62	12	20	48	30.5	Ⅱ	51	6.6	—	—	23.5
56				44								
54				42								
63				51								
74				62								
114				102								

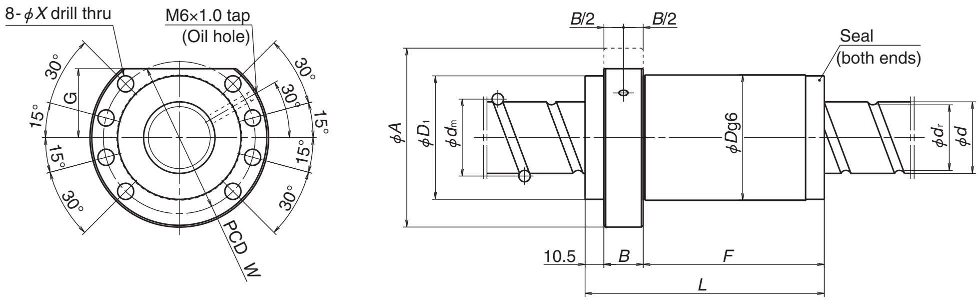
End deflector type



Flange TYPE Ⅲ

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	Basic load rating (N) Static C_{0a}	Axial rigidity K (N/μm)
BSS3205-4E	32	5	3.175	32.5	29.2	4	16800	41700	534
BSS3210-6E		10	5.556	33	27.2	6	50900	110000	865
BSS3212-5E		12				5	43000	91300	716
BSS3216-5E		16				5	44300	90800	716
BSS3220-5E		20				5	43900	91200	708
BSS3232-2E		32				2	17700	32900	261
BSS3264-2E		64				2	16800	32900	232
BSS3605-3E	36	5	3.175	36.5	33.2	3	13500	34100	433
BSS3610-6E		10	6.35	37	30.4	6	65000	141000	970
BSS3612-6E		12				6	64800	141000	967
BSS3616-6E		16				6	64500	142000	961
BSS3620-6E		20				6	64000	141000	959
BSS4010-5E	40	10	6.35	41	34.4	5	58100	130000	875
BSS4012-5E		12				5	58000	130000	873
BSS4016-5E		16				5	57700	131000	875
BSS4020-5E		20				5	57400	130000	868
BSS4025-4E		25				4	46300	102000	686
BSS4030-3E		30				3	36100	74800	505
BSS4040-2E		40				2	23700	47100	319
BSS4080-2E		80				2	22200	46600	286
BSS4510-5E	45	10	6.35	46	39.4	5	62400	147000	961
BSS4512-5E		12				5	62300	147000	959
BSS4516-5E		16				5	62100	147000	955
BSS4520-5E		20				5	61800	146000	950
BSS4525-5E		25				5	61400	147000	954
BSS4530-4E		30				4	49600	115000	752
BSS5010-4E	50	10	6.35	51	44.4	4	52600	129000	836
BSS5012-4E		12				4	52500	129000	944
BSS5016-4E		16				4	52400	128000	832
BSS5020-4E		20				4	52200	129000	837
BSS5025-4E		25				4	51900	129000	828
BSS5030-4E		30				4	51500	128000	821
BSS5050-2E		50				2	26100	58300	383
BSS50100-2E		100				2	24100	58900	342

Note: The axial rigidity in the table above is a theoretical value derived from elastic displacement between screw grooves and balls when axial load is applied to a ball nut for which preload is set at 3% of the basic dynamic load rating (C_a).



Flange TYPE Ⅳ

Unit: mm

Nut entire length L	Nut diameter D	Seal section diameter D_1	Flange diameter A	Flange width B	Nut length F	Notched flange G	Flange TYPE	Bolt hole PCD W	Bolt hole dimension X
55	56	55	86	12	32.5	34	Ⅲ	71	9
104				18	75.5				
103					74.5				
122					93.5				
141					112.5				
94					65.5				
153					124.5				
50	65	64	95	12	27.5	36	Ⅳ	80	9
109				22	76.5				
120					87.5				
143					110.5				
166					133.5				
99	70	69	100	22	66.5	38.5	Ⅳ	85	9
108					75.5				
127					94.5				
146					113.5				
145					112.5				
134					101.5				
110					77.5				
184					151.5				
99	75	74	110	22	66.5	43	Ⅳ	93	11
108					75.5				
127					94.5				
146					113.5				
170					137.5				
164					131.5				
89	82	81	118	22	56.5	46	Ⅳ	100	11
96					63.5				
111					78.5				
126					93.5				
145					112.5				
164					131.5				
130					97.5				
224					191.5				

B-3-3.2 Return Tube Type Ball Screw

1. Features

Return tube type is standard recirculation system for ball screws. It has various combinations of shaft dia. and lead.

2. Specifications

(1) Recirculation system

The structure of return tube recirculation system is shown below.

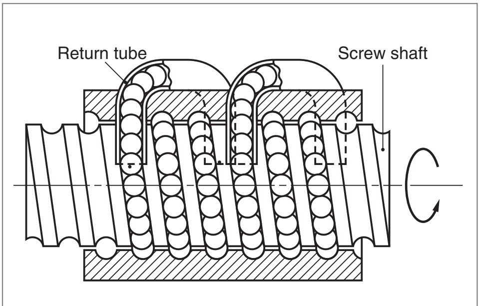


Fig.1 Structure of return tube recirculation system

Table 1 Accuracy grade and axial play

Accuracy grade	SFT, PFT, ZFT, DFT: C0, C1, C2, C3, C5, Ct7 LSFT, LPFT, LDFT: C1, C2, C3, C5, Ct7 (Ct7 is not included in DFT, LDFT)
Axial play	Z, 0 mm (Preload); T, 0.005 mm or less S, 0.020 mm or less; N, 0.050 mm or less

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are shown in Table 1. Please consult NSK for other grades.

(3) Allowable d·n value and the criterion of maximum rotational speed

Allowable d·n value and the criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below. Basic measure must be taken for the high speed ball screws respectively.

Allowable d·n value :

Standard specification ; 70000 or less

High-speed specification; 100000 or less

Standard of rotational speed : 3000 min^{-1}

Note: Please also review the critical speed. Refer to "Technical Description: Permissible rotational speed" (Page B51) for details.

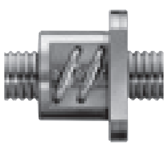
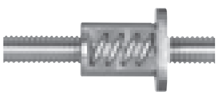
(4) Other specifications

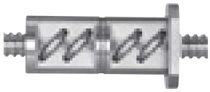
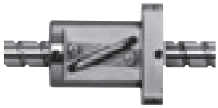
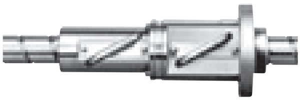
Please consult NSK for other specifications not listed in the dimension tables.

3. Product categories

There are four different preloaded systems with several models. Since the leads are in the range from 1/2 to the same length of the shaft diameter (medium-high helix lead), LSFT, LPFT, LDFT Type ball screws are suitable for high-speed operation.

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)

Nut model	Shape	Flange shape	Nut shape	Preload system
DFT		Flanged Circular Ⅰ, Ⅱ	Circular	D preload (medium preload) (heavy preload)
LSFT		Flanged d=20mm or under Rectangle d=25mm or over Circular Ⅱ	d=20mm or under Circular 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. Example of model number in dimension tables

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇ Model number

SFT 14 05 - 2.5

- SFT — Nut model: SFT, PFT, ZFT, DFT, LSFT, LPFT, LDFT
- 14 — Screw shaft diameter (mm)
- 05 — Lead (mm)
- 2.5 — Effective turns of balls (Note)

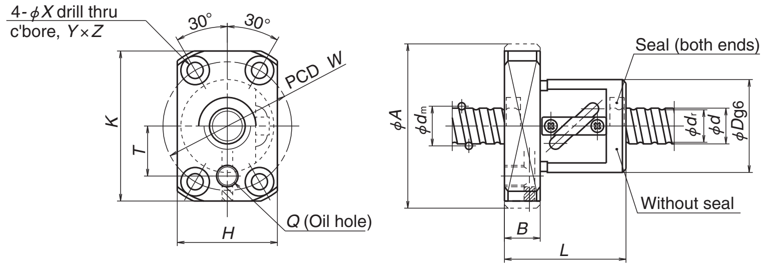
Note: In case of Z preload, the number here is twice as large as the effective turns of balls.

◇ Reference number for ball screw

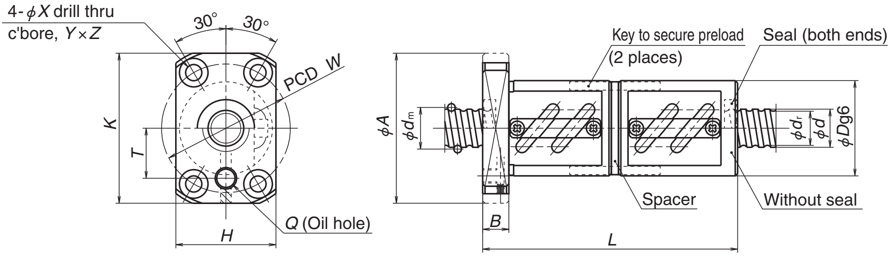
W 14 01 - ** P - C3 Z 5

- W — Product code
- 14 — Screw shaft diameter (mm)
- 01 — Effective threaded length (in the unit of 100 mm)
- ** — NSK design serial number
- P — Preload code: No code, non-preload; P, P preload; Z, Z preload; D, D preload
- C3 — Accuracy grade code: C0, C1, C2, C3, C5, C7 (Ct7)
- Z — Axial play code: Z, T, S, N
- 5 — Lead (mm)

Return tube type



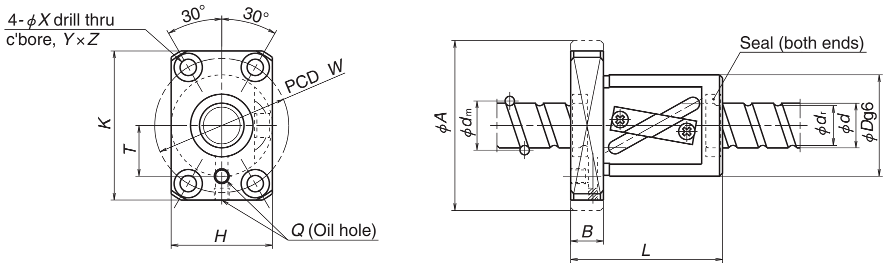
PFT, SFT



DFT

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	Static C_{0a}	Axial rigidity K (N/μm)
* **PFT 1004-2.5**	P	10	4	2.000	10.3	8.2	2.5×1	2020	2210	76
SFT 1004-2.5	Clearance							3210	4420	90
PFT 1204-2.5	P	12	4	2.381	12.3	9.8	2.5×1	2780	3140	89
PFT 1204-3	P						1.5×2	3250	3770	106
SFT 1204-2.5	Clearance						2.5×1	4410	6280	106
SFT 1204-3	Clearance						1.5×2	5160	7540	126
* **PFT 1205-2.5**	P		5	2.381	12.3	9.8	2.5×1	2770	3130	89
PFT 1205-3	P						1.5×2	3240	3760	106
SFT 1205-2.5	Clearance						2.5×1	4390	6260	106
SFT 1205-3	Clearance						1.5×2	5140	7510	126
* **LPFT 1210-2.5**	P		10	2.381	12.5	10.0	2.5×1	2790	3220	90
LSFT 1210-2.5	Clearance							4430	6430	110
* **PFT 1405-2.5**	P	14	5	3.175	14.5	11.2	2.5×1	5020	5970	116
SFT 1405-2.5	Clearance						2.5×1	7970	11900	140
PFT 1405-5	P						2.5×2	9110	11900	225
SFT 1405-5	Clearance						2.5×2	14500	23900	274
* **LPFT 1408-2.5**	P		8	3.175	14.5	11.2	2.5×1	4960	5920	120
LSFT 1408-2.5	Clearance							7880	11800	140
* **LPFT 1510-2.5**	P	15	10	3.175	15.5	12.2	2.5×1	5130	6420	127
LSFT 1510-2.5	Clearance							8140	12800	150
PFT 1604-3	P	16	4	2.381	16.3	13.8	1.5×2	3740	5130	135
SFT 1604-2.5	Clearance						2.5×1	5070	8500	134
DFT 1604-2.5	D						2.5×1	5070	8500	263
PFT 1604-5	P						2.5×2	5800	8500	215
SFT 1604-3	Clearance						1.5×2	5930	10300	160
DFT 1604-3	D						1.5×2	5930	10300	315

Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape.
2. Seals are equipped as a standard for LSFT and LPFT of shaft diameter 12 mm or smaller. The outside dimensions are the same as those of without seals.
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



LPFT, LSFT

B
476

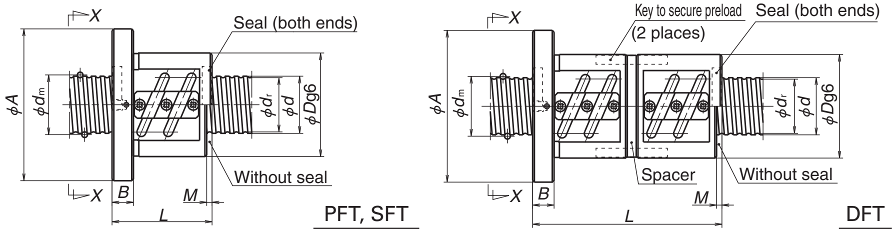
Unit: mm

Ball nut dimensions											
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
34	26	46	10	28	42	4.5	8	4.5	36	14	M6×1
38 44 38 44	30	50	10	32	45	4.5	8	4.5	40	15	M6×1
40 48 40 48	30	50	10	32	45	4.5	8	4.5	40	15	M6×1
50	30	50	10	32	45	4.5	8	4.5	40	15	M6×1
40 40 55 55	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
46	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
51	34	57	11	34	50	5.5	9.5	5.5	45	17	M6×1
45 38 70 50 45 85	34 34 36 34 34 36	57	11	34 34 36 34 34 36	50	5.5	9.5	5.5	45	17	M6×1

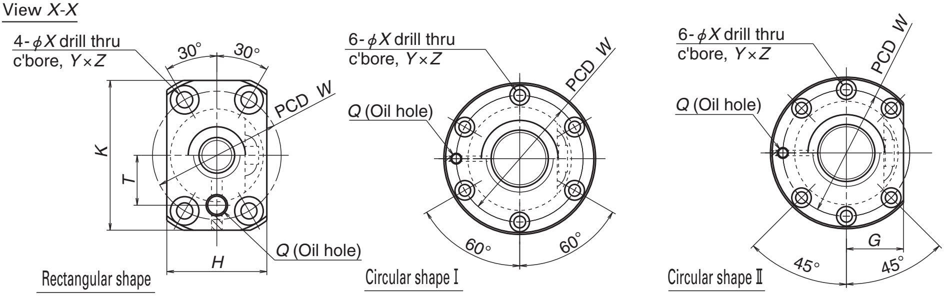
Remarks 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.

5. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.
6. The models marked with ✱ are in FA type of standard ball screw with finished shaft end.
7. Preload system: P, Oversize ball preload; D, Double nut preload (Refer to Page B5)

Return tube type

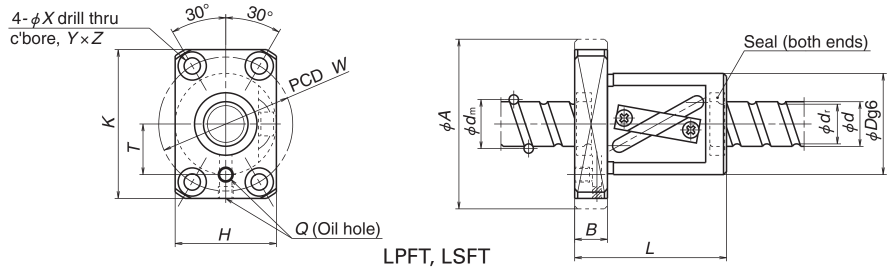


View X-X



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)
PFT 1605-3	P	16	5	3.175	16.5	13.2	1.5×2	6350	8070	158
SFT 1605-2.5	Clearance						2.5×1	8620	13800	158
DFT 1605-2.5	D						2.5×1	8620	13800	311
PFT 1605-5	P						2.5×2	9850	13800	258
SFT 1605-3	Clearance						1.5×2	10100	16100	188
DFT 1605-3	D						1.5×2	10100	16100	370
SFT 1605-5	Clearance						2.5×2	15600	27600	307
DFT 1605-5	D						2.5×2	15600	27600	603
* PFT 1606-2.5	P		6	3.175	16.5	13.2	2.5×1	5410	6880	133
SFT 1606-2.5	Clearance						2.5×1	8590	13800	158
DFT 1606-2.5	D						2.5×1	8590	13800	311
SFT 1606-3	Clearance						1.5×2	10100	16100	188
DFT 1606-3	D						1.5×2	10100	16100	370
* LPFT 1616-1.5	P		16	3.175	16.75	13.4	1.5×1	4180	5390	110
LSFT 1616-1.5	Clearance						1.5×1	5480	8080	100
SFT 2004-2.5	Clearance	20	4	2.381	20.3	17.8	2.5×1	5730	10900	160
DFT 2004-2.5	D						2.5×1	5730	10900	315
* PFT 2004-5	P						2.5×2	6550	10900	260
SFT 2004-5	Clearance						2.5×2	10400	21800	309
DFT 2004-5	D						2.5×2	10400	21800	608
PFT 2005-3	P		5	3.175	20.5	17.2	1.5×2	7140	10300	191
SFT 2005-2.5	Clearance						2.5×1	9690	17100	190
DFT 2005-2.5	D						2.5×1	9690	17100	376
* PFT 2005-5	P						2.5×2	11100	17100	311
SFT 2005-3	Clearance						1.5×2	11300	20500	227
DFT 2005-3	D						1.5×2	11300	20500	446
SFT 2005-5	Clearance						2.5×2	17600	34200	370
DFT 2005-5	D						2.5×2	17600	34200	726

Remarks:
1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".
3. Seals are equipped as a standard for LSFT and LPFT of shaft diameter 12 mm or smaller. The outside dimensions are the same as those of without seals.
4. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



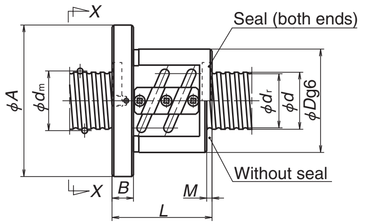
LPFT, LSFT

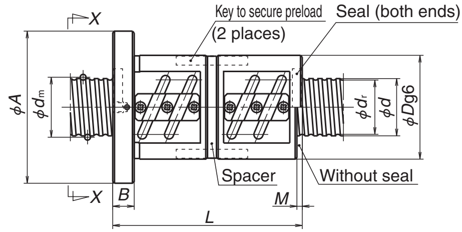
Unit: mm

Ball nut dimensions													
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
L	*D*	*A*	*B*	*G*	*H*	*K*	*M*	*X*	*Y*	*Z*	*W*	*T*	*Q*
52 42 77 57 52 97 57 107	40	63	11	—	40	55	—	5.5	9.5	5.5	51	20	M6×1
44 44 86 56 110	40	63	11	—	40	55	—	5.5	9.5	5.5	51	20	M6×1
56 56	40	63	12	—	40	55	—	5.5	9.5	5.5	51	17	M6×1
37 69 49 49 93	40	63	11	24	—	—	3	5.5	9.5	5.5	51	—	M6×1
52 41 76 56 52 97 56 106	44	67	11	26	—	—	3	5.5	9.5	5.5	55	—	M6×1

Remarks 5. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.
6. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.
7. The models marked with ✻ are in FA or SA type of standard ball screw with finished shaft end.
8. Preload system: P, Oversize ball preload; D, Double nut preload (Refer to Page B5)

Return tube type

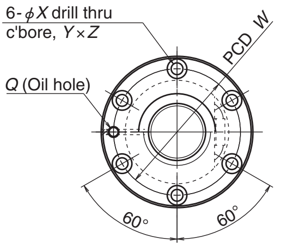




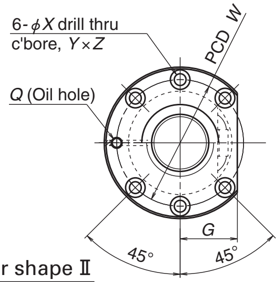
View *X*-*X*

PFT, ZFT, SFT

DFT



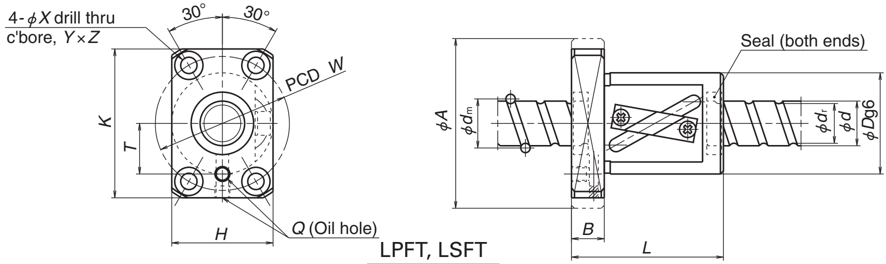
Circular shape Ⅰ



Circular shape Ⅱ

Model No.	Preload system	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls Turns × Circuits	Basic load rating (N) Dynamic C_a	Static C_{0a}	Axial rigidity K (N/μm)
PFT 2006-2.5	P	20	6	3.969	20.5	16.4	2.5×1	8120	10500	164
PFT 2006-3	P						1.5×2	9500	12600	195
SFT 2006-2.5	Clearance						2.5×1	12900	21000	195
DFT 2006-2.5	D						2.5×1	12900	21000	384
SFT 2006-3	Clearance						1.5×2	15100	25200	232
DFT 2006-3	D						1.5×2	15100	25200	456
PFT 2008-2.5	P		8	3.969	20.5	16.4	2.5×1	8080	10500	164
SFT 2008-2.5	Clearance						2.5×1	12800	20900	195
DFT 2008-2.5	D						2.5×1	12800	20900	384
SFT 2008-3	Clearance						1.5×2	15000	25100	232
DFT 2008-3	D						1.5×2	15000	25100	456
* LPFT 2010-2.5	P		10	3.969	21.0	16.9	2.5×1	8350	11000	169
LSFT 2010-2.5	Clearance						2.5×1	13300	21900	202
LPFT 2016-2.5	P		16	3.969	21.0	16.9	2.5×1	8170	10800	169
LSFT 2016-2.5	Clearance						2.5×1	13000	21600	202
* LPFT 2020-1.5	P		20	3.969	21.0	16.9	1.5×1	6250	8760	137
LSFT 2020-1.5	Clearance						1.5×1	8190	13100	127
SFT 2504-2.5	Clearance	25	4	2.381	25.3	22.8	2.5×1	6220	13600	193
ZFT 2504-5	Z						2.5×1	6220	13600	379
* PFT 2504-5	P						2.5×2	7110	13600	312
SFT 2504-5	Clearance						2.5×2	11300	27200	374
ZFT 2504-10	Z						2.5×2	11300	27200	735
PFT 2505-3	P		5	3.175	25.5	22.2	1.5×2	7940	12800	223
SFT 2505-2.5	Clearance						2.5×1	10800	21800	231
ZFT 2505-5	Z						2.5×1	10800	21800	454
* PFT 2505-5	P						2.5×2	12300	21800	372
SFT 2505-3	Clearance						1.5×2	12600	25600	271
DFT 2505-3	D						1.5×2	12600	25600	532
SFT 2505-5	Clearance						2.5×2	19600	43600	447
ZFT 2505-10	Z						2.5×2	19600	43600	876

Remarks:
1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".
3. Seals are equipped as a standard for LSFT and LPFT of shaft diameter 12 mm or smaller. The outside dimensions are the same as those of without seals.
4. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



LPFT, LSFT

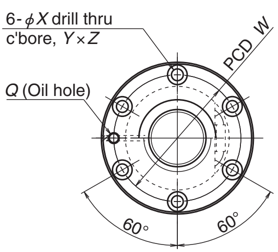
Unit: mm

Ball nut dimensions													
Nut entire length *L*	Nut diameter *D*	Flanged diameter *A*	Flanged width *B*	Notched flange *G*	Rectangle flanged diameter *H*	*K*	Seal dimension *M*	Bolt hole dimension *X*	*Y*	*Z*	Bolt hole PCD *W*	Oil hole length *T*	Oil hole *Q*
44 56 44 86 56 110	48	71	11	27	—	—	3	5.5	9.5	5.5	59	—	M6×1
54 54 102 64 120	48	75	13	28	—	—	5	6.6	11	6.5	61	—	M6×1
54 54	46	74	13	—	46	66	—	6.6	11	6.5	59	24	M6×1
72 72	46	74	13	—	46	66	—	6.6	11	6.5	59	24	M6×1
63 63	46	74	13	—	46	66	—	6.6	11	6.5	59	24	M6×1
36 48 48 48 72	46	69	11	26	—	—	3	5.5	9.5	5.5	57	—	M6×1
52 40 55 55 52 102 55 85	50	73	11	28	—	—	3	5.5	9.5	5.5	61	—	M6×1

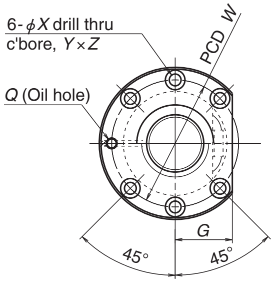
Remarks 5. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.
6. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.
7. The models marked with ✻ are in FA or SA type of standard ball screw with finished shaft end.
8. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

Return tube type

View *X*-*X*



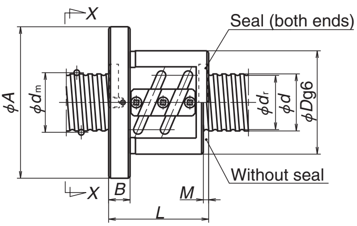
Circular shape Ⅰ



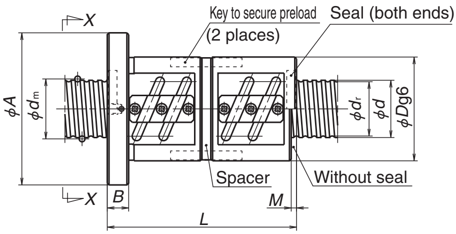
Circular shape Ⅱ

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	Static C_{0a}	Axial rigidity K (N/μm)
PFT 2506-3	P	25	6	3.969	25.5	21.4	1.5×2	10700	16000	235
SFT 2506-2.5	Clearance						2.5×1	14500	26700	235
ZFT 2506-5	Z						2.5×1	14500	26700	462
* **PFT 2506-5**	P						2.5×2	16600	26700	383
SFT 2506-3	Clearance						1.5×2	17000	32000	280
DFT 2506-3	D						1.5×2	17000	32000	551
SFT 2506-5	Clearance						2.5×2	26300	53400	456
ZFT 2506-10	Z						2.5×2	26300	53400	896
PFT 2508-2.5	P		8	4.762	25.5	20.5	2.5×1	11700	15900	203
PFT 2508-3	P						1.5×2	13700	18900	234
SFT 2508-2.5	Clearance						2.5×1	18500	31800	242
ZFT 2508-5	Z						2.5×1	18500	31800	476
SFT 2508-3	Clearance						1.5×2	21700	37900	286
DFT 2508-3	D						1.5×2	21700	37900	562
PFT 2510-2.5	P		10	4.762	25.5	20.5	2.5×1	11600	15900	203
ZFT 2510-3	Z						1.5×1	11900	18900	291
PFT 2510-3	P						1.5×2	13600	18900	234
SFT 2510-2.5	Clearance						2.5×1	18500	31700	242
DFT 2510-2.5	D						2.5×1	18500	31700	475
SFT 2510-3	Clearance						1.5×2	21600	37800	286
DFT 2510-3	D						1.5×2	21600	37800	562
SFT 2510-3.5	Clearance						3.5×1	24700	44600	330
DFT 2510-3.5	D						3.5×1	24700	44600	649

Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



PFT, ZFT, SFT



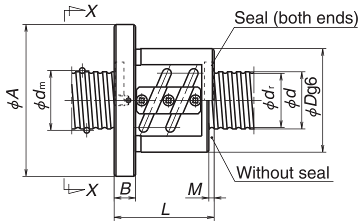
DFT

Unit: mm

Ball nut dimensions										
Nut entire length L	Nut diameter D	Flanged diameter A	Flanged width B	Notched flange G	Seal dimension M	Bolt hole dimension X	Y	Z	Bolt hole PCD W	Oil hole Q
56 44 62 62 56 110 62 98	53	76	11	29	3	5.5	9.5	5.5	64	M6×1
56 69 56 80 69 133	58	85	13	32	5	6.6	11	6.5	71	M6×1
67 81 81 67 127 81 151 77 147	58	85	15	32	8	6.6	11	6.5	71	M6×1

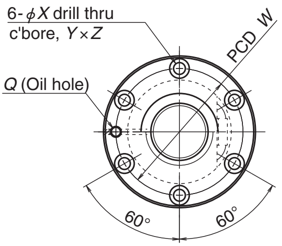
Remarks 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.
5. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.
6. The models marked with ✻ are in SA type of standard ball screw with finished shaft end.
7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

Return tube type

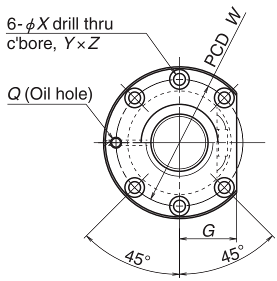


PFT, ZFT, SFT

View X-X



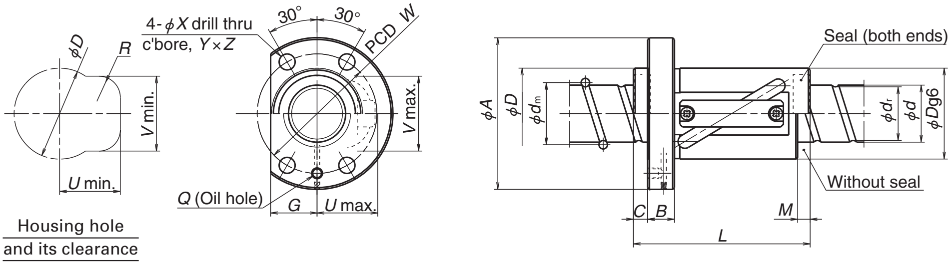
Circular shape Ⅰ



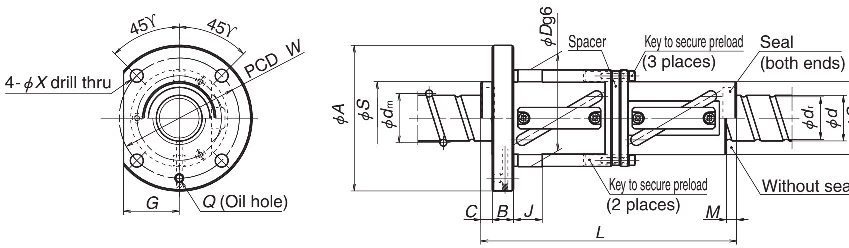
Circular shape Ⅱ

Model No.	Preload system	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls Turns × Circuits	Basic load rating (N) Dynamic C_a	Static C_{0a}	Axial rigidity K (N/μm)	Nut entire length L
LPFT 2516-2.5	P	25	16	4.762	26.25	21.3	2.5×1	11400	16500	210	84
LPFT 2516-3	P						1.5×2	13400	19500	247	100
LSFT 2516-2.5	Clearance						2.5×1	18100	33000	250	84
LDFT 2516-2.5	D						2.5×1	18100	33000	490	152
LSFT 2516-3	Clearance						1.5×2	21200	39000	295	100
LDFT 2516-3	D						1.5×2	21200	39000	577	181
* LPFT 2520-2.5	P		20	4.762	26.25	21.3	2.5×1	11700	16300	210	96
LPFT 2520-3	P						1.5×2	13700	19300	247	116
LSFT 2520-2.5	Clearance						2.5×1	18600	32600	250	96
LDFT 2520-2.5	D						2.5×1	18600	32600	490	177
LSFT 2520-3	Clearance						1.5×2	21800	38600	295	116
LDFT 2520-3	D						1.5×2	21800	38600	577	217
* LPFT 2525-1.5	P		25	4.762	26.25	21.3	1.5×1	7400	9860	127	90
LDFT 2525-1.5	D							11700	19700	308	166
LSFT 2525-1.5	Clearance							11700	19700	157	90
SFT 2805-2.5	Clearance	28	5	3.175	28.5	25.2	2.5×1	11300	24400	252	41
ZFT 2805-5	Z						2.5×1	11300	24400	495	56
PFT 2805-5	P						2.5×2	13000	24400	410	56
SFT 2805-5	Clearance						2.5×2	20600	48700	487	56
* ZFT 2805-10	Z						2.5×2	20600	48700	959	86

Remarks:
1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, ZFT, and SFT, the nut length "L" is shortened by dimension "M".
3. If there is no seal for LSFT and LDFT of shaft diameter 25 mm or larger, the nut length "L" is shortened by dimension "M" and "C".
4. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



LPFT, LSFT



LDFT

Unit: mm

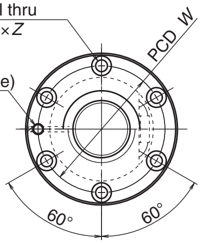
Ball nut dimensions															
Nut diameter		Flanged diameter	Flanged width	Notched flange	Tube projecting type			Seal dimension		Diameter g6	Bolt hole dimension			Bolt hole PCD	Oil hole
D	*S*	*A*	*B*	*G*	*U*	*V*	*R*	*M*	*C*	*J*	*X*	*Y*	*Z*	*W*	*Q*
44	—	71	12	23	31	35	12	6	8	—	6.6	—	—	57	M6×1
44	—	71		23	31	35	12			—				57	
44	—	71		23	31	35	12			—				57	
62	44	89		34	—	—	—			18				75	
44	—	71		23	31	35	12			—				57	
62	44	89		34	—	—	—			18				75	
44	—	71	12	23	31	35	12	7	8	—	6.6	—	—	57	M6×1
44	—	71		23	31	35	12			—				57	
44	—	71		23	31	35	12			—				57	
62	44	89		34	—	—	—			18				75	
44	—	71		23	31	35	12			—				57	
62	44	89		34	—	—	—			18				75	
44	—	71	12	23	32	34	12	10	10	—	6.6	—	—	57	M6×1
62	44	89		34	—	—	—			18				75	
44	—	71		23	32	34	12			—				57	
55	—	85	12	31	—	—	—	3	—	—	6.6	11	6.5	69	M6×1

Remarks 5. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.

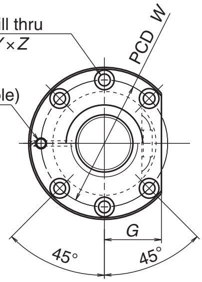
6. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.
7. The models marked with ✻ are in FA and SA type of standard ball screw with finished shaft end.
8. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

Return tube type

View *X*-*X*



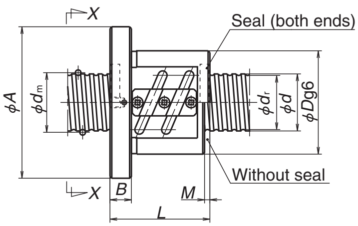
Circular shape Ⅰ



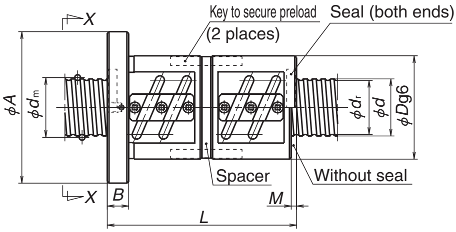
Circular shape Ⅱ

	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	Static C_{0a}	Axial rigidity K (N/μm)
	PFT 2806-3	P	28	6	3.175	28.5	25.2	1.5×2	8350	14600	252
	SFT 2806-2.5	Clearance						2.5×1	11300	24300	252
	ZFT 2806-5	Z						2.5×1	11300	24300	495
	PFT 2806-5	P						2.5×2	12900	24300	410
	SFT 2806-3	Clearance						1.5×2	13200	29200	300
	DFT 2806-3	D						1.5×2	13200	29200	590
	SFT 2806-5	Clearance						2.5×2	20600	48700	487
*	**ZFT 2806-10**	Z						2.5×2	20600	48700	959
	PFT 2810-2.5	P		10	4.762	28.5	23.5	2.5×1	12300	17900	220
	ZFT 2810-3	Z						1.5×1	12600	21400	320
	PFT 2810-3	P						1.5×2	14400	21400	265
	SFT 2810-2.5	Clearance						2.5×1	19600	35800	265
	DFT 2810-2.5	D						2.5×1	19600	35800	522
	SFT 2810-3	Clearance						1.5×2	22900	42700	314
	DFT 2810-3	D						1.5×2	22900	42700	618
	SFT 3204-2.5	Clearance	32	4	2.381	32.3	29.8	2.5×1	6850	17500	234
	ZFT 3204-5	Z						2.5×1	6850	17500	461
	PFT 3204-5	P						2.5×2	7840	17500	382
	SFT 3204-5	Clearance						2.5×2	12400	35000	454
	ZFT 3204-10	Z						2.5×2	12400	35000	892
	PFT 3205-3	P		5	3.175	32.5	29.2	1.5×2	8850	16800	281
	SFT 3205-2.5	Clearance						2.5×1	12000	28000	281
	ZFT 3205-5	Z						2.5×1	12000	28000	552
*	**PFT 3205-5**	P						2.5×2	13700	28000	455
	SFT 3205-3	Clearance						1.5×2	14000	33600	333
	DFT 3205-3	D						1.5×2	14000	33600	655
	PFT 3205-7.5	P						2.5×3	19500	42000	672
	SFT 3205-5	Clearance						2.5×2	21800	56000	543
*	**ZFT 3205-10**	Z						2.5×2	21800	56000	1070
	SFT 3205-7.5	Clearance						2.5×3	30900	84000	799
	DFT 3205-7.5	D						2.5×3	30900	84000	1572

Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



PFT, ZFT, SFT



DFT

Unit: mm

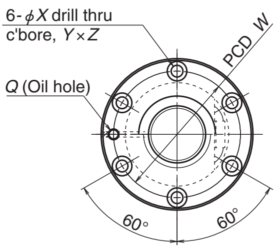
Ball nut dimensions										
Nut entire length *L*	Nut diameter *D*	Flanged diameter *A*	Flanged width *B*	Notched flange *G*	Seal dimension *M*	Bolt hole dimension *X*	*Y*	*Z*	Bolt hole PCD *W*	Oil hole *Q*
57 45 63 63 57 111 63 99	55	85	12	31	3	6.6	11	6.5	69	M6×1
68 82 82 68 128 82 152	60	94	15	36	7	9	14	8.5	76	M6×1
37 49 49 49 73	54	81	12	31	3	6.6	11	6.5	67	M6×1
53 41 56 56 53 103 71 56 86 71 136	58	85	12	32	3	6.6	11	6.5	71	M6×1

Remarks 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.

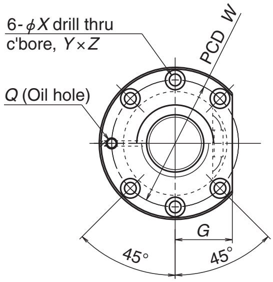
5. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.
6. The models marked with ✻ are in SA type of standard ball screw with finished shaft end.
7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

Return tube type

View *X*-*X*



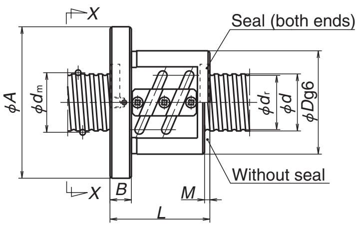
Circular shape I



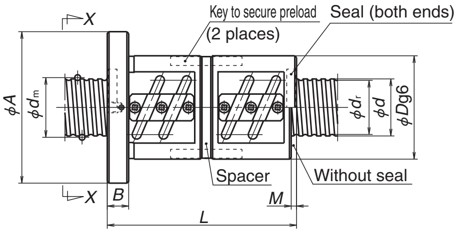
Circular shape II

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	Static C_{0a}	Axial rigidity K (N/μm)
PFT 3206-3	P	32	6	3.969	32.5	28.4	1.5×2	11800	20600	285
SFT 3206-2.5	Clearance						2.5×1	16000	34700	287
ZFT 3206-5	Z						2.5×1	16000	34700	563
PFT 3206-5	P						2.5×2	18300	34700	468
SFT 3206-3	Clearance						1.5×2	18800	41200	339
DFT 3206-3	D						1.5×2	18800	41200	666
SFT 3206-5	Clearance						2.5×2	29100	69300	555
* **ZFT 3206-10**	Z						2.5×2	29100	69300	1090
PFT 3208-3	P		8	4.762	32.5	27.5	1.5×2	15100	24700	294
SFT 3208-2.5	Clearance						2.5×1	20600	40900	292
ZFT 3208-5	Z						2.5×1	20600	40900	573
PFT 3208-5	P						2.5×2	23500	40900	470
SFT 3208-3	Clearance						1.5×2	24000	49400	349
ZFT 3208-6	Z						1.5×2	24000	49400	686
SFT 3208-5	Clearance						2.5×2	37300	81800	565
DFT 3208-5	D						2.5×2	37300	81800	1110
PFT 3210-2.5	P		10	6.35	33.0	26.4	2.5×1	18900	27600	255
ZFT 3210-3	Z						1.5×1	19300	32300	365
PFT 3210-3	P						1.5×2	22100	32300	303
SFT 3210-2.5	Clearance						2.5×1	30000	55100	302
* **ZFT 3210-5**	Z						2.5×1	30000	55100	594
PFT 3210-5	P						2.5×2	34300	55100	494
SFT 3210-3	Clearance						1.5×2	35100	64500	360
DFT 3210-3	D						1.5×2	35100	64500	707
SFT 3210-3.5	Clearance						3.5×1	40100	76600	422
DFT 3210-3.5	D						3.5×1	40100	76600	829
SFT 3210-5	Clearance						2.5×2	54500	110000	585
* **DFT 3210-5**	D						2.5×2	54500	110000	1150
PFT 3212-2.5	P		12	6.35	33.0	26.4	2.5×1	18800	27500	255
ZFT 3212-3	Z						1.5×1	19300	32200	365
PFT 3212-3	P						1.5×2	22000	32200	303
SFT 3212-2.5	Clearance						2.5×1	29900	55000	302
DFT 3212-2.5	D						2.5×1	29900	55000	603
SFT 3212-3	Clearance						1.5×2	35000	64400	360
DFT 3212-3	D						1.5×2	35000	64400	707

Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



PFT, ZFT, SFT



DFT

Unit: mm

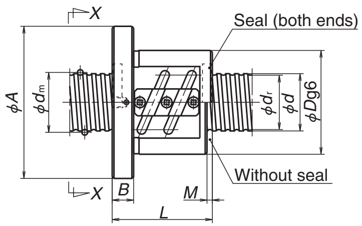
Ball nut dimensions										
Nut entire length *L*	Nut diameter *D*	Flanged diameter *A*	Flanged width *B*	Notched flange *G*	Seal dimension *M*	Bolt hole dimension *X*	*Y*	*Z*	Bolt hole PCD *W*	Oil hole *Q*
57 45 63 63 57 111 63 99	62	89	12	34	3	6.6	11	6.5	75	M6×1
71 58 82 82 71 111 82 154	66	100	15	38	5	9	14	8.5	82	M6×1
70 87 87 70 100 100 87 167 80 150 100 190	74	108	15	41	7	9	14	8.5	90	M6×1
81 97 97 81 153 97 181	74	108	18	41	9	9	14	8.5	90	M6×1

Remarks 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.

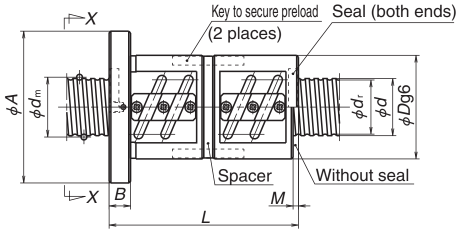
5. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.
6. The models marked with ✻ are in SA type of standard ball screw with finished shaft end.
7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

B
488

Return tube type

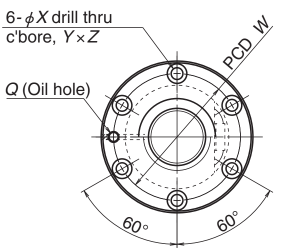


PFT, ZFT, SFT

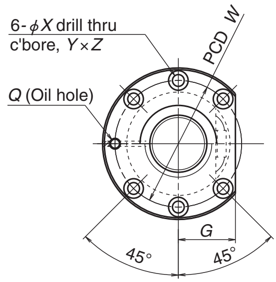


DFT

View *X*-*X*



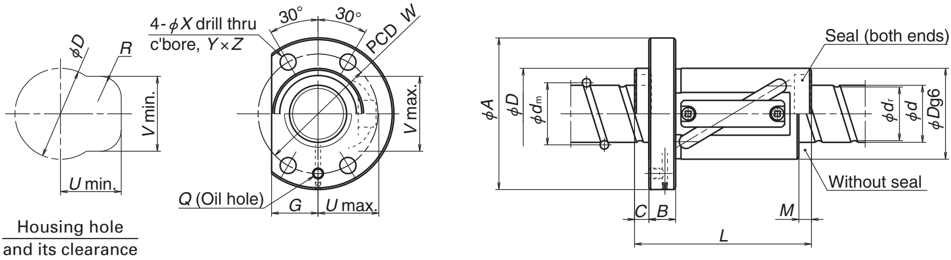
Circular shape Ⅰ



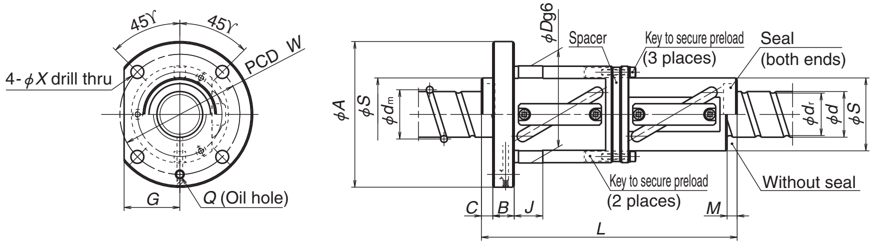
Circular shape Ⅱ

Model No.	Preload system	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls Turns × Circuits	Basic load rating (N) Dynamic C_a	Static C_{0a}	Axial rigidity K (N/μm)	Nut entire length L
LPFT 3220-2.5	P						2.5×1	13000	20900	251	99
LPFT 3220-3	P						1.5×2	15300	25100	297	119
LSFT 3220-2.5	Clearance		20	4.762	33.25	28.3	2.5×1	20700	41900	300	99
LDFT 3220-2.5	D						2.5×1	20700	41900	604	179
LSFT 3220-3	Clearance						1.5×2	24200	50200	360	119
LDFT 3220-3	D						1.5×2	24200	50200	708	219
* LPFT 3225-2.5	P						2.5×1	12900	21100	251	117
LPFT 3225-3	P	32					1.5×2	15100	24900	297	142
LSFT 3225-2.5	Clearance		25	4.762	33.25	28.3	2.5×1	20400	42200	300	117
LDFT 3225-2.5	D						2.5×1	20400	42200	604	218
LSFT 3225-3	Clearance						1.5×2	23900	49700	360	142
LDFT 3225-3	D						1.5×2	23900	49700	708	268
* LPFT 3232-1.5	P							8360	12600	161	109
LSFT 3232-1.5	Clearance		32	4.762	33.25	28.3	1.5×1	13300	25200	190	109
LDFT 3232-1.5	D							13300	25200	376	205
ZFT 3605-5	Z						2.5×1	12600	31600	607	59
PFT 3605-5	P						2.5×2	14400	31600	504	59
PFT 3605-7.5	P						2.5×3	20400	47500	740	74
SFT 3605-5	Clearance	36	5	3.175	36.5	33.2	2.5×2	22900	63300	597	59
ZFT 3605-10	Z						2.5×2	22900	63300	1170	89
SFT 3605-7.5	Clearance						2.5×3	32400	94900	878	74
DFT 3605-7.5	D						2.5×3	32400	94900	1730	139

Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, ZFT, and SFT, the nut length "L" is shortened by dimension "M".
3. If there is no seal for LSFT and LDFT of shaft diameter 25 mm or larger, the nut length "L" is shortened by dimension "M" and "C".
4. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



LPFT, LSFT



LDFT

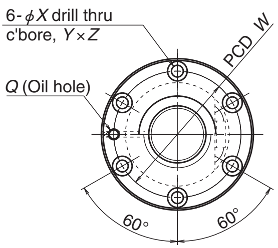
Unit: mm

Ball nut dimensions															
Nut diameter		Flanged diameter	Flanged width	Notched flange	Tube projecting type			Seal dimension		Diameter g6	Bolt hole dimension			Bolt hole PCD	Oil hole
D	S	A	B	G	U	V	R	M	C	J	X	Y	Z	W	Q
51	—	85	15	26	34	42	12	7	8	—	9	—	—	67	M6×1
51	—	85		26	34	42	12			—				67	
51	—	85		26	34	42	12			—				67	
68	51	102		39	—	—	—			20				84	
51	—	85		26	34	42	12			—				67	
68	51	102		39	—	—	—			20				84	
51	—	85	15	26	34	42	12	10	10	—	9	—	—	67	M6×1
51	—	85		26	34	42	12			—				67	
51	—	85		26	34	42	12			—				67	
68	51	102		39	—	—	—			20				84	
51	—	85		26	34	42	12			—				67	
68	51	102		39	—	—	—			20				84	
51	—	85	15	26	34	42	12	13	12	—	9	—	—	67	M6×1
51	—	85		26	34	42	12			—				67	
68	51	102		39	—	—	—			20				84	
65	—	100	15	38	—	—	—	3	—	—	9	14	8.5	82	M6×1

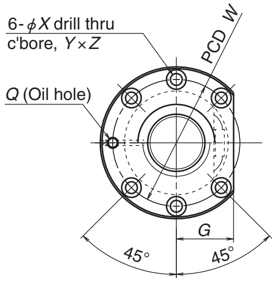
Remarks
5. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.
6. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.
7. The models marked with ✻ are in FA type of standard ball screw with finished shaft end.
8. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

Return tube type

View *X-X*



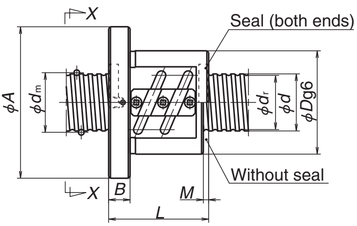
Circular shape I



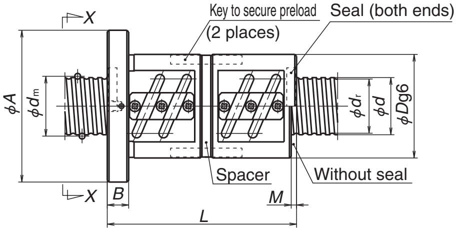
Circular shape II

Model No.	Preload system	Shaft dia. 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)
ZFT 3606-5	Z						2.5×1	17200	39200	625
PFT 3606-5	P						2.5×2	19700	39200	518
PFT 3606-7.5	P						2.5×3	27900	58800	763
SFT 3606-5	Clearance		6	3.969	36.5	32.4	2.5×2	31300	78400	615
ZFT 3606-10	Z						2.5×2	31300	78400	1210
SFT 3606-7.5	Clearance						2.5×3	44400	118000	905
DFT 3606-7.5	D						2.5×3	44400	118000	1780
PFT 3610-2.5	P						2.5×1	20100	30500	278
ZFT 3610-3	Z	36					1.5×1	20600	36600	404
PFT 3610-3	P						1.5×2	23600	36600	327
SFT 3610-2.5	Clearance						2.5×1	32000	61100	334
ZFT 3610-5	Z		10	6.35	37.0	30.4	2.5×1	32000	61100	657
PFT 3610-5	P						2.5×2	36600	61100	537
SFT 3610-3	Clearance						1.5×2	37400	73300	397
DFT 3610-3	D						1.5×2	37400	73300	781
SFT 3610-5	Clearance						2.5×2	58000	122000	647
DFT 3610-5	D						2.5×2	58000	122000	1270
PFT 4005-3	P						1.5×2	9700	21200	337
SFT 4005-2.5	Clearance						2.5×1	13200	35300	336
ZFT 4005-5	Z						2.5×1	13200	35300	661
PFT 4005-5	P						2.5×2	15100	35300	548
SFT 4005-3	Clearance						1.5×2	15400	42300	399
DFT 4005-3	D		5	3.175	40.5	37.2	1.5×2	15400	42300	785
PFT 4005-7.5	P						2.5×3	21300	52900	806
SFT 4005-5	Clearance						2.5×2	23900	70500	649
* **ZFT 4005-10**	Z						2.5×2	23900	70500	1280
SFT 4005-7.5	Clearance	40					2.5×3	33900	106000	956
DFT 4005-7.5	D						2.5×3	33900	106000	1870
ZFT 4006-5	Z						2.5×1	18000	43800	679
PFT 4006-5	P						2.5×2	20500	43800	564
SFT 4006-3	Clearance						1.5×2	21000	52500	411
DFT 4006-3	D						1.5×2	21000	52500	807
PFT 4006-7.5	P		6	3.969	40.5	36.4	2.5×3	29100	65600	827
SFT 4006-5	Clearance						2.5×2	32600	87500	668
ZFT 4006-10	Z						2.5×2	32600	87500	1320
SFT 4006-7.5	Clearance						2.5×3	46200	131000	984
DFT 4006-7.5	D						2.5×3	46200	131000	1940

Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



PFT, ZFT, SFT



DFT

Unit: mm

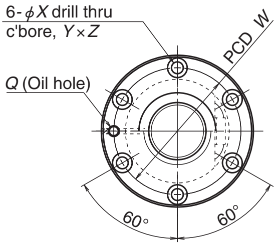
Ball nut dimensions										
Nut entire length *L*	Nut diameter *D*	Flanged diameter *A*	Flanged width *B*	Notched flange *G*	Seal dimension *M*	Bolt hole dimension *X*	*Y*	*Z*	Bolt hole PCD *W*	Oil hole *Q*
66 66 84 66 102 84 162	65	100	15	38	3	9	14	8.5	82	M6×1
73 90 90 73 103 103 90 170 103 193	75	120	18	45	7	11	17.5	11	98	M6×1
56 44 59 59 56 106 74 59 89 74 139	67	101	15	39	3	9	14	8.5	83	Rc1/8
66 66 60 114 84 66 102 84 162	70	104	15	40	3	9	14	8.5	86	Rc1/8

Remarks 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.

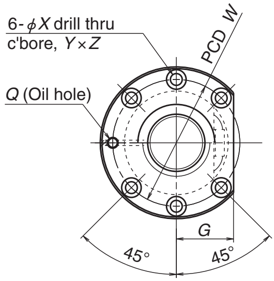
5. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.
6. The models marked with ✻ are in SA type of standard ball screw with finished shaft end.
7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

Return tube type

View *X-X*



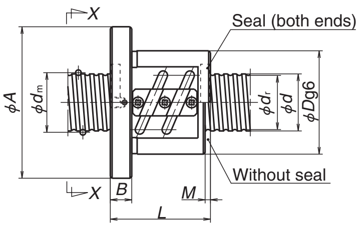
Circular shape I



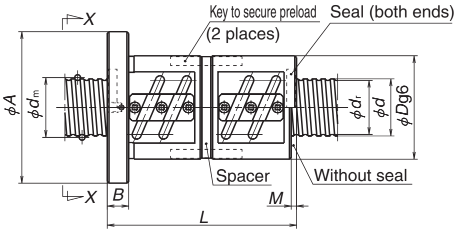
Circular shape II

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)
PFT 4008-3	P						1.5×2	16700	31200	352
SFT 4008-2.5	Clearance						2.5×1	22700	51500	349
ZFT 4008-5	Z						2.5×1	22700	51500	687
PFT 4008-5	P		8	4.762	40.5	35.5	2.5×2	25900	51500	570
SFT 4008-3	Clearance						1.5×2	26500	62500	418
DFT 4008-3	D						1.5×2	26500	62500	822
SFT 4008-5	Clearance						2.5×2	41100	103000	675
ZFT 4008-10	Z						2.5×2	41100	103000	1330
PFT 4010-2.5	P						2.5×1	21300	34200	307
PFT 4010-3	P						1.5×2	24900	41000	366
SFT 4010-2.5	Clearance						2.5×1	33700	68300	365
ZFT 4010-5	Z						2.5×1	33700	68300	717
PFT 4010-5	P						2.5×2	38600	68300	595
SFT 4010-3	Clearance		10	6.35	41	34.4	1.5×2	39500	82000	434
ZFT 4010-6	Z	40					1.5×2	39500	82000	854
ZFT 4010-7	Z						3.5×1	45100	97100	988
SFT 4010-3.5	Clearance						3.5×1	45100	97100	503
SFT 4010-5	Clearance						2.5×2	61200	137000	706
* **DFT 4010-5**	D						2.5×2	61200	137000	1390
PFT 4012-2.5	P						2.5×1	24900	38600	310
SFT 4012-2.5	Clearance						2.5×1	39500	77200	373
ZFT 4012-5	Z		12	7.144	41.5	34.1	2.5×1	39500	77200	733
PFT 4012-5	P						2.5×2	45200	77200	600
SFT 4012-5	Clearance						2.5×2	71700	154000	722
* **DFT 4012-5**	D						2.5×2	71700	154000	1420
ZFT 4016-3	Z						1.5×1	25400	46200	451
SFT 4016-2.5	Clearance						2.5×1	39300	77000	373
DFT 4016-2.5	D		16	7.144	41.5	34.1	2.5×1	39300	77000	733
SFT 4016-3	Clearance						1.5×2	46000	92400	440
DFT 4016-3	D						1.5×2	46000	92400	872

Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



PFT, ZFT, SFT



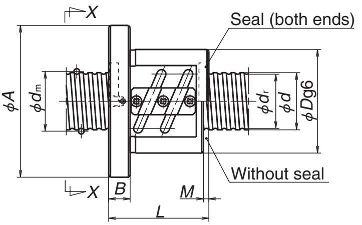
DFT

Unit: mm

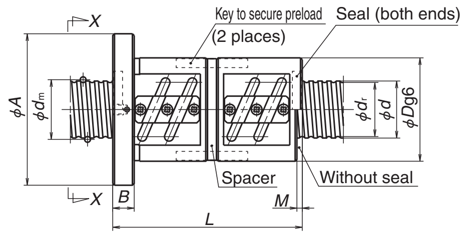
Ball nut dimensions										
Nut entire length *L*	Nut diameter *D*	Flanged diameter *A*	Flanged width *B*	Notched flange *G*	Seal dimension *M*	Bolt hole dimension *X*	*Y*	*Z*	Bolt hole PCD *W*	Oil hole *Q*
71 58 82 82 71 135 82 130	74	108	15	41	5	9	14	8.5	90	Rc1/8
73 90 73 103 103 90 140 123 83 103 193	82	124	18	47	7	11	17.5	11	102	Rc1/8
81 81 117 117 117 225	86	128	18	48	9	11	17.5	11	106	Rc1/8
118 102 182 118 214	86	128	22	48	14	11	17.5	11	106	Rc1/8

Remarks 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.
5. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.
6. The models marked with ✻ are in SA type of standard ball screw with finished shaft end.
7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

Return tube type

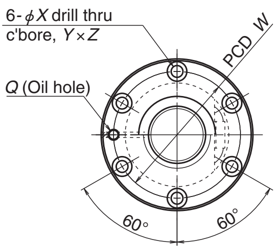


ZFT, SFT

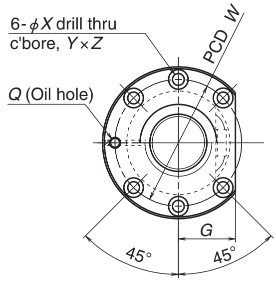


DFT

View *X*-*X*



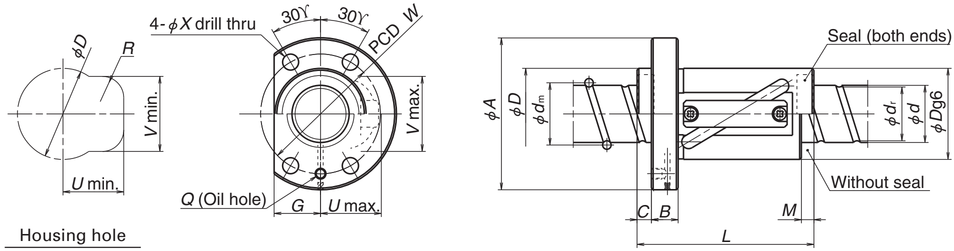
Circular shape Ⅰ



Circular shape Ⅱ

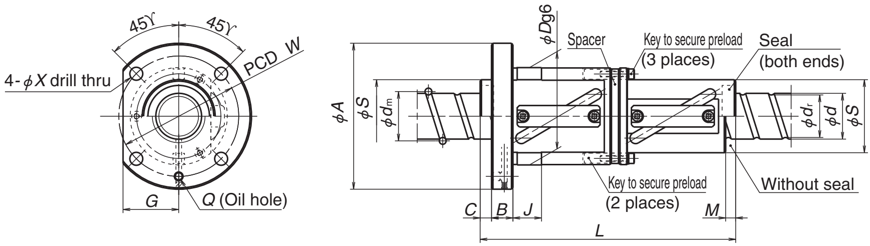
Model No.	Preload system	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls Turns × Circuits	Basic load rating (N) Dynamic C_a	Static C_{0a}	Axial rigidity K (N/μm)	Nut entire length L
LPFT 4025-2.5	P	40	25	6.35	41.75	35.1	2.5×1	21500	35100	315	123
LPFT 4025-3	P						1.5×2	25100	41800	347	148
LSFT 4025-2.5	Clearance						2.5×1	34100	70100	375	123
LDFT 4025-2.5	D						2.5×1	34100	70100	737	223
LSFT 4025-3	Clearance						1.5×2	39900	83600	444	148
LDFT 4025-3	D						1.5×2	39900	83600	873	273
LPFT 4032-2.5	P		32	6.35	41.75	35.1	2.5×1	21200	35300	315	146
LSFT 4032-2.5	Clearance							33600	70700	375	146
LDFT 4032-2.5	D							33600	70700	737	274
LPFT 4040-1.5	P		40	6.35	41.75	35.1	1.5×1	13400	21000	199	133
LSFT 4040-1.5	Clearance							21200	42000	237	133
LDFT 4040-1.5	D							21200	42000	465	253
ZFT 4510-5	Z	45	10	6.35	46.0	39.4	2.5×1	36300	78500	784	103
SFT 4510-5	Clearance						2.5×2	65800	157000	772	103
DFT 4510-5	D						2.5×2	65800	157000	1520	193
SFT 4510-7.5	Clearance						2.5×3	93300	235000	1140	133
DFT 4510-7.5	D						2.5×3	93300	235000	2230	253
SFT 4512-2.5	Clearance		12	7.144	46.5	39.1	2.5×1	41600	88200	412	83
ZFT 4512-5	Z						2.5×1	41600	88200	811	119
SFT 4512-5	Clearance						2.5×2	75600	176000	798	119
DFT 4512-5	D						2.5×2	75600	176000	1570	227

Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, ZFT, and SFT, the nut length "L" is shortened by dimension "M".
3. If there is no seal for LSFT and LDFT of shaft diameter 25 mm or larger, the nut length "L" is shortened by dimension "M" and "C".
4. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



Housing hole and its clearance

LPFT, LSFT



LDFT

Unit: mm

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
64	—	106	18	33	42	52	15	10	10	—	11	—	—	84	Rc1/8
64	—	106		33	42	52	15			—				84	
64	—	106		33	42	52	15			—				84	
84	64	126		48	—	—	—			22				104	
64	—	106		33	42	52	15			—				84	
84	64	126		48	—	—	—			22				104	
64	—	106	18	33	42	52	15	13	12	—	11	—	—	84	Rc1/8
64	—	106		33	42	52	15			—				84	
84	64	126		48	—	—	—			22				104	
64	—	106	18	33	42	52	15	16	14	—	11	—	—	84	Rc1/8
64	—	106		33	42	52	15			—				84	
84	64	126		48	—	—	—			22				104	
88	—	132	18	50	—	—	—	7	—	—	11	17.5	11	110	Rc1/8
90	—	132	18	50	—	—	—	8	—	—	11	17.5	11	110	Rc1/8

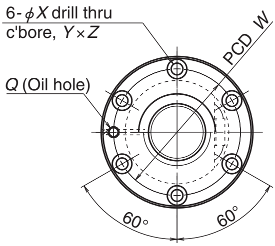
Remarks 5. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.

6. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.

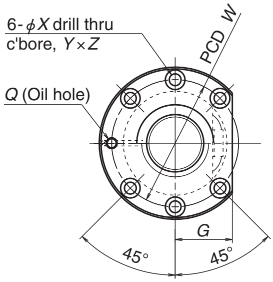
7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

Return tube type

View *X-X*



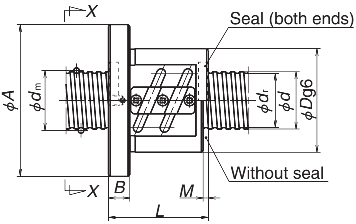
Circular shape Ⅰ



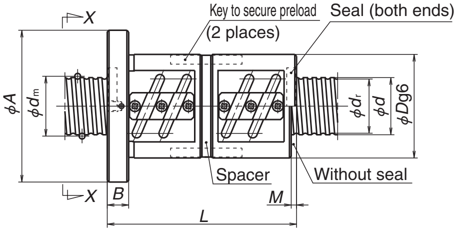
Circular shape Ⅱ

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)
SFT 5005-3	Clearance	50	5	3.175	50.5	47.2	1.5×2	16800	52500	472
ZFT 5005-6	Z						1.5×2	16800	52500	930
SFT 5005-4.5	Clearance						1.5×3	23900	78800	696
ZFT 5005-9	Z						1.5×3	23900	78800	1360
SFT 5006-3	Clearance		6	3.969	50.5	46.4	1.5×2	23000	66100	486
DFT 5006-3	D						1.5×2	23000	66100	956
SFT 5006-5	Clearance						2.5×2	35700	110000	794
ZFT 5006-10	Z						2.5×2	35700	110000	1562
SFT 5006-7.5	Clearance						2.5×3	50700	165000	1170
DFT 5006-7.5	D						2.5×3	50700	164000	2300
SFT 5008-3	Clearance		8	4.762	50.5	45.5	1.5×2	29500	78900	496
DFT 5008-3	D						1.5×2	29500	78900	975
SFT 5008-5	Clearance						2.5×2	45700	131000	815
ZFT 5008-10	Z						2.5×2	45700	131000	1600
SFT 5008-7.5	Clearance						2.5×3	64800	196000	1200
DFT 5008-7.5	D						2.5×3	64800	196000	2350
SFT 5010-2.5	Clearance		10	6.35	51.0	44.4	2.5×1	37500	87200	440
ZFT 5010-5	Z						2.5×1	37500	87200	866
SFT 5010-3	Clearance						1.5×2	43900	102000	517
DFT 5010-3	D						1.5×2	43900	102000	1010
ZFT 5010-7	Z						3.5×1	50100	122000	1190
SFT 5010-5	Clearance						2.5×2	68100	174000	853
* **ZFT 5010-10**	Z						2.5×2	68100	174000	1677
SFT 5010-7.5	Clearance						2.5×3	96500	262000	1250
DFT 5010-7.5	D						2.5×3	96500	262000	2460
SFT 5012-2.5	Clearance		12	7.938	51.5	43.2	2.5×1	50400	109000	449
ZFT 5012-5	Z						2.5×1	50400	109000	883
SFT 5012-5	Clearance						2.5×2	91500	218000	869
DFT 5012-5	D						2.5×2	91500	218000	1710
SFT 5016-2.5	Clearance		16	7.938	51.5	43.2	2.5×1	50300	109000	449
ZFT 5016-5	Z						2.5×1	50300	109000	883
SFT 5016-5	Clearance						2.5×2	91200	218000	869
DFT 5016-5	D						2.5×2	91200	218000	1710
ZFT 5020-3	Z		20	7.938	51.5	43.2	1.5×1	32300	63800	542
SFT 5020-2.5	Clearance						2.5×1	50100	108000	449
DFT 5020-2.5	D						2.5×1	50100	108000	883
SFT 5020-3	Clearance						1.5×2	58600	128000	534
DFT 5020-3	D						1.5×2	58600	128000	1050

Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



ZFT, SFT



DFT

Unit: mm

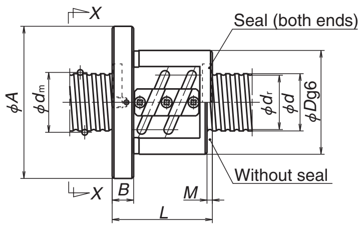
Ball nut dimensions										
Nut entire length *L*	Nut diameter *D*	Flanged diameter *A*	Flanged width *B*	Notched flange *G*	Seal dimension *M*	Bolt hole dimension *X*	*Y*	*Z*	Bolt hole PCD *W*	Oil hole *Q*
58 83 68 103	80	114	15	43	3	9	14	8.5	96	Rc1/8
62 116 68 104 86 164	84	118	15	45	3	9	14	8.5	100	Rc1/8
74 138 85 133 109 205	87	129	18	49	5	11	17.5	11	107	Rc1/8
73 103 90 170 123 103 163 133 253	93	135	18	51	7	11	17.5	11	113	Rc1/8
87 123 123 231	100	146	22	55	8	14	20	13	122	Rc1/8
104 152 152 280	100	146	22	55	14	14	20	13	122	Rc1/8
147 127 227 147 267	100	146	28	55	17	14	20	13	122	Rc1/8

Remarks 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.

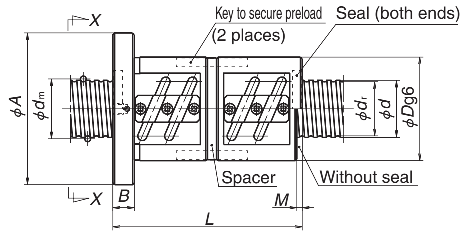
5. The models marked with ✻ are in SA type of standard ball screw with finished shaft end.

6. Preload system: Z, Offset preload; D, Double nut preload (Refer to Page B5)

Return tube type

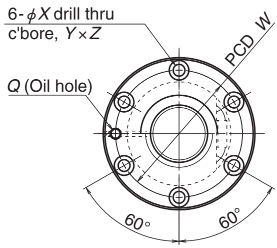


ZFT, SFT

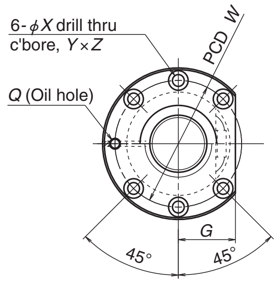


DFT

View *X*-*X*



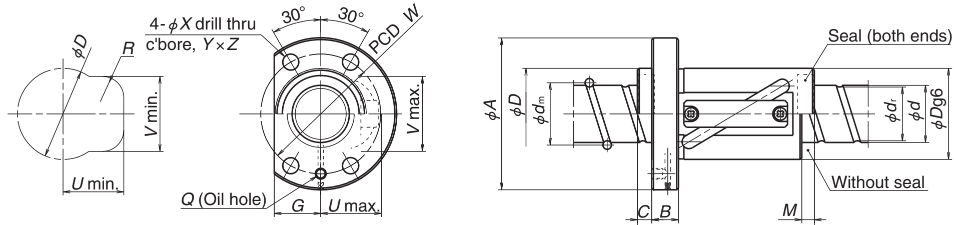
Circular shape I



Circular shape II

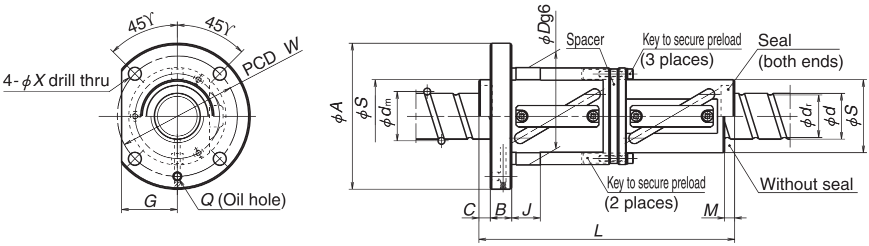
Model No.	Preload system	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls Turns × Circuits	Basic load rating (N) Dynamic C_a	Static C_{0a}	Axial rigidity K (N/μm)	Nut entire length L
LPFT 5025-2.5	P	50	25	7.938	52.25	44	2.5×1	32300	55100	388	129
LPFT 5025-3	P						1.5×2	37800	65700	450	154
LSFT 5025-2.5	Clearance						2.5×1	51300	110000	462	129
LDFT 5025-2.5	D						2.5×1	51300	110000	905	229
LSFT 5025-3	Clearance						1.5×2	60100	131000	547	154
LDFT 5025-3	D						1.5×2	60100	131000	1070	279
LPFT 5032-2.5	P		32	7.938	52.25	44	2.5×1	32000	54700	388	151
LPFT 5032-3	P						1.5×2	37500	65300	450	183
LSFT 5032-2.5	Clearance						2.5×1	50900	109000	462	151
LDFT 5032-2.5	D						2.5×1	50900	109000	905	279
LSFT 5032-3	Clearance						1.5×2	59500	131000	547	183
LDFT 5032-3	D						1.5×2	59500	131000	1070	343
LPFT 5040-2.5	P		40	7.938	52.25	44	2.5×1	31600	55200	388	178
LSFT 5040-2.5	Clearance							50200	110000	462	178
LDFT 5040-2.5	D							50200	110000	922	338
LPFT 5050-1.5	P		50	7.938	52.25	44	1.5×1	20000	32800	245	161
LSFT 5050-1.5	Clearance							31700	65700	290	161
LDFT 5050-1.5	D							31700	65700	572	312
ZFT 5510-5	Z	55	10	6.35	56.0	49.4	2.5×1	38700	96000	929	103
SFT 5510-5	Clearance						2.5×2	70200	192000	916	103
ZFT 5510-10	Z						2.5×2	70200	192000	1800	163
DFT 5510-5	D						2.5×2	70200	192000	1800	193
SFT 5510-7.5	Clearance						2.5×3	99500	288000	1350	133
DFT 5510-7.5	D						2.5×3	99500	288000	2650	253

Remarks: 1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, ZFT, and SFT, the nut length "L" is shortened by dimension "M".
3. If there is no seal for LSFT and LDFT of shaft diameter 25 mm or larger, the nut length "L" is shortened by dimension "M" and "C".
4. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



Housing hole and its clearance

LPFT, LSFT



LDFT

Unit: mm

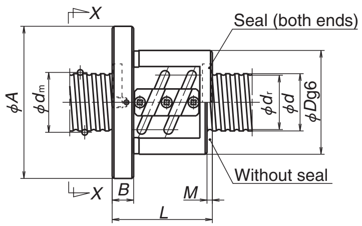
Ball nut dimensions															
Nut diameter		Flanged diameter	Flanged width	Notched flange	Tube projecting type			Seal dimension		Diameter g6	Bolt hole dimension			Bolt hole PCD	Oil hole
D	S	A	B	G	U	V	R	M	C	J	X	Y	Z	W	Q
80	—	126	22	41	52	64	19	11	11	—	14	—	—	102	Rc1/8
80	—	126		41	52	64	19			—				102	
80	—	126		41	52	64	19			—				102	
106	80	152		56	—	—	—			25				128	
80	—	126		41	52	64	19			—				102	
106	80	152		56	—	—	—			25				128	
80	—	126	22	41	52	64	19	14	12	—	14	—	—	102	Rc1/8
80	—	126		41	52	64	19			—				102	
80	—	126		41	52	64	19			—				102	
106	80	152		56	—	—	—			25				128	
80	—	126		41	52	64	19			—				102	
106	80	152		56	—	—	—			25				128	
80	—	126	22	41	52	64	19	17	14	—	14	—	—	102	Rc1/8
80	—	126		41	52	64	19			—				102	
106	80	152		56	—	—	—			25				128	
80	—	126	22	41	52	64	19	21	16	—	14	—	—	102	Rc1/8
80	—	126		41	52	64	19			—				102	
106	80	152		56	—	—	—			25				128	
102	—	144	18	54	—	—	—	7	—	—	11	17.5	11	122	Rc1/8

Remarks 5. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.

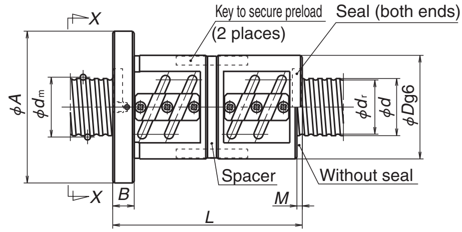
6. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.

7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

Return tube type

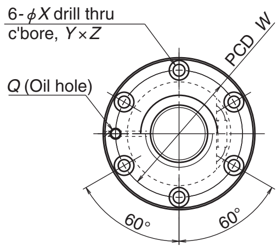


SFT, ZFT

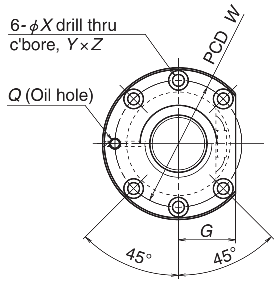


DFT

View *X*-*X*



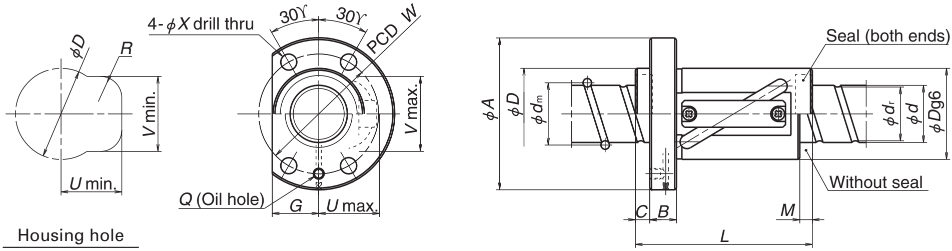
Circular shape Ⅰ



Circular shape Ⅱ

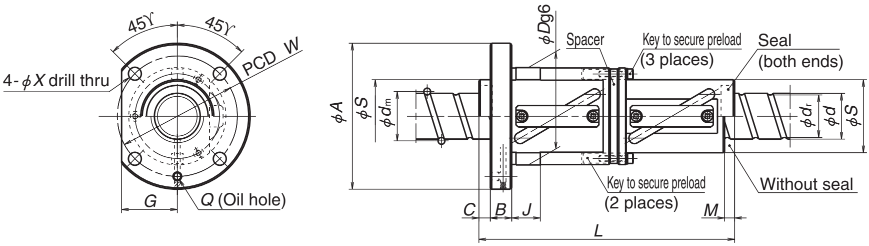
Model No.	Preload system	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls Turns × Circuits	Basic load rating (N) Dynamic C_a	Static C_{0a}	Axial rigidity K (N/μm)	Nut entire length L
SFT 6310-2.5	Clearance	63	10	6.35	64.0	57.4	2.5×1	41100	111000	528	77
ZFT 6310-5	Z						2.5×1	41100	111000	1038	107
SFT 6310-5	Clearance						2.5×2	74600	221000	1020	107
ZFT 6310-10	Z						2.5×2	74600	221000	2000	167
SFT 6310-7.5	Clearance						2.5×3	106000	332000	1500	137
DFT 6310-7.5	D						2.5×3	106000	332000	2950	257
SFT 6320-2.5	Clearance		20	9.525	65.0	55.2	2.5×1	93400	227000	713	127
DFT 6320-2.5	D						2.5×1	93400	227000	1400	227
SFT 6320-5	Clearance						2.5×2	170000	453000	1380	187
DFT 6320-5	D						2.5×2	170000	453000	2710	347
LPFT 6340-2.5	P		40	7.938	65.25	57	2.5×1	35300	69200	466	178
LPFT 6340-3	P						1.5×2	41300	83100	551	218
LSFT 6340-2.5	Clearance						2.5×1	56000	138000	560	178
LDFT 6340-2.5	D						2.5×1	56000	138000	1100	339
LSFT 6340-3	Clearance						1.5×2	65500	166000	667	218
LDFT 6340-3	D						1.5×2	65500	166000	1310	419
LPFT 6350-1.5	P		50	7.938	65.25	57	1.5×1	22400	41100	285	161
LPFT 6350-2.5	P						2.5×1	34800	69600	478	211
LSFT 6350-1.5	Clearance						1.5×1	35600	82200	346	161
LDFT 6350-1.5	D						1.5×1	35600	82200	678	311
LSFT 6350-2.5	Clearance						2.5×1	55300	139000	560	211
LDFT 6350-2.5	D						2.5×1	55300	139000	1120	411

Remarks:
1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, ZFT, and SFT, the nut length "L" is shortened by dimension "M".
3. If there is no seal for LSFT and LDFT of shaft diameter 25 mm or larger, the nut length "L" is shortened by dimension "M" and "C".
4. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



Housing hole and its clearance

LPFT, LSFT



LDFT

Unit: mm

Ball nut dimensions															
Nut diameter		Flanged diameter	Flanged width	Notched flange	Tube projecting type			Seal dimension		Diameter g6	Bolt hole dimension			Bolt hole PCD	Oil hole
D	S	A	B	G	U	V	R	M	C	J	X	Y	Z	W	Q
108	—	154	22	58	—	—	—	7	—	—	14	20	13	130	Rc1/8
122	—	180	28	69	—	—	—	17	—	—	18	26	17.5	150	Rc1/8
97	—	144	22	49	58	77	19	15	14	—	14	—	—	120	Rc1/8
97	—	144		49	58	77	19			—				120	
97	—	144		49	58	77	19			—				120	
122	97	168		62	—	—	—			29				144	
97	—	144		49	58	77	19			—				120	
122	97	168		62	—	—	—			29				144	
97	—	144	22	49	58	77	19	19	16	—	14	—	—	120	Rc1/8
97	—	144		49	58	77	19			—				120	
97	—	144		49	58	77	19			—				120	
122	97	168		62	—	—	—			29				144	
97	—	144		49	58	77	19			—				120	
122	97	168		62	—	—	—			29				144	

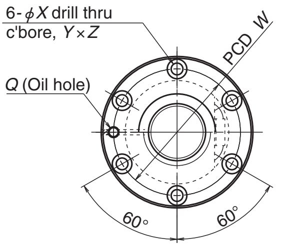
Remarks 5. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.

6. For PFT and LPFT, the basic load ratings differ from the other models as the spacer balls are installed.

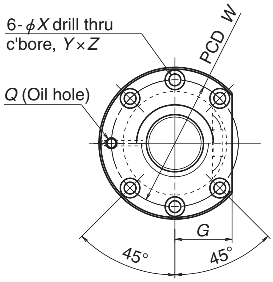
7. Preload system: P, Oversize ball preload; Z, Offset preload; D, Double nut preload (Refer to Page B5)

Return tube type

View X-X



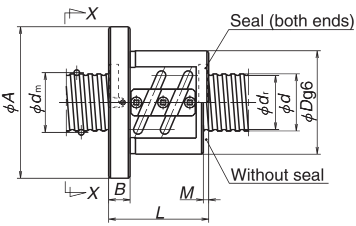
Circular shape Ⅰ



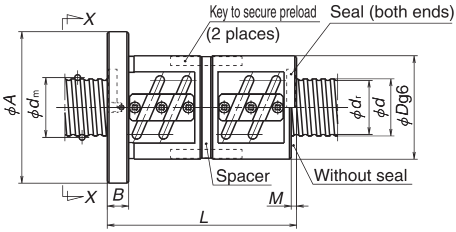
Circular shape Ⅱ

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	Static C_{0a}	Axial rigidity K (N/μm)
SFT 8010-5	Clearance	80	10	6.35	81.0	74.4	2.5×2	83200	282000	1240
DFT 8010-5	D						2.5×2	83200	282000	2430
SFT 8010-7.5	Clearance						2.5×3	118000	423000	1830
DFT 8010-7.5	D						2.5×3	118000	423000	3590
SFT 8012-5	Clearance		12	7.938	81.5	73.2	2.5×2	113000	350000	1280
DFT 8012-5	D						2.5×2	113000	350000	2500
SFT 8012-7.5	Clearance						2.5×3	161000	525000	1880
DFT 8012-7.5	D						2.5×3	161000	525000	3690
SFT 8016-5	Clearance		16	9.525	82.0	72.2	2.5×2	192000	581000	1680
DFT 8016-5	D						2.5×2	192000	581000	3300
SFT 8016-7.5	Clearance						2.5×3	271000	872000	2470
DFT 8016-7.5	D						2.5×3	271000	872000	4850
SFT 8020-5	Clearance		20	9.525	82.0	72.2	2.5×2	191000	581000	1680
DFT 8020-5	D						2.5×2	191000	581000	3300
SFT 8020-7.5	Clearance						2.5×3	271000	871000	2470
DFT 8020-7.5	D						2.5×3	271000	871000	4850
SFT 10012-5	Clearance	100	12	7.938	101.5	93.2	2.5×2	124000	441000	1530
DFT 10012-5	D						2.5×2	124000	441000	2990
SFT 10012-7.5	Clearance						2.5×3	176000	661000	2250
DFT 10012-7.5	D						2.5×3	176000	661000	4400
SFT 10016-5	Clearance		16	9.525	102	92.2	2.5×2	208000	736000	2010
DFT 10016-5	D						2.5×2	208000	736000	3930
SFT 10016-7.5	Clearance						2.5×3	295000	1100000	2950
DFT 10016-7.5	D						2.5×3	295000	1100000	5790
SFT 10020-5	Clearance		20	9.525	102	92.2	2.5×2	208000	735000	2010
DFT 10020-5	D						2.5×2	208000	735000	3930
SFT 10020-7.5	Clearance						2.5×3	294000	1100000	2950
DFT 10020-7.5	D						2.5×3	294000	1100000	5780
SFT 12516-5	Clearance	125	16	9.525	127	117.2	2.5×2	231000	918000	2390
DFT 12516-5	D						2.5×2	231000	918000	4690
SFT 12516-7.5	Clearance						2.5×3	327000	1380000	3520
DFT 12516-7.5	D						2.5×3	327000	1380000	6890
SFT 12520-5	Clearance		20	9.525	127	117.2	2.5×2	230000	917000	2390
DFT 12520-5	D						2.5×2	230000	917000	4690
SFT 12520-7.5	Clearance						2.5×3	327000	1380000	3520
DFT 12520-7.5	D						2.5×3	327000	1380000	6890

Remarks:
1. Nut flange for shaft diameter 16 mm or smaller comes in rectangular shape. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for PFT, SFT, and DFT, the nut length "L" is shortened by dimension "M".
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



SFT



DFT

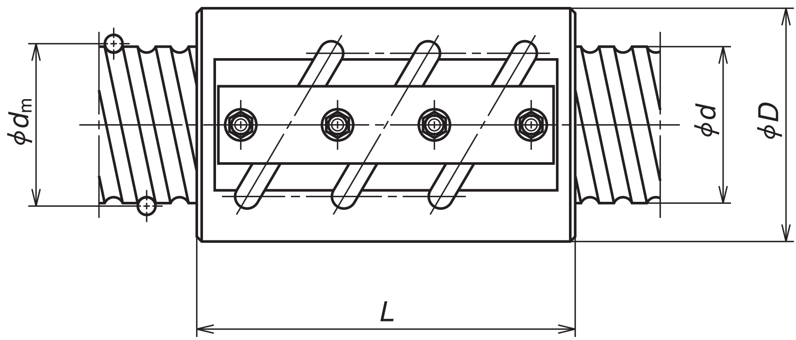
Unit: mm

Ball nut dimensions										
Nut entire length *L*	Nut diameter *D*	Flanged diameter *A*	Flanged width *B*	Notched flange *G*	Seal dimension *M*	Bolt hole dimension *X*	*Y*	*Z*	Bolt hole PCD *W*	Oil hole *Q*
107 197 137 257	130	176	22	66	7	14	20	13	152	Rc1/8
123 231 159 303	136	182	22	68	8	14	20	13	158	Rc1/8
158 302 206 398	143	204	28	77	10	18	26	17.5	172	Rc1/8
187 347 247 467	143	204	28	77	17	18	26	17.5	172	Rc1/8
129 237 165 309	160	220	28	82	8	18	26	17.5	188	Rc1/8
162 306 210 402	170	243	32	91	10	22	32	21.5	205	Rc1/8
191 351 251 471	170	243	32	91	17	22	32	21.5	205	Rc1/8
170 314 218 410	200	290	36	109	10	26	39	25.5	243	Rc1/8
199 379 259 499	200	290	36	109	12	26	39	25.5	243	Rc1/8

Remarks 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.

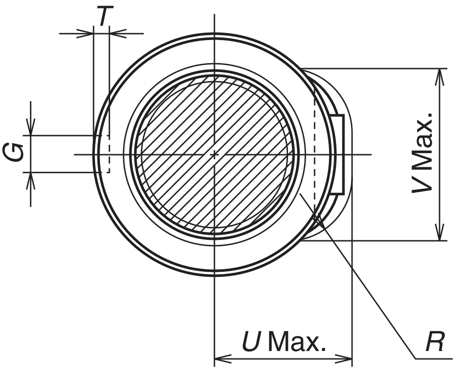
5. Preload system: D; Double nut preload (Refer to Page B5)

Return tube type



Model No.	Axial play (Max.)	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	Static C_{0a}
GSCT14025-5 GSCT14025-7.5	0.25	140	25	15.875	143	126.0	2.5×2 2.5×3	321000 427000	1390000 2090000
GSCT14032-5 GSCT14032-7.5	0.35		32	22.225	144	121.0	2.5×2 2.5×3	504000 669000	1960000 2930000
GSCT14040-5 GSCT14040-7.5	0.35		40	22.225	144	121.0	2.5×2 2.5×3	503000 668000	1950000 2930000
GSCT14050-5 GSCT14050-7.5	0.40		50	25.4	145	119.0	2.5×2 2.5×3	607000 807000	2230000 3340000
GSCT16032-5 GSCT16032-7.5	0.35	160	32	22.225	164	141.0	2.5×2 2.5×3	540000 717000	2240000 3360000
GSCT16040-5 GSCT16040-7.5	0.35		40	22.225	164	141.0	2.5×2 2.5×3	539000 716000	2240000 3360000
GSCT16050-5 GSCT16050-7.5	0.40		50	25.4	165	139.0	2.5×2 2.5×3	639000 849000	2550000 3820000
GSCT20032-5 GSCT20032-7.5	0.35	200	32	22.225	204	181.0	2.5×2 2.5×3	601000 798000	2810000 4220000
GSCT20040-5 GSCT20040-7.5	0.35		40	22.225	204	181.0	2.5×2 2.5×3	600000 797000	2810000 4220000
GSCT20050-5 GSCT20050-7.5	0.40		50	25.4	205	179.0	2.5×2 2.5×3	711000 944000	3190000 4790000
GSCT25040-5 GSCT25040-7.5	0.40	250	40	25.4	255	229.0	2.5×2 2.5×3	781000 1040000	3990000 5990000
GSCT25050-5 GSCT25050-7.5	0.51		50	31.75	256	223.0	2.5×2 2.5×3	973000 1290000	4990000 7490000

Remarks 1. Precision grade is equivalent to Ct10 grade of JIS B1192 (Refer to Page B41)
2. The entire nut length (L) is the size without seal. The size with a seal is longer by the size of "MS."



Unit: mm

Nut dimensions							
Nut entire length	Nut diameter	Key dimension		Tube projecting dimension			Seal dimension
L	*D*	*G*	*T*	*U*	*V*	*R*	(*MS*)
200 275	210	32	11	115	154	50	40
252 348	220			135	163	60	48
306 426	220			135	163	60	58
377 527	225			141	167	70	70
252 348	245	36	12	141	180	60	48
306 426	245			141	180	60	58
377 527	250			147	185	70	70
252 348	295	45	15	162	216	70	48
306 426	295			162	216		58
377 527	300			168	221		70
312 432	355	50	17	194	266	70	58
385 535	370			206	274	90	70

B-3-3.3 Deflector Type Ball Screws

1. Features

Deflector type has the smallest nut compared to the other recirculation systems, and suitable for fine lead operation.

2. Specifications

(1) Recirculation system

It has a compact nut outside diameter, and suits for small lead driving. Fig.1 shows the structure of the deflector recirculation system.

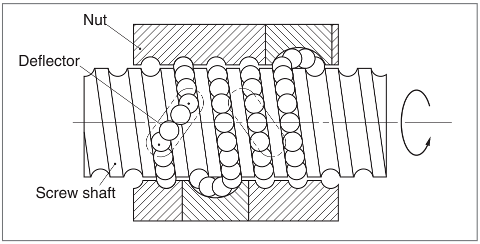


Fig. 1 Structure of deflector recirculation system

Table 1 Accuracy grade and axial play

Accuracy grade	C0, C1, C2, C3, C5, Ct7 (Ct7 is not included in DFD)
Axial play	Z, 0 mm (Preload); T, 0.005 mm or less S, 0.020 mm or less; N, 0.050 mm or less

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are shown in Table 1. Please consult NSK for other grades.

(3) Allowable d·n value and the criterion of maximum rotational speed

Allowable d·n value and the criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below. Basic measure must be taken for the high speed ball screws respectively.

Allowable d·n value:

Standard specification ; 84000 or less

High-speed specification; 100000 or less

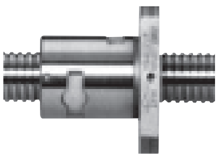
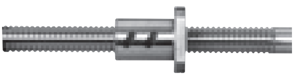
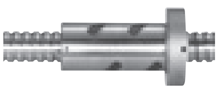
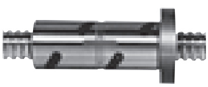
Standard of rotational speed : 3000 min^{-1}

Note: Please also review the critical speed. Refer to "Technical Description: Permissible rotational speed" (Page B51) for details.

(4) Other specifications

Please consult NSK for other specifications not listed in the dimension tables.

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.
NSK has a patent for this product.

4. Design Precautions

When designing the screw shaft end, one end of the screw must meet either one of the following conditions. If not, we cannot install the ball nut on the screw shaft.

- Cut the ball groove through to the shaft end.
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove "dr" specified on the dimension table.

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B103).

5. Example of model number in dimension tables

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇Model number

SFD 40 08 - 4

- SFD — Nut model: SFD, ZFD, DFD, MSFD, MPFD
- 40 — Screw shaft diameter (mm)
- 08 — Lead (mm)
- 4 — Effective turns of balls (Note)

Note: In case of ZFD, the number here is twice as large as the effective turns of balls.

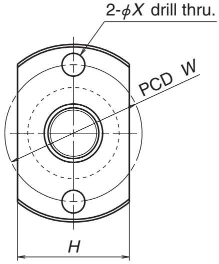
◇Reference number for ball screw

W 40 08 - D Y - C3 Z 5**

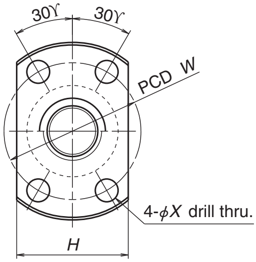
- W — Product code
- 40 — Screw shaft diameter (mm)
- 08 — Effective threaded length (in the unit of 100mm)
- ** — NSK design serial number
- D — Preload code: No code, non-preload; Z, Z preload; D, D preload; P, P preload
- Y — Deflector recirculation system
- C3 — Accuracy grade code: C0, C1, C2, C3, C5, C7(Ct7)
- Z — Axial play code: Z, T, S, N
- 5 — Lead (mm)

Deflector type

View *X*-*X*



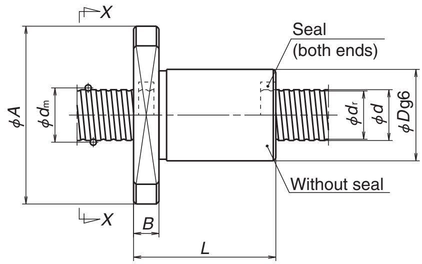
Lead l =0.5mm



Lead l > 1mm

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	Static C_{0a}
MSFD 0400.5-3 **MPFD 0400.5-3**	Clearance P	4	0.5	0.400	4.1	3.6	1×3	205	280
MSFD 0401-2 * **MPFD 0401-2**	Clearance P		1	0.800	4.2	3.2	1×2	370	370
MSFD 0600.5-3 **MPFD 0600.5-3**	Clearance P	6	0.5	0.400	6.1	5.6	1×3	240	430
MSFD 0601-3 * **MPFD 0601-3**	Clearance P		1	0.800	6.2	5.2	1×3	680	920
MSFD 0602-3 **MPFD 0602-3**	Clearance P		2	0.800	6.2	5.2	1×3	675	920
MSFD 0800.5-3 **MPFD 0800.5-3**	Clearance P	8	0.5	0.400	8.1	7.6	1×3	275	595
MSFD 0801-3 * **MPFD 0801-3**	Clearance P		1	0.800	8.2	7.2	1×3	790	1290
MSFD 0801.5-3 * **MPFD 0801.5-3**	Clearance P		1.5	1.000	8.3	7.0	1×3	1270	1970
MSFD 0802-3 * **MPFD 0802-3**	Clearance P		2	1.200	8.3	6.9	1×3	1560	2200
MSFD 1001-3 **MPFD 1001-3**	Clearance P	10	1	0.800	10.2	9.2	1×3	880	1660
MSFD 1002-3 * **MPFD 1002-3**	Clearance P		2	1.200	10.3	8.9	1×3	1800	2970
MSFD 1002.5-3 * **MPFD 1002.5-3**	Clearance P		2.5	1.588	10.4	8.6	1×3	2500	3630
MSFD 1201-3 **MPFD 1201-3**	Clearance P	12	1	0.800	12.2	11.2	1×3	940	1980
MSFD 1202-3 * **MPFD 1202-3**	Clearance P		2	1.200	12.3	10.9	1×3	1960	3620
MSFD 1202.5-3 * **MPFD 1202.5-3**	Clearance P		2.5	1.588	12.4	10.6	1×3	2790	4530
MSFD 1203-3 **MPFD 1203-3**	Clearance P		3	2.000	12.5	10.2	1×3	3680	5400
MSFD 1402-3 **MPFD 1402-3**	Clearance P	14	2	1.200	14.3	12.9	1×3	2100	4260
MSFD 1403-3 **MPFD 1403-3**	Clearance P		3	2.000	14.5	12.2	1×3	4010	6480

Remarks
1. If the shaft OD is less than 6 mm or the lead is less than 1 mm, a seal is not installed in the nut. (Refer to Page B72 for dust protection.)
2. Ball nuts with shaft diameters under 14 mm do not have oil holes.
3. Right turn screw is standard. Please consult NSK for left turn screw.

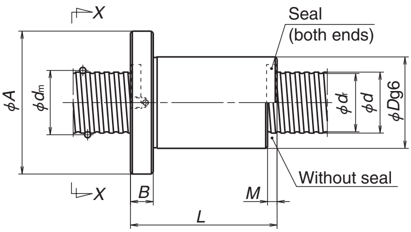


Unit: mm

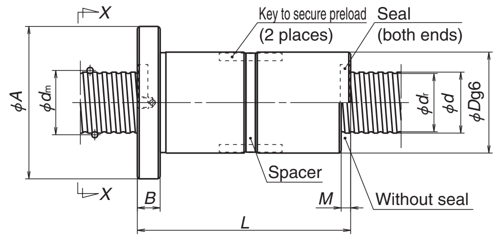
Axial rigidity K (N/μm)	Ball nut dimensions						
	Nut entire length *L*	Nut diameter *D*	Flanged diameter *A*	Flanged width *B*	Flanged dimension *H*	Bolt hole dimension *X*	Bolt hole PCD *W*
30 47	13	10	22	3	11	3.4	16
22 34	12	10	20	3	14	2.9	15
42 66	13	12	24	3	13	3.4	18
49 76	15	12	24	3.5	16	3.4	18
49 76	17	13	25	4	17	3.4	19
54 85	13	14	27	3	15	3.4	21
64 99	16	14	27	4	18	3.4	21
76 117	22	15	28	4	19	3.4	22
73 113	26	16	29	4	20	3.4	23
77 120	16	16	29	4	20	3.4	23
91 138	28	18	35	5	22	4.5	27
90 140	32	19	36	5	23	4.5	28
88 137	16	18	31	4	22	3.4	25
108 168	28	20	37	5	24	4.5	29
107 167	32	21	38	5	25	4.5	30
107 166	36	22	39	5	26	4.5	31
122 191	29	22	41	6	26	5.5	32
127 196	37	24	43	6	28	5.5	34

Remarks 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.
5. The models marked with ✻ are in MA type of standard ball screw with finished shaft end.
6. Preload system: P; Oversize ball preload (Refer to Page B5)

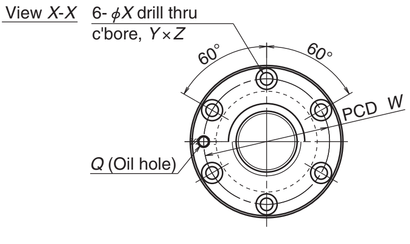
Deflector type



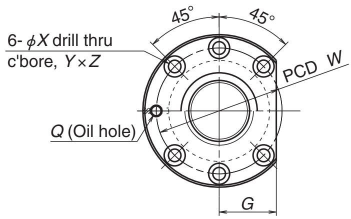
SFD, ZFD



DFD



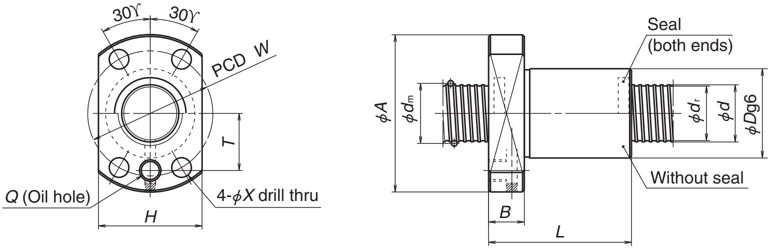
Circular shape Ⅰ



Circular shape Ⅱ

Model No.	Preload system	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls Turns × Circuits	Basic load rating (N) Dynamic C_a	Basic load rating (N) Static C_{0a}	Axial rigidity K (N/μm)
MSFD 1602-4	Clearance	16	2	1.588	16.4	14.6	1×4	4150	8450	185
* **MPFD 1602-4**	P									288
MSFD 1602.5-4	Clearance		2.5	1.588	16.4	14.6	1×4	4150	8450	185
* **MPFD 1602.5-4**	P									288
MSFD 2002-4	Clearance	20	2	1.588	20.4	18.6	1×4	4620	10900	225
MPFD 2002-4	P									351
SFD 2005-3	Clearance		5	3.175	20.75	17.4	1×3	10100	17400	196
ZFD 2005-6	Z						1×3	10100	17400	382
SFD 2005-4	Clearance						1×4	13000	23300	255
DFD 2005-4	D						1×4	13000	23300	509
SFD 2006-3	Clearance		6	3.969	21	16.9	1×3	13100	20500	196
ZFD 2006-6	Z						1×3	13100	20500	382
SFD 2006-4	Clearance						1×4	16800	27400	255
DFD 2006-4	D						1×4	16800	27400	498
MSFD 2502-4	Clearance	25	2	1.588	25.4	23.6	1×4	5100	13900	273
MPFD 2502-4	P									425
SFD 2505-3	Clearance		5	3.175	25.75	22.4	1×3	11600	22900	245
* **ZFD 2505-6**	Z						1×3	11600	22900	480
SFD 2505-4	Clearance						1×4	14800	30500	323
DFD 2505-4	D						1×4	14800	30500	630
SFD 2506-3	Clearance		6	3.969	26	21.9	1×3	15200	27300	245
ZFD 2506-6	Z						1×3	15200	27300	470
SFD 2506-4	Clearance						1×4	19400	36400	323
DFD 2506-4	D						1×4	19400	36400	626
ZFD 2510-4	Z		10	4.762	26.25	21.3	1×2	13300	21200	323
SFD 2510-3	Clearance						1×3	18900	31800	245
DFD 2510-3	D						1×3	18900	31800	479

Remarks
1. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for SFD, ZFD, and DFD, the nut length "L" is shortened by dimension "M". For MSFD and MPFD, the nut length is the same as those with seal.
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw. Please consult NSK for MSFD, MPFD.



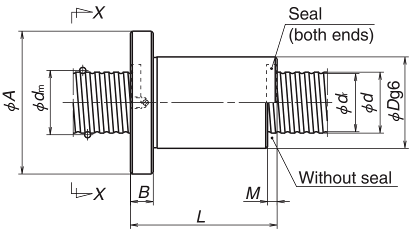
MSFD, MPFD

Unit: mm

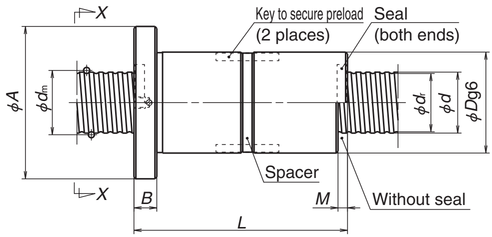
Ball nut dimensions												
Nut entire length	Nut diameter	Flanged diameter	Flanged width	Notched flange		Seal dimension	Bolt hole dimension			Bolt hole PCD	Oil hole dimension	Oil hole
L	*D*	*A*	*B*	*G*	*H*	*M*	*X*	*Y*	*Z*	*W*	*T*	*Q*
40	25	44	10	—	29	—	5.5	—	—	35	16	M6×1
44	25	44	10	—	29	—	5.5	—	—	35	16	M6×1
40	30	49	10	—	34	—	5.5	—	—	40	18.5	M6×1
46 66 51 91	35 35 35 41	58 58 58 64	11	22.5 22.5 22.5 25	—	5	5.5	9.5	5.5	46 46 46 52	—	M6×1
52 76 60 108	35 35 35 42	58 58 58 65	11	22.5 22.5 22.5 25	—	6	5.5	9.5	5.5	46 46 46 53	—	M6×1
40	36	55	10	—	40	—	5.5	—	—	46	21.5	M6×1
46 66 51 91	40 40 40 46	63 63 63 69	11	24 24 24 26	—	5	5.5	9.5	5.5	51 51 51 57	—	M6×1
52 76 60 108	40 40 40 47	63 63 63 70	11	24 24 24 27	—	6	5.5	9.5	5.5	51 51 51 58	—	M6×1
88 80 140	42 42 47	69 69 74	15	26 26 28	—	10	6.6	11	6.5	55 55 60	—	M6×1

Remarks
4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.
5. It is recommended to use with seal when shaft diameter is 16 mm or larger and have oil hole.
6. The models marked with ✻ are in MA type of standard ball screw with finished shaft end.
7. Preload system: Z, Offset preload; P, Oversize ball preload; D, Double nut preload (Refer to Page B5)

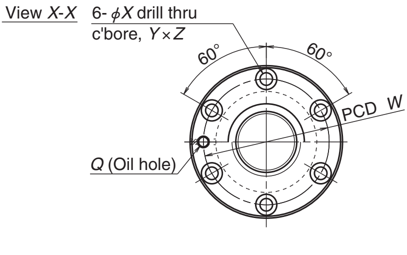
Deflector type



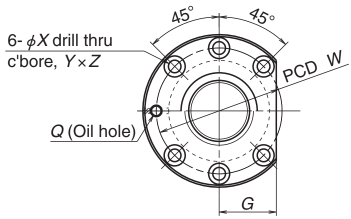
SFD, ZFD



DFD



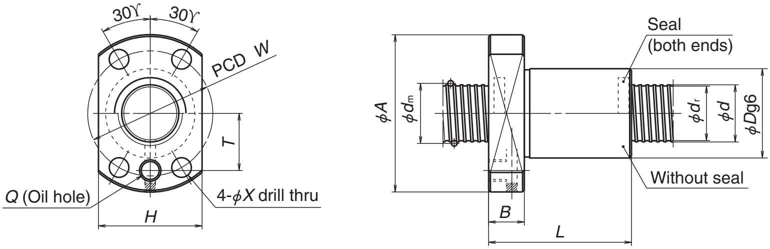
Circular shape I



Circular shape II

Model No.	Preload system	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls Turns × Circuits	Basic load rating (N) Dynamic C_a	Static C_{0a}	Axial rigidity K (N/μm)
MSFD 3202-6	Clearance	32	2	1.588	32.4	30.6	1×6	8030	27100	494
MPFD 3202-6	P									769
SFD 3205-3	Clearance		5	3.175	32.75	29.4	1×3	13100	30500	304
ZFD 3205-6	Z						1×3	13100	30500	598
SFD 3205-4	Clearance						1×4	16800	40600	409
* **ZFD 3205-8**	Z						1×4	16800	40600	784
SFD 3205-6	Clearance						1×6	23800	60900	588
DFD 3205-6	D						1×6	23800	60900	1160
SFD 3206-3	Clearance		6	3.969	33	28.9	1×3	17700	37400	314
ZFD 3206-6	Z						1×3	17700	37400	608
SFD 3206-4	Clearance						1×4	22600	49900	412
ZFD 3206-8	Z						1×4	22600	49900	804
SFD 3206-6	Clearance						1×6	32100	74800	598
DFD 3206-6	D						1×6	32100	74800	1190
SFD 3208-3	Clearance		8	4.762	33.25	28.3	1×3	21600	41700	304
ZFD 3208-6	Z						1×3	21600	41700	588
SFD 3208-4	Clearance						1×4	27700	55600	392
ZFD 3208-8	Z						1×4	27700	55600	774
SFD 3210-3	Clearance		10	6.35	33.75	27.1	1×3	30500	52500	300
* **ZFD 3210-6**	Z						1×3	30500	52500	588
SFD 3210-4	Clearance						1×4	39000	70000	392
DFD 3210-4	D						1×4	39000	70000	773

Remarks
1. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for SFD, ZFD, and DFD, the nut length "L" is shortened by dimension "M". For MSFD and MPFD, the nut length is the same as those with seal.
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw. Please consult NSK for MSFD, MPFD.



MSFD, MPFD

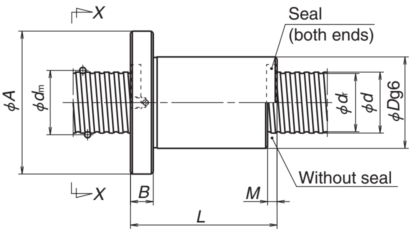
Unit: mm

Ball nut dimensions												
Nut entire length	Nut diameter	Flanged diameter	Flanged width	Notched flange		Seal dimension	Bolt hole dimension			Bolt hole PCD	Oil hole dimension	Oil hole
L	*D*	*A*	*B*	*G*	*H*	*M*	*X*	*Y*	*Z*	*W*	*T*	*Q*
50	42	65	10	—	46	—	6.6	—	—	54	26.5	M6×1
47	48	75	12	29	—	5	6.6	11	6.5	61	—	M6×1
67	48	75		29						61		
52	48	75		29						61		
77	48	75		29						61		
62	48	75		29						61		
112	53	80		30						66		
53	48	75	12	29	—	6	6.6	11	6.5	61	—	M6×1
77	48	75		29						61		
61	48	75		29						61		
90	48	75		29						61		
73	48	75		29						61		
133	54	81		31						67		
67	50	84	15	32	—	8	9	14	8.5	66	—	M6×1
99												
76												
116												
80	54	88	15	34	—	10	9	14	8.5	70	—	M6×1
120												
90												
160												

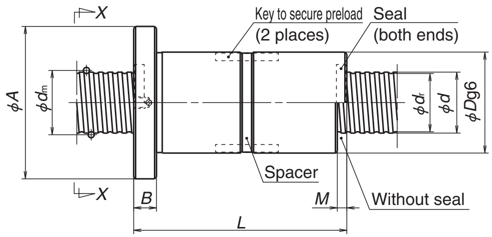
Remarks 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.

5. It is recommended to use with seal when shaft diameter is 16 mm or larger and have oil hole.
6. The models marked with ✻ are in SS type of standard ball screw with blank shaft end.
7. Preload system: Z, Offset preload; P, Oversize ball preload; D, Double nut preload (Refer to Page B5)

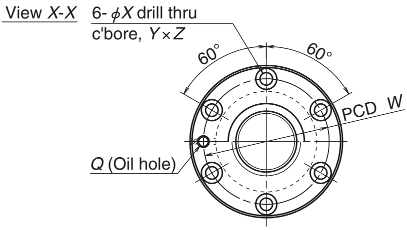
Deflector type



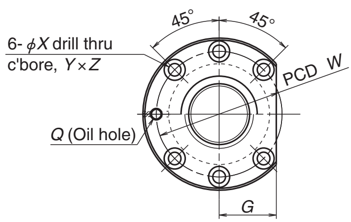
SFD, ZFD



DFD



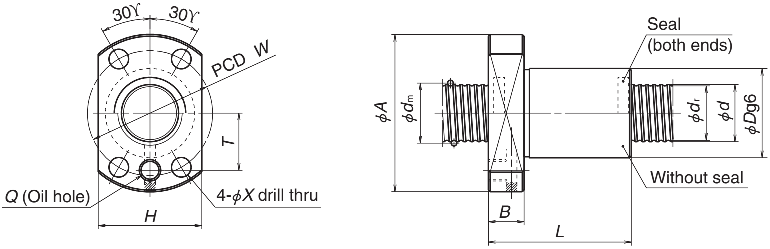
Circular shape Ⅰ



Circular shape Ⅱ

Model No.	Preload system	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls Turns × Circuits	Basic load rating (N) Dynamic C_a	Basic load rating (N) Static C_{0a}	Axial rigidity K (N/μm)
MSFD 4002-6	Clearance	40	2	1.588	40.4	38.6	1×6	8720	33900	588
MPFD 4002-6	P									916
SFD 4005-4	Clearance		5	3.175	40.75	37.4	1×4	18700	52200	490
ZFD 4005-8	Z						1×4	18700	52200	960
SFD 4005-6	Clearance						1×6	26500	78300	725
ZFD 4005-12	Z						1×6	26500	78300	1410
SFD 4006-4	Clearance		6	3.969	41.0	36.9	1×4	25100	63500	490
ZFD 4006-8	Z						1×4	25100	63500	970
SFD 4006-6	Clearance						1×6	35600	92500	725
ZFD 4006-12	Z						1×6	35600	92500	1431
SFD 4008-4	Clearance		8	4.762	41.25	36.3	1×4	32000	75000	500
ZFD 4008-8	Z						1×4	32000	75000	990
SFD 4008-6	Clearance						1×6	45400	113000	735
DFD 4008-6	D						1×6	45400	113000	1460
SFD 4010-3	Clearance		10	6.35	41.75	35.1	1×3	35300	69800	372
ZFD 4010-6	Z						1×3	35300	69800	735
SFD 4010-4	Clearance						1×4	45200	93100	490
ZFD 4010-8	Z						1×4	45200	93100	970
SFD 5005-4	Clearance	50	5	3.175	50.75	47.4	1×4	20700	66700	593
ZFD 5005-8	Z						1×4	20700	66700	1170
SFD 5005-6	Clearance						1×6	29300	100000	872
ZFD 5005-12	Z						1×6	29300	100000	1720
SFD 5006-4	Clearance		6	3.969	51.0	46.9	1×4	27900	81600	598
ZFD 5006-8	Z						1×4	27900	81600	1190
SFD 5006-6	Clearance						1×6	39600	122000	892
ZFD 5006-12	Z						1×6	39600	122000	1750

Remarks
1. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for SFD, ZFD, and DFD, the nut length "L" is shortened by dimension "M". For MSFD and MPFD, the nut length is the same as those with seal.
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw. Please consult NSK for MSFD, MPFD.



MSFD, MPFD

Unit: mm

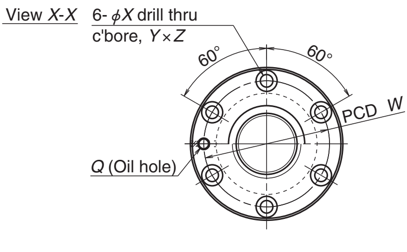
Ball nut dimensions												
Nut entire length	Nut diameter	Flanged diameter	Flanged width	Notched flange		Seal dimension	Bolt hole dimension			Bolt hole PCD	Oil hole dimension	Oil hole
L	*D*	*A*	*B*	*G*	*H*	*M*	*X*	*Y*	*Z*	*W*	*T*	*Q*
50	51	74	10	—	55	—	6.6	—	—	63	31	M6×1
55 80 65 101	56	90	15	34	—	5	9	14	8.5	72	—	Rc1/8
64 93 76 118	56	90	15	34	—	6	9	14	8.5	72	—	Rc1/8
76 116 93 168	60 60 60 62	94 94 94 96	15	36 36 36 37	—	8	9	14	8.5	76 76 76 78	—	Rc1/8
83 123 93 143	62	104	18	40	—	10	11	17.5	11	82	—	Rc1/8
55 80 65 101	66	100	15	38	—	5	9	14	8.5	82	—	Rc1/8
64 93 76 118	66	100	15	38	—	6	9	14	8.5	82	—	Rc1/8

Remarks 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.

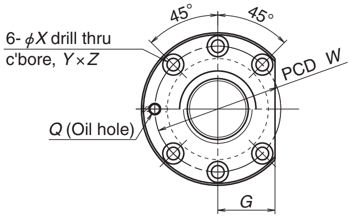
5. It is recommended to use with seal when shaft diameter is 16 mm or larger and have oil hole.

6. Preload system: Z, Offset preload; P, Oversize ball preload; D, Double nut preload (Refer to Page B5)

Deflector type



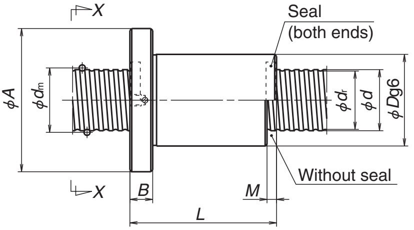
Circular shape I



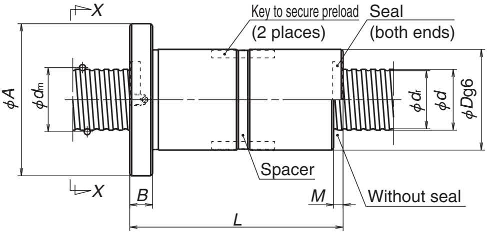
Circular shape II

Model No.	Preload system	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls Turns × Circuits	Basic load rating (N) Dynamic C_a	Basic load rating (N) Static C_{0a}	Axial rigidity K (N/μm)
SFD 5008-4	Clearance	50	8	4.762	51.25	46.3	1×4	35300	94700	598
ZFD 5008-8	Z						1×4	35300	94700	1180
SFD 5008-6	Clearance						1×6	50000	142000	887
DFD 5008-6	D						1×6	50000	142000	1740
SFD 5010-3	Clearance		10	6.35	51.75	45.1	1×3	40200	91500	461
ZFD 5010-6	Z						1×3	40200	91500	914
SFD 5010-4	Clearance						1×4	51500	122000	608
ZFD 5010-8	Z						1×4	51500	122000	1200
SFD 5010-6	Clearance						1×6	72900	183000	902
DFD 5010-6	D						1×6	72900	183000	1770
SFD 5012-3	Clearance		12	7.938	52.25	44	1×3	52800	109000	461
ZFD 5012-6	Z						1×3	52800	109000	906
SFD 5012-4	Clearance						1×4	67600	145000	608
DFD 5012-4	D						1×4	67600	145000	1200
SFD 5020-3	Clearance		20	7.938	52.25	44	1×3	52400	109000	461
DFD 5020-3	D						1×3	52400	109000	908
SFD 6306-4	Clearance	63	6	3.969	64.0	59.9	1×4	30800	104000	735
ZFD 6306-8	Z						1×4	30800	104000	1430
SFD 6306-6	Clearance						1×6	43600	156000	1180
ZFD 6306-12	Z						1×6	43600	156000	2110
SFD 6308-4	Clearance		8	4.762	64.25	59.3	1×4	39600	124000	745
ZFD 6308-8	Z						1×4	39600	124000	1460
SFD 6308-6	Clearance						1×6	56200	186000	1100
DFD 6308-6	D						1×6	56200	186000	2150
SFD 6310-4	Clearance		10	6.35	64.75	58.1	1×4	58700	162000	764
ZFD 6310-8	Z						1×4	58700	162000	1510
SFD 6310-6	Clearance						1×6	83200	244000	1130
DFD 6310-6	D						1×6	83200	244000	2210
ZFD 6312-6	Z		12	7.938	65.25	57	1×3	59900	143000	1120
SFD 6312-4	Clearance						1×4	76800	191000	755
DFD 6312-4	D						1×4	76800	191000	1480
SFD 6312-6	Clearance						1×6	109000	286000	1110
DFD 6312-6	D						1×6	109000	286000	2180
SFD 6320-3	Clearance		20	9.525	65.75	56	1×3	98400	231000	735
DFD 6320-3	D									1440

Remarks
1. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for SFD, ZFD, and DFD, the nut length "L" is shortened by dimension "M". For MSFD and MPFD, the nut length is the same as those with seal.
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



SFD, ZFD



DFD

Unit: mm

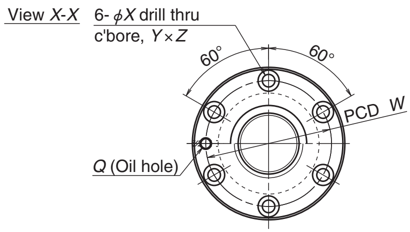
Ball nut dimensions										
Nut entire length *L*	Nut diameter *D*	Flanged diameter *A*	Flanged width *B*	Notched flange *G*	Seal dimension *M*	Bolt hole dimension *X*	*Y*	*Z*	Bolt hole PCD *W*	Oil hole *Q*
79	70	112	18	43	8	11	17.5	11	90	Rc1/8
119	70	112		43					90	
96	70	112		43					90	
171	72	114		44					92	
83	72	114	18	44	10	11	17.5	11	92	Rc1/8
123										
93										
143										
114										
205										
99	75	121	22	47	12	14	20	13	97	Rc1/8
147										
111										
195										
146	75	121	28	47	20	14	20	13	97	Rc1/8
253										
67	80	122	18	47	6	11	17.5	11	100	Rc1/8
96										
79										
121										
79	82	124	18	47	8	11	17.5	11	102	Rc1/8
119	82	124		47					102	
96	82	124		47					102	
175	85	127		48					105	
97	85	131	22	50	10	14	20	13	107	Rc1/8
147										
118										
214										
147	90	136	22	52	12	14	20	13	112	Rc1/8
111										
195										
136										
248										
146	95	153	28	59	20	18	26	17.5	123	Rc1/8
253										

Remarks 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.

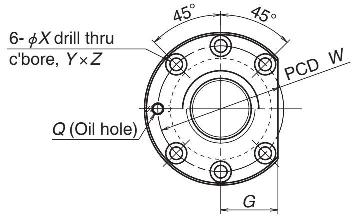
5. It is recommended to use with seal when shaft diameter is 16 mm or larger and have oil hole.

6. Preload system: Z, Offset preload; D, Double nut preload (Refer to Page B5)

Deflector type



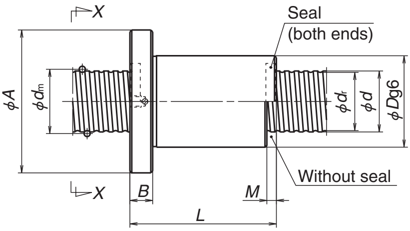
Circular shape Ⅰ



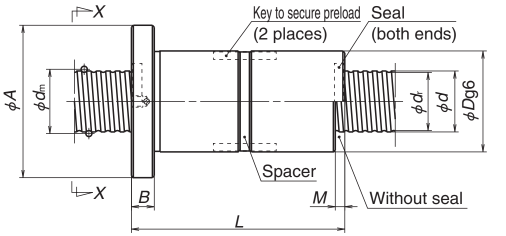
Circular shape Ⅱ

Model No.	Preload system	Shaft dia. d	Lead l	Ball dia. D_w	Ball circle dia. d_m	Root dia. d_r	Effective turns of balls Turns × Circuits	Basic load rating (N) Dynamic C_a	Basic load rating (N) Static C_{0a}	Axial rigidity K (N/μm)
SFD 8010-4	Clearance	80	10	6.35	81.75	75.1	1×4	65100	209000	931
DFD 8010-4	D						1×4	65100	209000	1840
SFD 8010-6	Clearance						1×6	92200	313000	1370
DFD 8010-6	D						1×6	92200	313000	2710
SFD 8012-4	Clearance		12	7.938	82.25	74	1×4	87400	254000	941
DFD 8012-4	D						1×4	87400	254000	1860
SFD 8012-6	Clearance						1×6	124000	381000	1392
DFD 8012-6	D						1×6	124000	381000	2730
SFD 8020-3	Clearance		20	9.525	82.75	73	1×3	114000	312000	931
DFD 8020-3	D						1×3	114000	312000	1830
SFD 8020-4	Clearance						1×4	146000	416000	1230
DFD 8020-4	D						1×4	146000	416000	2410
SFD 10010-6	Clearance	100	10	6.35	101.75	95.1	1×6	102000	400000	1670
DFD 10010-6	D									3270
SFD 10012-6	Clearance		12	7.938	102.25	94	1×6	138000	490000	1680
DFD 10012-6	D									3320
SFD 10020-4	Clearance		20	9.525	102.75	93	1×4	161000	525000	1470
DFD 10020-4	D									2890

Remarks
1. It comes in circular shape I and circular shape II for shaft diameter 20 mm or larger. Select a flange that is suitable for the space available for nut installation.
2. If there is no seal for SFD, ZFD, and DFD, the nut length "L" is shortened by dimension "M". For MSFD and MPFD, the nut length is the same as those with seal.
3. The right turn screw is standard. "L" is added to the end of the model code for the left turn screw.



SFD



DFD

Unit: mm

Ball nut dimensions										
Nut entire length *L*	Nut diameter *D*	Flanged diameter *A*	Flanged width *B*	Notched flange *G*	Seal dimension *M*	Bolt hole dimension *X*	Bolt hole dimension *Y*	Bolt hole dimension *Z*	Bolt hole PCD *W*	Oil hole *Q*
97 172 118 214	105	151	22	57	10	14	20	13	127	Rc1/8
111 195 136 248	110	156	22	59	12	14	20	13	132	Rc1/8
146 253 168 297	115	173	28	66	20	18	26	17.5	143	Rc1/8
118 214	125	171	22	64	10	14	20	13	147	Rc1/8
142 254	130	188	28	71	12	18	26	17.5	158	Rc1/8
172 301	135	205	32	79	20	22	32	21.5	169	Rc1/8

Remarks 4. The axial rigidity in the table above is a theoretical value obtained from the elastic deformation between screw groove and ball when the axial load is 30% of the basic dynamic load rating (C_a) with clearance, 10% with D preload, and 5% with P preload. Refer to "Technical description" (Page B41) if axial load differs from the conditions above, or when considering change in the deformation of the ball nut itself.
5. It is recommended to use with seal when shaft diameter is 16 mm or larger and have oil hole.
6. Preload system: D; Double nut preload (Refer to Page B5)

B-3-3.4 End Cap Type Ball Screw

1. Features

End cap recirculation system is suitable for high helix lead and multiple start threads.
Since the leads are 1 to 3 times larger than their screw shaft diameter, it makes them more suitable for high speed operation.

2. Specifications

(1) Recirculation system

The structure of end cap recirculation system is shown in Fig. 1.

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are shown in Table 1. Please consult NSK for other grades.

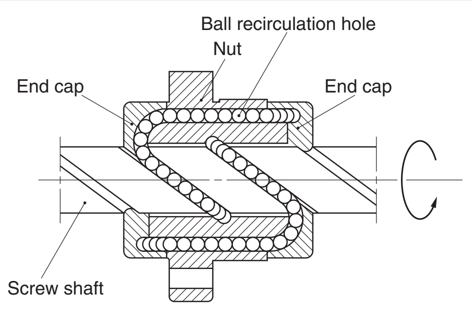


Fig. 1 Structure of end cap recirculation system

Table 1 Accuracy grade and axial play

Accuracy grade	LSFC, LPFC: C1, C2, C3, C5, Ct7 USFC, UPFC: C3, C5, Ct7 (Three times lead or over are C5, Ct7)
Axial play	Z, 0 mm (Preload); T, 0.005 mm or less, S, 0.020 mm or less; N, 0.050 mm or less

(3) Allowable d·n value and the criterion of maximum rotational speed.

Allowable d·n value and the criterion of maximum rotational speed are shown below. Please consult NSK for high-speed specification. Basic measure must be taken for the high speed ball screws respectively.

Allowable d·n value:

Standard specification ; 80000 or less

High-speed specification; 100000 or less

Standard of rotational speed : 3000 min^{-1}

※Please also review the critical speed. Refer to "Technical Description: Permissible rotational speed" (Page B51) for details.

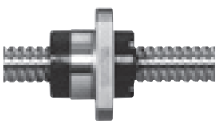
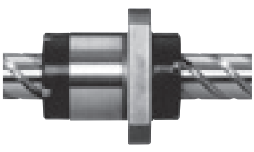
(4) Other specifications

Please consult NSK for other specifications not listed in the dimension tables.

3. Product categories

There are two different preload systems with several models (Table 2).

Table 2 End cap type ball screws product categories

Nut model	Shape	Flange shape	Nut shape	Preload system
LSFC		Flanged Circular Ⅲ	Circular	Non-preload, Slight axial play
LPFC			Circular	P preload (light preload) no spacer ball
USFC		Flanged Rectangular	Circular	Non-preload, Slight axial play
UPFC			Circular	P preload (light preload) no spacer ball

4. Design Precautions

When designing the screw shaft end, one end of the screw must meet either one of the following conditions. If not, we cannot install the ball nut on the screw shaft.

- Cut the ball groove through to the shaft end.
- The diameters of bearing journals and the gear or pulley seat must be less than the root diameter of ball groove "dr" specified on the dimension table.

Special bearings which have higher-load carrying capacity are available.

For general precautions regarding ball screws, refer to "Design Precautions" (Page B84) and "Handling Precautions" (Page B103).

5. Example of model number in dimension tables

A structure of "Model number" and "Reference number for ball screw" are as follows.

◇Model number

UPFC 25 25 - 3

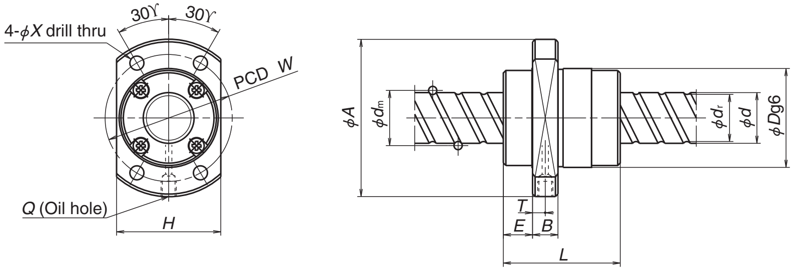
- UPFC: Nut model: LSFC, LPFC, USFC, UPFC
- 25: Screw shaft diameter (mm)
- 25: Lead (mm)
- 3: Effective turns of balls

◇Reference number for ball screw

W 25 09 - ** P G X - C3 Z 25

- W: Product code
- 25: Screw shaft diameter (mm)
- 09: Effective threaded length (in the unit of 100 mm)
- **: NSK design serial number
- P: Preload code: No code, non-preload; P, P preload
- G: End cap recirculation system
- X: Appearance/specification code
- C3: Accuracy grade code: C1, C2, C3, C5, C7 (Ct7)
- Z: Axial play code: Z, T, S, N
- 25: Lead (mm)

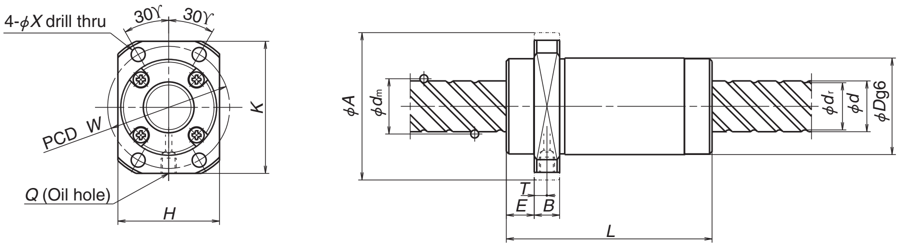
End cap type



LSFC, LPFC

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)
USFC 1220-1.5	Clearance	12	20	2.381	12.5	9.9	1.7×1	2960	4370	66
UPFC 1220-1.5	P									103
USFC 1520-1.5	Clearance	15	20	3.175	15.5	12.2	1.7×1	5660	8700	97
* **UPFC 1520-1.5**	P									151
USFC 1540-1	Clearance		40	3.175	15.75	12.2	0.7×2	3960	6070	62
UPFC 1540-1	P						0.7×2	3960	6070	97
USFC 1540-2	Clearance						0.7×4	7190	12100	121
UPFC 1540-2	P						0.7×4	7190	12100	188
LSFC 1616-3	Clearance	16	16	2.778	16.65	13.7	1.7×2	7120	12300	172
LPFC 1616-3	P						1.7×2	7120	12300	268
LSFC 1616-6	Clearance						1.7×4	12900	24700	334
LPFC 1616-6	P						1.7×4	12900	24700	520
USFC 1632-1	Clearance		32	3.175	16.75	13.4	0.7×2	4320	6760	74
* **UPFC 1632-1**	P						0.7×2	4320	6760	116
USFC 1632-3	Clearance						1.7×2	9270	16600	176
UPFC 1632-3	P						1.7×2	9270	16600	273
USFC 1632-6	Clearance						1.7×4	16800	33300	340
UPFC 1632-6	P						1.7×4	16800	33300	530
USFC 1650-1	Clearance		50	3.175	16.75	13.4	0.7×2	3960	7060	65
UPFC 1650-1	P						0.7×2	3960	7060	102
USFC 1650-2	Clearance						0.7×4	7200	14100	126
UPFC 1650-2	P						0.7×4	7200	14100	197
LSFC 2020-3	Clearance	20	20	3.175	20.75	17.4	1.7×2	11100	21200	238
LPFC 2020-3	P						1.7×2	11100	21200	370
LSFC 2020-6	Clearance						1.7×4	20100	42500	462
LPFC 2020-6	P						1.7×4	20100	42500	718
USFC 2040-1	Clearance		40	3.175	20.75	17.4	0.7×2	4870	8420	89
* **UPFC 2040-1**	P						0.7×2	4870	8420	138
USFC 2040-3	Clearance						1.7×2	10400	21000	211
UPFC 2040-3	P						1.7×2	10400	21000	328
USFC 2040-6	Clearance						1.7×4	18900	42100	409
UPFC 2040-6	P						1.7×4	18900	42100	636
USFC 2060-1	Clearance		60	3.175	20.75	17.4	0.7×2	4460	8630	78
UPFC 2060-1	P						0.7×2	4460	8630	121
USFC 2060-2	Clearance						0.7×4	8090	17300	151
UPFC 2060-2	P						0.7×4	8090	17300	235

Remarks 1. For LSFC and USFC type ball screws, rigidities in the table are theoretical values obtained from the elastic deformation between the screw groove and the ball when the axial load is 30% of the basic dynamic load rating (C_a). For LPFC and UPFC type, rigidities are theoretical values 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 B41) if the preload differs from the conditions above, or when considering a change in the deformation of the ball nut itself.



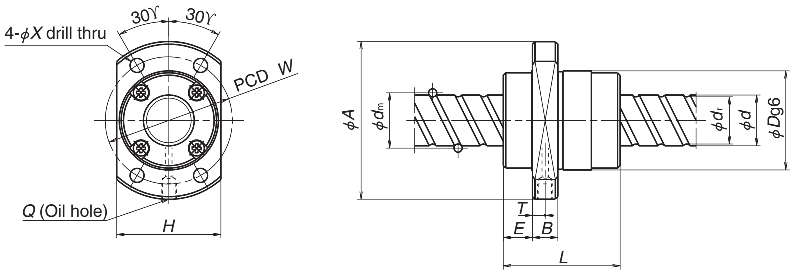
USFC, UPFC

Unit: mm

Ball nut dimensions										
Nut entire length *L*	Nut diameter *D*	Flanged diameter *A*	Flanged width *B*	Flanged dimension *H*	Flanged dimension *K*	End cap dimension *E*	Bolt hole dimension *X*	Bolt hole PCD *W*	Oil hole *Q*	Oil hole position *T*
44	26	44	10	28	40	9	4.5	35	M6×1	5
45	34	55	10	36	50	11	5.5	45	M6×1	5
40	32	53	10	33	48	12	5.5	43	M6×1	5
38	32	53	10	34	—	10	4.5	42	M6×1	5
34 34 66 66 66 66	34	55	10	36	50	10.5	5.5	45	M6×1	5
50	34	55	10	36	50	12	5.5	45	M6×1	5
46	39	62	10	41	—	11.5	5.5	50	M6×1	5
41 41 81 81 81 81	38	58	10	40	52	11	5.5	48	M6×1	5.5
58	38	58	10	40	52	12.3	5.5	48	M6×1	5

Remarks 2. The right turn screw is standard. Please consult NSK for left turn screw.
3. The models marked with ∗ are in FA type of standard ball screw with finished shaft end.
4. Preload system: P; Oversize ball preload (Refer to Page B5)

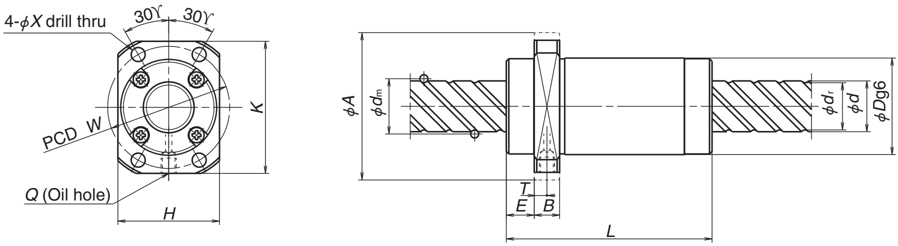
End cap type



LSFC, LPFC

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)
LSFC 2525-3	Clearance	25	25	3.969	26.0	21.9	1.7×2	16600	33200	293
LPFC 2525-3	P						1.7×2	16600	33200	456
LSFC 2525-6	Clearance						1.7×4	30100	66400	568
LPFC 2525-6	P						1.7×4	30100	66400	883
USFC 2550-1	Clearance		50	3.969	26.0	21.9	0.7×2	7280	13200	109
* **UPFC 2550-1**	P						0.7×2	7280	13200	170
USFC 2550-3	Clearance						1.7×2	15600	33700	264
UPFC 2550-3	P						1.7×2	15600	33700	412
USFC 2550-6	Clearance						1.7×4	28300	67500	512
UPFC 2550-6	P						1.7×4	28300	67500	796
USFC 2580-1	Clearance		80	3,969	26.0	21.9	0.7×2	6560	13800	94
UPFC 2580-1	P						0.7×2	6560	13800	147
USFC 2580-2	Clearance						0.7×4	11900	27600	184
UPFC 2580-2	P						0.7×4	11900	27600	285
LSFC 3232-3	Clearance	32	32	4.762	33.25	28.3	1.7×2	24100	50700	366
LPFC 3232-3	P						1.7×2	24100	50700	570
LSFC 3232-6	Clearance						1.7×4	43800	101000	709
LPFC 3232-6	P						1.7×4	43800	101000	1104
USFC 3264-1	Clearance		64	4.762	33.25	28.3	0.7×2	10300	21400	143
UPFC 3264-1	P						0.7×2	10300	21400	222
USFC 3264-3	Clearance						1.7×2	22000	51100	329
UPFC 3264-3	P						1.7×2	22000	51100	512
USFC 3264-6	Clearance						1.7×4	39900	102000	636
UPFC 3264-6	P						1.7×4	39900	102000	991
LSFC 4040-3	Clearance	40	40	6.350	41.75	35.2	1.7×2	38600	85100	455
LPFC 4040-3	P						1.7×2	38600	85100	708
LSFC 4040-6	Clearance						1.7×4	70100	170000	880
LPFC 4040-6	P						1.7×4	70100	170000	1370
LSFC 5050-3	Clearance	50	50	7,938	52.25	44.1	1.7×2	57700	133000	560
LPFC 5050-3	P						1.7×2	57700	133000	871
LSFC 5050-6	Clearance						1.7×4	105000	266000	1084
LPFC 5050-6	P						1.7×4	105000	266000	1688

Remarks 1. For LSFC and USFC type ball screws, rigidities in the table are theoretical values obtained from the elastic deformation between the screw groove and the ball when the axial load is 30% of the basic dynamic load rating (C_a). For LPFC and UPFC type, rigidities are theoretical values 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 B41) if the preload differs from the conditions above, or when considering a change in the deformation of the ball nut itself.



USFC, UPFC

Unit: mm

Ball nut dimensions										
Nut entire length *L*	Nut diameter *D*	Flanged diameter *A*	Flanged width *B*	Flanged dimension *H*	Flanged dimension *K*	End cap dimension *E*	Bolt hole dimension *X*	Bolt hole PCD *W*	Oil hole *Q*	Oil hole position *T*
55	47	74	12	49	—	13	6.6	60	M6×1	6
50 50 100 100 100 100	46	70	12	48	63	13	6.6	58	M6×1	7
75	46	70	12	48	63	14.5	6.6	58	M6×1	6
70	58	92	12	60	—	16	9	74	M6×1	5.5
62 62 126 126 126 126	58	92	12	60	82	15.5	9	74	M6×1	7.5
85	73	114	15	75	—	19.5	11	93	M6×1	6.5
107	90	135	20	92	—	21.5	14	112	M6×1	7

Remarks 2. The right turn screw is standard. Please consult NSK for left turn screw.
3. The models marked with ✻ are in FA type of standard ball screw with finished shaft end.
4. Preload system: P; Oversize ball preload (Refer to Page B5)

C-1 Monocarrier™

C-2 MCM Series

Monoca

C BLOCK

C-3 MCH Series

rrier™

C1-C22
C23-C59
C61-C80

C-1 Monocarrier™

C-1-1 Features

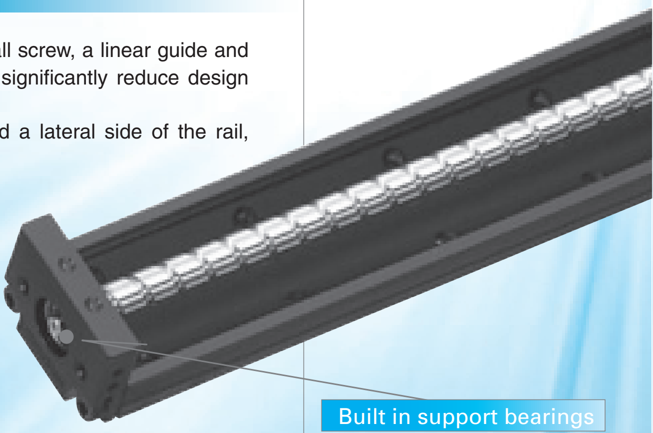
NSK's Monocarrier is the culmination of technology and innovation in linear motion. This lightweight, compact single axis linear actuator integrates quality NSK ball screw, linear guide and support bearings into one unit.

4 Long term maintenance free

- ◯Use of NSK K1 Lubrication Units and grease maintains a smooth lubricating performance for long periods in mechanical environments where lubrication is difficult to apply, where use of oil is not permitted because of hygienic issues, or where the mechanical equipment is subjected to frequent wash downs.
- ◯NSK K1 lubrication unit is available for food processing machines and medical equipment.
- ◯Grease for clean environments and for general machinery is available.

2 All -in-one structure

- ◯The all-in-one structure integrates a ball screw, a linear guide and support bearings into a single unit to significantly reduce design and installation time.
- ◯Multiple datum planes, the bottom and a lateral side of the rail, facilitate highly accurate installation.
- ◯Immediate operation after installation and run-in is possible.
- ◯A wide selection of fine to high helix leads are available.



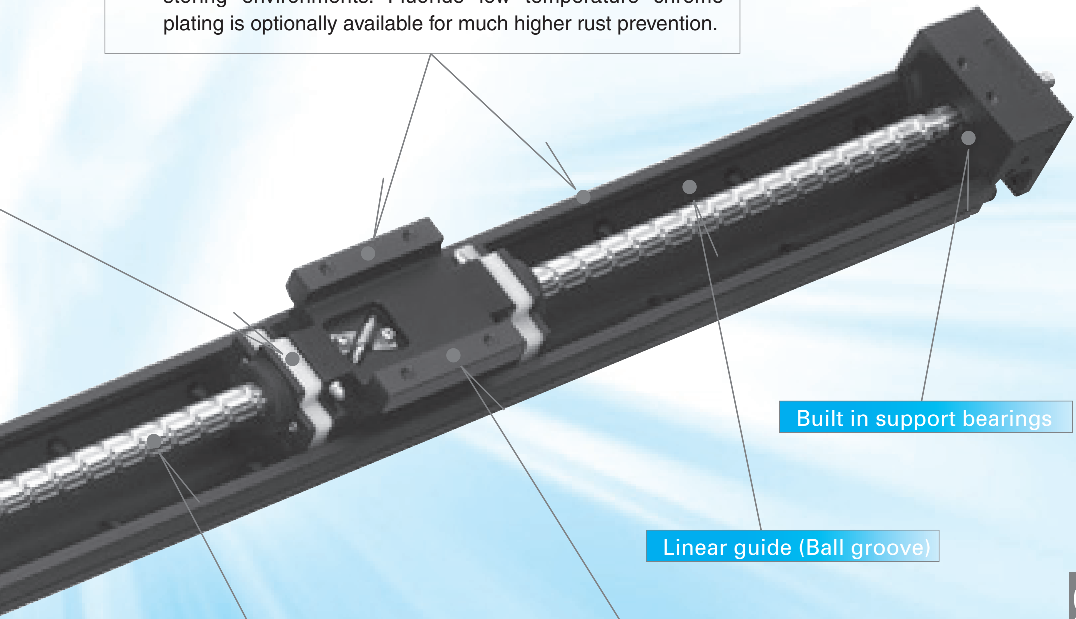
M O N O C

1 Light weight, compact design

◯Available in two different shapes of cross-section, depending on application.
Light weight type : MCM Series
Rigid type : MCH Series
The design has minimal space requirements.

3 Superb antirust capability

◯Low temperature chrome plating is a standard feature for the bodies and sliders to control rusting in normal operating and storing environments. Fluoride low temperature chrome plating is optionally available for much higher rust prevention.



Built in support bearings

Linear guide (Ball groove)

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.

C2

ARRIER™

C-1-2 Classification and Series

Table 2.1

	Light Weight	Beam Rigidity	Moment Rigidity
MCM Series	◎	○	○
MCH Series	○	◎	○

【MCM Series Cross-sections】

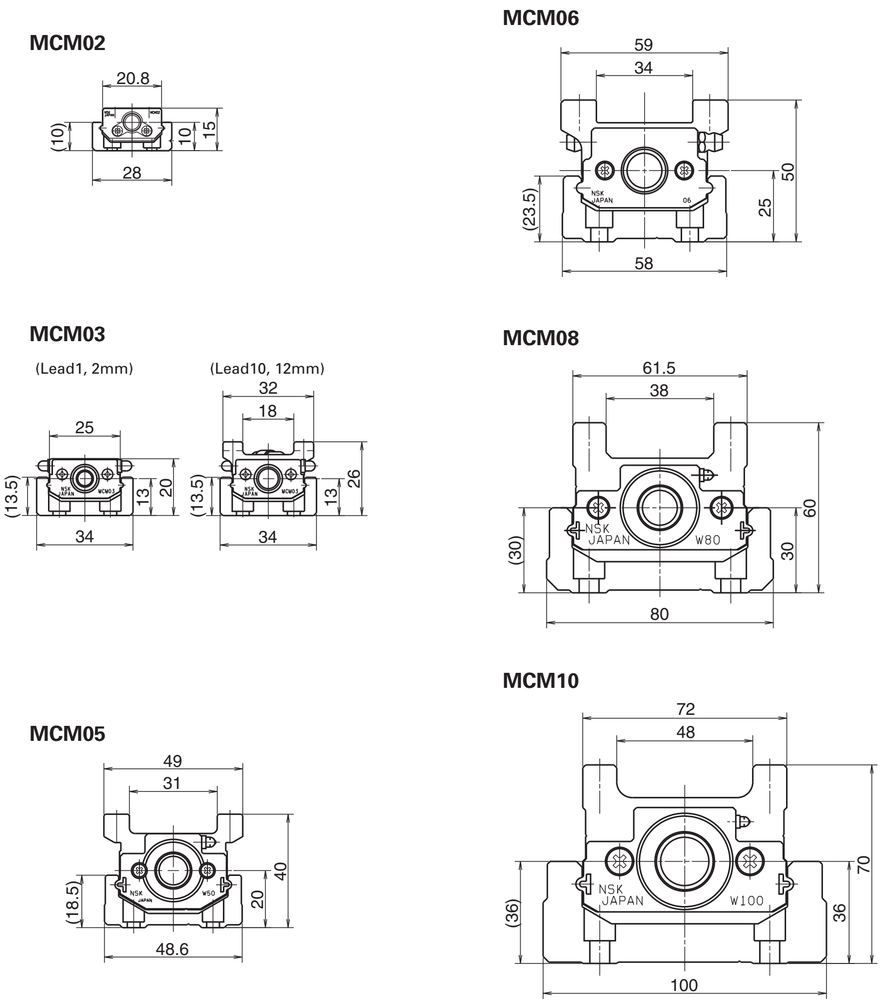


Fig. 2.1

Accuracy	Long Stroke	Size Variation
◎	○	◎
◎	◎	○

【MCH Series Cross-sections】

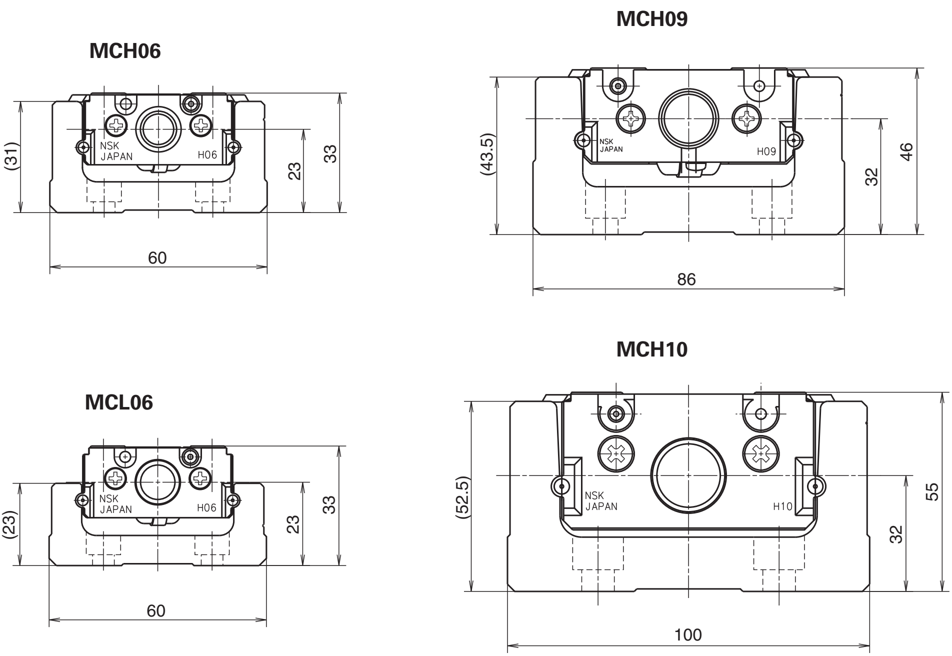


Fig. 2.2

C-1-3 Optional Components

MCM Series

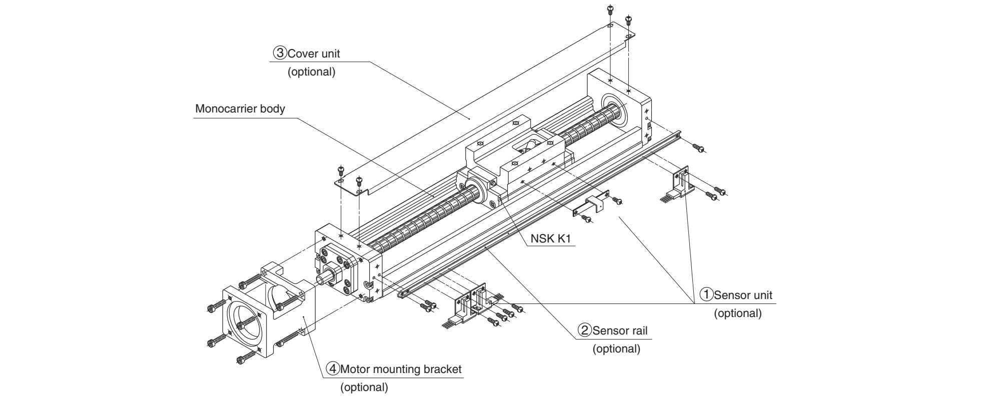


Fig. 3.1 Assembly Optional components for MCM10 (example)

① Sensor unit : Sensors, sensor mounting parts and a sensor dog are available in a set.
∗ When a sensor unit is used, the full cover unit cannot be used.
② Sensor rail : Rail for sensor mounting is available.
③ Cover unit : Top cover or full cover (included top cover and side cover) is available.
④ Motor bracket for motor mounting : Available for a variety of models.
Note: We assemble optional components upon request.

MCH Series

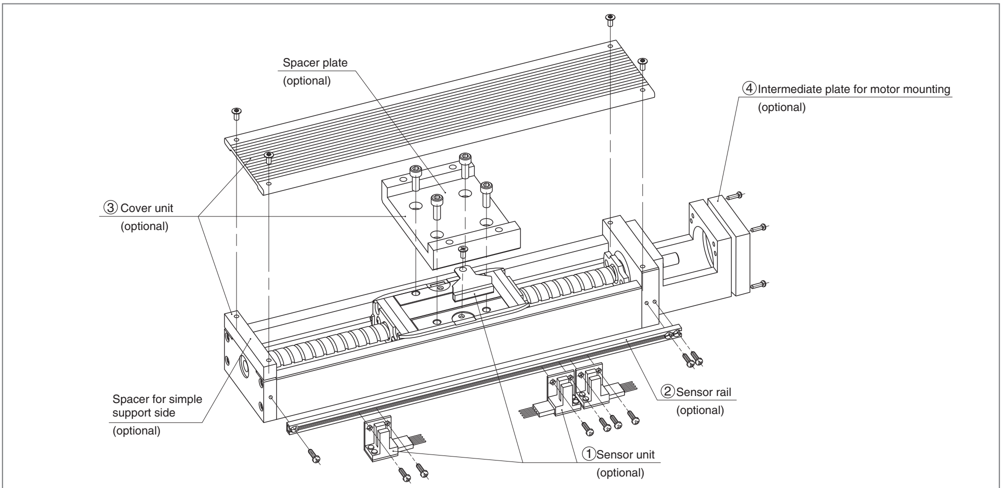


Fig. 3.2 Assembly Optional components for MCH10 (example)

① Sensor unit : Sensors, sensor mounting parts and a sensor dog are available in a set.
② Sensor rail : Rail for sensor mounting is available.
③ Cover unit : Top cover (included spacer plate and spacer for simple support side) is available.
④ Intermediate plate for motor mounting : Available for a variety of models.
Note: We assemble optional components upon request.

C-1-4 Selection of Monocarrier

C-1-4. 1 Procedures for Selecting Monocarrier

Select a reference type of Monocarrier based on stroke and rigidity (Refer to Fig. 4.2, 4.3).

Select a ball screw lead referring to "C-1-4.3 Maximum Speed" so that the rotational speed does not exceed the limit.

Study the loads to be applied to the linear guide and obtain the equivalent load (Fe) substituting them for equation ① or ② on Page C13. Obtain the mean effective load (Fm) 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 (Fm) substituting them for equation ③ on Page C14, then calculate the life.

C-1-4. 2 Rigidity

Rigidity of rail

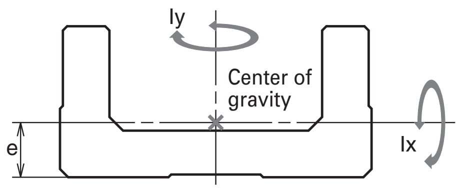


Fig. 4.1

Table 4.1 Rigidity of rail

Nominal size	Geometrical moment of inertia ×10⁴ (mm⁴)		Center of gravity (mm)	Mass (kg/100mm)
	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

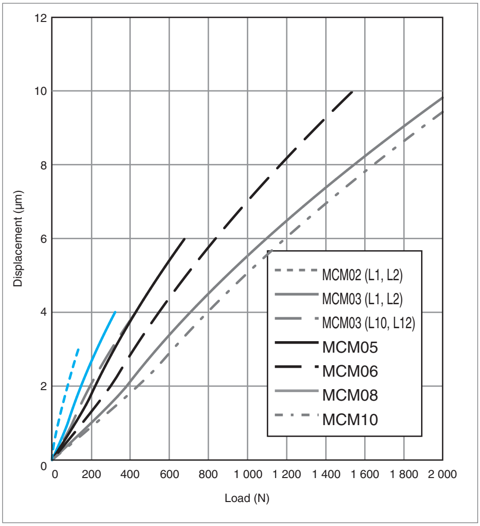


Fig. 4.2 MCM Series Rigidity in radial direction

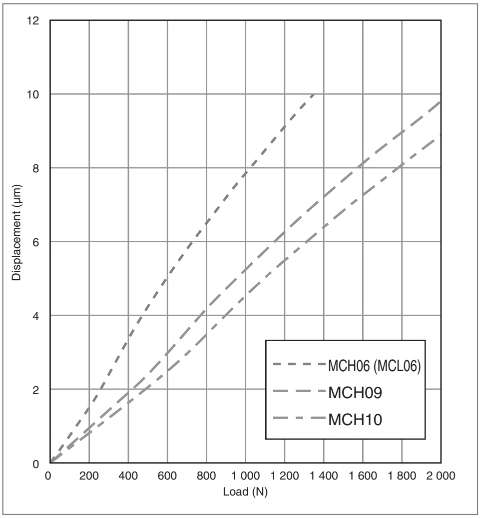


Fig. 4.3 MCH Series Rigidity in radial direction

C-1-4. 3 Maximum Speed

(1) Maximum Speed of MCM Series

Maximum speed of the Monocarrier is determined by the critical speed of the ball screw shaft and the d · n value.
Do not exceed the 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	1000
MCM05 Double slider	10	60 – 510	280 – 730	500
	20	210 – 510	430 – 730	1000
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	1000
		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	1000
		710	940	980

Note: When operating the Monocarriers near the critical speed or exceeding the maximum speed in the table, please consult NSK.

	Ball screw lead	stroke (mm)	Rail length L_2 (mm)	Maximum speed (mm/s)
MCM08 Single slider	5	50 – 200	220 – 370	250
	10	100 – 700	270 – 870	500
		800	970	390
	20	300 – 700	470 – 870	1000
		800	970	780
MCM08 Double slider	10	80 – 680	370 – 970	500
	20	180 – 680	470 – 970	1000
MCM10 Single slider	10	200 – 800	380 – 980	500
		900	1080	440
		1000	1180	360
	20	300 – 800	480 – 980	1000
		900	1080	880
		1000	1180	720
MCM10 Double slider	10	70 – 670	380 – 980	500
		870	1180	440
	20	170 – 670	480 – 980	1000
		870	1180	880

Note: When operating the Monocarriers near the critical speed or exceeding the maximum speed in the table, please consult NSK.

(2) Maximum Speed of MCH Series

Maximum speed of the Monocarrier is determined by the critical speed of the ball screw shaft and the d · n value.
Do not exceed the 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	1000
		800	940	830
MCH09 Double slider	5	150 – 650	440 – 940	250
	10	150 – 650	440 – 940	500
	20	150 – 650	440 – 940	1000

Note: When operating the Monocarriers near the critical speed or exceeding the maximum speed in the table, please consult NSK.

	Ball screw lead	stroke (mm)	Rail length L_2 (mm)	Maximum speed (mm/s)
MCH10 Single slider	10	400 – 800	580 – 980	500
		900	1080	440
		1000	1180	360
		1100	1280	300
		1200	1380	250
	20	400 – 800	580 – 980	1000
		900	1080	870
		1000	1180	720
		1100	1280	600
		1200	1380	510
MCH10 Double slider	10	250 – 750	580 – 1080	500
		850	1180	480
		950	1280	390
		1050	1380	320
	20	250 – 750	580 – 1080	1000
		850	1180	950
		950	1280	780
		1050	1380	650

Note: When operating the Monocarriers near the critical speed or exceeding the maximum speed in the table, please consult NSK.

C-1-4. 4 Accuracy Grade

The accuracy grade of Monocarrier standard inventories is high grade (H), except for lead 1 and 2 of MCM02, and 03.

When you require strokes longer than 1200 mm, please consult NSK about the accuracy grade.

Table 4.4 (Unit : μm)

Grade	High grade			Precision			
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	
– 1000		23			35	15	
– 1200		30			40	20	

C-1-4. 5 Stroke and Ball Screw Lead

(1) MCM Series Standard Combinations of Stroke and Ball Screw Lead

Table 4.5 Single slider

(○mark, Standard inventory; ☆mark, Short-term delivery) (Unit : mm)

Nominal size	MCM02		MCM03				MCM05			MCM06			MCM08			MCM10	
lead / stroke	1	2	1	2	10	12	5	10	20	5	10	20	5	10	20	10	20
50	○	○	○	○	☆	☆	○	○	☆	○	☆	☆	☆	☆			
100	○	○	○	○	○	○	○	○	☆	○	○	☆	☆	○	☆	☆	☆
150	○	○	☆	☆	☆	☆	☆	○	☆	☆	☆	☆	☆	☆	☆	☆	☆
200					○	☆	○	○	☆	○	○	☆	☆	○	☆	○	☆
250					☆	☆	☆	○	☆	☆	☆	☆	☆	☆	☆	☆	☆
300							☆	○	○	○	○	○	☆	○	○	○	○
400							☆	○	○	○	○	○	☆	○	○	○	○
500							☆	○	○	☆	○	○	☆	○	○	☆	☆
600							☆	○	○	☆	☆	☆	☆	○	☆	○	☆
700										☆	○	○	☆	☆	☆	☆	☆
800										☆	☆	☆	☆	☆	☆	○	☆
900																☆	☆
1000																☆	☆

Table 4.6 Double slider

(☆mark, Short-term delivery) (Unit : mm)

Nominal size	MCM05		MCM06			MCM08		MCM10	
lead / stroke	10	20	5	10	20	10	20	10	20
60	☆								
70								☆	
80						☆			
110	☆		☆	☆					
160	☆								
170								☆	☆
180						☆	☆		
210	☆	☆	☆	☆	☆				
270								☆	☆
280						☆	☆		
310	☆	☆	☆	☆	☆				
370								☆	☆
380						☆	☆		
410	☆	☆	☆	☆	☆				
470								☆	☆
480						☆	☆		
510	☆	☆		☆	☆				
570								☆	☆
580						☆	☆		
610				☆	☆				
670								☆	☆
680						☆	☆		
710				☆	☆				
870								☆	☆

Note: Please consult NSK about double slider of MCM 02 and 03.

(2) MCH Series Standard Combinations of Stroke and Ball Screw Lead

Table 4.7 Single slider

(○mark, Standard inventory; ☆mark, Short-term delivery) (Unit : mm)

Nominal size	MCH06			MCH09			MCH10	
stroke \ lead	5	10	20	5	10	20	10	20
50	○	○	☆					
100	○	○	☆	☆	☆	☆	☆	☆
200	○	○	○	○	○	☆	☆	☆
300	☆	○	○	○	○	☆	☆	☆
400	☆	○	○	○	○	☆	○	○
500	☆	○	○	☆	○	○	○	○
600				☆	○	○	○	○
700				☆	☆	☆	○	○
800				☆	○	○	○	○
900							☆	○
1000							☆	○
1100							☆	☆
1200							☆	☆

Table 4.8 Double slider

(☆mark, Short-term delivery) (Unit : mm)

Nominal size	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								☆
1050								☆

Table 4.9 Limitations

	Nominal size	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	Single	900
			Double	810
	MCM06	5, 10, 20	Single	1000
			Double	910
	MCM08	5, 10, 20	Single	1000
			Double	880
	MCM10	10, 20	Single	1800
			Double	1670
MCH series	MCH06	5, 10, 20	Single	600
			Double	500
	MCH09	5, 10, 20	Single	1000
			Double	850
	MCH10	10, 20	Single	1800
			Double	1650
	MCL06	5, 10, 20	Single	500

C-1-4. 6 Basic Load Rating

(1) MCM Series Basic Load Rating

Table 4.10 Basic Load Rating

Nominal size	Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) Ball screw C_a	Basic dynamic load rating (N) Linear guide C	Basic dynamic load rating (N) Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Basic static load rating (N) Linear guide C_0	Support unit Limit load (N)
MCM02	1	ϕ 6	405 (High grade) 480 (Precision)	4910	615	1	555 (High grade) 615 (Precision)	2120	490
	2		400 (High grade) 475 (Precision)	3900		2	555 (High grade) 610 (Precision)		
MCM03	1	ϕ 6	870	10900	2670	1	1230	4900	1040
	2		865	8650		2	1220		
	10	ϕ 8	1310	6250		10	1710	6620	
	12		1320	5880		12	1730		
MCM05	5	ϕ 12	4390	15600	4400	5	6260	10900	1450
	10		2860	12400		10	3830		
	20		2660	9850		20	3800		
MCM06	5	ϕ 16	8620	25200	6550	5	13800	17000	2730
	10	ϕ 15	8140	20000		10	12800		
	20		5080	15900		20	7460		
MCM08	5	ϕ 16	8620	30800	7100	5	13800	22800	3040
	10	ϕ 15	8140	24400		10	12800		
	20		5080	19400		20	7460		
MCM10	10	ϕ 20	13300	33500	7600	10	21900	29400	3380
	20		8190	26600		20	13100		

Notes: ●Basic dynamic and static load ratings indicate the values for one slider. ●Basic dynamic load rating of the linear guide is the load of perpendicular direction to the axis that allows 90% of a group of the same Monocarriers to operate " Rated running distance" in the table, that is equivalent to 1 million revolutions of the ball screw and the support unit, under the same condition without causing flaking by rolling contact fatigue. ●Basic dynamic load rating of the ball screw is a load to axial direction that allows 90% of ball screws of a group of the same Monocarriers to rotate 1 million revolutions under the same condition without causing flaking by rolling contact fatigue. ●Basic dynamic load rating of the support unit is a constant load to axial direction that allows 90% of support units of the same group of Monocarriers to rotate 1 million revolutions under the same condition without causing flaking by rolling contact fatigue. ●Basic static load rating is a load that results in combined permanent deformations at the contact points of balls and ball grooves of respective parts is 0.01% of the diameter.

Table 4.11 Basic static moment load of linear guide

Nominal size	Lead (mm)	Slider	Basic static moment (N · m) Rolling M_{RO}	Basic static moment (N · m) Pitching M_{PO}	Basic static moment (N · m) 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	Single	229	89	89
		Double	455	765	765
MCM06	5, 10, 20	Single	415	174	174
		Double	825	1220	1220
MCM08	5, 10, 20	Single	770	300	300
		Double	1540	2050	2050
MCM10	10, 20	Single	1170	425	425
		Double	2340	2940	2940

Notes: ● Basic static moment of double slider is a value when two sliders equipped with NSK K1 are butted against each other.
● The basic static moment is the value when a rolling contact pressure of balls exceeds 4000 N/mm².
● If you plan to apply extremely heavy load, please consult NSK for estimation of fatigue life.

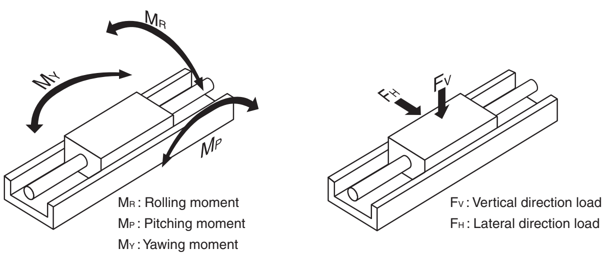


Fig. 4.4

(2) MCH Series Basic Load Rating

Table 4.12 Basic Load Rating

Nominal size	Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) Ball screw C_a	Linear guide C	Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Linear guide C_0	Support unit Limit load (N)
MCH06 (MCL06)	5	ϕ 12	3510 (High grade) 4390 (Precision)	22800	4400	5	5360 (High grade) 6260 (Precision)	16300	1450
	10		2270 (High grade) 2860 (Precision)	18100		10	3160 (High grade) 3830 (Precision)		
	20		2090 (High grade) 2660 (Precision)	14400		20	3200 (High grade) 3800 (Precision)		
MCH09	5	ϕ 15	8020 (High grade) 8300 (Precision)	40600	7100	5	13100 (High grade) 12700 (Precision)	30500	3040
	10		6110 (High grade) 8140 (Precision)	32200		10	9310 (High grade) 12800 (Precision)		
	20		3790 (High grade) 5080 (Precision)	25500		20	5600 (High grade) 7460 (Precision)		
MCH10	10	ϕ 20	9580 (High grade) 13300 (Precision)	44600	7600	10	17300 (High grade) 21900 (Precision)	42000	3380
	20		6100 (High grade) 8190 (Precision)	35400		20	10100 (High grade) 13100 (Precision)		

Notes: ●Basic dynamic and static load ratings indicate the values for one slider. ●Basic dynamic load rating of the linear guide is the load of perpendicular direction to the axis that allows 90% of a group of the same Monocarriers to operate " Rated running distance" in the table, that is equivalent to 1 million revolutions of the ball screw and the support unit, under the same condition without causing flaking by rolling contact fatigue. ●Basic dynamic load rating of the ball screw is a load to axial direction that allows 90% of ball screws of a group of the same Monocarriers to rotate 1 million revolutions under the same condition without causing flaking by rolling contact fatigue. ●Basic dynamic load rating of the support unit is a constant load to axial direction that allows 90% of support units of the same group of Monocarriers to rotate 1 million revolutions under the same condition without causing flaking by rolling contact fatigue. ●Basic static load rating is a load that results in combined permanent deformations at the contact points of balls and ball grooves of respective parts is 0.01% of the diameter.

Table 4.13 Basic static moment load of linear guide

Nominal size	Slider	Basic static moment (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
MCH06 (MCL06)	Single	335	133	133
	Double	770	730	730
MCH09	Single	890	385	385
	Double	1780	2070	2070
MCH10	Single	1460	610	610
	Double	2920	3430	3430

Notes: ● Basic static moment of double slider is a value when two sliders equipped with NSK K1 are butted against each other.
● The basic static moment is the value when a rolling contact pressure of balls exceeds 4000 N/mm².
● If you plan to apply extremely heavy load, please consult NSK for estimation of fatigue life.

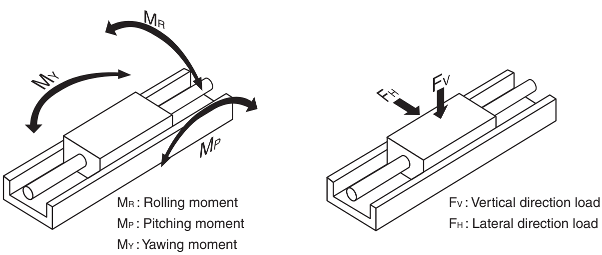


Fig. 4.5

C-1-4. 7 Estimation of Life Expectancy

(1) Life of Linear Guide

Study the load to be applied to the linear guide of Monocarrier (Fig. 4.6). The equivalent load (Fe) is determined by substituting the load for equation ① (Eq.② : in case of the tightly coupled double slider type).

● In case of the single slider

$$Fe = Y_H F_H + Y_V F_V + Y_R \varepsilon_R M_R + Y_P \varepsilon_P M_P + Y_Y \varepsilon_Y M_Y \cdots ①$$

● In case of the double slider

$$Fe = \frac{Y_H F_H}{2} + \frac{Y_V F_V}{2} + Y_R \varepsilon_{Rd} M_R + Y_P \varepsilon_{Pd} M_P + Y_Y \varepsilon_{Yd} M_Y \cdots ②$$

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.

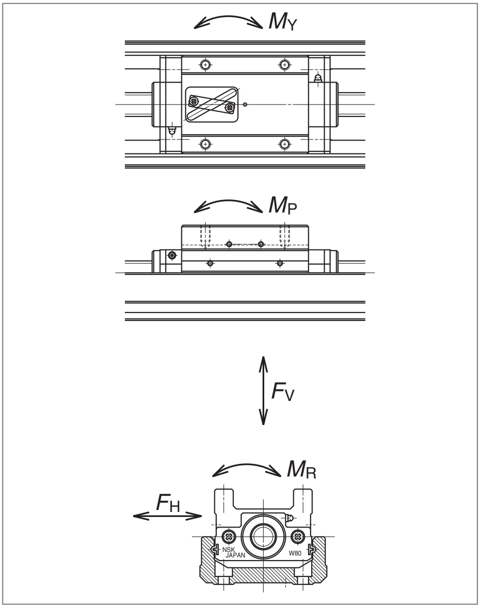


Fig. 4.6 Direction of load

Table 4.14 Dynamic equivalent coefficient

Nominal size	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.

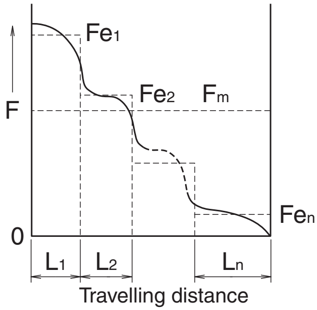


Fig. 4.7 Stepwise Fluctuating Load

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

$$Fm = \sqrt[3]{\frac{1}{L}\left(Fe_1^{\,3}L_1 + Fe_2^{\,3}L_2 + \cdots Fe_n^{\,3}L_n\right)} \cdots③$$

Fm : Mean effective load of fluctuating loads
L : Total travelling distance

The life of linear guide is calculated by Eq. ④

$$L = L_a \times \left(\frac{C}{f_W \cdot Fm}\right)^3 \cdots\cdots④$$

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.

$$L = \ell \times \left(\frac{C_a}{f_W \cdot Fm}\right)^3 \times 10^6 \cdots\cdots⑤$$

ℓ : Lead of ball screw (mm)
L : Life of ball screw (mm)
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
14

C-1-4. 8 Example of Life Estimation

This section offers an example how to estimate the life of Monocarrier based on the life of each component.

<<Example of calculation-1>>

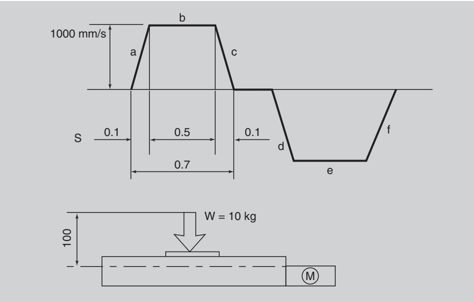


Fig. 4.8

1. Use condition

Stroke	: 600 mm
Maximum Speed	: 1000 mm/s
Load Mass	: W = 10 kg
Acceleration	: $g = 9.8\ m/s^2$
Setting Position	: Horizontal
Operating Profile	: See above figure

2. Selection of Nominal size (Interim Selection)

Firstly, select a greater ball screw lead as the maximum speed is 1000 mm/s. The interim selection is MCM06060H20K00, a single slider specification MCM06 that has 600 mm stroke, as the stroke is 600 mm.

3. Calculation

3-1. Linear guide

3-1-1. Fatigue life

Multiply the result of the Eq. ① by the dynamic equivalent coefficient (Table 4.14 single slider) to convert the load volume. From above operation profile,

i) Constant speed $Fe_1 = Y_V F_V = Y_V W_g = 1 \cdot 10 \cdot 9.8 = 98\ N$

ii) Accelerating $Fe_2 = Y_V F_V + Y_P \varepsilon_P M_P = 0.5 \cdot 10 \cdot 9.8 + 1 \cdot 65.1 \cdot 0.1 \cdot 100 = 700\ N$

iii) Decelerating $Fe_3 = Y_V F_V + Y_P \varepsilon_P M_P = 0.5 \cdot 10 \cdot 9.8 + 1 \cdot 65.1 \cdot 0.1 \cdot 100 = 700\ N$

Mean effective load Fm

$$Fm = \sqrt[3]{\frac{1}{L}\left(Fe_1^3 \cdot L_1 + Fe_2^3 \cdot L_2 + Fe_3^3 \cdot L_3\right)}$$

$$= \sqrt[3]{\frac{1}{600}\left(98^3 \cdot 500 + 700^3 \cdot 50 + 700^3 \cdot 50\right)}$$

$$= 387\ N$$

$$L = \left(\frac{C}{f_w \cdot F_m}\right)^3 \times L_a$$

$$= \left(\frac{15900}{1.2 \cdot 387}\right)^3 \times 20$$

$$= 8.02 \times 10^5\ km$$

3-1-2. Static safety factor; Divide the basic static load rating by the maximum load.

$$F_S = \frac{C_0}{Fe} = \frac{C_0}{Fe_2} = \frac{17000}{700} = 24.2$$

3-2. Ball screw

3-2-1. Fatigue life; Obtain the axial load of each stage of operation referring to the operation profile, then calculate the mean load.

By the process above,

i) Constant speed

$Fe_1 = \mu \cdot W \cdot g = 0.01 \cdot 10 \cdot 9.8 = 0.98$

ii) Accelerating

$Fe_2 = Fe_1 + W\alpha = 101\ N$

iii) Decelerating

$Fe_3 = Fe_1 - W\alpha = 99\ N$

Axial mean effective load Fm

$$Fm = \sqrt[3]{\frac{1}{L}\left(Fe_1^3 \cdot L_1 + Fe_2^3 \cdot L_2 + Fe_3^3 \cdot L_3\right)}$$

$$= \sqrt[3]{\frac{1}{600}\left(0.98^3 \cdot 500 + 101^3 \cdot 50 + 99^3 \cdot 50\right)}$$

$$= 55\ N$$

$$L = \left(\frac{C_a}{f_w \cdot F_m}\right)^3 \times \ell \times 10^6$$

$$= \left(\frac{5080}{1.2 \cdot 55}\right)^3 \times 20 \times 10^6\ (mm)$$

$$= 9.1 \times 10^6\ km$$

3-2-2. Static safety factor; Divide the basic static load rating by the maximum axial load.

$$F_S = \frac{C_{0a}}{Fe} = \frac{C_{0a}}{Fe_2} = \frac{7460}{101} = 73.8$$

3-2-3. Maximum rotational speed; According to the table of maximum speed on page C7, MCM06 with 20 mm lead and 600 mm stroke, is possible to operate under the maximum speed of 1000 mm/s.

3-3. Support unit

3-3-1. Fatigue life; Use the axial load Fm = 55 N, that is the result of above calculation 3-2-1.

$$L = \left(\frac{C_a}{fw \cdot Fm}\right)^3 \times \ell \times 10^6 = \left(\frac{6550}{1.2 \times 55}\right)^3 \times 20 \times 10^6 \text{(mm)}$$

$$= 1.95 \times 10^7 \text{ km}$$

3-3-2. Static safety factor; Divide the limit load by the maximum axial load.

$$F_S = \frac{C_{0a}}{Fe} = \frac{C_{0a}}{Fe_2} = \frac{2730}{101} = 27.0$$

3-4. Result

MCM06060H20K00	Linear guide	Ball screw	Support unit
Fatigue life	8.02×10^5 km	6.5×10^6 km	1.95×10^7 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>>

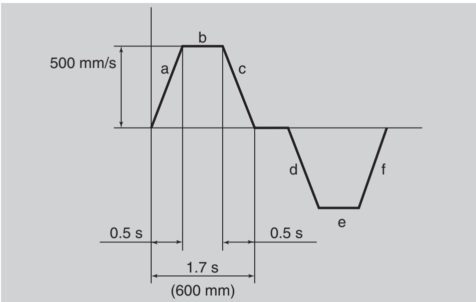


Fig. 4.9

1. Use condition
   - Stroke : 600 mm
   - Maximum Speed : 500 mm/s
   - Load Mass : W = 20 kg
   - Acceleration : 9.8 m/s²
   - Setting Position : Vertical
   - Operating Profile : See above figure

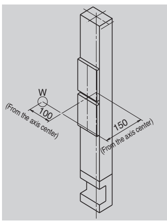


Fig. 4.10

2. Selection of Nominal size (Interim Selection)
Select a 10 mm lead ball screw as the maximum speed is 500 mm/s.
The interim selection is MCM08068H10D00 as a double slider specification of MCM08 has 680 mm stroke, and the setting position is vertical.

3. Calculation
3-1. Linear guide
3-1-1. Fatigue life; Multiply the result of the Eq. ② by the dynamic equivalent coefficient (Table 4.14. double slider) to convert the load volume. From operation profile (Fig. 4.9), the acceleration is 1 m/s².

i) Constant speed $Fe_1 = Y_P \times \varepsilon_{Pd} \times M_P + Y_Y \times \varepsilon_{Yd} \times M_Y$
$= 1 \cdot 7.6 \cdot 20 \cdot 9.8 \cdot 0.15 + 0.5 \cdot 7.6 \cdot 20 \cdot 9.8 \cdot 0.1 = 298$ N

ii) Accelerating $Fe_2 = Y_P \times \varepsilon_{Pd} \times M_P + Y_Y \times \varepsilon_{Yd} \times M_Y$
$= 1 \cdot 7.6 \cdot 20 \cdot (9.8 + 0.15) \cdot 0.15 + 0.5 \cdot 7.6 \cdot 20 \cdot (9.8 + 1.0) \cdot 0.1 = 329$ N

iii) Decelerating $Fe_3 = Y_P \times \varepsilon_{Pd} \times M_P + Y_Y \times \varepsilon_{Yd} \times M_Y = 1 \cdot 7.6 \cdot 20 \cdot (9.8 - 1.0) \cdot 0.15 + 0.5 \cdot 7.6 \cdot 20 \cdot (9.8 - 1.0) \cdot 0.1 = 268$ N

Mean effective load *Fm*

$$Fm = \sqrt[3]{\frac{1}{L}\left(Fe_1^3 \cdot L_1 + Fe_2^3 \cdot L_2 + Fe_3^3 \cdot L_3\right)}$$

$$= \sqrt[3]{\frac{1}{600}\left(298^3 \cdot 350 + 329^3 \cdot 125 + 268^3 \cdot 125\right)}$$

$$= 300 \text{ N}$$

$$L = L_a \times \left(\frac{C}{f_w \cdot F_m}\right)^3$$

$$= 10 \times \left(\frac{24400}{1.2 \cdot 300}\right)^3$$

$$= 3.11 \times 10^6 \text{ km}$$

3-1-2. Static safety factor; Divide the basic static load rating by the maximum load.

$$F_S = \frac{C_0}{Fe} = \frac{C_0}{Fe_2} = \frac{22800}{329} = 69.3$$

3-2. Ball screw
3-2-1. Fatigue life; Obtain the axial load of each stage of operation referring to the operation profile, then calculate the mean load.

i) Constant speed
$Fe_1 = W \cdot g = 20 \cdot 9.8 = 196$ N

ii) Accelerating
$Fe_2 = Fe_1 + W \cdot \alpha = 196 + 20 \cdot 1 = 216$ N

iii) Decelerating
$Fe_3 = Fe_1 - W \cdot \alpha = 196 - 20 \cdot 1 = 176$ N

Axial mean effective load Fm

$$Fm = \sqrt[3]{\frac{1}{L}\left(Fe_1^3 \cdot L_1 + Fe_2^3 \cdot L_2 + Fe_3^3 \cdot L_3\right)}$$
$$= \sqrt[3]{\frac{1}{600}\left(196^3 \cdot 350 + 216^3 \cdot 125 + 176^3 \cdot 125\right)}$$
$$= 197 \text{ N}$$
$$L = \ell \times \left(\frac{C_a}{f_w \cdot F_m}\right)^3 \times 10^6$$
$$= 10 \times \left(\frac{8140}{1.2 \cdot 197}\right)^3 \times 10^6$$
$$= 4.1 \times 10^5 \text{ km}$$

3-2-2. Static safety factor; Divide the basic static load rating by the maximum axial load.

$$F_S = \frac{C_{0a}}{Fe} = \frac{C_{0a}}{Fe_2} = \frac{12800}{216} = 59.2$$

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.

$$L = \ell \times \left(\frac{C_a}{fw \cdot Fm}\right)^3 \times 10^6 = 10 \times \left(\frac{7100}{1.2 \times 197}\right)^3 \times 10^6$$
$$= 2.70 \times 10^5 \text{ km}$$

3-3-2. Static safety factor; Divide the limit load by the maximum axial load.

$$F_S = \frac{C_{0a}}{Fe} = \frac{C_{0a}}{Fe_2} = \frac{3040}{216} = 14.0$$

3-4. Result

MCM08068H10D00	Linear guide	Ball screw	Support unit
Fatigue life	3.11 × 10^6 km	2.66 × 10^5 km	2.70 × 10^5 km
Static safety factor	69.3	58.7	14.0

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.
4. A Nozzle for the NSK grease gun for MCH Monocarriers is available as an option.
   NSK reference number: NSK HGP NZ8

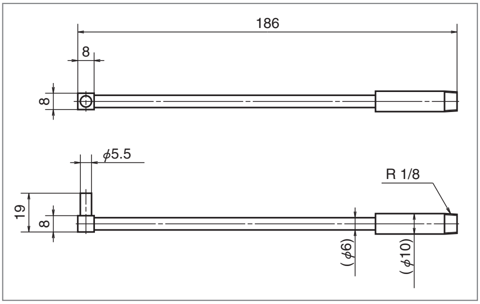


Fig. 5.1 NSK HGP NZ8

Precautions for handling

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: 1800 mm
No lubricant	All grease removed
NSK K1	All grease removed + NSK K1

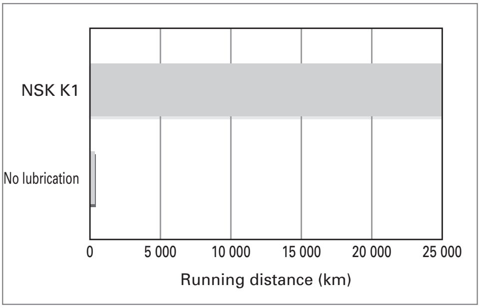


Fig. 5.2 Results of high-speed durability test of linear guides without lubricant

(2) High-Speed Durability Test of Ball Screws without Lubricant

Results of high-speed durability testing of ball screw without lubrication are shown in Fig.5.3. While the ball screw cannot be operated without a lubricant at 8.5 km without damage, the installation of the NSK K1 permits the ball screw to run over 21 000 km without any problem.

Conditions	Test piece: BS2020 (ball screw)
	Shaft diameter: 20 mm
	Lead: 20 mm
	Load: none
	Speed: 1.3 m/s (4 000 min^{-1})
	Stroke: 600 mm
No lubricant	All grease removed
NSK K1	All grease removed + NSK K1

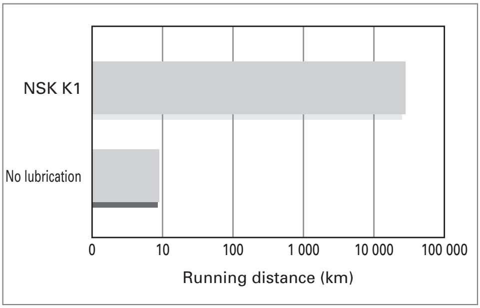


Fig. 5.3 Results of high-speed durability test of ball screws without lubricant

●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 mm²/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.

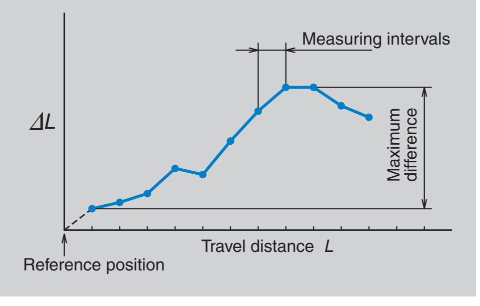


Fig. 7.1

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.

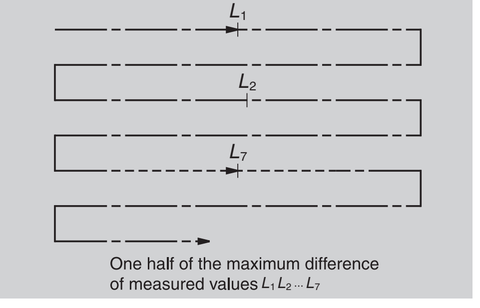


Fig. 7.2

C-1-7. 3 Running Parallelism (Vertical direction)

We specify the parallelism of slider to the datum bottom face of rail. An indicator is fixed on the slider making its stylus slightly touching on the rail bottom surface. The slider is moved in the axial direction for the checking. We define the total indicator reading as the running parallelism. During the checking, the rail is not fixed to the table base. Please be aware that, in general application, the rail is fixed to the machine base, and thus the wobbly rolling error will be added to the running parallelism.

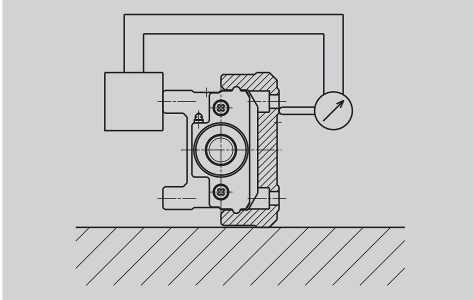


Fig. 7.3 Setting of indicator

C-1-8 Special Specifications

Please consult NSK if your requirement is not in the standard products.

(1) Surface Treatment

- Fluoride low temperature chrome plating

Note: Ball screw parts (including low temperature chrome plating.)

(2) Special Machining (Processing)

①Shaft end processing
- Key way processing
- One flat or two flats processing

②Pin hole processing
- Slider
- Rail

Note: Due to interference with the internal construction, the position of pin hole is limited. Please consult NSK for the pin position.

(3) Motor Bracket and Intermediate Plate for Motor Mounting

- We provide motor mounting brackets and intermediate plates that are not listed in the catalog.
- We assemble motor upon request, if the motor is provided in advance.

Note: Motion check of the motor is unavailable.

(4) Reversed Motor Mount

The reversed motor mount is available. Please consult NSK.

Notes: 1) We don't check motor running condition.
2) Please refer to the bottom of page C77 to 79 for the configuration of reversed motor mounting of the MCH series.

(5) Right and Left Turn Thread

Right and left turn ball screw is available. Please consult NSK for available leads.

(6) Ball-Screw-Less Specification (Only Linear Guide Part)

A ball-screw-less rail part with the same cross section of standard Monocarriers is available for a driven linear guide. It will lessen a height adjustment work compared with a construction with two standard Monocarriers.

Note: Height grinding adjustment of the two axes assembly is not available.

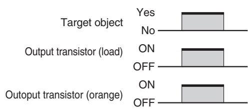
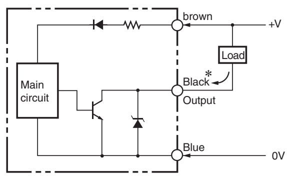
C-1-9 Sensor Specification

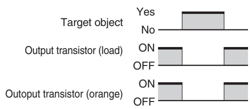
C-1-9. 1 Proximity Switch

Use of OMRON E2S-W13, E2S-W14

Item	E2S–W13 type	E2S–W14 type
Setting surface	Front face	
Sensing distance	1.6 mm ±15%	
Setting distance	0 to 1.2 mm	
Differential travel	10% max. of sensing distance	
Detectable object type	Ferrous metal	
Standard sensing object	Iron,12 × 12 × 1 mm	
Response frequency	1 kHz min.	
Power supply voltage (operating voltage range)	12 to 24 VDC; ripple (p--p), 10% max (10 to 30 VDC)	
Current consumption	13 mA max. at 24 VDC with no load	
Control output (Switching Capacity)	NPN open collector output, 50 mA max. (30 VDC max.)	
Control output (Residual voltage)	1.0 V max. with a load current of 50 mA and a cable length of 1 m	
Indicator	Operation indicator (orange)	
Operating status (with sensing object approaching)	NO (a-contact)	NC (b-contact)
Wire lead length	1000 mm	

Notes: 1) Do not make a wrong connection.
2) Please contact NSK for PNP output type.

<table>
<tr><th>Movement mode</th><th>Output type</th><th>Type</th><th>Time chart</th><th>Output circuit</th></tr>
<tr><td>NO</td><td rowspan="2">NPN</td><td>E2S-W13 type</td><td>
</td><td rowspan="2">

*(Maximum load current : 50 mA)</td></tr>
<tr><td>NC</td><td>E2S-W14 type</td><td>
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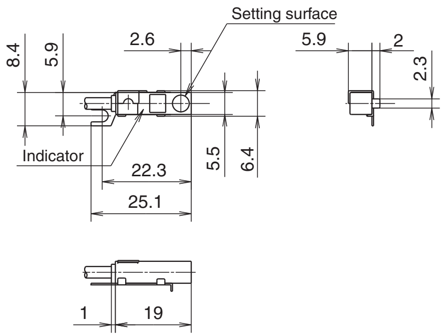
E2S-W13 (a-contact)
E2S-W14 (b-contact)
The external appearances are the same.
A connector is mounted to the sensor in the right figure.

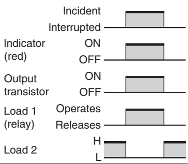
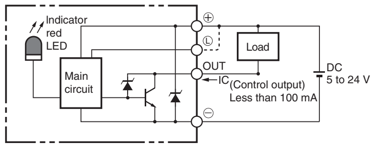
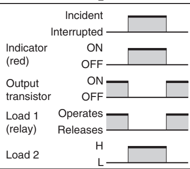


C-1-9. 2 Photo Sensor

Use of OMRON EE-SX674

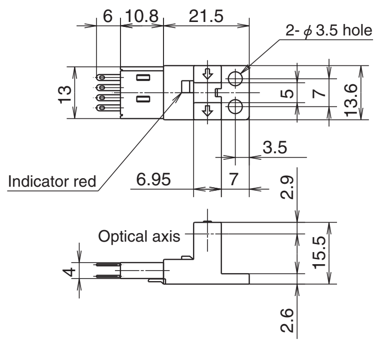
Item	EE-SX674 type
Slot width	5 mm
Standard reference object	Opaque, 2 × 0.8 mm
Differential distance	0.025 mm
Light source	GaAs infrared LED with a peak wavelength of 940 nm
Indicator(Without detecting object)	ON GaP red LED (peak emission wavelength, 690 nm)
Supply voltage	5 to 24 VDC ±10%; ripple (p--p), 10% max.
Current consumption	35 mA max.
Control output	NPN open collector output models, At 5 to 24 VDC, 100 mA load current
Response frequency	1 kHz max. (3 kHz typ.)
Ambient illumination	Fluorescent light, 1 000 lx max.
Ambient temperature	Operating, -25°C to 55°C (-13°F to 131°F); Storage, -30°C to 80°C (-22°F to 176°F)
Ambient humidity	Operating, 5 to 85% RH; Storage, 5 to 95% RH
Connecting method	EE-1001/1006 Connectors, soldering terminals

Notes: 1) Do not make a wrong connection.
2) Please contact NSK for PNP output type.

Type	Movement mode	Time chart	Connection terminal	Output circuit
EE-SX674 type	Light-ON		When terminals L and ⊕ are short circuited	
	Dark-ON		When terminals L and ⊕ are open circuited	

EE-SX674 (Sensor)
EE-1001 (Connector)

A connector is mounted to the sensor in the right figure.



MCM Series

C-2 MCM Series

C-2-1 MCM Series Reference Number Coding

[Body]

Reference number : MC M 08 040 H 10 K 0 0

Monocarrier

M type: MCM Series

Nominal size (rail width, Unit: 10 mm)

Stroke (Unit: 10 mm)

Accuracy grade (H, High grade; P, Precision grade)

NSK management number

Grease specification: O (standard AS2)

Clean grease specification: B (LG2)

Slider specification K: Single slider

(See page C9) D: Double slider

Ball screw lead (mm)

[With Option part]

Reference number : MC E 08 040 H 10 K 0 0 K 0 0 0

E: With MCM option part

NSK management number

Sensor unit

Cover unit

Motor bracket

Note : Optional components are available separately.

Table 1 Sensor unit (See page C37)

Reference number code	Specification	Reference number
0	N/A	—
1	Proximity switch (b-contact 3 pieces)	MC – SRxx – 10
2	Proximity switch (a-contact 3 pieces)	MC – SRxx – 11
3	Proximity switch (a-contact 1 pieces, b-contact 2 pieces)	MC – SRxx – 12
4	Photo sensor 3 pieces	MC – SRxx – 13

xx: Reference number
Note: Sensor rail is not included in a sensor unit. If you require the rail, please request separately. (See page C38 to 40.)

Table 2 Cover unit (See page C41 – 42)

Reference number code	Specification	Reference number
0	N/A	—
1	With top cover	MC – CVxxxxx – 01 (02) ∗
2	Full cover	MC – CVxxxxx – 00

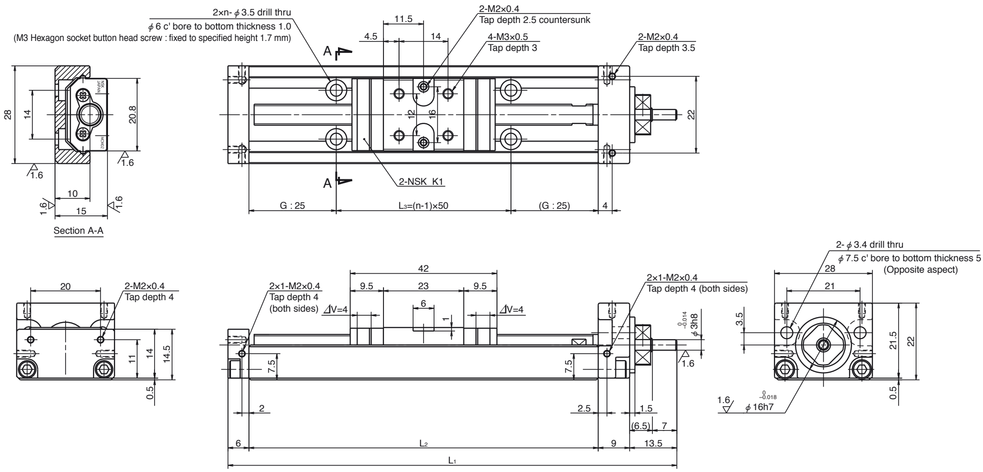
xxxxx: Reference number and stroke number
∗: Monocarrier "-02" is only used for MCM03
Note: When a sensor unit is used, the full cover unit cannot be used.

Table 3 The reference number of motor bracket (See page C43 – 58)

Reference number code	Reference number				
	MCM03	MCM05	MCM06	MCM08	MCM10
0	N/A	N/A	N/A	N/A	N/A
1	**MC-BK03-146-00**	**MC-BK05-145-00**	**MC-BK06-145-00**	**MC-BK08-145-00**	**MC-BK10-170-00**
2	**MC-BK03-148-01**	**MC-BK05-146-00**	**MC-BK06-146-00**	**MC-BK08-146-00**	**MC-BK10-170-01**
3	**MC-BK03-231-00**	**MC-BK05-148-00**	**MC-BK06-148-00**	**MC-BK08-160-00**	**MC-BK10-190-00**
4	—	**MC-BK05-160-00**	**MC-BK06-160-00**	**MC-BK08-170-00**	**MC-BK10-270-00**
5	—	**MC-BK05-250-00**	**MC-BK06-170-00**	**MC-BK08-170-01**	—
6	—	—	**MC-BK06-170-01**	**MC-BK08-190-00**	—
7	—	—	**MC-BK06-250-00**	**MC-BK08-250-00**	—
8	—	—	—	**MC-BK08-270-00**	—

C-2-2 MCM Series Dimension Table of Standard Products

MCM02



Dimension of MCM02 (Single slider) ⊿V is thickness of NSK K1

Reference number	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									

Note: Items not marked are available from standard stock.

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 the dynamic torque in the table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.
4. Stroke limit = stroke + (4 [margin] × 2)

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	
1	ϕ 6	405 (High grade) 480 (Precision)	4910	615	1	555 (High grade) 615 (Precision)	2120	490
2		400 (High grade) 475 (Precision)	3900		2	555 (High grade) 610 (Precision)		

Basic static moment load of linear guide

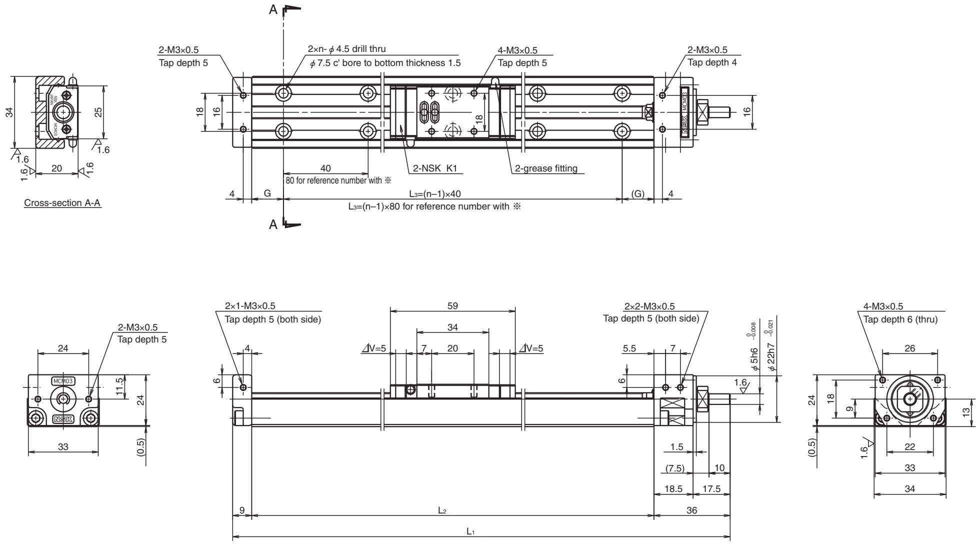
Slider	Basic static moment load (N · m)		
	Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	24	8	8

C 26

MCM03

Accuracy grade: Precision (P)

Ball screw lead 1 and 2



Dimension of MCM03 (Single slider) ⊿V is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm) L_1	L_2	G	L_3	No. of mounting hole n	Inertia $\times 10^{-5}$ (kg · m^2)	Mass (kg)
※**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	

Notes: 1. Items not marked are available from standard stock.
2. Items marked with ☆ are designated as "quick delivery item" upon request.
3. Bolt hole pitch L_3 on the 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 the dynamic torque in the table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.
4. Optional spacer is required, when using a cover unit, sensor unit or the both together in ball screw lead of 1 and 2 mm (See page C41).
5. Stroke limit = stroke + (3 [margin] × 2)

Basic load rating

Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) 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)
1	ϕ6	870	10900	2670	1	1230	4900	1040
2		865	8650		2	1220		

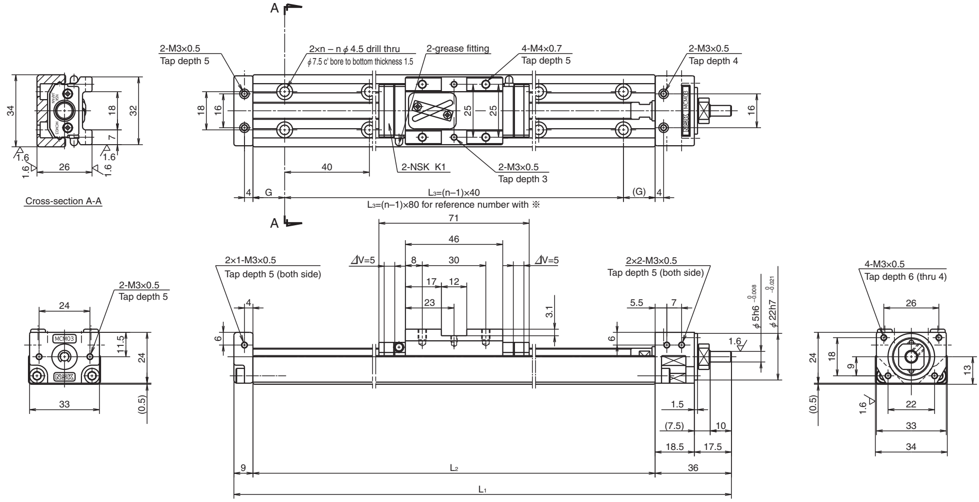
Basic static moment load of linear guide

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)

ΔV is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm) L_1	L_2	G	L_3	No. of mounting hole n	Inertia $\times 10^{-5}$ (kg · m^2)	Mass (kg)
☆※**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	

Notes: 1. Items not marked are available from standard stock.
2. Items marked with ☆ are designated as "quick delivery item" upon request.
3. Bolt hole pitch L_3 on the 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 the dynamic torque in the table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.
4. Stroke limit = stroke + (9.5 [margin] × 2)

Basic load rating

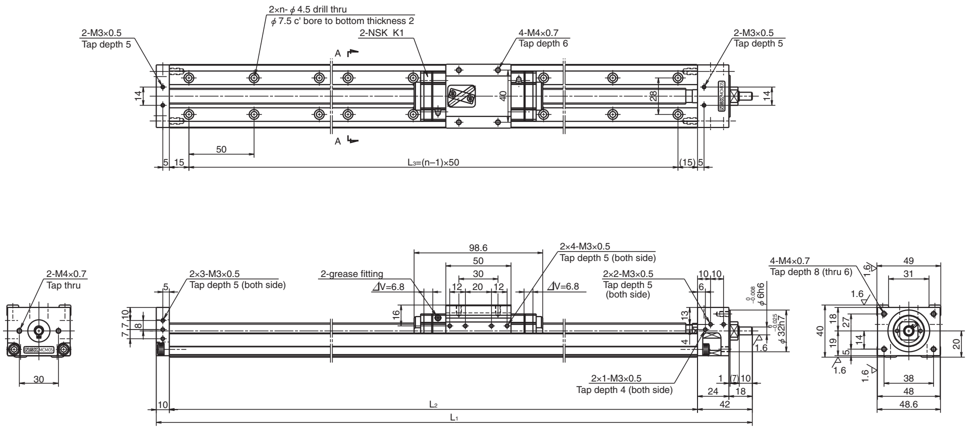
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Linear guides C_0	Support unit load limit (N)
10	ϕ 8	1310	6250	2670	10	1710	6620	1040
12		1320	5880		12	1730		

Basic static moment load of linear guide

Slider	Basic static moment load (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	92	51	51

MCM05

Accuracy grade: High grade (H)



Dimension of MCM05 (Single slider) ⊿V is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting hole n	Inertia × 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	
☆ MCM05030H05K00	300	330 (345)	5	482	430	400	9	0.053	2.3
MCM05030H10K00			10					0.063	
MCM05030H20K00			20					0.101	
☆ MCM05040H05K00	400	430 (445)	5	582	530	500	11	0.064	2.7
MCM05040H10K00			10					0.074	
MCM05040H20K00			20					0.112	
☆ MCM05050H05K00	500	530 (545)	5	682	630	600	13	0.076	3.1
MCM05050H10K00			10					0.085	
MCM05050H20K00			20					0.123	
☆ MCM05060H05K00	600	630 (645)	5	782	730	700	15	0.087	3.5
MCM05060H10K00			10					0.096	
MCM05060H20K00			20					0.134	

Notes: 1. Items not marked are available from standard stock.
2. Items marked with ☆ are designated as "quick delivery item" upon request.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	5	1.0 – 4.8
	10	1.1 – 5.8
	20	1.6 – 7.9

Notes:
1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.
4. Stroke limit = stroke + (15 [margin] × 2)

Basic load rating

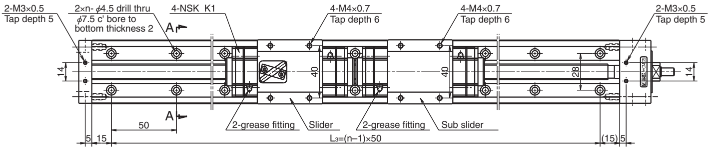
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Linear guides C_0	Support unit load limit (N)
5	ϕ 12	4390	15600	4400	5	6260	10900	1450
10		2860	12400		10	3830		
20		2660	9850		20	3800		

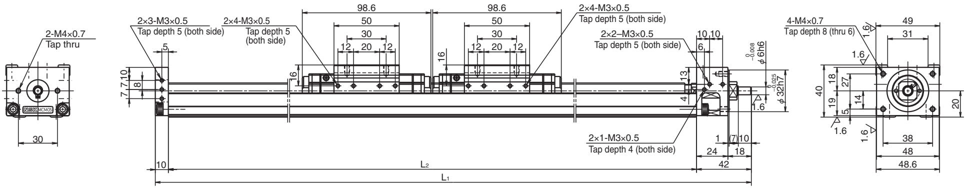
Basic static moment load of linear guide

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)

⊿V is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting hole n	Inertia $\times 10^{-4}$ (kg · m^2)	Mass (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	10	482	430	400	9	0.075	2.8
☆**MCM05021H20D00**		(260)	20					0.151	
☆**MCM05031H10D00**	310	333	10	582	530	500	11	0.086	3.2
☆**MCM05031H20D00**		(360)	20					0.162	
☆**MCM05041H10D00**	410	433	10	682	630	600	13	0.098	3.6
☆**MCM05041H20D00**		(460)	20					0.174	
☆**MCM05051H10D00**	510	533	10	782	730	700	15	0.109	4.2
☆**MCM05051H20D00**		(560)	20					0.185	

Notes: 1. Items not marked are available from standard stock.
2. Items marked with ☆ are designated as "quick delivery item" upon request.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	10	1.5 – 7.6
	20	2.3 – 11.8

Notes:
1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.
4. Stroke limit = stroke + (11.4 [margin] × 2)

Basic load rating

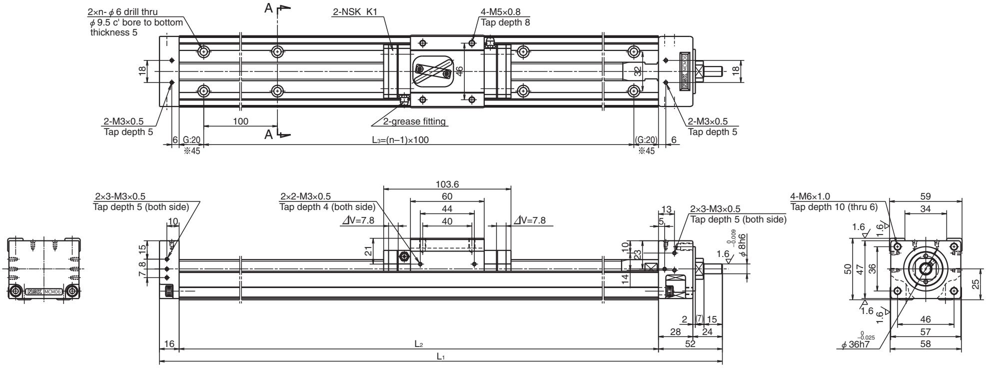
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Linear guides C_0	Support unit load limit (N)
5	ϕ 12	4390	15600	4400	5	6260	10900	1450
10		2860	12400		10	3830		
20		2660	9850		20	3800		

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)

V is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting hole n	Inertia $\times 10^{-4}$ (kg · m²)	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	
MCM06040H05K00	400	435 (452)	5	608	540	500	6	0.219	5.2
MCM06040H10K00			10					0.180	
MCM06040H20K00			20					0.225	
☆ MCM06050H05K00	500	535 (552)	5	708	640	600	7	0.258	6.0
MCM06050H10K00			10					0.209	
MCM06050H20K00			20					0.255	
☆ MCM06060H05K00	600	635 (652)	5	808	740	700	8	0.297	6.7
☆ MCM06060H10K00			10					0.239	
☆ MCM06060H20K00			20					0.284	
☆ MCM06070H05K00	700	735 (752)	5	908	840	800	9	0.335	7.4
MCM06070H10K00			10					0.268	
MCM06070H20K00			20					0.314	
☆ MCM06080H05K00	800	835 (852)	5	1008	940	900	10	0.374	8.1
☆ MCM06080H10K00			10					0.298	
☆ MCM06080H20K00			20					0.343	

Notes: 1. Items not marked are available from standard stock.
2. Items marked with ☆ are designated as "quick delivery item" upon request.
3. Dimension G is 45 for those marked with ※.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)		
	5	1.9 – 7.4
	10	2.2 – 8.6
	20	2.8 – 11.0

Notes:
1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.
4. Stroke limit = stroke + (17.5 [margin] × 2)

Basic load rating

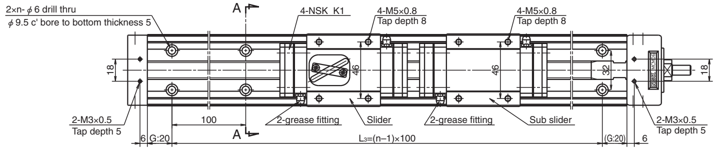
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Linear guides C_0	Support unit load limit (N)
5	ϕ 16	8620	25200	6550	5	13800	17000	2730
10	ϕ 15	8140	20000		10	12800		
20		5080	15900		20	7460		

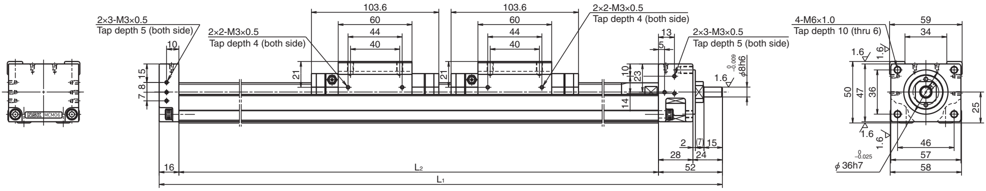
Basic static moment load of linear guide

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) ⊿V is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting hole n	Inertia × 10^{-4} (kg · m^2)	Mass (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	
☆**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	1008	940	900	10	0.313	8.7
☆**MCM06071H20D00**			20					0.404	

Notes: 1. Items not marked are available from standard stock.
2. Items marked with ☆ are designated as "quick delivery item" upon request.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	5	2.3 – 8.5
	10	2.7 – 10.9
	20	4.0 – 15.9

Notes:
1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.
4. Stroke limit = stroke + (11.4 [margin] × 2)

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Basic load rating

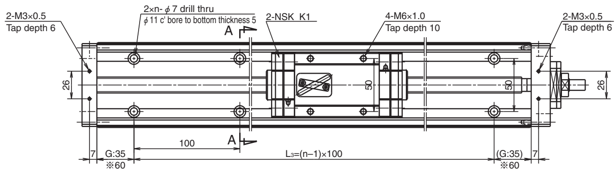
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Linear guides C_0	Support unit load limit (N)
5	ϕ16	8620	25200	6550	5	13800	17000	2730
10	ϕ15	8140	20000		10	12800		
20		5080	15900		20	7460		

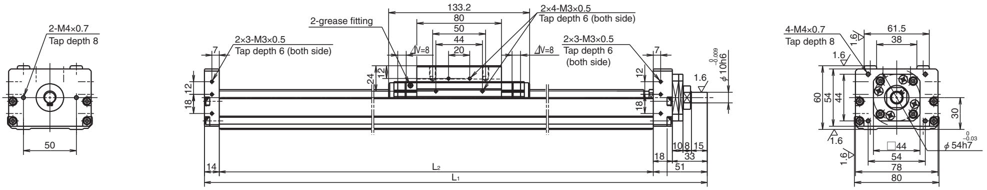
Basic static moment load of linear guide

Slider	Basic static moment load (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	825	1220	1220

MCM08

Accuracy grade: High grade (H)





Dimension of MCM08 (Single slider) ΔV is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting hole n	Inertia $\times 10^{-4}$ (kg · m^2)	Mass (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	
☆ MCM08040H05K00	400	435 (451)	5	635	570	500	6	0.236	7.4
MCM08040H10K00			10					0.203	
MCM08040H20K00			20					0.279	
☆ MCM08050H05K00	500	535 (551)	5	735	670	600	7	0.275	8.4
MCM08050H10K00			10					0.232	
MCM08050H20K00			20					0.308	
☆ MCM08060H05K00	600	635 (651)	5	835	770	700	8	0.314	9.3
MCM08060H10K00			10					0.262	
☆ MCM08060H20K00			20					0.338	
☆ MCM08070H05K00	700	735 (751)	5	935	870	800	9	0.353	10.5
☆ MCM08070H10K00			10					0.291	
☆ MCM08070H20K00			20					0.367	
☆ MCM08080H05K00	800	835 (851)	5	1035	970	900	10	0.391	11.2
☆ MCM08080H10K00			10					0.320	
☆ MCM08080H20K00			20					0.396	

Notes: 1. Items not marked are available from standard stock.
2. Items marked with ☆ are designated as "quick delivery item" upon request.
3. Dimension G is 60 for those marked with ※.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	5	1.0 – 5.9
	10	2.0 – 7.8
	20	2.5 – 10.8

Notes:
1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.
4. Stroke limit = stroke + (17.5 [margin] × 2)

Basic load rating

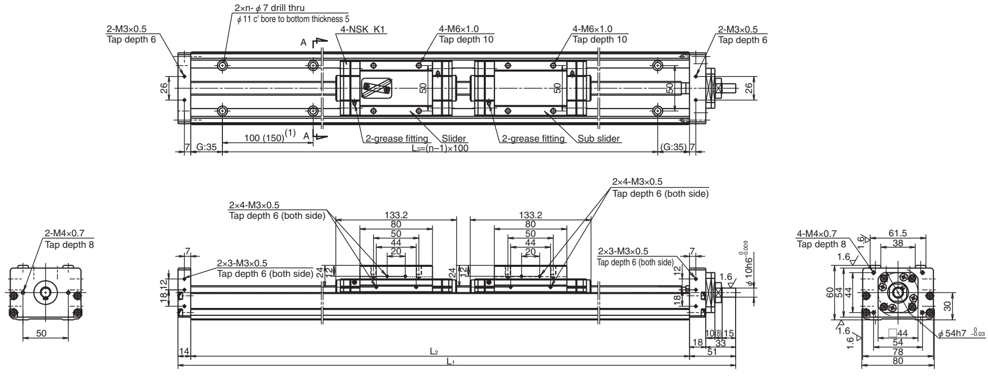
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Linear guides C_0	Support unit load limit (N)
5	ϕ 16	8620	30800	7100	5	13800	22800	3040
10	ϕ 15	8140	24400		10	12800		
20		5080	19400		20	7460		

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)

⊿V is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting hole n	Inertia $\times 10^{-4}$ (kg · m^2)	Mass (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	
☆ **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	

Notes: 1. Items not marked are available from standard stock.
2. Items marked with ☆ are designated as "quick delivery item" upon request.
3. Dimension (1) is 150mm for those marked with ※.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	10	2.5 – 10.8
	20	4.0 – 17.2

Notes:
1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.
4. Stroke limit = stroke + (11.8 [margin] × 2)

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	ϕ 16	8620	30800	7100	5	13800	22800	3040
10	ϕ 15	8140	24400		10	12800		
20		5080	19400		20	7460		

Basic static moment load of linear guide

Slider	Basic static moment load (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	1540	2050	2050

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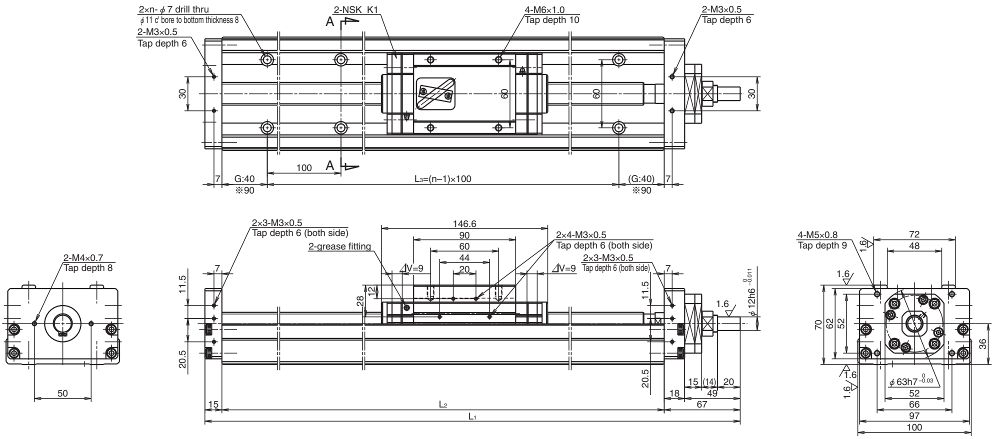
MCM10

Accuracy grade: High grade (H)



Dimension of MCM10 (Single slider)

⊿V is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	No. of mounting hole n	Inertia $\times 10^{-4}$ (kg · m^2)	Mass (kg)
☆ **MCM10010H10K00**	100	130	10	362	280	200	3	0.332	7.8
☆ **MCM10010H20K00**		(151)	20					0.446	
☆◇**MCM10015H10K00**	150	180	10	412	330	300	4	0.378	8.7
☆◇**MCM10015H20K00**		(201)	20					0.492	
MCM10020H10K00	200	230	10	462	380	300	4	0.425	9.5
☆ **MCM10020H20K00**		(251)	20					0.539	
☆◇**MCM10025H10K00**	250	280	10	512	430	400	5	0.472	10.4
☆◇**MCM10025H20K00**		(301)	20					0.586	
MCM10030H10K00	300	330	10	562	480	400	5	0.519	11.2
MCM10030H20K00		(351)	20					0.633	
MCM10040H10K00	400	430	10	662	580	500	6	0.612	13.0
MCM10040H20K00		(451)	20					0.726	
☆ **MCM10050H10K00**	500	530	10	762	680	600	7	0.706	14.6
☆ **MCM10050H20K00**		(551)	20					0.820	
MCM10060H10K00	600	630	10	862	780	700	8	0.800	16.3
☆ **MCM10060H20K00**		(651)	20					0.914	
☆ **MCM10070H10K00**	700	730	10	962	880	800	9	0.893	18.0
☆ **MCM10070H20K00**		(751)	20					1.007	
MCM10080H10K00	800	830	10	1062	980	900	10	0.987	19.7
☆ **MCM10080H20K00**		(851)	20					1.101	
☆ **MCM10090H10K00**	900	930	10	1162	1080	1000	11	1.081	21.4
☆ **MCM10090H20K00**		(951)	20					1.195	
☆※**MCM10100H10K00**	1000	1030	10	1262	1180	1000	11	1.174	23.1
☆※**MCM10100H20K00**		(1051)	20					1.288	

Notes: 1. Items not marked are available from standard stock.
2. Items marked with ☆ are designated as "quick delivery item" upon request.
3. Dimension G is 90 for those marked with ※.
4. Dimension G is 15 for those marked with ◇.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	10	2.7 – 10.8
	20	3.1 – 12.7

Notes:
1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.
4. Stroke limit = stroke + (15 [margin] × 2)

Basic load rating

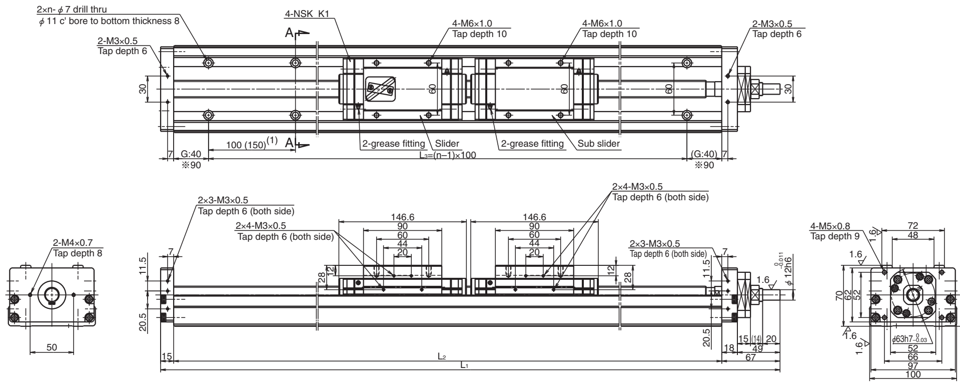
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Linear guides C_0	Support unit load limit (N)
10	ϕ20	13300	33500	7600	10	21900	29400	3380
20		8190	26600		20	13100		

Basic static moment load of linear guide

Slider	Basic static moment load (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	1170	425	425

MCM10 (Double slider)

Accuracy grade: High grade (H)



Dimension of MCM10 (Double slider)

△V is thickness of NSK K1

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm) 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	10	562	480	400	5	0.557	12.7
☆ MCM10017H20D00		(222)	20					0.785	
☆ MCM10027H10D00	270	286	10	662	580	500	6	0.650	13.4
☆ MCM10027H20D00		(322)	20					0.878	
☆ MCM10037H10D00	370	386	10	762	680	600	7	0.744	15.1
☆ MCM10037H20D00		(422)	20					0.972	
☆ MCM10047H10D00	470	486	10	862	780	700	8	0.838	17.8
☆ MCM10047H20D00		(522)	20					1.066	
☆ MCM10057H10D00	570	586	10	962	880	800	9	0.931	19.5
☆ MCM10057H20D00		(622)	20					1.159	
☆ MCM10067H10D00	670	686	10	1062	980	900	10	1.025	21.2
☆ MCM10067H20D00		(722)	20					1.253	
☆※MCM10087H10D00	870	886	10	1262	1180	1000	11	1.212	23.6
☆※MCM10087H20D00		(922)	20					1.440	

Notes: 1. Items not marked are available from standard stock.
2. Items marked with ☆ are designated as "quick delivery item" upon request.
3. Dimension G is 90 for those marked with ※.
4. Dimension (1) is 150mm for those marked with ◇.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	10	4.2 – 15.6
	20	5.0 – 19.6

Notes:
1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.
4. Stroke limit = stroke + (8.4 [margin] × 2)

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	13300	33500	7600	10	21900	29400	3380
20		8190	26600		20	13100		

Basic static moment load of linear guide

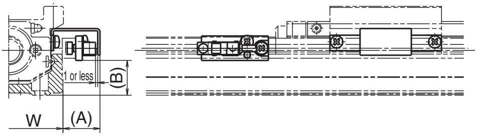
Slider	Basic static moment load (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	2340	2940	2940

C-2-3 MCM Series Option Part

C-2-3. 1 Sensor Unit

Standard stock

●Proximity switch



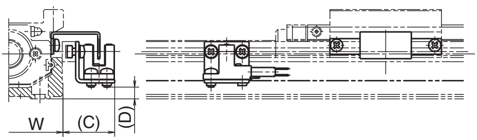
(Example of assembly)

Type		Reference number			Dimension (A) (mm)	Dimension (B) (mm)	Body width W (mm)
MCM02		MC-SR02-00	MC-SR02-01	MC-SR02-02	17	2	28
MCM03		MC-SR03-10	MC-SR03-11	MC-SR03-12	17	3	34
MCM05		MC-SR05-10	MC-SR05-11	MC-SR05-12	17	15	48.6
MCM06		MC-SR06-10	MC-SR06-11	MC-SR06-12	17	19	58
MCM08		MC-SR08-10	MC-SR08-11	MC-SR08-12	16	27	80
MCM10		MC-SR10-10	MC-SR10-11	MC-SR10-12	16	35	100
Quantity	Proximity switch (a-contact)	—	3	1	E2S-W13 (OMRON Corp.)		
	Proximity switch (b-contact)	3	—	2	E2S-W14 (OMRON Corp.)		

Note: 1. See page C21 for specification of proximity switch. 2. A sensor unit consists of sensors, a sensor dog and sensor mounting parts.

You require an optional spacer plate when you use a cover unit or a sensor unit for an MCM03 with the lead of 1 or 2 mm. (Refer to page C41.)

●Photo sensor



(Example of assembly)

Type	Reference number	Dimension (C) (mm)	Dimension (D) (mm)	Body width W (mm)	Remarks
MCM03	MC-SR03-13	24	0.5	34	
MCM05	MC-SR05-13	24	5	48.6	EE-SX674 (OMRON Corp.)
MCM06	MC-SR06-13	24	9	58	3 sets
MCM08	MC-SR08-13	23	17	80	(EE-1001 connector attachment)
MCM10	MC-SR10-13	22	24	100	

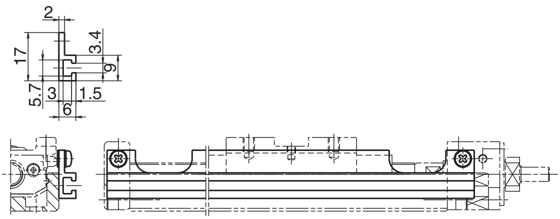
Note: 1. See page C22 for specification of photo sensor. 2. A sensor unit consists of sensors, a sensor dog and sensor mounting parts.

You require an optional spacer plate when you use a cover unit or a sensor unit for an MCM03 with the lead of 1 or 2 mm. (Refer to page C41.)

(1) Sensor Rail

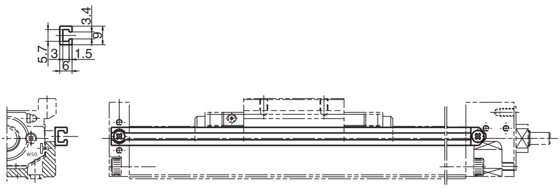
Standard stock

Sensor rail for MCM03: MC-SRL3- ∗ ∗ ∗ ∗



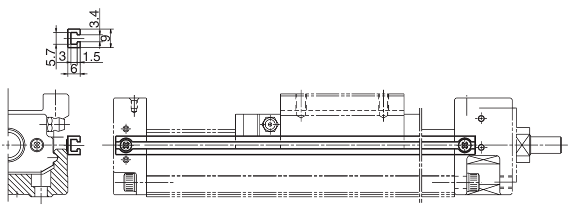
(Example of assembly)

Sensor rail for MCM05: MC-SRL5- ∗ ∗ ∗ ∗



(Example of assembly)

Sensor rail for MCM02: MC-SRL2- ∗ ∗ ∗ ∗
Sensor rail for MCM06: MC-SRL6- ∗ ∗ ∗ ∗
Sensor rail for MCM08: MC-SRL8- ∗ ∗ ∗ ∗
Sensor rail for MCM10: MC-SRL1- ∗ ∗ ∗ ∗



(Example of assembly)

∗ ∗ ∗ ∗ is the same as rail dimension L_2

Please place and assemble the seat during the attachment of the sensor rail and the support unit attaching part for MCM03, MCM05, MCM06 and MCM08.

Body of MCM Series and Sensor Rail Combination Table

Table 4

Nominal size	Body length L_2 (mm)	Reference number	Sensor rail reference number
MCM02	100	MCM02005H01K MCM02005P01K MCM02005H02K MCM02005P02K	MC-SRL2-0100
	150	MCM02010H01K MCM02010P01K MCM02010H02K MCM02010P02K	MC-SRL2-0150
	200	MCM02015H01K MCM02015P01K MCM02015H02K MCM02015P02K	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 MCM05021H10D00 MCM05021H20D00	MC-SRL5-0430
	530	MCM05040H05K00 MCM05040H10K00 MCM05040H20K00 MCM05031H10D00 MCM05031H20D00	MC-SRL5-0530
	630	MCM05050H05K00 MCM05050H10K00 MCM05050H20K00 MCM05041H10D00 MCM05041H20D00	MC-SRL5-0630
	730	MCM05060H05K00 MCM05060H10K00 MCM05060H20K00 MCM05051H10D00 MCM05051H20D00	MC-SRL5-0730

Nominal size	Body length L_2 (mm)	Reference number	Sensor rail reference number
MCM06	190	MCM06005H05K00 MCM06005H10K00 MCM06005H20K00	MC-SRL6-0190
	240	MCM06010H05K00 MCM06010H10K00 MCM06010H20K00	MC-SRL6-0240
	290	MCM06015H05K00 MCM06015H10K00 MCM06015H20K00	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

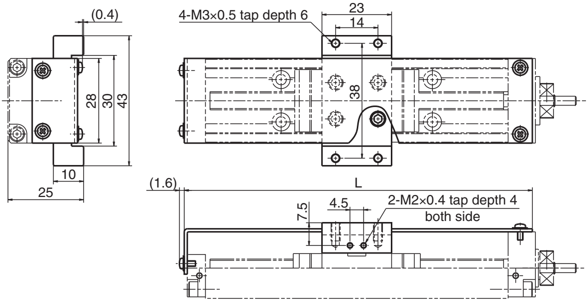
Nominal size	Body length L_2 (mm)	Reference number	Sensor rail reference number
MCM08	220	MCM08005H05K00 MCM08005H10K00	MC-SRL8-0220
	270	MCM08010H05K00 MCM08010H10K00 MCM08010H20K00	MC-SRL8-0270
	320	MCM08015H05K00 MCM08015H10K00 MCM08015H20K00	MC-SRL8-0320
	370	MCM08020H05K00 MCM08020H10K00 MCM08020H20K00 MCM08008H10D00	MC-SRL8-0370
	420	MCM08025H05K00 MCM08025H10K00 MCM08025H20K00	MC-SRL8-0420
	470	MCM08030H05K00 MCM08030H10K00 MCM08030H20K00 MCM08018H10D00 MCM08018H20D00	MC-SRL8-0470
	570	MCM08040H05K00 MCM08040H10K00 MCM08040H20K00 MCM08028H10D00 MCM08028H20D00	MC-SRL8-0570
	670	MCM08050H05K00 MCM08050H10K00 MCM08050H20K00 MCM08038H10D00 MCM08038H20D00	MC-SRL8-0670
	770	MCM08060H05K00 MCM08060H10K00 MCM08060H20K00 MCM08048H10D00 MCM08048H20D00	MC-SRL8-0770
	870	MCM08070H05K00 MCM08070H10K00 MCM08070H20K00 MCM08058H10D00 MCM08058H20D00	MC-SRL8-0870
	970	MCM08080H05K00 MCM08080H10K00 MCM08080H20K00 MCM08068H10D00 MCM08068H20D00	MC-SRL8-0970

Nominal size	Body length L_2 (mm)	Reference number	Sensor rail reference number
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 MCM10037H10D00 MCM10037H20D00	MC-SRL1-0680
	780	MCM10060H10K00 MCM10060H20K00 MCM10047H10D00 MCM10047H20D00	MC-SRL1-0780
	880	MCM10070H10K00 MCM10070H20K00 MCM10057H10D00 MCM10057H20D00	MC-SRL1-0880
	980	MCM10080H10K00 MCM10080H20K00 MCM10067H10D00 MCM10067H20D00	MC-SRL1-0980
	1080	MCM10090H10K00 MCM10090H20K00	MC-SRL1-1080
	1180	MCM10100H10K00 MCM10100H20K00 MCM10087H10D00 MCM10087H20D00	MC-SRL1-1180

C-2-3. 2 Cover Unit

Standard stock

Cover Unit for MCM02



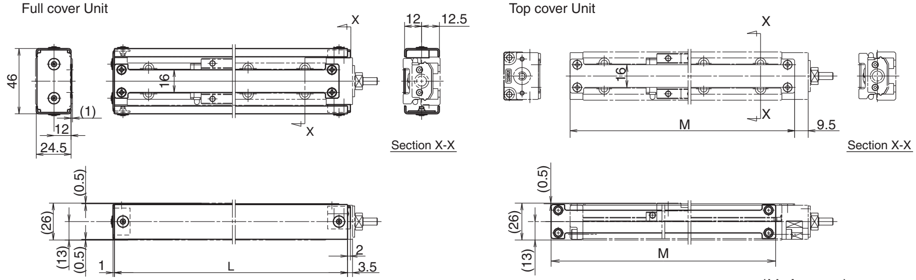
(Unit: mm)

Stroke	Reference number	Length(*L*)
50	**MC-CV02005-00**	115
100	**MC-CV02010-00**	165
150	**MC-CV02015-00**	215

Note: Height of screw head is not included.

Cover Unit for MCM03

· Optional spacer (MC-SP03-00) is required for a main unit with ball screw lead of 1 and 2 mm.

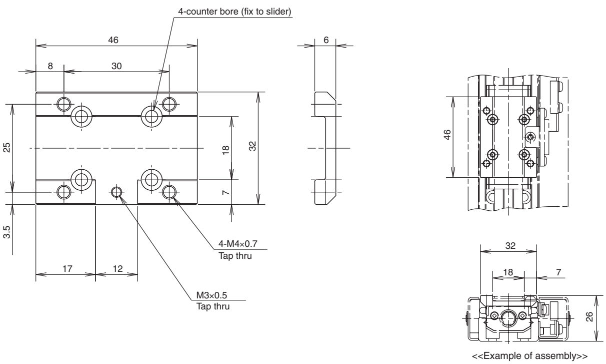


(Unit: mm)

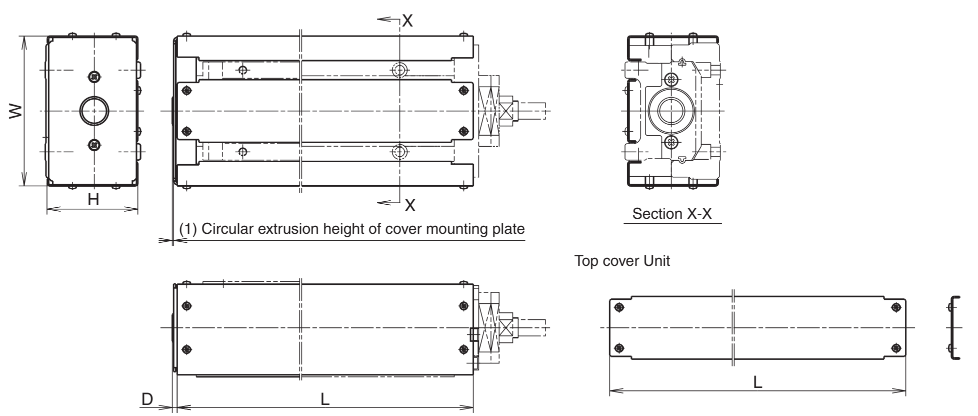
Stroke	Reference number		Cover Length	
	Top cover Unit	Full cover Unit	Length (*L*)	Length (*M*)
50 (lead 1, 2)	**MC-CV03005-02**	***MC-CV03005-01**	139	133
50 (lead 10, 12)	**MC-CV03005-02A**	***MC-CV03005-01A**	164	158
100	**MC-CV03010-02**	***MC-CV03010-01**	214	208
150	**MC-CV03015-02**	***MC-CV03015-01**	264	258
200	**MC-CV03020-02**	***MC-CV03020-01**	314	308
250	**MC-CV03025-02**	***MC-CV03025-01**	364	358

Notes: 1. The full-cover unit cannot be used when the sensor unit is used. 2. Height of screw head is not included.

Spacer for MCM03 (Optional) MC-SP03-00 (for ball screw lead 1 and 2 mm)



Cover Unit for MCM05, 06, 08, and 10



Note: A cover mounting plate is not used to MCM06.

(Unit: mm)

Reference number	Stroke		Cover unit Reference number		Cover length			
	Single slider	Double slider	Top cover Unit	*Full cover Unit	Length (L)	Height (H)	Width (W)	End part (D)
MCM05	50	—	MC-CV05005-01	MC-CV05005-00	200	38.5	65	2.6
	100	—	MC-CV05010-01	MC-CV05010-00	250			
	150	60	MC-CV05015-01	MC-CV05015-00	300			
	200	110	MC-CV05020-01	MC-CV05020-00	350			
	250	160	MC-CV05025-01	MC-CV05025-00	400			
	300	210	MC-CV05030-01	MC-CV05030-00	450			
	400	310	MC-CV05040-01	MC-CV05040-00	550			
	500	410	MC-CV05050-01	MC-CV05050-00	650			
	600	510	MC-CV05060-01	MC-CV05060-00	750			
MCM06	50	—	MC-CV06005-01	MC-CV06005-00	225	48.5	75	—
	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			

*When a sensor unit is used, the full-cover unit cannot be used. Not include height such as screw

Note: The dimensions of cover shown above do not include the head height of fixing machine screws. Add the head of machine screws of approximately 2.5 mm to the outer measurement of a cover unit. Set a margin for mechanical interference with surrounding components.

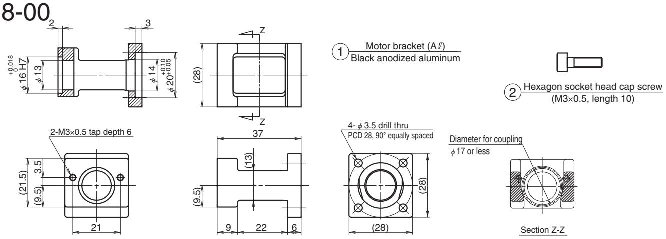
C-2-3. 3 Motor Bracket

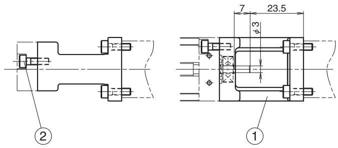
●Motor models are subject to change at the motor manufacturers. For details, please contact the manufacture.

Standard stock

Motor Bracket for MCM02

■Reference number
MC-BK02-128-00

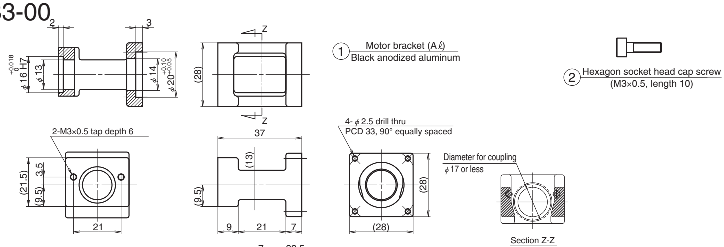


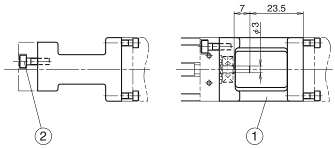


Note: Be sure to align the centerlines when installing the motor.

Compatible motor	
Maker	Motor models
Yaskawa Electric Corp. (Σ- mini Series)	SGMM-A1(10W) SGMM-A2(20W)

■Reference number
MC-BK02-133-00

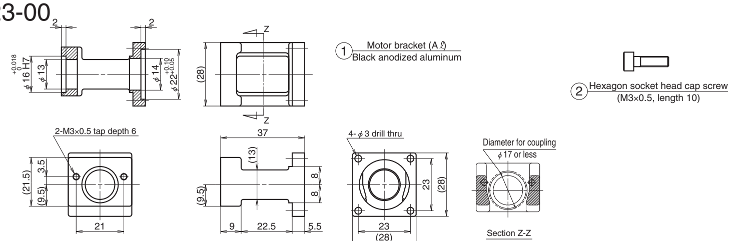


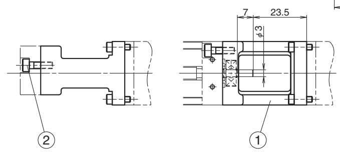


Note: Be sure to align the centerlines when installing the motor.

Compatible motor	
Maker	Motor models
Mitsubishi Electric Corp. (Melservo series)	HC-AQ013(10W) HC-AQ023(20W)

■Reference number
MC-BK02-223-00





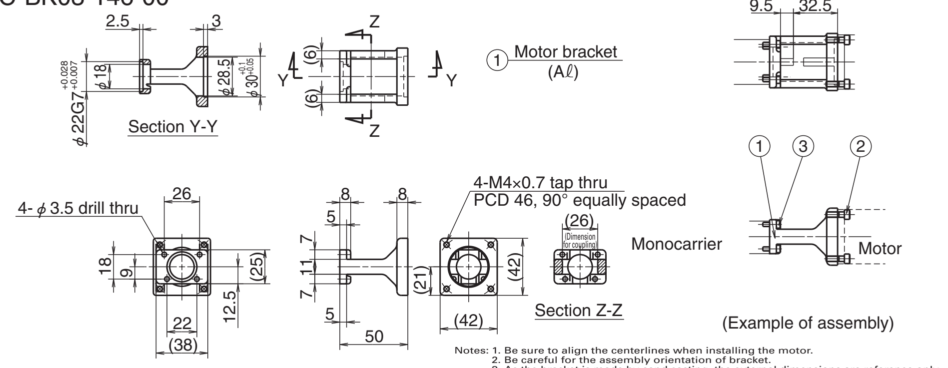
Note: Be sure to align the centerlines when installing the motor.

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

Standard stock

■Reference number
MC-BK03-146-00



Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

2 Hexagon socket head cap screw (M4, length 12)

3 Hexagon socket head cap screw (M3, length 10)

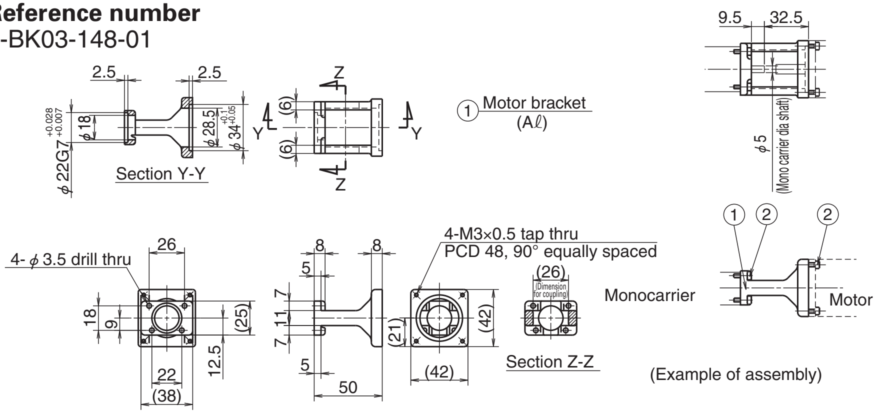
Compatible motor

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), P30B04006(60W), P30B04010(100W)

Motor Bracket for MCM03

Standard stock

■Reference number
MC-BK03-148-01



2 Hexagon socket head cap screw (M3, length 10)

Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor

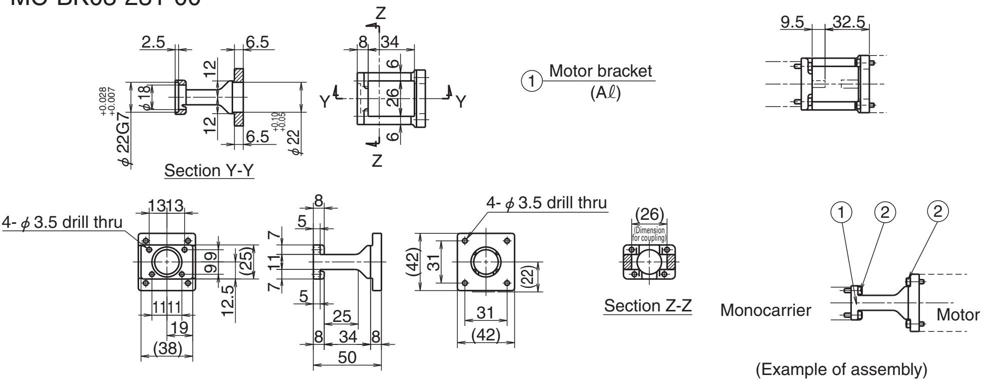
Maker	Motor models
Sanyo Denki Co., Ltd.	P50B04040(60W), P50B04010(100W)

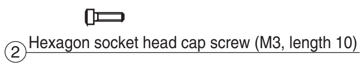
C 44

Standard stock

Motor Bracket for MCM03

■Reference number
MC-BK03-231-00





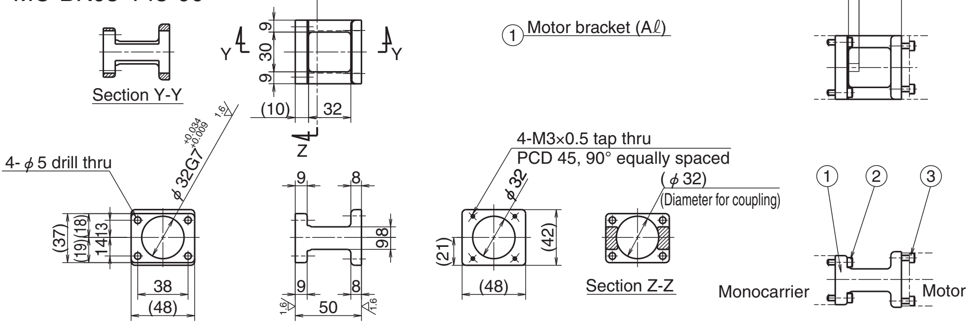
Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

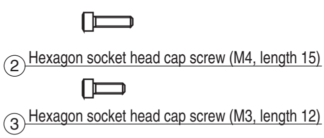
Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	PBM423xxx, 103F55xx
Oriental Motor Co., Ltd.	AS46, ASC46, UPK54x, PK54x, CSK54x, CFK54x UMK24x, CSK24x, PK24x

Standard stock

Motor Bracket for MCM05

■Reference number
MC-BK05-145-00





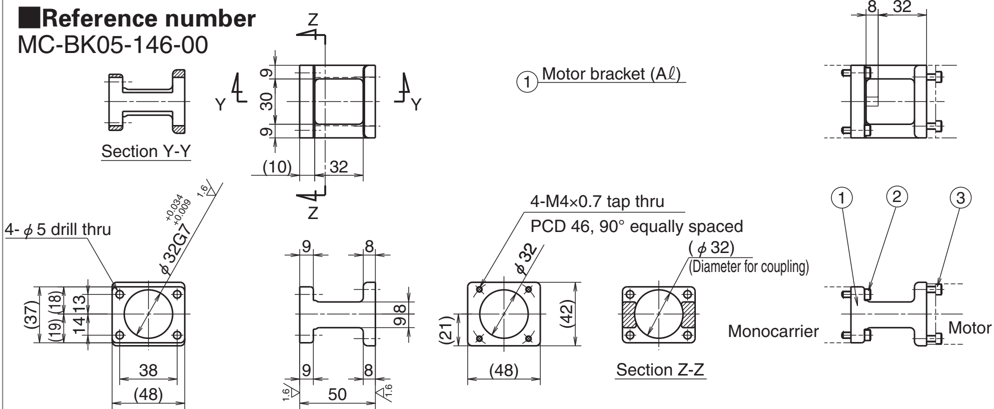
Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

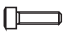
Compatible motor	
Maker	Motor models
Matsushita Electric Co., Ltd.	MSMD5A(50W), MSMD01(100W)

Standard stock

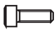
Motor Bracket for MCM05

■Reference number
MC-BK05-146-00





② Hexagon socket head cap screw (M4, length 15)



③ Hexagon socket head cap screw (M4, length 12)

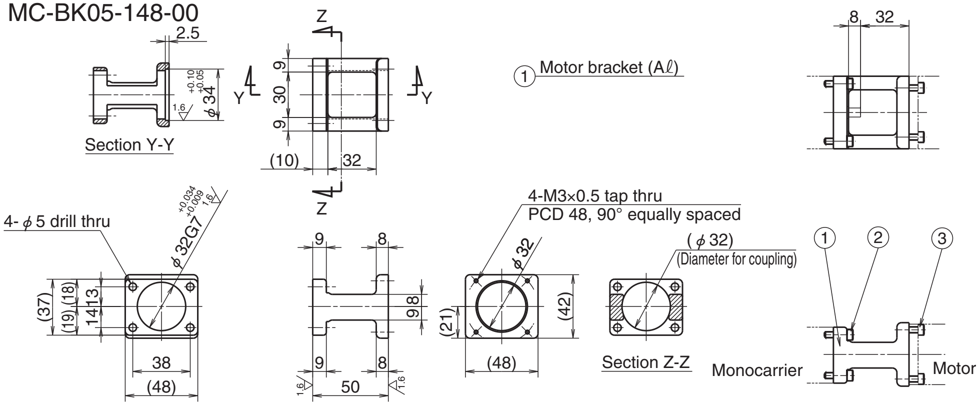
Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

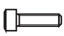
Compatible motor	
Maker	Motor models
Yaskawa Electric Corp.	SGMAH-A3(30W), SGMJV-A5A(50W), SGMAV-A5A(50W) SGMJV-01A(100W), SGMAV-01A(100W), SGMAV-C2A(150W)
Mitsubishi Electric Corp.	HF-KP053(50W), HF-MP053(50W), HC-KFS053(50W), HC-MFS053(50W) HF-KP13(100W), HF-MP13(100W), HC-KFS13(100W), HC-MFS13(100W)
OMRON Corp.	R88M-W03(30W), R88M-W05(50W), R88M-W10(100W)
Sanyo Denki Co., Ltd.	P30B04003(30W), P30B04005(50W), P30B04006(60W), P30B04010(100W)

Standard stock

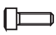
Motor Bracket for MCM05

■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 the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

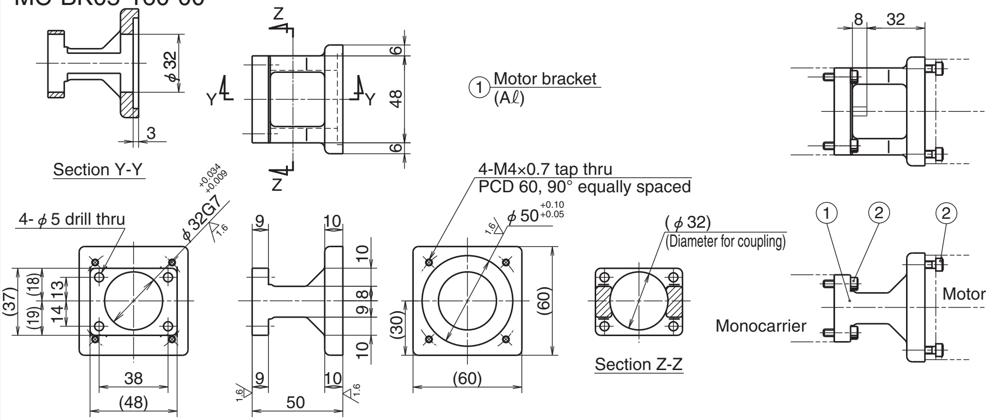
Compatible motor	
Maker	Motor models
Matsushita Electric Co., Ltd.	MAMA01(100W)

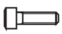
C 46

Standard stock

Motor Bracket for MCM05

■Reference number
MC-BK05-160-00





② Hexagon socket head cap screw (M4, length 15)

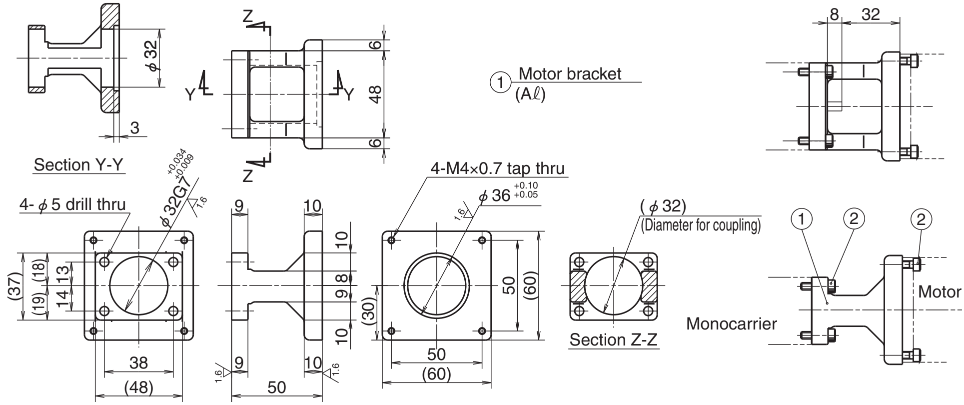
Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

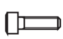
Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	P50B05005(50W), P50B05010(100W), P50B05020(200W)

Standard stock

Motor Bracket for MCM05

■Reference number
MC-BK05-250-00





② Hexagon socket head cap screw (M4, length 15)

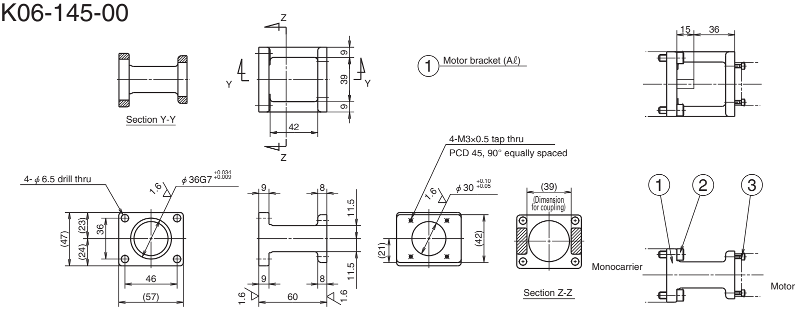
Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

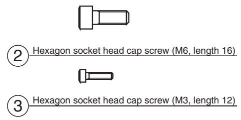
Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	PBM603xxx, PBM604xxx, 103F78xx
Oriental Motor Co., Ltd.	AS66, ASC66, UPK56x, UFK56x PK56x, CSK56x, CFK56x

Motor Bracket for MCM06

Standard stock

■Reference number
MC-BK06-145-00





Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

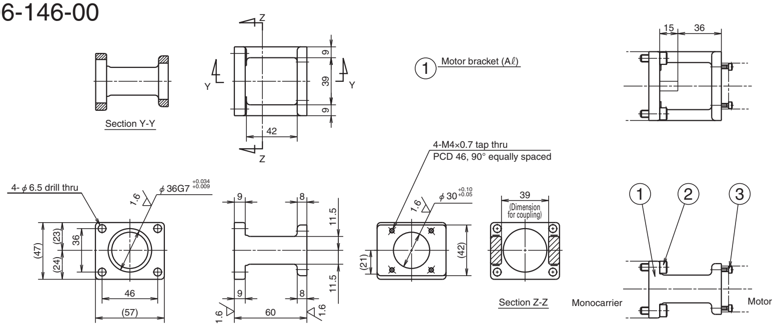
Compatible motor

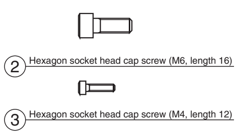
Maker	Motor models
Matsushita Electric Industrial Co., Ltd.	MSMD5A(50W), MSMD01(100W)

Motor Bracket for MCM06

Standard stock

■Reference number
MC-BK06-146-00





Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor

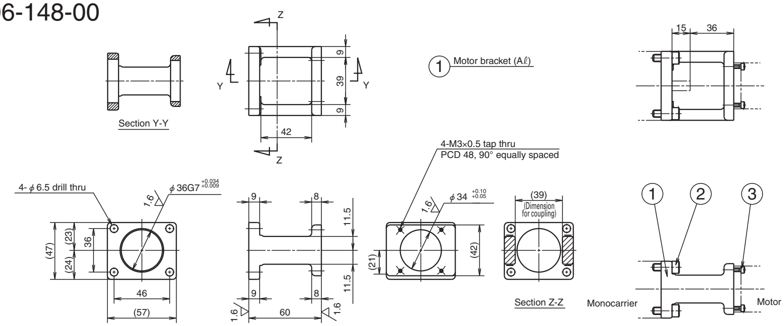
Maker	Motor models
Yaskawa Electric Corp.	SGMJV-A5A(50W), SGMAV-A5A(50W) SGMJV-01A(100W), SGMAV-01A(100W), SGMAV-C2A(150W)
Mitsubishi Electric Corp.	HF-KP053(50W), HF-MP053(50W), HC-KFS053(50W), HC-MFS053(50W) HF-KP13(100W), HF-MP13(100W), HC-KFS13(100W), HC-MFS13(100W)
OMRON Corp.	R88M-W03(30W), R88M-W05(50W), R88M-W10(100W)
Sanyo Denki Co., Ltd.	P30B04003(30W), P30B04005(50W), P30B04006(60W), P30B04010(100W)

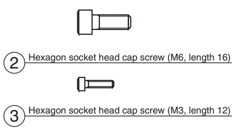
C 48

Standard stock

Motor Bracket for MCM06

■Reference number
MC-BK06-148-00





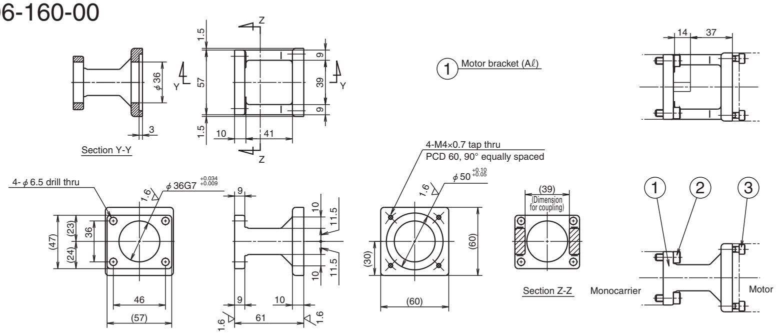
Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

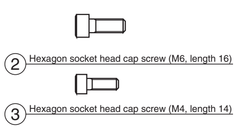
Compatible motor	
Maker	Motor models
Matsushita Electric Co., Ltd.	MAMA01(100W)
Sanyo Denki Co., Ltd.	P50B04040(60W), P50B04010(100W)

Standard stock

Motor Bracket for MCM06

■Reference number
MC-BK06-160-00





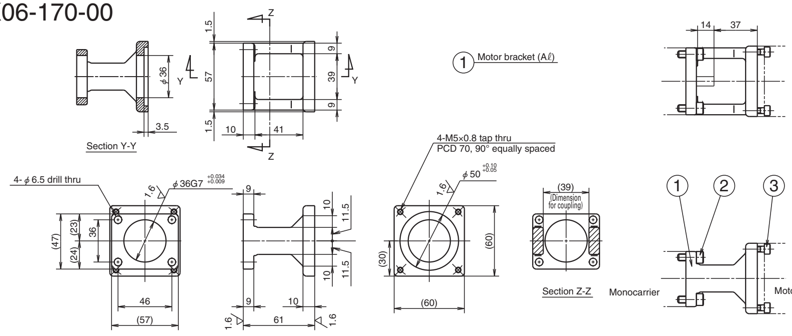
Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

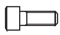
Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	P50B05005(50W), P50B05010(100W), P50B05020(200W)

Standard stock

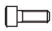
Motor Bracket for MCM06

■Reference number
MC-BK06-170-00





2 Hexagon socket head cap screw (M6, length 16)



3 Hexagon socket head cap screw (M5, length 14)

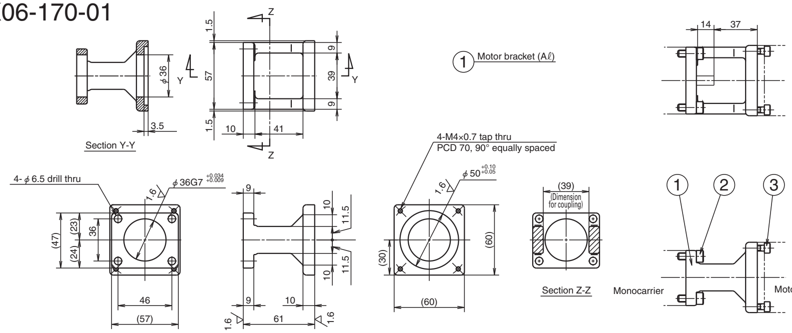
Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

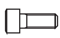
Compatible motor	
Maker	Motor models
Yaskawa Electric Corp.	SGMJV-02A(200W), SGMAV-02A(200W), SGMJV-04A(400W), SGMAV-04A(400W)
Mitsubishi Electric Corp.	HF-KP23(200W), HF-MP23(200W), HC-KP43(400W), HC-MP43(400W) HC-KFS23(200W), HC-MFS23(200W), HC-KFS43(400W), HC-MFS43(400W)
OMRON Corp.	R88M-W20(200W), R88M-W40(400W)
Sanyo Denki Co., Ltd.	P30B06020(200W), P30B06040(400W)

Standard stock

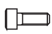
Motor Bracket for MCM06

■Reference number
MC-BK06-170-01





2 Hexagon socket head cap screw (M6, length 16)



3 Hexagon socket head cap screw (M4, length 14)

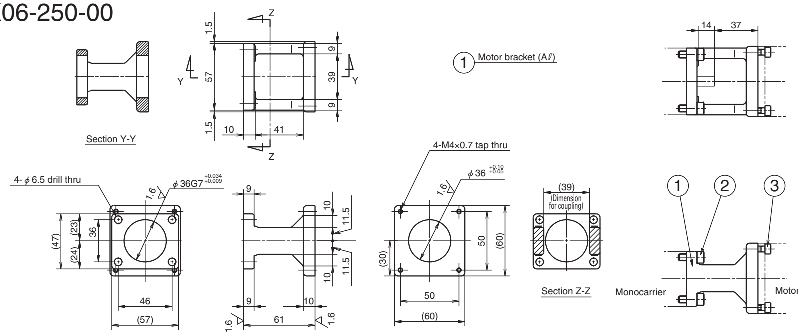
Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

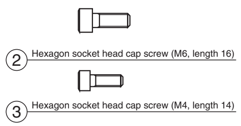
Compatible motor	
Maker	Motor models
Matsushita Electric Industrial Co., Ltd.	MSMD02(200W), MAMA02(200W), MSMD04(400W), MAMA04(400W)

Standard stock

Motor Bracket for MCM06

■Reference number
MC-BK06-250-00





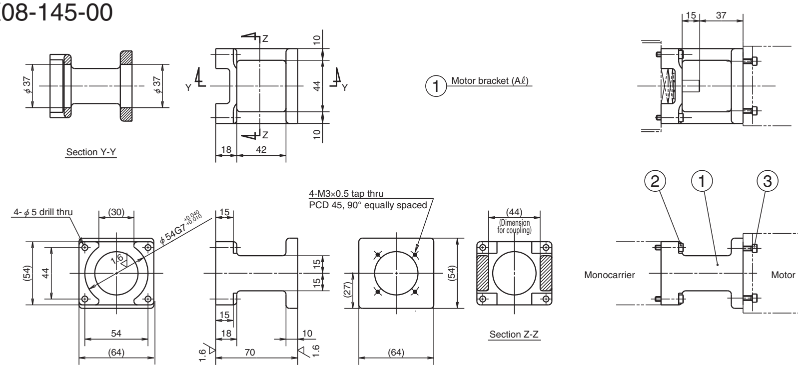
Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

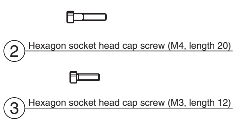
Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	PBM603xxx, PBM604xxx, 103F78xx
Oriental Motor Co., Ltd.	AS66, ASC66, UPK56x, PK56x, CSK56x CFK56x, UMK56x, UFK56x

Standard stock

Motor Bracket for MCM08

■Reference number
MC-BK08-145-00





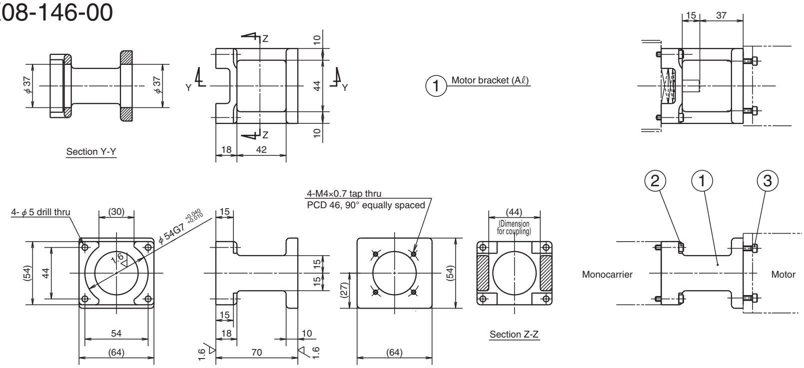
Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

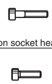
Compatible motor	
Maker	Motor models
Matsushita Electric Industrial Co., Ltd.	MSMD01(100W)

Standard stock

Motor Bracket for MCM08

■Reference number
MC-BK08-146-00





② Hexagon socket head cap screw (M4, length 20)

③ Hexagon socket head cap screw (M4, length 14)

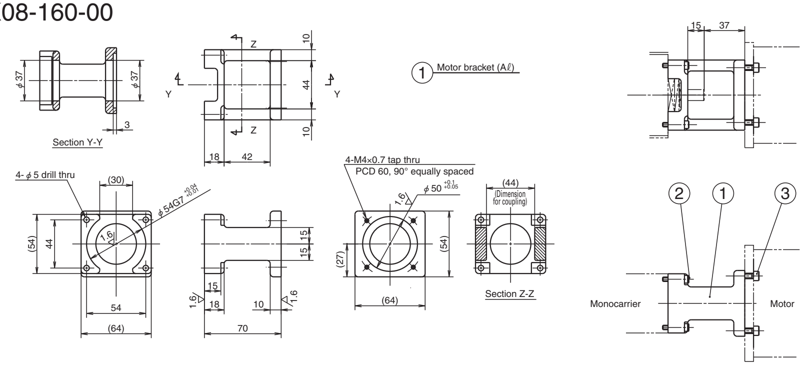
Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor	
Maker	Motor models
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), P30B04006(60W), P30B04010(100W)

Standard stock

Motor Bracket for MCM08

■Reference number
MC-BK08-160-00



② Hexagon socket head cap screw (M4, length 20)

③ Hexagon socket head cap screw (M4, length 14)

Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

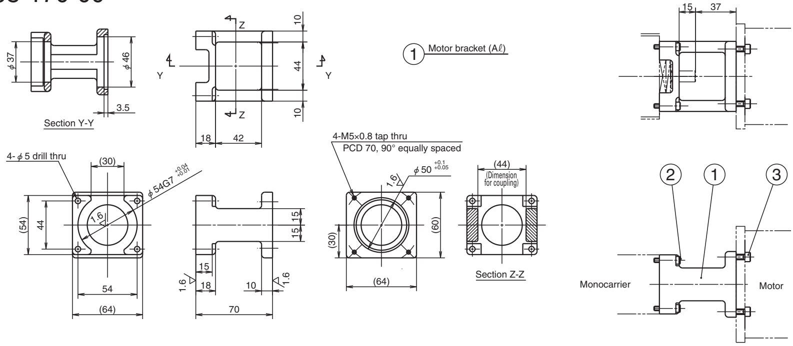
Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	P50B05005(50W), P50B05010(100W), P50B05020(200W)

C 52

Standard stock

Motor Bracket for MCM08

■Reference number
MC-BK08-170-00



② Hexagon socket head cap screw (M4, length 20)

③ Hexagon socket head cap screw (M5, length 14)

Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

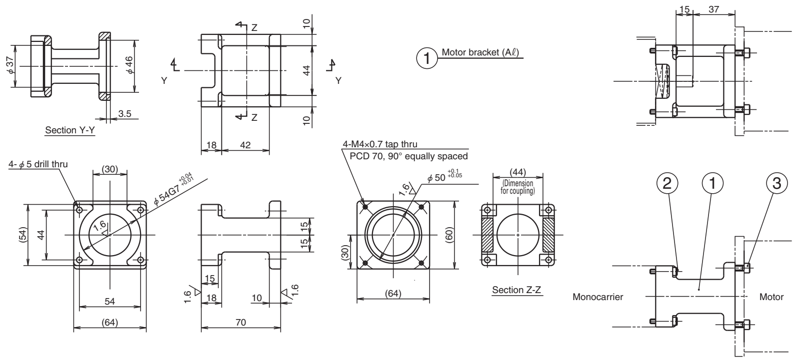
Compatible motor

Maker	Motor models
Yaskawa Electric Corp.	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)

Standard stock

Motor Bracket for MCM08

■Reference number
MC-BK08-170-01



② Hexagon socket head cap screw (M4, length 20)

③ Hexagon socket head cap screw (M4, length 14)

Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

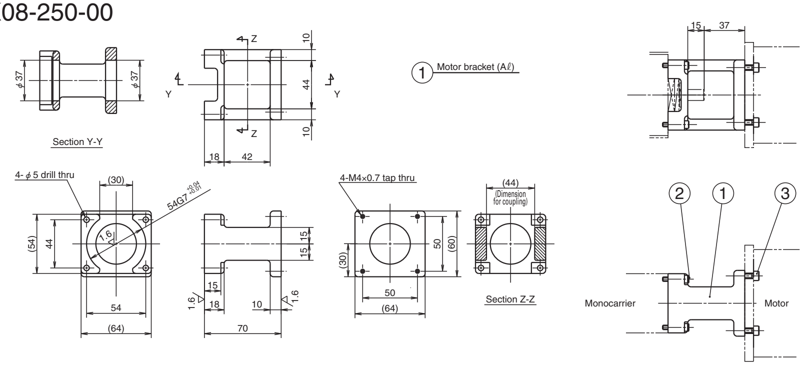
Compatible motor

Maker	Motor models
Matsushita Electric Industrial Co., Ltd.	MSMD02(200W), MAMA02(200W), MSMD04(400W), MAMA04(400WW)

Motor Bracket for MCM08

Standard stock

■Reference number
MC-BK08-250-00



② Hexagon socket head cap screw (M4, length 20)

③ Hexagon socket head cap screw (M4, length 14)

Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

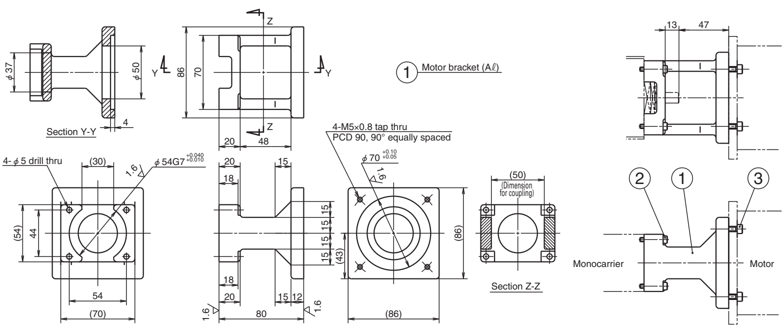
Compatible motor

Maker	Motor models
Sanyo Denki Co., Ltd.	PBM603xxx, PBM604xxx, 103F78xx
Oriental Motor Co., Ltd.	AS66, ASC66, UPK56xx, PK56xx, CSK56x CFK56x, UMK56x, UFK56x

Motor Bracket for MCM08

Standard stock

■Reference number
MC-BK08-190-00



② Hexagon socket head cap screw (M4, length 22)

③ Hexagon socket head cap screw (M5, length 16)

Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor

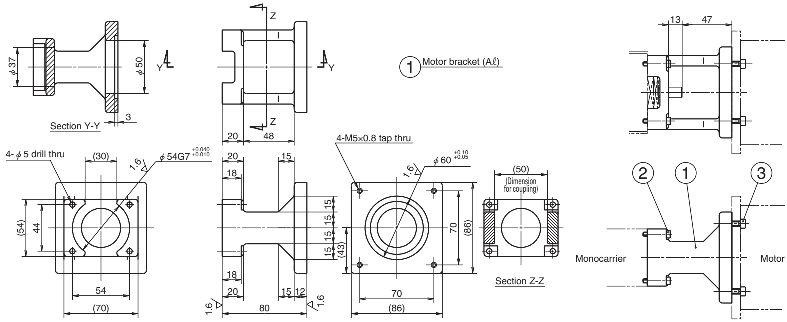
Maker	Motor models
Sanyo Denki Co., Ltd.	P50B07020(200W), P50B07030(300W), P50B07040(400W)

C 54

Standard stock

Motor Bracket for MCM08

■Reference number
MC-BK08-270-00




② Hexagon socket head cap screw (M4, length 22)


③ Hexagon socket head cap screw (M5, length 16)

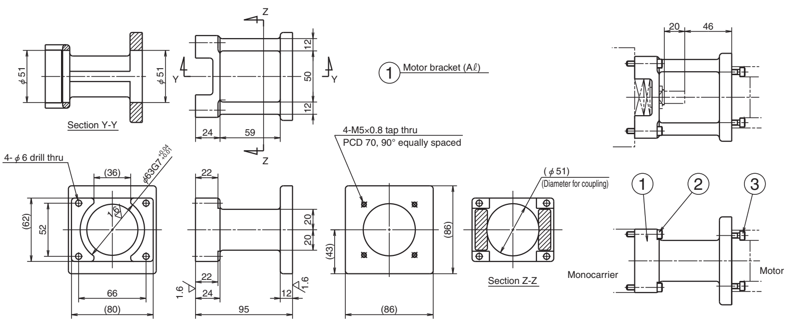
Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor	
Maker	Motor models
Oriental Motor Co., Ltd.	AS98, ASC98, UPK59x, PK59x CSK59x, CFK59x, UMK59x, UFK59x
Sanyo Denki Co., Ltd.	103F85xx

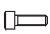
Standard stock

Motor Bracket for MCM10

■Reference number
MC-BK10-170-00




② Hexagon socket head cap screw (M5, length 30)


③ Hexagon socket head cap screw (M5, length 16)

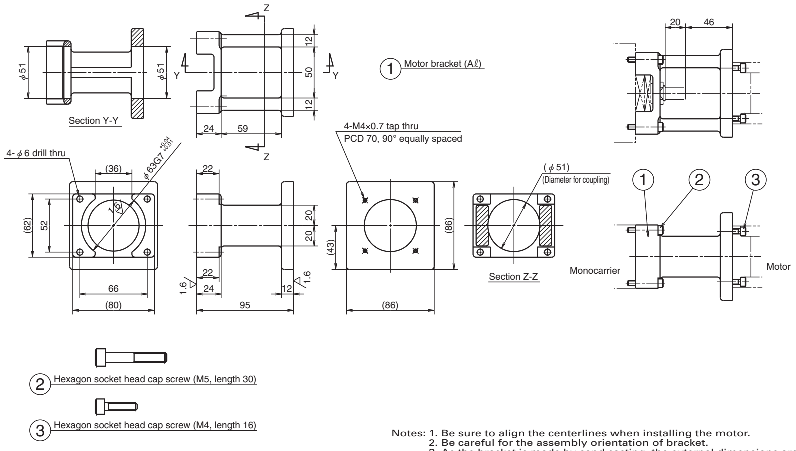
Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor	
Maker	Motor models
Yaskawa Electric Corp.	SGMJV-02A(200W), 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

Standard stock

■Reference number
MC-BK10-170-01



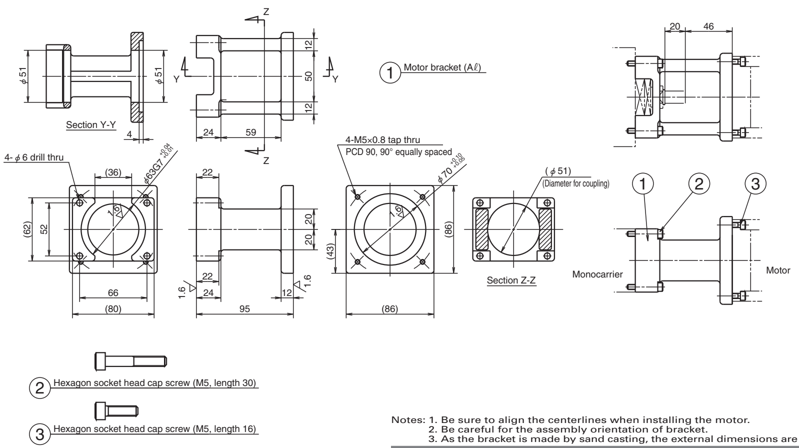
Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor	
Maker	Motor models
Matsushita Electric Industrial Co., Ltd.	MSMD02(200W), MAMA02(200W), MSMD04(400W), MAMA04(400W)

Motor Bracket for MCM10

Standard stock

■Reference number
MC-BK10-190-00



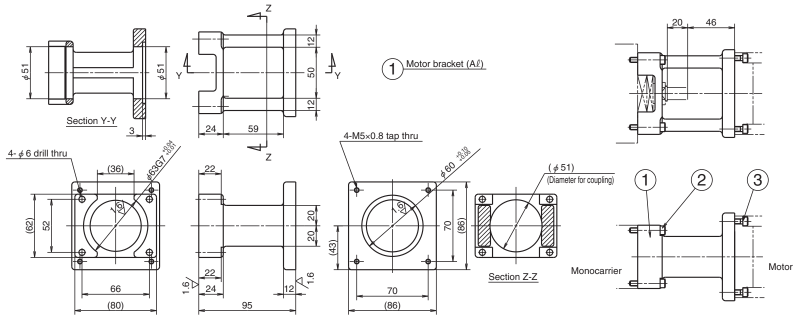
Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

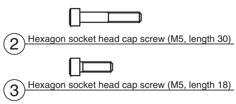
Compatible motor	
Maker	Motor models
Matsushita Electric Industrial Co., Ltd.	MSMD08(750W), MAMA08(750W)
Sanyo Denki Co., Ltd.	P50B07020(200W), P50B07030(300W), P50B07040(400W)

Standard stock

Motor Bracket for MCM10

■Reference number
MC-BK10-270-00





Notes: 1. Be sure to align the centerlines when installing the motor.
2. Be careful for the assembly orientation of bracket.
3. As the bracket is made by sand casting, the external dimensions are reference only.

Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	103F85xx
Oriental Motor Co., Ltd.	AS98, ASC98, UPK59x, PK59x, CSK59x CFK59x, UMK59x, UFK59x

Availability Motor Table of Motor Bracket for MCM Series

Table 5

Nominal size	Reference number code	Motor bracket reference number	Motor manufacturer	Stepping motor model number	Wattage of AC servo motor 10	20	30	50	60	100	150	200	300	400	750
MCM02	1	MC-BK02-128-00	Yaskawa Electric Corp.		SGMM-A1	SGMM-A2									
	2	MC-BK02-133-00	Mitsubishi Electric Corp.		HC-AQ013	HC-AQ023									
	3	MC-BK02-223-00	Oriental Motor Co., Ltd.	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	P30B04006	P30B04010					
	2	MC-BK03-148-01	Sanyo Denki Co., Ltd.						P50B04040	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	Matsushita Electric Industrial 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	P30B04006	P30B04010					
	3	MC-BK05-148-00	Matsushita Electric Industrial 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	Matsushita Electric Industrial 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	P30B04006	P30B04010					
	3	MC-BK06-148-00	Sanyo Denki Co., Ltd.						P50B04040	P50B04010					
			Matsushita Electric Industrial 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	Matsushita Electric Industrial 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 UMK56x, UFK56x											

Nominal size	Reference number code	Motor bracket reference number	Motor manufacturer	Stepping motor model number	10	20	30	50	60	100	150	200	300	400	750
					Wattage of AC servo motor										
MCM08	1	MC-BK08-145-00	Matsushita Electric Industrial Co., Ltd.							MSMD01					
MCM08	2	MC-BK08-146-00	Yaskawa Electric Corp.							SGMJV-01A SGMAV-01A	SGMAV-C2A				
MCM08	2	MC-BK08-146-00	Mitsubishi Electric Corp.							HF-KP13 HF-MP13 HC-KFS13 HC-MFS13					
MCM08	2	MC-BK08-146-00	Sanyo Denki Co., Ltd.				P30B04003	P30B04005	P30B04006	P30B04010					
MCM08	3	MC-BK08-160-00	Sanyo Denki Co., Ltd.					P50B05005		P50B05010		P50B05020			
MCM08	4	MC-BK08-170-00	Yaskawa Electric Corp.									SGMJV-02A SGMAV-02A		SGMJV-04A SGMAV-04A	
MCM08	4	MC-BK08-170-00	Mitsubishi Electric Corp.									HF-KP23 HF-MP23 HC-KFS23 HC-MFS23		HF-KP43 HF-MP43 HC-KFS43 HC-MFS43	
MCM08	4	MC-BK08-170-00	OMRON Corp.									R88M-W20		R88M-W40	
MCM08	4	MC-BK08-170-00	Sanyo Denki Co., Ltd.									P30B06020		P30B06040	
MCM08	5	MC-BK08-170-01	Matsushita Electric Industrial Co., Ltd.									MSMD02 MAMA02		MSMD04 MAMA04	
MCM08	6	MC-BK08-190-00	Sanyo Denki Co., Ltd.									P50B07020	P50B07030	P50B07040	
MCM08	7	MC-BK08-250-00	Sanyo Denki Co., Ltd.	PBM603xxx, PBM604xxx											
MCM08	7	MC-BK08-250-00	Sanyo Denki Co., Ltd.	103F78xx											
MCM08	7	MC-BK08-250-00	Oriental Motor Co., Ltd.	AS66, ASC66 UPK56x, PK56x CSK56x, CFK56x UMK56x, UFK56x											
MCM08	8	MC-BK08-270-00	Sanyo Denki Co., Ltd.	103F85xx											
MCM08	8	MC-BK08-270-00	Oriental Motor Co., Ltd.	AS98, ASC98 UPK59x, PK59x CSK59x, CFK59x UMK59x, UFK59x											
MCM10	1	MC-BK10-170-00	Yaskawa Electric Corp.									SGMJV-02A SGMAV-02A		SGMJV-04A SGMAV-04A	
MCM10	1	MC-BK10-170-00	Mitsubishi Electric Corp.									HF-KP23 HF-MP23 HC-KFS23 HC-MFS23		HF-KP43 HF-MP43 HC-KFS43 HC-MFS43	
MCM10	1	MC-BK10-170-00	OMRON Corp.									R88M-W20		R88M-W40	
MCM10	1	MC-BK10-170-00	Sanyo Denki Co., Ltd.									P30B06020		P30B06040	
MCM10	2	MC-BK10-170-01	Matsushita Electric Industrial Co., Ltd.									MSMD02 MAMA02		MSMD04 MAMA04	
MCM10	3	MC-BK10-190-00	Matsushita Electric Industrial Co., Ltd.												MSMD08 MAMA08
MCM10	3	MC-BK10-190-00	Sanyo Denki Co., Ltd.									P50B07020	P50B07030	P50B07040	
MCM10	4	MC-BK10-270-00	Sanyo Denki Co., Ltd.	103F85xx											
MCM10	4	MC-BK10-270-00	Oriental Motor Co., Ltd.	AS98, ASC98 UPK59x, PK59x CSK59x, CFK59x UMK59x, UFK59x											

MCH Series

C-3 MCH Series

C-3-1 MCH Series Reference Number Coding

[Body]

Reference number : MC H 06 040 H 10 K (B 0) ※1

- MC: Monocarrier
- H: H Type: MCH Series; L Type: MCH Series low profile rail (only for 06 size)
- 06: Nominal size (rail width, Unit: 10mm)
- 040: Stroke (Unit: 10mm)
- H: Accuracy grade (H, High grade; P, Precision grade).
- 10: Ball screw lead (mm)
- K: Slider specification K: Single slider (See page C10) D: Double slider
- B: Grease specification: B (LG2)(See page C19)
- 0: Special specification

※1 : These two code fields shall be added when non-standard grease is used. The coding of an MCH Monocarrier with standard grease shall have 12 characters as shown above.

[With Option part]

Reference number : MC S 06 040 H 10 K 0 0 K 0 0 0

- S : With MCH optional components; R : With MCL optional components
- K: NSK management number
- 0: Sensor unit
- 0: Cover unit
- 0: Intermediate plate for motor bracket

Note : Optional components are available separately.

Table 1 Sensor unit (See page C71)

Reference number code	Specification	Reference number
0	N/A	—
1	Proximity switch (b-contact 3 pieces)	MC—SRHxx—10
2	Proximity switch (a-contact 3 pieces)	MC—SRHxx—11
3	Proximity switch (a-contact 1 piece, b-contact 2 pieces)	MC—SRHxx—12
4	Photo sensor 3 pieces	MC—SRHxx—13

xx: Reference number
Note: Sensor rail is not included in a sensor unit. If you require the rail, please request separately. (See page C71 to 72.)

Table 2 Cover unit (See page C73 – 75)

Reference number code	Specification	Reference number
0	N/A	—
1	For single slider	MC—HVxxxxx—00
	For double slider	MC—HVxxxxxD00

xxxxx: Reference number and stroke number

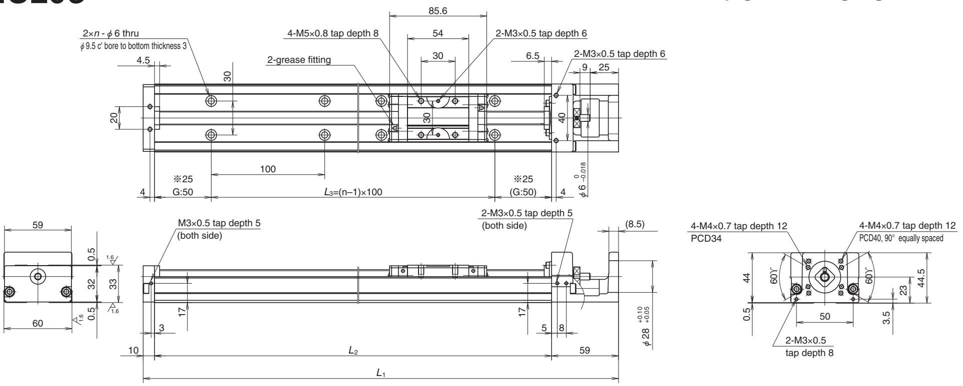
Table 3 Intermediate plate for motor bracket (See page C77 – 80)

Reference number code	Type		
	MCH06 (MCL06)	MCH09	MCH10
0	N/A	N/A	N/A
1	**MC-BKH06-145-00**	**MC-BKH09-145-00**	**MC-BKH10-170-00**
2	**MC-BKH06-146-00**	**MC-BKH09-146-00**	**MC-BKH10-170-01**
3	**MC-BKH06-231-00**	**MC-BKH09-170-00**	**MC-BKH10-190-00**
4	**MC-BKH06-250-00**	**MC-BKH09-170-01**	**MC-BKH10-190-01**
5	—	**MC-BKH09-231-00**	**MC-BKH10-250-00**
6	—	**MC-BKH09-250-00**	**MC-BKH10-270-00**

C-3-2 MCH Series Dimension Table of Standard Products

MCL06

Accuracy grade: High grade (H)



●The rail of MCL 06 is made lighter than that of MCH 06 by lowering the rail height. The weight ratio between the MCH 06 and MCL 06 is 5 to 4.

●Double slider specification is also available for the MCL 06.

●Combinations of stroke and ball screw lead of the MCL 06 are the same as those of the MCH 06.

Dimension of MCL06 (Single slider)

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	n	Inertia $\times 10^{-6}$(kg · m^2)	Mass (kg)
☆※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	

Notes: 1. Items not marked are available from standard stock.
2. Items marked with ☆ are designated as "quick delivery item" upon request.
3. Dimension of G is 25 instead of 50 for those marked with ※.

Monocarrier dynamic torque specification (N · cm)

Ball screw lead (mm)	5	1.0 – 4.8
	10	1.1 – 5.8
	20	1.6 – 7.9

Notes:
1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.

Basic load rating

Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) 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	ϕ 12	3510 (High grade) 4390 (Precision)	22800	4400	5	5360 (High grade) 6260 (Precision)	10900	1450
10		2270 (High grade) 2860 (Precision)	18100		10	3160 (High grade) 3830 (Precision)		
20		2090 (High grade) 2660 (Precision)	14400		20	3200 (High grade) 3800 (Precision)		

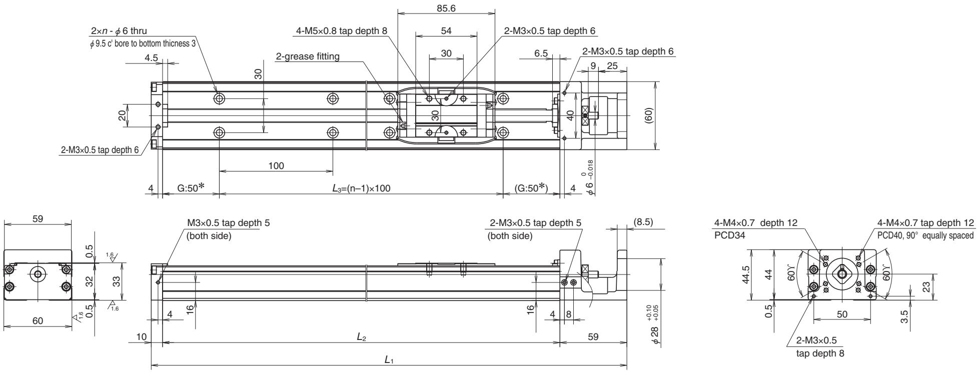
Basic static moment load of linear guide

Slider	Basic static moment load (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Single	335	133	133

C 64

MCH06

Accuracy grade: High grade (H)



Dimension of MCH06 (Single slider)

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	n	Inertia × 10^{-6}(kg · m^2)	Mass (kg)
※ **MCH06005H05K**	50	53 (65)	5	219	150	100	2	2.38	1.8
※ **MCH06005H10K**			10					3.45	
☆※ **MCH06005H20K**			20					7.25	
MCH06010H05K	100	103 (115)	5	269	200	100	2	3.17	2.2
MCH06010H10K			10					4.12	
☆ **MCH06010H20K**			20					7,92	
MCH06020H05K	200	203 (215)	5	369	300	200	3	4.51	3.0
MCH06020H10K			10					5.46	
MCH06020H20K			20					9.26	
☆ **MCH06030H05K**	300	303 (315)	5	469	400	300	4	5.85	3.7
MCH06030H10K			10					6.80	
MCH06030H20K			20					10.6	
☆ **MCH06040H05K**	400	403 (415)	5	569	500	400	5	7.18	4.5
MCH06040H10K			10					8.13	
MCH06040H20K			20					11.9	
☆ **MCH06050H05K**	500	503 (515)	5	669	600	500	6	8.52	5.2
MCH06050H10K			10					9.47	
MCH06050H20K			20					13.3	

Notes: 1. Items not marked are available from standard stock.
2. Items marked with ☆ are designated as "quick delivery item" upon request.
3. Dimension of G is 25 instead of 50 for those marked with ※.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	5	1.0 – 4.8
	10	1.1 – 5.8
	20	1.6 – 7.9

Notes:
1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.

Basic load rating

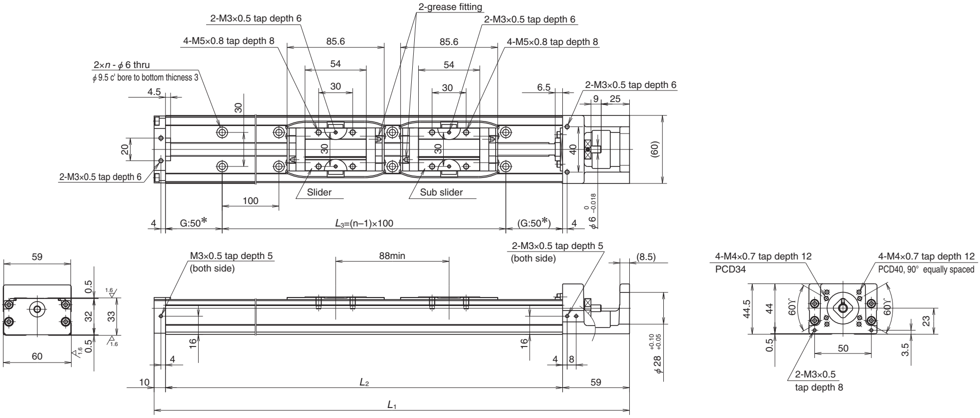
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Linear guides C_0	Support unit load limit (N)
5	φ12	3510 (High grade) 4390 (Precision)	22800	4400	5	5360 (High grade) 6260 (Precision)	16300	1450
10		2270 (High grade) 2860 (Precision)	18100		10	3160 (High grade) 3830 (Precision)		
20		2090 (High grade) 2660 (Precision)	14400		20	3200 (High grade) 3800 (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 number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	n	Inertia × 10^{-6}(kg · m^2)	Mass (kg)
☆**MCH06010H05D**	100	115	5	369	300	200	3	4.82	3.5
☆**MCH06010H10D**		(139)	10					6.72	
☆**MCH06020H05D**	200	215	5	469	400	300	4	8.06	4.2
☆**MCH06020H10D**		(239)	10					15.7	
☆**MCH06030H05D**	300	315	5	569	500	400	5	9.40	5.0
☆**MCH06030H10D**		(339)	10					17.0	
☆**MCH06040H10D**	400	415	10	669	600	500	6	10.7	5.7
☆**MCH06040H20D**		(439)	20					18.3	

Notes: 1. Items not marked are available from standard stock.
2. Items marked with ☆ are designated as "quick delivery item" upon request.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	5	1.2 – 5.2
	10	1.5 – 9.6
	20	2.3 – 11.8

Notes:
1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.

Basic load rating

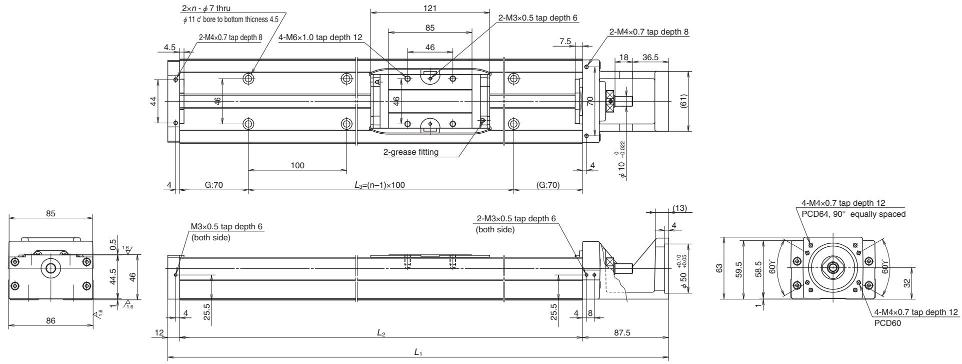
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Linear guides C_0	Support unit load limit (N)
5	ϕ12	3510 (High grade) 4390 (Precision)	22800	4400	5	5360 (High grade) 6260 (Precision)	16300	1450
10		2270 (High grade) 2860 (Precision)	18100		10	3160 (High grade) 3830 (Precision)		
20		2090 (High grade) 2660 (Precision)	14400		20	3200 (High grade) 3800 (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 number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm) L_1	L_2	L_3	n	Inertia $\times 10^{-6}$(kg · m^2)	Mass (kg)
☆MCH09010H05K	100	107 (121)	5	339.5	240	100	2	9.2	5.0
☆MCH09010H10K			10					10.7	
☆MCH09010H20K			20					16.8	
MCH09020H05K	200	207 (221)	5	439.5	340	200	3	12.4	6.5
MCH09020H10K			10					13.9	
☆MCH09020H20K			20					20.0	
MCH09030H05K	300	307 (321)	5	539.5	440	300	4	15.6	8.1
MCH09030H10K			10					17.1	
☆MCH09030H20K			20					23.2	
MCH09040H05K	400	407 (421)	5	639.5	540	400	5	18.8	9.7
MCH09040H10K			10					20.3	
☆MCH09040H20K			20					26.4	
☆MCH09050H05K	500	507 (521)	5	739.5	640	500	6	22.0	11
MCH09050H10K			10					23.5	
MCH09050H20K			20					29.6	
☆MCH09060H05K	600	607 (621)	5	839.5	740	600	7	25.2	13
MCH09060H10K			10					26.7	
MCH09060H20K			20					32.8	
☆MCH09070H05K	700	707 (721)	5	939.5	840	700	8	28.4	14.5
☆MCH09070H10K			10					30.0	
☆MCH09070H20K			20					36.0	
☆MCH09080H05K	800	807 (821)	5	1 039.5	940	800	9	31.6	16
MCH09080H10K			10					33.2	
MCH09080H20K			20					39.2	

Notes: 1. Items not marked are available from standard stock.
2. Items marked with ☆ are designated as "quick delivery item" upon request.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	5	1.0 – 5.9
	10	2.0 – 7.8
	20	2.0 – 10.8

Notes:
1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.

Basic load rating

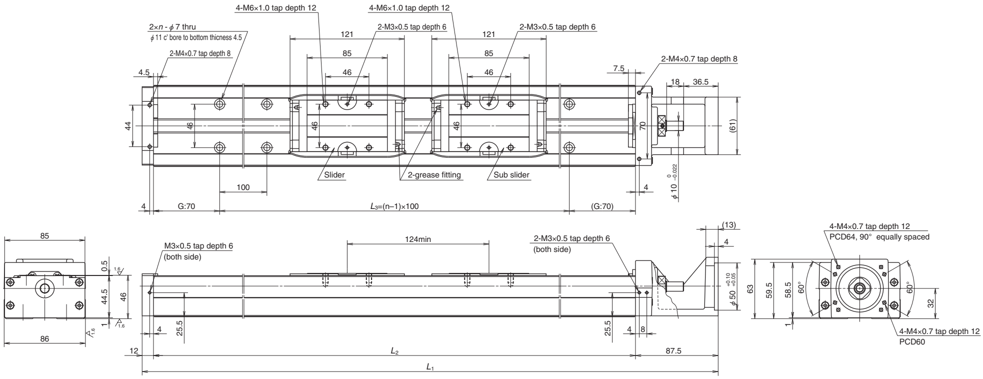
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Linear guides C_0	Support unit load limit (N)
5	ϕ 15	8020 (High grade) 8300 (Precision)	40600	7100	5	13100 (High grade) 12700 (Precision)	30500	3040
10		6110 (High grade) 8140 (Precision)	32200		10	9310 (High grade) 12800 (Precision)		
20		3790 (High grade) 5080 (Precision)	25500		20	5600 (High grade) 7460 (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 number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm)				Inertia × 10^{-6}(kg · m²)	Mass (kg)
				L_1	L_2	L_3	n		
☆MCH09015H05D	150	183	5	539.5	440	300	4	16.1	8.9
☆MCH09015H10D		(211)	10					19.2	
☆MCH09025H05D	250	283	5	639.5	540	400	5	19.3	11
☆MCH09025H10D		(311)	10					22.4	
☆MCH09035H05D	350	383	5	739.5	640	500	6	22.5	12
☆MCH09035H10D		(411)	10					25.6	
☆MCH09045H10D	450	483	10	839.5	740	600	7	28.8	14
☆MCH09045H20D		(511)	20					40.9	
☆MCH09065H10D	650	683	10	1 039.5	940	800	9	35.2	17
☆MCH09065H20D		(711)	20					47.3	

Notes: 1. Items not marked are available from standard stock.
2. Items marked with ☆ are designated as "quick delivery item" upon request.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	5	1.5 – 7.0
	10	2.5 – 10.8
	20	4.0 – 17.2

Notes:
1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.

Basic load rating

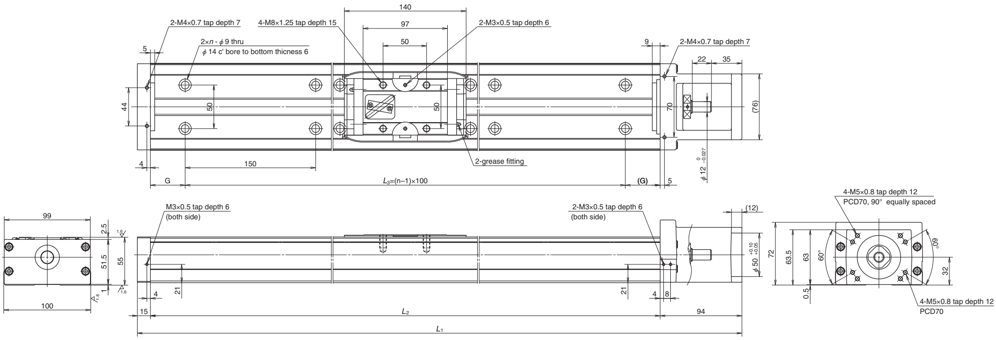
Lead	Shaft dia	Basic dynamic load rating (N)				Basic static load rating (N)		Support unit load limit (N)
ℓ (mm)	d (mm)	Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Ball screw C_{0a}	Linear guides C_0	
5	ϕ15	8020 (High grade) 8300 (Precision)	40600	7100	5	13100 (High grade) 12700 (Precision)	30500	3040
10		6110 (High grade) 8140 (Precision)	32200		10	9310 (High grade) 12800 (Precision)		
20		3790 (High grade) 5080 (Precision)	25500		20	5600 (High grade) 7460 (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	1780	2070	2070

MCH10

Accuracy grade: High grade (H)



Dimension of MCH10 (Single slider)

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm) L_1	L_2	G	L_3	n	Inertia × 10^{-6}(kg · m^2)	Mass (kg)
☆MCH10010H10K	100	126	10	389	280	65	150	2	33.2	7.3
☆MCH10010H20K		(142)	20						41.1	
☆MCH10020H10K	200	226	10	489	380	40	300	3	43.4	9.5
☆MCH10020H20K		(242)	20						51.3	
☆MCH10030H10K	300	326	10	589	480	15	450	4	53.7	12
☆MCH10030H20K		(342)	20						61.6	
MCH10040H10K	400	426	10	689	580	65	450	4	62.4	14
MCH10040H20K		(442)	20						71.8	
MCH10050H10K	500	526	10	789	680	40	600	5	74.7	16
MCH10050H20K		(542)	20						82.3	
MCH10060H10K	600	626	10	889	780	15	750	6	84.9	19
MCH10060H20K		(642)	20						92.5	
MCH10070H10K	700	726	10	989	880	65	750	6	95.1	21
MCH10070H20K		(742)	20						103	
MCH10080H10K	800	826	10	1 089	980	40	900	7	105	23
MCH10080H20K		(842)	20						113	
☆MCH10090H10K	900	926	10	1 189	1 080	15	1 050	8	116	25
MCH10090H20K		(942)	20						123	
☆MCH10100H10K	1 000	1 026	10	1 289	1 180	65	1 050	8	126	27
MCH10100H20K		(1 042)	20						133	
☆MCH10110H10K	1 100	1 126	10	1 389	1 280	40	1 200	9	136	29
☆MCH10110H20K		(1 142)	20						143	
☆MCH10120H10K	1 200	1 226	10	1 489	1 380	15	1 350	10	146	32
☆MCH10120H20K		(1 242)	20						154	

Notes: 1. Items not marked are available from standard stock.
2. Items marked with ☆ are designated as "quick delivery item" upon request.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	10	2.7 – 10.8
	20	3.1 – 12.7

Notes:
1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.

Basic load rating

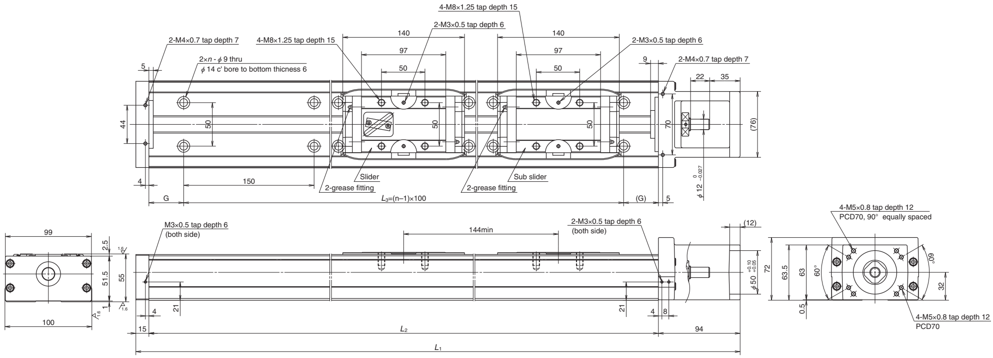
Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) Ball screw C_a	Linear guides C	Support unit C_a	Rated running distance L_a (km)	Basic static load rating (N) Ball screw C_{0a}	Linear guides C_0	Support unit load limit (N)
10	ϕ 20	9580 (High grade) 13300 (Precision)	44600	7600	10	17300 (High grade) 21900 (Precision)	42000	3380
20		6100 (High grade) 8190 (Precision)	35400		20	10100 (High grade) 13100 (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	1460	610	610

MCH10 (Double slider)

Accuracy grade: High grade (H)



Dimension of MCH10 (Double slider)

Reference number	Nominal stroke (mm)	Stroke limit(mm) (K1 is not equipped)	Ball screw lead (mm)	Body length (mm) L_1	L_2	G	L_3	n	Inertia $\times 10^{-6}$(kg · m^2)	Mass (kg)
☆MCH10025H10D	250	282	10	689	580	65	450	4	67.1	15
☆MCH10025H20D		(314)	20						82.4	
☆MCH10035H10D	350	382	10	789	680	40	600	5	77.3	17
☆MCH10035H20D		(414)	20						92.5	
☆MCH10045H10D	450	482	10	889	780	15	750	6	87.5	20
☆MCH10045H20D		(514)	20						103	
☆MCH10055H10D	550	582	10	989	880	65	750	6	97.7	22
☆MCH10055H20D		(614)	20						113	
☆MCH10065H10D	650	682	10	1 089	980	40	900	7	108	24
☆MCH10065H20D		(714)	20						123	
☆MCH10075H20D	750	782(814)	20	1 189	1 080	15	1 050	8	133	26
☆MCH10085H20D	850	882(914)	20	1 289	1 180	65	1 050	8	143	28
☆MCH10095H20D	950	982(1 014)	20	1 389	1 280	40	1 200	9	154	30
☆MCH10105H20D	1 050	1 082(1 114)	20	1 489	1 380	15	1 350	10	164	33

Notes: 1. Items not marked are available from standard stock.
2. Items marked with ☆ are designated as "quick delivery item" upon request.

Monocarrier dynamic torque specification (N · cm)		
Ball screw lead (mm)	10	4.2 – 15.6
	20	5.0 – 19.6

Notes:
1. Frictional resistance of NSK K1 is included in the dynamic torque in the table.
2. Grease is packed into ball screw, linear guide parts and support unit.
3. Consult NSK for life estimates under large moment loads.

Basic load rating

Lead ℓ (mm)	Shaft dia d (mm)	Basic dynamic load rating (N) 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	9580 (High grade) 13300 (Precision)	44600	7600	10	17300 (High grade) 21900 (Precision)	42000	3380
20		6100 (High grade) 8190 (Precision)	35400		20	10100 (High grade) 13100 (Precision)		

Basic static moment load of linear guide

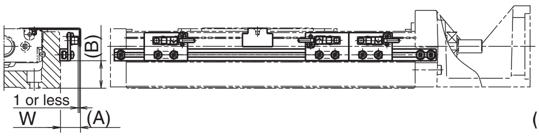
Slider	Basic static moment load (N · m) Rolling M_{RO}	Pitching M_{PO}	Yawing M_{YO}
Double	2920	3430	3430

C-3-3 MCH Series Option Part

C-3-3. 1 Sensor Unit

Standard stock

●Proximity switch

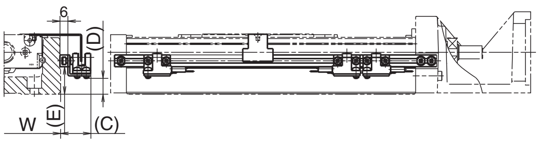


(Example of assembly)

Type		Reference number			Dimension(A) (mm)	Dimension(B) (mm)	Body width W (mm)
MCH06		MC-SRH06-10	MC-SRH06-11	MC-SRH06-12	17	10	60
MCH09		MC-SRH09-10	MC-SRH09-11	MC-SRH09-12	16	21	86
MCH10		MC-SRH10-10	MC-SRH10-11	MC-SRH10-12	16	16	100
Quantity	Proximity switch (a-contact)	—	3	1	E2S-W13 (OMRON Corp.)		
	Proximity switch (b-contact)	3	—	2	E2S-W14 (OMRON Corp.)		

Notes: 1. See page C21 for specification of proximity switch. 2. A sensor unit consists of sensors, a sensor dog and sensor mounting parts.

●Photo sensor



(Example of assembly)

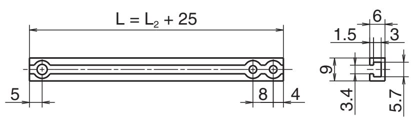
Type	Reference number	Dimension(C) (mm)	Dimension(D) (mm)	Dimension(E) (mm)	Body width W (mm)	Remarks
MCH06	MC-SRH06-13	24	2	11	60	EE-SX674 (OMRON Corp.)
MCH09	MC-SRH09-13	23	12	21	86	3 sets
MCH10	MC-SRH10-13	23	29	16	100	(EE-1001 connector atachment)

Notes: 1. See page C22 for specification of photo sensor. 2. A sensor unit consists of sensors, a sensor dog and sensor mounting parts.

●Sensor rail

Reference number : MC-SRL-＊＊＊＊

● ＊＊＊＊ is the same as rail dimension L_2.



Body of MCH Series and Sensor Rail Combination Table

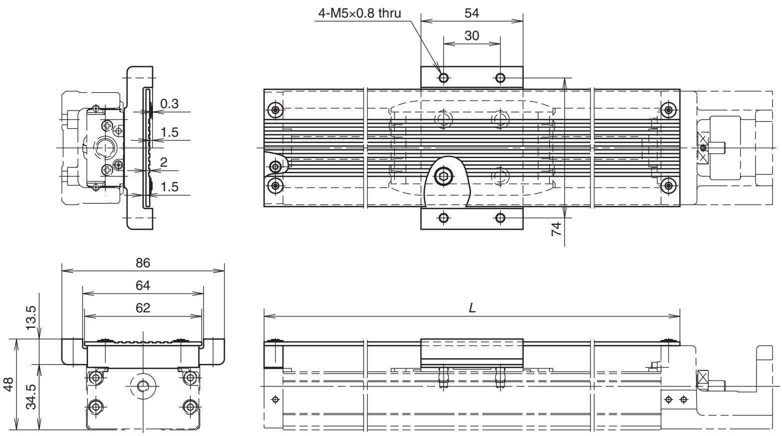
Table 4

Nominal size	Body length L_2 (mm)	Reference number	Sensor rail reference number
MCH06	150	MCH06005H05K MCH06005H10K MCH06005H20K	MC-SRL-0150
	200	MCH06010H05K MCH06010H10K MCH06010H20K	MC-SRL-0200
	300	MCH06020H05K MCH06020H10K MCH06020H20K 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
MCH09	840	MCH09080H05K MCH09080H10K MCH09080H20K	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
	1080	MCH10090H10K MCH10090H20K MCH10075H20D	MC-SRL-1080
	1180	MCH10100H10K MCH10100H20K MCH10085H20D	MC-SRL-1180
	1280	MCH10110H10K MCH10110H20K MCH10095H20D	MC-SRL-1280
	1380	MCH10120H10K MCH10120H20K MCH10105H20D	MC-SRL-1380

C-3-3. 2 Cover Unit

Standard stock

Cover unit for MCH06
Cover unit for MCL06

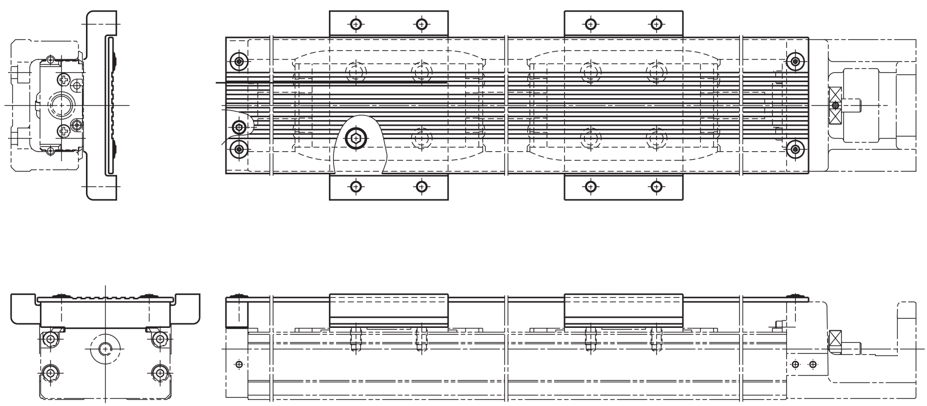


(Unit: mm)

Single slider		Double slider		Top cover length
Stroke	Reference number	Stroke	Reference number	*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

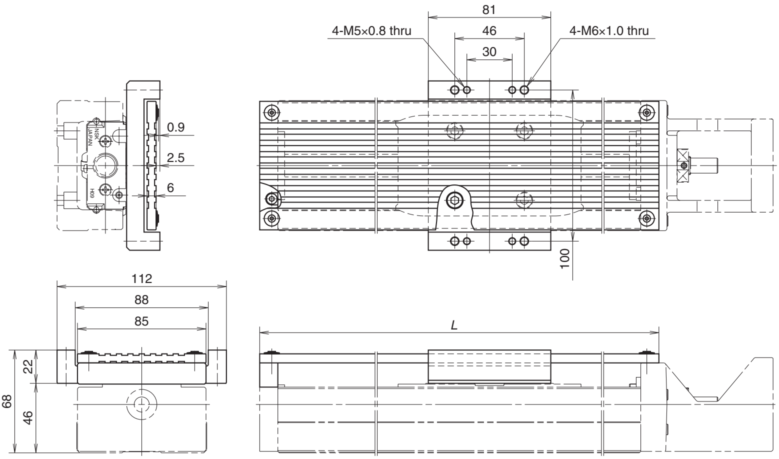
●Cover unit for double sliders (reference drawing)

Two spacers are attached for the double slider.



Standard stock

Cover unit for MCH09

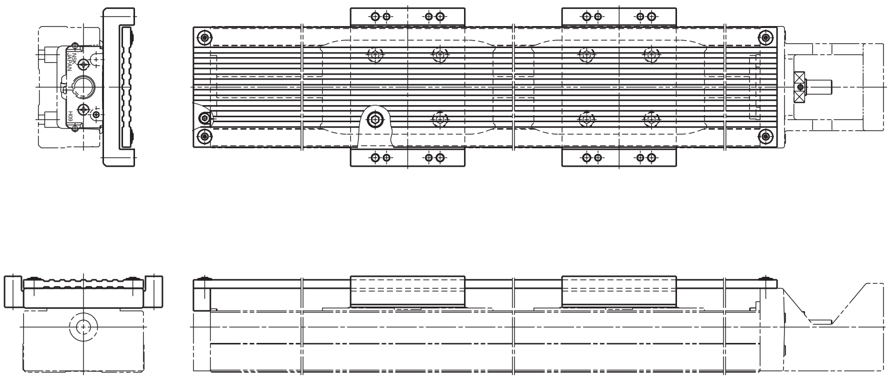


(Unit: mm)

Single slider		Double slider		Top cover length
Stroke	Reference number	Stroke	Reference number	*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

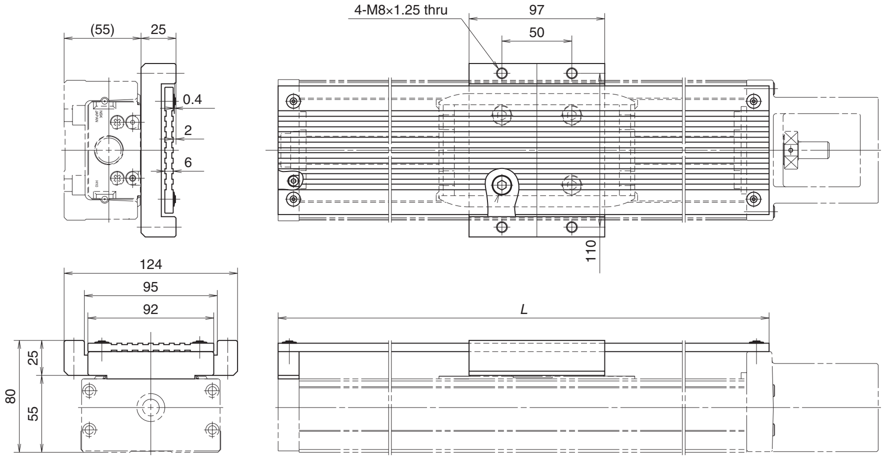
●Cover unit for double sliders (reference drawing)

Two spacers are attached for the double slider.



Standard stock

Cover unit for MCH10

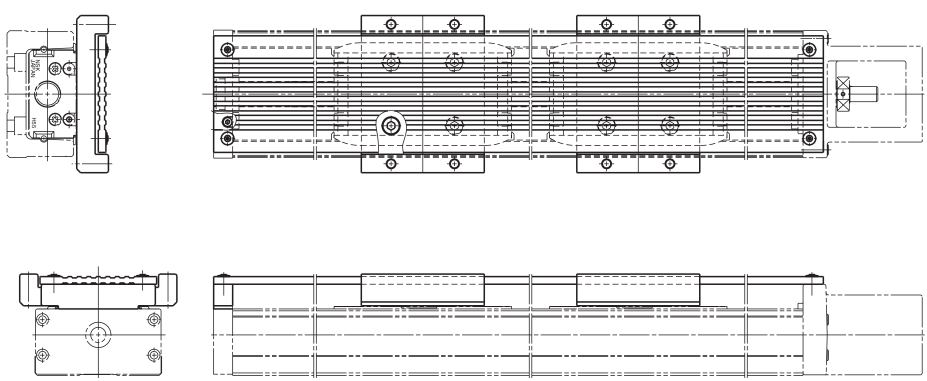


(Unit: mm)

Single slider		Double slider		Top cover length
Stroke	Reference number	Stroke	Reference number	*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	1010
900	MC-HV10090-00	750	MC-HV10075D00	1110
1000	MC-HV10100-00	850	MC-HV10085D00	1210
1100	MC-HV10110-00	950	MC-HV10095D00	1310
1200	MC-HV10120-00	1050	MC-HV10105D00	1410

●Cover unit for double sliders (reference drawing)

Two spacers are attached for the double slider.



C-3-3. 3 Intermediate Plate for Motor

Standard stock

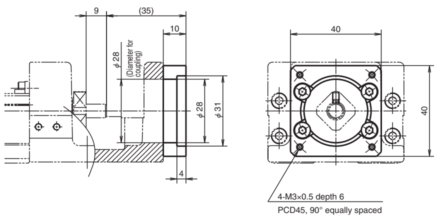
●Please ask NSK for a motor that is not listed in the compatible motor list.

●In case of motor indirect mount, please consult with NSK. ●Be sure to align the center lines when installing the motor.

●Motor models are subject to change at the motor manufacturers. For details, please contact the manufacture.

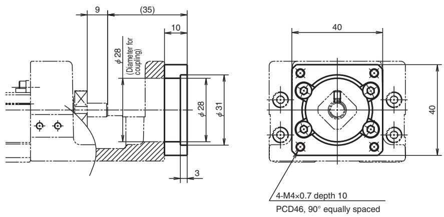
Motor Bracket for MCH06 and MCL06

Reference number : MC-BKH06-145-00



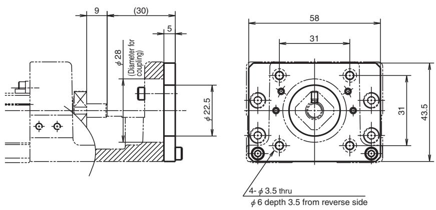
Compatible motor	
Maker	Motor models
Matsushita Electric Industrial Co., Ltd.	MSMD5A(50W), MSMD01(100W)

Reference number : MC-BKH06-146-00



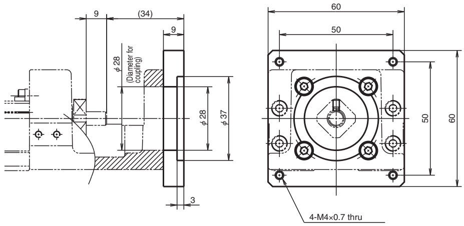
Compatible motor	
Maker	Motor models
Yaskawa Electric Corp.	SGMAH-A3(30W), SGMJV-A5A(50W), SGMAV-A5A(50W) SGMJV-01A(100W), SGMAV-01A(100W)
Mitsubishi Electric Corp.	HF-KP053(50W), HF-MP053(50W), HC-KFS053(50W) HC-MFS053(50W), HF-KP13(100W), HF-MP13(100W) HC-KFS13(100W), HC-MFS13(100W)
OMRON Corp.	R88M-W03(30W), R88M-W05(50W), R88M-W10(100W)
Sanyo Denki Co., Ltd.	P30B04xxx P Series

Reference number : MC-BKH06-231-00



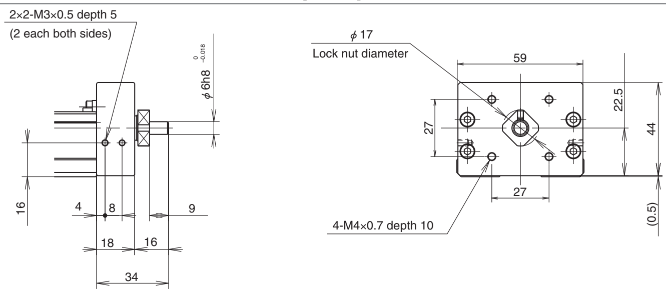
Compatible motor	
Maker	Motor models
Oriental Motor Co., Ltd.	AS46, ASC46, UPK54x, PK54x, CSK54x, CFK54x, UMK24x, CSK24x, PK24x
Sanyo Denki Co., Ltd.	PBM423xxx, 103F55xx

Reference number : MC-BKH06-250-00



Compatible motor	
Maker	Motor models
Oriental Motor Co., Ltd.	AS66, ASC66, UPK56x, UFK56x, PK56x, CSK56x, CFK56x MUMS02(200W), MUMS04(400W)
Sanyo Denki Co., Ltd.	PBM603xx, PBM604xx, 103F78xx

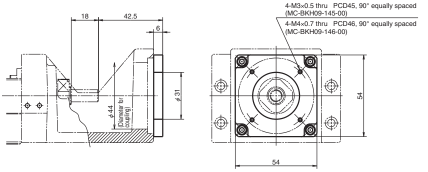
Diameter of ball screw shaft end to install a pulley for indirect motor mount of MCH06



Standard stock

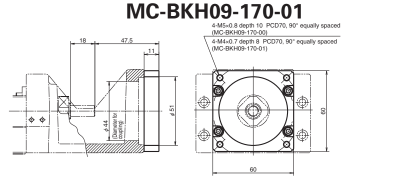
Motor Bracket for MCH09

Reference number : MC-BKH09-145-00 MC-BKH09-146-00



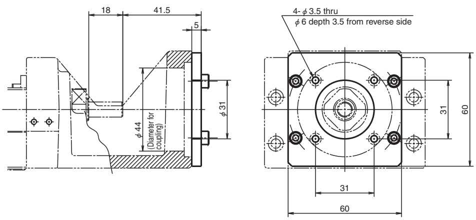
Reference number	Compatible motor	
	Maker	Motor models
MC-BKH09-145-00	Matsushita Electric Industrial Co., Ltd.	MSMD5A(50W), MSMD01(100W)
MC-BKH09-146-00	Yaskawa Electric Corp.	SGMJV-A5A(50W), SGMAV-A5A(50W) SGMJV-01A(100W), SGMAV-01A(100W)
	Mitsubishi Electric Corp.	HF-KP053(50W), HF-MP05(50W), HC-KFS053(50W) 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



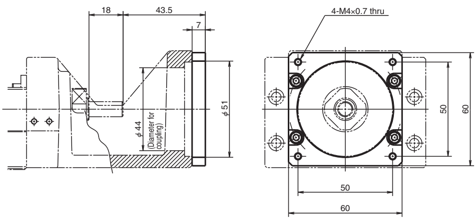
Reference number	Compatible motor	
	Maker	Motor models
MC-BKH09-170-00	Yaskawa Electric Corp.	SGMJV-02A(200W), SGMAV-02A(200W) SGMJV-04A(400W), SGMAV-04A(400W)
	Mitsubishi Electric Corp.	HF-KP23(200W), HF-MP23(200W), HF-KP43(400W) HF-MP43(400W), HC-KFS23(200W), HC-MFS23(200W) HC-KFS43(400W), HC-MFS43(400W)
	OMRON Corp.	R88M-W20(200W), R88M-W40(400W)
	Sanyo Denki Co., Ltd.	P30B06xxx P Series
MC-BKH09-170-01	Matsushita Electric Industrial Co., Ltd.	MSMD02(200W), MSMA02(200W) MSMA04(400W), MSMD04(400W)

Reference number : MC-BKH09-231-00



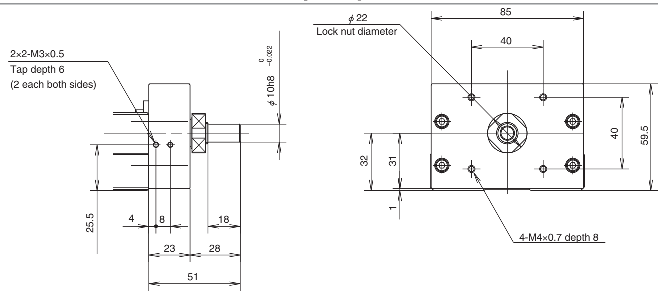
Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	PBM423xxx, 103F55xx
Oriental Motor Co., Ltd.	AS46, ASC46, UPK54x, PK54x, CSK54x, CFK54x UMK24x, CSK24x, PK24x

Reference number : MC-BKH09-250-00



Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	PBM603xx, PBM604xx, 103F78xx
Oriental Motor Co., Ltd.	AS66, ASC66, UPK56x, UFK56x, PK56x CSK56x, CFK56x

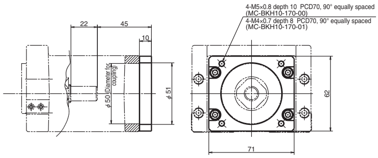
Diameter of ball screw shaft end to install a pulley for indirect motor mount of MCH09



Standard stock

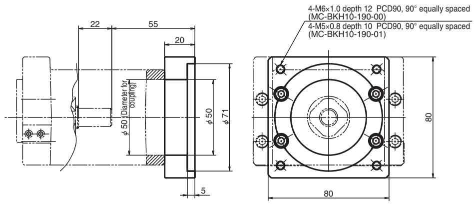
Motor Bracket for MCH10

Reference number : MC-BKH10-170-00
MC-BKH10-170-01



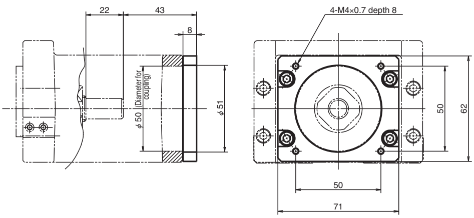
Reference number	Compatible motor	
	Maker	Motor models
MC-BKH10-170-00	Yaskawa Electric Corp.	SGMJV-02A(200W), SGMAV-02A(200W) SGMJV-04A(400W), SGMAV-04A(400W)
	Mitsubishi Electric Corp.	HF-KP23(200W), HF-MP23(200W), HF-KP43(400W) HF-MP43(400W), HC-KFS23(200W), HC-MFS23(200W) HC-KFS43(400W), HC-MFS43(400W)
	OMRON Corp.	R88M-W20(200W), R88M-W40(400W)
	Sanyo Denki Co., Ltd.	P30B06xxx P Series
MC-BKH10-170-01	Matsushita Electric Industrial Co., Ltd.	MSMD02(200W), MSMA02(200W) MSMD04(400W), MSMA04(400W)

Reference number : MC-BKH10-190-00
MC-BKH10-190-01



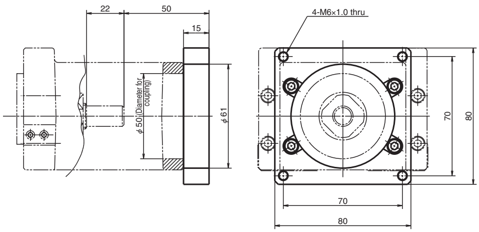
Reference number	Compatible motor	
	Maker	Motor models
MC-BKH10-190-00	Mitsubishi Electric Corp.	HC-KFS73(750W), HC-MFS73(750W) HF-KP73(750W), HF-MP73(750W)
MC-BKH10-190-01	Sanyo Denki Co., Ltd.	P50B07xxx P Series

Reference number : MC-BKH10-250-00



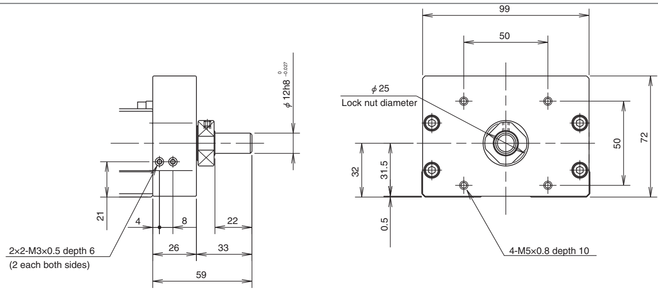
Compatible motor	
Maker	Motor models
Sanyo Denki Co., Ltd.	PBM603xx, PBM604xx, 103F78xx
Oriental Motor Co., Ltd.	AS66, ASC66, UPK56x, PK56x, CSK56x, CFK56x UMK56x, UFK56X

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 indirect motor mount of MCH10



Availability Motor Table of Intermediate Plate for MCH Series

Table 5

Nominal size	Reference number code	Motor bracket reference number	Motor manufacturer	Stepping motor model number	Wattage of AC servo motor 30	50	100	200	400	750
MCH06 MCL06	1	MC-BKH06-145-00	Matsushita Electric Industrial Co., Ltd.			MSMD5A	MSMD01			
	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				MUMS02	MUMS04	
MCH09	1	MC-BKH09-145-00	Matsushita Electric Industrial 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	Matsushita Electric Industrial 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	Matsushita Electric Industrial 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

D BLOCK

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 Grease	D8
					NSK K1 lubrication unit	D10
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	LG2 Grease	D8
					NSK K1 lubrication unit	D10
					Fluoride low temperature chrome plating	D5
	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	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 –	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 Grease	D8
					NSK K1 lubrication unit	D10
		Martensitic stainless steel	Martensitic stainless steel	Austenitic stainless steel	LG2 Grease	D8
					NSK K1 lubrication unit	D10
					Fluoride low temperature chrome plating	D5
	Atmosphere-Vacuum, normal temperature				Fluoride grease	
	Atmosphere-Vacuum up to 200°C					
	Atmosphere 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 –	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

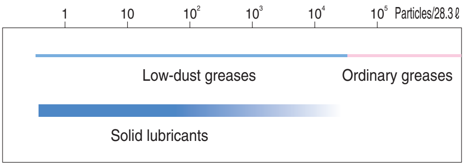


Fig. 2.2 Lubrication in vacuum

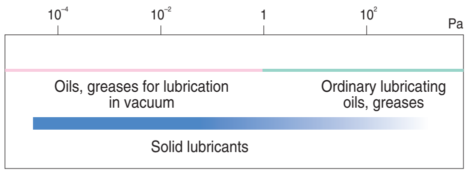


Fig. 2.3 Lubrication in corrosive environment

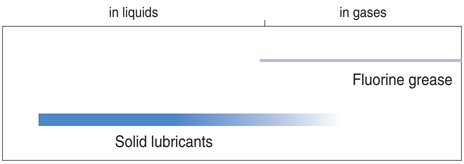


Fig. 2.4 Lubrication in high temperature

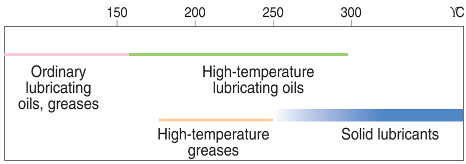


Fig. 2.5 Lubrication in low temperature

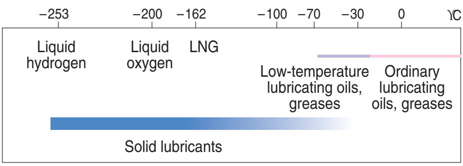


Fig. 2.6 Lubrication in radioactive environment

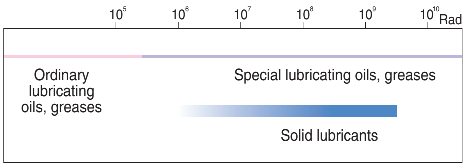
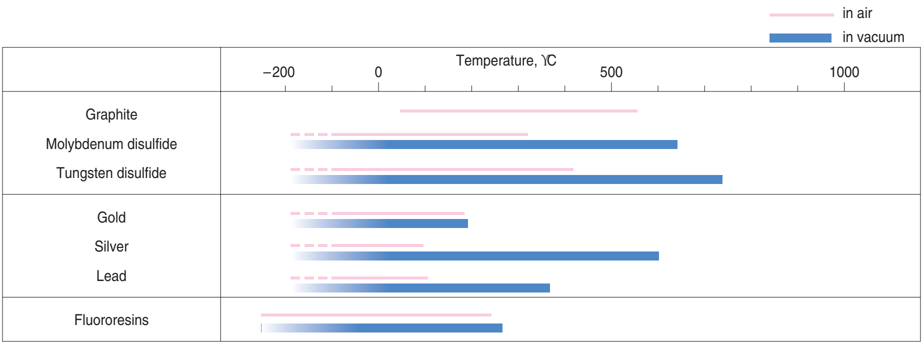


Fig. 2.7 Temperature range for using solid lubricants



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 (1) HB
For clean environment, vacuum environment, corrosion resistance, low temperature, high temperature, radioactive resistance	Martensitic stainless steel SUS440C	10.1	200	580
	Austenitic stainless steel SUS304	16.3	193	150
	Precipitation hardening stainless steel SUS630	10.8	200	277 – 363
Nonmagnetic	Nonmagnetic stainless steel	17.0	195	420

Note (1) Hardness of steel is usually indicated by Rockwell C Scale. For comparison, these figures are expressed by Brinell number.

D 4

1.3 Rust Prevention and Surface Treatment

1. Fluoride low temperature chrome plating

The use environment of NSK linear guides and ball screws is expanding from general industrial machines, semiconductor and liquid crystal manufacturing systems to aerospace equipment.
Among all measures to cope with environment, rust prevention is the most challenging. Such environment includes: Moisture for washers and other equipment; Chemicals used in the wet processing of semiconductor and liquid crystal display manufacturing equipment.
NSK developed electrolytic rust prevention black film treatment (black chrome plating) which is added by fluoro resin impregnating treatment. (hereinafter referred as "Fluoride low temperature chrome plating") This surface treatment methods has proved its superiority as the rust prevention of linear guides and ball screws which are used in above equipment.

● What is "Fluoride low temperature chrome plating ?"

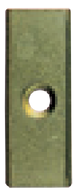
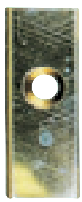
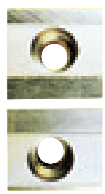
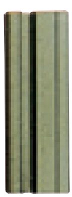
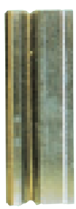
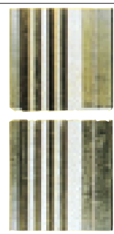
This is a type of black chrome plating which forms a black film (1 to 2 μm) on the metal surface. Fluoroplastic coating is added to the film to increase corrosion resistance.

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

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

● Humidity cabinet corrosion resistance test

Table 3.1 Results of the humidity cabinet test

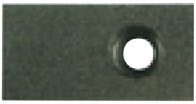
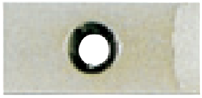
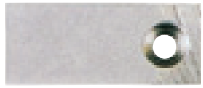
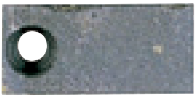
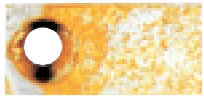
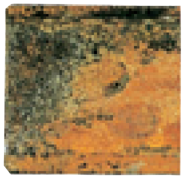
Characteristic \ Test sample			Fluoride low temperature chrome plating (recommended)	Hard chrome plating (reference)	Electroless nickel plating (reference)	Equivalent to SUS440C material	Standard steel
Rust prevention ability	Rusting	Top	(Ground) B	(Ground) B	(Ground) A	(Ground) C	(Ground) D
		Side	(Ground)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

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

● Corrosion resistance test against chemicals

Table 3.2 Result of the corrosion resistance test

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

Fluoride low temperature chrome plating		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

Life of surface treatment by peeling

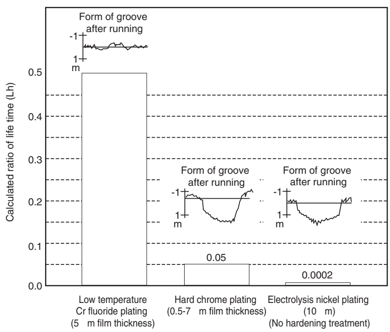


Fig. 3.1 Result of durability test

● Total evaluation

Table 3.3 Evaluation

	Available length	Rust prevention ability	Quality stability	Durability	Cost
Fluoride low temperature chrome plating	◎ (4 m)	◎	○	◎	◎
Hard chrome plating	△ (2 m)	○	X	△	△
Electroless nickel plating	◎ (4 m)	◎	△	X	△
Material equivalent to SUS440C	○ (3.5 m)	○	◎	◎	△

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

D 6

1.4 Measures Against Special Environments

1. In vacuum

● Silver-film plated ball screw

Ball screws that are plated by soft metal (special silver film) as a solid lubricant are developed the application for vacuum environment such as semiconductor manufacturing equipment and surface modification systems.

● Durability test in high vacuum

Test equipment and conditions

Table 4.1 shows ball screw specifications. Figure 4.1 is a schematic of the testing system in vacuum chamber. Table 4.2 shows testing conditions.

Table 4.1 Ball screw specifications

Shaft diameter		12 mm
Lead		4 mm
Steel ball diameter		2.381 mm
Numbers of circuit of balls		2.5 turns, 1 circuit
Axis load (preload)		29.4 N
Maximum surface pressure (preload volume)		about 690 Pa
Material	Shaft	SUS630
	Nut	SUS440C
	Ball return tube	SUS304
	Steel balls	SUS440C
Solid lubricant		Special silver film

Table 4.2 Testing conditions

Rotational speed	300 min^{-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.

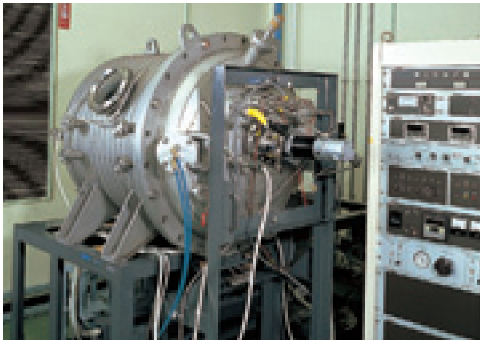


Photo 4.1 Vacuum testing system

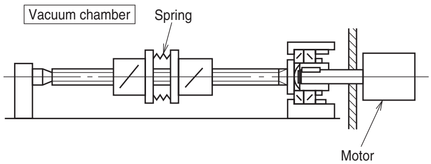


Fig. 4.1 Schematic of the testing system

Test results of the ball screw ①

The torque tendency was stable until about 1 x 10^7 rev. Then the torque characteristics slightly deteriorated. At about 1.35 x 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 ②

Torque value is a little higher in the test ①. The value is also little unstable. The torque momentarily soared several times during the test (some 10N • cm). It is thought this is attributable to the repeated peeling/sticking of the surface film made of soft metal (silver, etc.).

When the torque finally soared at 1.13 x 10^7 rev., it was determined that the ball screw reached the end of its life.

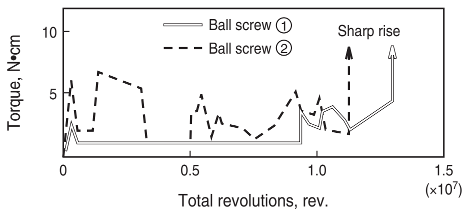


Fig. 4.2 Torque variation

Table 4.3 Ball screw durability

Classification		Ball screw ①	Ball screw ②
Life	Total revolutions (rev.)	1.35×10^7	1.13×10^7
	Total traveling distance (km)	54.0	45.2
	Total traveling hours(1) (h)	750	628

Note: (1) 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, LGU

NSK Clean Grease LG2 is used in clean room for NSK linear guides, ball screws, Monocarriers, Robot Modules, Megathrust motors, XY tables, etc. with low-dust emitting specifications. For its low dust emission and high durability, LG2 earns trust and high reputation of semiconductor equipment manufacturers.
LG2 is superior in many areas to fluorine greases which are commonly used in clean room.

Features

- **Remarkably low dust emission**
- **Long life -- More than ten times longer than fluoride greases, and equivalent to ordinary greases.**
- **Excellent rust prevention -- Significantly higher capacity than fluorine greases.**
- **Low and stable torque -- 20% or less than that of fluorine greases**

Table 4.4 Nature of Clean Grease LG2

Name	Thickener	Base oil	Base oil kinematic viscosity mm^2/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

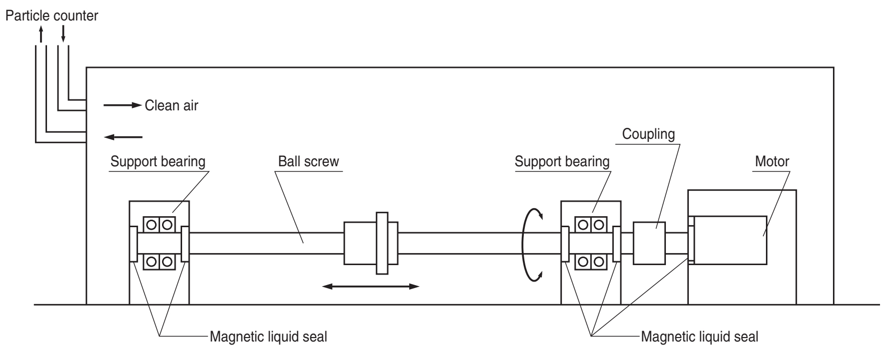


Fig. 4.3 Setting to measure dust generated by ball screw

● Feature 1: Remarkably low dust emission

Compared with fluoride greases, dust emission by LG2 is low and stable for long period of time.

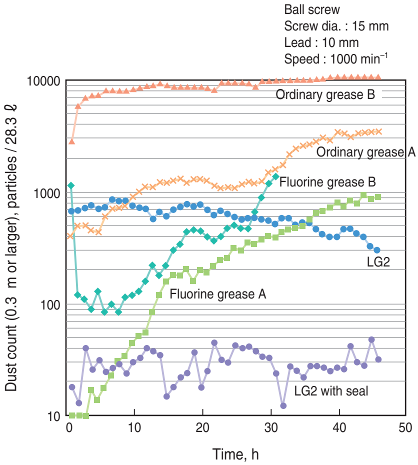


Fig. 4.4 Comparison in dust emission characteristics

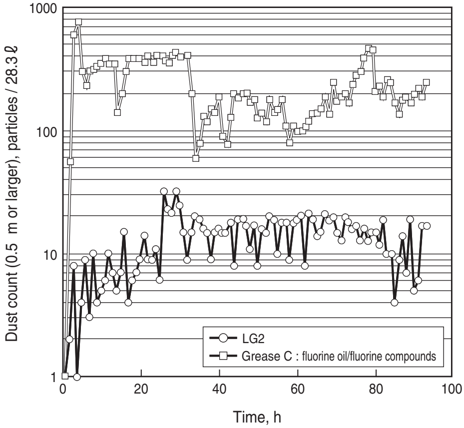


Fig. 4.5 Dust emission from linear guide (Linear guide: LU09)

● Feature 2 : Long life

Life is ten times or longer than fluorine greases, and equivalent to ordinary greases. This stretches maintenance intervals.

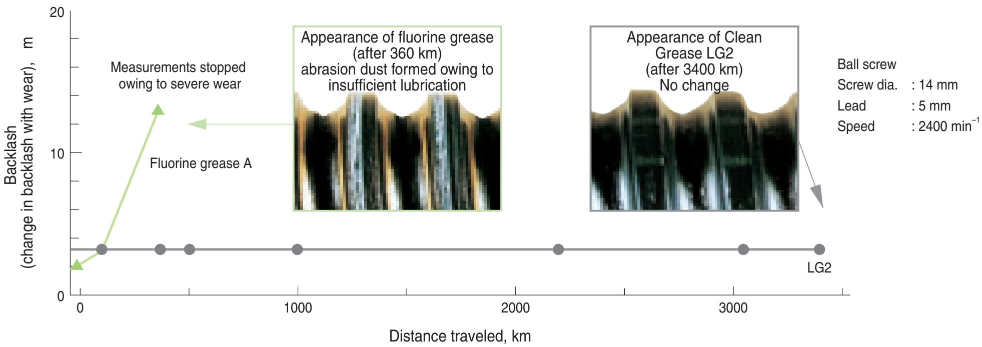
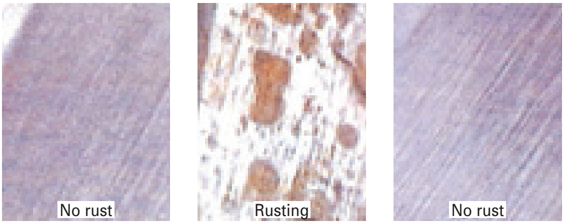


Fig. 4.6 Results of ball screw durability test

●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)



Clean Grease LG2 Fluorine grease A Ordinary grease A

Photo 4.2

Table 4.5 Rust prevention test on bearing

Type	Rusting after 7 days
NSK Clean Grease LG2	No rust
Fluorine grease B	Rusted

Test conditions : 19 mg is sealed in ball bearing 695
: Temp. 90°C, Humidity 60%
Evaluation : Studied by microscope

● Feature 4 : Stable torque

Torque is 20% or lower than fluorine greases.

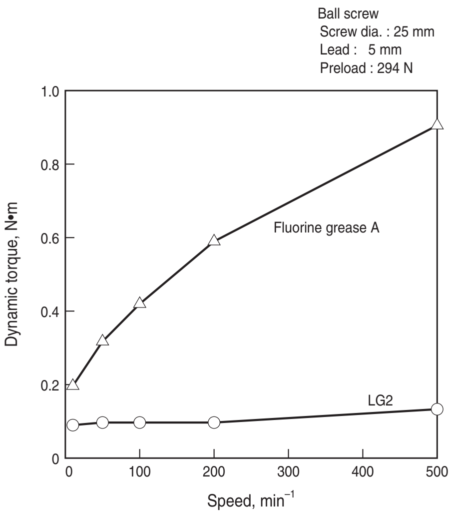


Fig. 4.7 Comparison of torque characteristics

● Total evaluation

Table 4.6 Evaluation

Characteristic	LG2	Fluorine grease	General grease
Dust generation	○	○ – △	△ – X
Torque	○	X	○ – △
Durability	○	△ – X	○
Rust prevention ability	○	△ – X	○

○ : Suitable △ : Not very suitable X : Problem in use

3. Environment with foreign matters

● NSK K1 lubrication unit (linear guide and ball screw)

Molded oil is made of a lubrication oil and polyolefin which has affinity with the lubrication oil. More than 70% of the mass is lubrication oil.
Molded oil which is formed into NSK K1 lubrication unit effectively seals linear guides, continually supplying lubrication oil. NSK K1 lubrication unit has made it possible to use linear guides in water or powder dust.
NSK K1 lubrication unit is available for ball screws.

Features

- **Extend maintenance-free intervals**
- **No contamination of surrounding environment**
- **Prolong life of the products exposed to water**

Refer to Page A38 and B209 for details of NSK K1 lubrication unit.

1.5 Table to Cope With Special Environments

1. Linear guides

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

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

2. Ball screws

Series	Special environment				
	Clean	Vacuum	Rust prevention	High temp.	Foreign matters
KA Series	○	○	○		
For Contaminated environments VSS Type					○
Made-to-order ball screw	○*	○*	○*	○*	○*

*Available in the made-to-order ball screw.
Please consult NSK.

1.6 Precautions for Handling

Please observe the following precautions to maintain high functions of ball screws and linear motion guide bearings in special environment over a long period.

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

2. Lubrication

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

2.1 Grease Lubrication

Grease lubrication is widely used because it does not require special oil supply system or piping. Grease lubricants made by NSK are:
- Various types of grease in bellowed container which can be instantly attached to the grease pump;
- NSK Grease Unit which comprise a hand grease pump and various nozzles. They are compact and easy to use.

1. NSK grease lubricants

Table 1.1 shows the marketed general grease widely used for linear guides and ball screws, in specific uses, conditions and purposes.

Table 1.1 Grease lubricant for linear guides and ball screws

Type	Thickener	Base oil	Base oil kinematic viscosity mm²/s (40°C)	Range of use temperature (°C)	Purpose
AS2	Lithium type	Mineral oil	130	– 10 – 110	For ball screws and linear guides for general use at high load.
PS2	Lithium type	Synthetic oil + mineral oil	15	– 50 – 110	For ball screws and linear guides for low temperature and high frequency operation.
LR3	Lithium type	Synthetic oil	30	– 30 – 130	For ball screws at high speed, medium load.
LG2	Lithium type	Synthetic oil + synthetic hydrocarbon oil	30	– 20 – 70	For ball screws and linear guides for clean environment.
LGU	Diurea	Synthetic hydrocarbon oil	100	– 30 – 120	For ball screws and linear guides for clean environment.
NF2	Urea composite type	Synthetic oil + mineral oil	27	– 40 – 100	For fretting resistant ball screws and linear guides.

(1) NSK Grease AS2

● Features

It is an environmentally friendly and widely used grease for high load application. It is mineral oil based grease containing lithium thickener and several additives. It is superb in load resistance as well as stability in 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 and ball screws. It is prevalently used in many applications because of its high base oil viscosity, high load resistance, and stability in oxidization. The AS2 has replaced the AV2 grease as the standard grease.

● Nature

Thickener	Lithium soap base
Base oil	Mineral oil
Consistency	275
Dropping point	185°C
Volume of evaporation	0.24% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	2.8% (100°C, 24 hr)
Base oil kinematic viscosity	130 mm²/s (40°C)

(2) NSK Grease PS2

● Features

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

● Application

It is a standard grease for NSK miniature linear guides and ball screws. It is especially superb for low temperature operation, but also functions well in normal temperatures, making it ideal for small equipment with light load.
(Previous reference number is NSK Grease No.2)

● 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 mm²/s (40°C)

(3) NSK Grease LR3

● Features

It contains a special synthetic oil for high temperature and stability, and a carefully selected anti-oxidation agent. This grease dramatically increases lubrication life under high temperature conditions. It is used for high speed, medium load. Lubrication life exceeded 2000 hours in the endurance test at 150°C. Its rust prevention capacity in severe conditions such as water and moist environments is further strengthened.

● Application

It is a standard grease for NSK standard linear guides and ball screws in finished shaft end FA Type. It is ideal for operation with medium load, at high speed such as positioning in high tact material handling equipment.
(Previous reference number is NSK Grease No.1)

● Nature

Thickener	Lithium soap base
Base oil	Mineral oil
Consistency	227
Dropping point	208°C
Volume of evaporation	0.30% (99°C, 22 hr)
Copper plate corrosion test	Satisfactory (Method B, 100°C, 24 hr)
Oil separation	1.9% (100°C, 24 hr)
Base oil kinematic viscosity	30 mm²/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 130°C.

● Nature

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

2. How to replenish grease

Use grease fitting to linear guide ball slide or to ball screw nut if exclusive grease supply component is not used. Supply required amount to grease fitting by a grease gun (pump).
Wipe off old grease and accumulated dust before supplying new grease. If grease fitting is not used, apply grease directly to the rail or to the ball groove of the screw shaft. Remove the seal if possible, and move a ball slide or ball nut few strokes so the grease permeates into the ball slide and inside the nut. A hand grease pump, an exclusive and easy lubrication device to linear guides and ball screws, is available at NSK.

3. Volume of grease to be replenished

Once grease is replenished, another supply is not required for a long period of time. But under some operational conditions, it is necessary to periodically replenish grease. The following are replenishing methods.
* When there is an exclusive grease supply system and the volume from the spout can be controlled, the criterion is:
• All at once, replenish the amount which fills about 50% of the internal space of the ball slide, or the internal space of the ball nut. This method eliminates waste of grease, and is efficient.
Tables 1.2 and 1.3 show internal spaces of ball slide and ball nut for reference.
* When replenishing using a grease gun:
Use a grease gun and fill the inside of ball slide and the ball nut with grease. Supply grease until it comes out from the ball slide or ball nut area. Move the ball slide or ball nut by hand while filling them with grease, so the grease permeates all areas. Do not operate the machine immediately after replenishing. Always try the system a few times to spread the grease throughout the system and to remove excess grease from inside. Trial operations are necessary because the resistance to sliding force of linear guide and the ball screw torque greatly increase immediately after replenishment (full-pack state) and may cause problems. Grease's agitating resistance is accountable for this phenomenon. Wipe off excess grease that accumulates at the end of the rail and screw shaft after trial runs, so the grease does not scatter to other areas.

Table 1.2 Inside space of the ball slide of linear guide

SH, SS Series

Unit: cm³

Model No. \ Series	SH		SS	
	High-load type	Super-high-load type	Medium-load type	High-load type
15	2	3	1.5	2
20	5	7	3	4
25	9	12	5	7
30	11	17	7	11
35	20	27	11	17
45	42	53	–	–
55	73	93	–	–

LH, LS Series

Unit: cm³

Model No. \ Series	LH		LS	
	High-load type	Super-high-load type	Medium-load type	High-load type
08	0.2	–	–	–
10	0.4	–	–	–
12	1.2	–	–	–
15	3	4	2	3
20	6	8	3	4
25	9	13	5	8
30	13	20	8	12
35	22	30	12	19
45	47	59	–	–
55	80	100	–	–
65	139	186	–	–
85	–	336	–	–

VH Series

Unit: cm³

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

RA Series

Unit: cm³

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

LA Series

Unit: cm³

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

HA, HS Series

Unit: cm³

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

PE, PU Series

Unit: cm³

Model No. \ Series	PE		PU	
	Standard type	High-load type	Standard type	High-load type
05	0.1	–	0.1	–
07	0.2	–	0.1	–
09	0.4	0.5	0.2	0.3
12	0.5	0.7	0.3	0.4
15	1.2	1.6	0.8	1.1

LW Series

Unit: cm³

Model No. \ Series	LW
17	3
21	3
27	7
35	24
50	52

LE, LU Series

Unit: cm³

Model No. \ Series	LE			LU	
	Medium-load type	Standard type	High-load type	Standard type	High-load type
05	0.1	0.1	–	0.1	–
07	0.1	0.2	0.3	0.1	–
09	0.2	0.4	0.5	0.2	0.3
12	0.3	0.5	0.7	0.3	0.4
15	0.8	1.2	1.6	0.8	1.1

TS Series

Unit: cm³

Model No. \ Series	TS
15	2
20	3
25	6
30	9
35	15

Table 1.3 Inside space of ball nut

Return tube type (single nut)

Unit: cm³

Nut model	Inside space	Nut model	Inside space	Nut model	Inside space	Nut model	Inside space
1004 – 2.5	0.8	2005 – 5	4.3	2525 – 1.5	7.5	4005 – 10	14
1205 – 2.5	1.2	2010 – 2.5	4.7	2805 – 5	6	4010 – 5	30
1210 – 2.5	1.4	2020 – 1.5	4.2	3205 – 5	7	4012 – 5	34
1405 – 2.5	2.2	2504 – 5	3.2	3206 – 5	9.5	4510 – 5	34
1510 – 2.5	2.3	2505 – 5	5	3210 – 5	22	5010 – 5	37
1605 – 2.5	2.6	2506 – 5	7	3225 – 2.5	17	5010 – 10	59
1616 – 1.5	2.1	2510 – 3	9.5	3232 – 1.5	15		
2004 – 5	2.7	2520 – 2.5	12	3610 – 5	32		

Deflector type (single nut)

Unit: cm³

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: cm³

Nut model	Inside space
1520 – 1.5	1.9
2040 – 1	2.8
2550 – 1	4.2

Remarks: Nut model: shaft diameter, lead, total number of turns of balls
Please consult NSK for other specifications.

4. Intervals of checks and replenishments

Although the grease is of high quality, it gradually deteriorates and its lubrication function diminishes. Also, the grease in the ball slide and ball nut is gradually removed by stroke movement. In some environments, the grease becomes dirty, and foreign objects may enter. New grease should be replenished depending on frequency of use. The following is a guide of intervals of grease replenishments to linear guides and ball screws.

Table 1.4 Intervals of checks and replenishments for grease lubrication

Intervals of checks	Items to check	Intervals of replenishments
3-6 months	Dirt, foreign matters such as cutting chip	Usually once per year. Every 3000 km for material handling system which travels more than 3000 km per year. Replenish if checking results warrant it necessary.

Note: 1) As a general rule, do not mix greases of different brands. Grease structure may be destroyed if greases of different thickeners are mixed. Even when greases have the same thickener, different additives in them may have an adverse effect on each other.

2) Grease viscosity varies by temperature. Viscosity is particular high in winter due to low temperature. Pay attention to increase in linear guide's sliding resistance and ball screw torque in such occasion.

5. NSK Grease Unit

Supply grease to NSK linear guides and ball screws by a manual type hand grease pump. Install the grease in bellows tube to the pump. Several types of grease (80 g) are available.

Grease in a bellows tube

(1) Composition of NSK Grease Unit

Components and grease types are shown below.

NSK Grease Unit

Component	Name	(tube type)	Reference number
NSK Grease (80 g in a bellows tube)	NSK Grease AS2	(Brown)	NSK GRS AS2
	NSK Grease PS2	(Orange)	NSK GRS PS2
	NSK Grease 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 the hand pump.)			NSK HGP
Grease nozzle (used with the hand grease pump)	NSK straight nozzle		NSK HGP NZ1
	NSK chuck nozzle		NSK HGP NZ2
	NSK drive fitting nozzle		NSK HGP NZ3
	NSK point nozzle		NSK HGP NZ4
	NSK flexible nozzle		NSK HGP NZ5
	NSK flexible extension pipe		NSK HGP NZ6
	NSK straight extension pipe		NSK HGP NZ7

(2) NSK Greases (80 g in a bellows tube)

Refer to Page D14 for their natures and details.

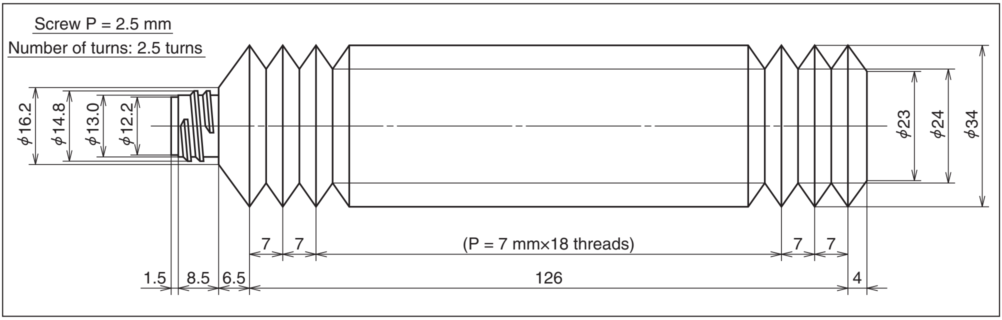


Fig. 3.1 Bellows tube

(3) NSK manual Grease Pump Unit

① **NSK Hand Grease Pump Unit (Reference number: NSK HGP)**

● **Features**

- Light-weight ·········· Can be operated by one hand, yet there is no worry to making a mistake.
- Inserting by high pressure···· Insert at 15 Mpa.
- No leaking ············ Does not leak when held upside down.
- Easy to change grease···· Simply attach the grease in bellows tube.
- Remaining grease ····· Can be confirmed through slit on the tube.
- Several nozzles ······ Five types of nozzles to choose from.

● **Specifications**

- Discharge pressure ·· 15 Mpa
- Spout volume ········ 0.35 g/stroke
- Mass of main body ··· 393 g
- Overall length ········ About 200 mm
- Overall width ········· About 200 mm
- Grease tube outer diameter ·· ϕ 38.1
- Accessory············· Several nozzles for a unique application can be attached

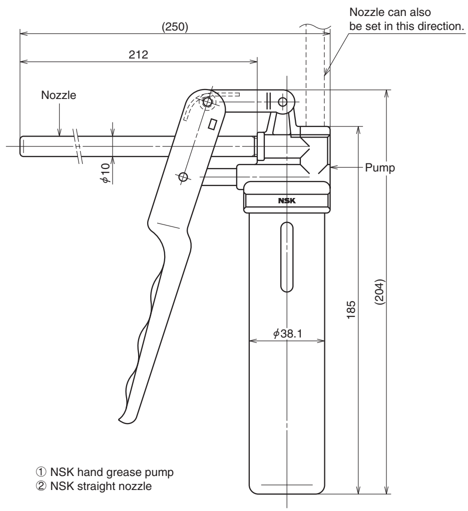


Fig. 3.2 NSK Hand Grease Pump with NSK straight nozzle

② Nozzles

Table 3.1 Nozzles that can be attached to NSK Hand Grease Pump

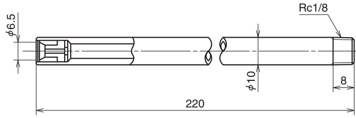
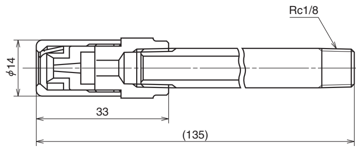
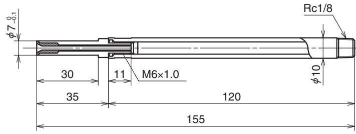
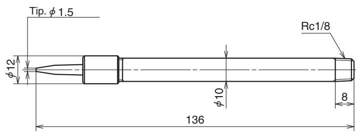
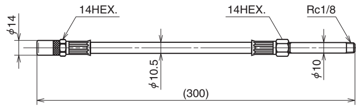
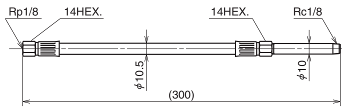
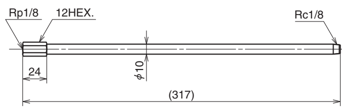
Name	Designation code	Use	Dimensions
NSK straight nozzle	NSK HGP NZ1	Can be used with grease fitting A, B, and C under JIS B1575 standard.	
NSK chuck nozzle	NSK HGP NZ2	Same as above. However, there is no need to press the hand pump because the grease fitting and the nozzle come to contact due to the chucking mechanism at the tip.	
NSK fitting nozzle	NSK HGP NZ3	Dedicated for the -φ3 drive-in grease fitting.	
NSK point nozzle	NSK HGP NZ4	Used for linear guides and ball screws which do not have grease fitting. Supplies grease directly to the ball grooves, or through the opening of ball slide or ball slide to inside.	
NSK flexible nozzle	NSK HGP NZ5	The tip of the flexible nozzle is chuck nozzle. Used to supply grease to the area where hand cannot reach.	
NSK flexible extension pipe	NSK HGP NZ6	Flexible extension pipe connects the grease pump and the nozzle	
NSK straight extension pipe	NSK HGP NZ7	Straight extension pipe connects the grease pump and the nozzle.	

Table 3.2 Grease fittings used for NSK linear guide

Series	Model number	Tap hole for grease fitting	Standard grease fitting	Straight nozzle NZ1	Chuck nozzles NZ2	Drive-in nipple nozzle NZ3	Point nozzle NZ4	Flexible nozzle NZ5
SH Series	SH15	ϕ3	Drive-in type			○		
	SH20, 25, 30, 35*)	M6×0.75	B type	○	○			○
	SH45, 55	Rc1/8	B type	○	○			○
SS Series	SS15	ϕ3	Drive-in type			○		
	SS20, 25, 30, 35*)	M6×0.75	B type	○	○			○
LH Series	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	○	○			○
LS Series	LS15	ϕ3	Drive-in type			○		
	LS20, 25, 30, 35*)	M6×0.75	B type	○	○			○
VH Series	VH15	ϕ3	Drive-in type			○		
	LH20, 25, 30, 35*)	M6×0.75	B type	○	○			○
	VH45, 55	Rc1/8	B type	○	○			○
LW Series	LW17	ϕ3	Drive-in type			○		
	LW21, 27, 35*)	M6×0.75	B type	○	○			○
	LW50	Rc1/8	B type	○	○			○
TS Series	TS15	ϕ3	Drive-in type			○		
	TS20, 25, 30, 35*)	M6×0.75	B type	○	○			○
RA Series	RA15, 20	ϕ3	Drive-in type			○		
	RA25, 30, 35*)	M6×0.75	B type	○	○			○
	RA45, 55, 65	Rc1/8	B type	○	○			○
LA Series	LA25, 30, 35*)	M6×0.75	B type	○	○			○
	LA45, 55, 65	Rc1/8	B type	○	○			○
PU Series	PU05, 07, 09, 12	–	–				○	
	PU15	ϕ3	Drive-in type			○		
PE Series	PE05, 07, 09, 12	–	–				○	
	PE15	ϕ3	Drive-in type			○		
LU Series	LU05, 07, 09, 12, 15	–	–				○	
LE Series	LE05, 07, 09, 12, 15	–	–				○	
HA Series	HA25, 30, 35*)	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	○	○			○

*) When using a chuck nozzle, make sure that it does not interfere with the table on linear guides.

Note: PU, PE, LU, and LE Series: Apply grease directly to ball groove, etc. using a point nozzle.

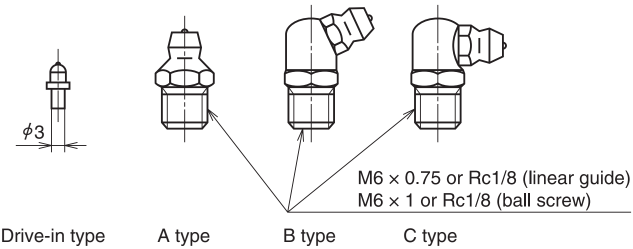


Fig. 3.3 Grease fittings

A long threaded grease fitting is required for NSK linear guides because of dust proof parts. Please refer to the sections pertaining to the lubrication and dust proof parts of each series.
Normally, grease fitting is not provided to NSK ball screw. However, ball nut has a tap hole to install a grease fitting. The user should install a grease fitting if necessary. If there is no tap hole, apply grease directly to the screw shaft and ball grooves.

2.2 Oil Lubrication

Required amount of new oil is regularly supplied by:

- Manual or automatic intermittent supply system;
- Oil mist lubricating system via piping.

Equipment for oil lubrication is more costly than grease lubrication. However, oil mist lubricating system supplies air as well as oil, raising the inner pressure of the ball slide. This prevents foreign matters from entering, and the air cools the system. Use an oil of high atomizing rate such as ISO VG 32 to 68 for the oil mist lubrication system.

ISO VG 68 to 220 are recommended for common intermittent replenishment system. Approximate volume of oil Q for a ball slide of linear guide per hour can be obtained by the following formula.

In case of ball type linear guides except the LA Series

$Q = n/150$ (cm^3/hr)

In case of LA Series, RA Series

$Q \geq n/100$ (cm^3/hr)

n: Linear guide code

e.g. When LH45 is used,

$n = 45$

Therefore,

$Q = 45/150 = 0.3$ cm^3/hr

Similarly, approximate oil supply volume Q to ball screw can be obtained by the following formula.

$Q = d/15$ (cm^3/hr)

d: Nominal shaft diameter of the ball screw

e.g. When the shaft diameter is 50,

$d = 50$

Therefore,

$Q = 50/15 = 3.3$ cm^3/hr

For oil lubrication by gravity drip, the oil supply position and installation position of the ball slide or ball nut are crucial. In case of linear guide, unless it is installed to a horizontal position, the oil flows only on the down side, and does not spread to all raceway surface. This may cause insufficient lubrication. For ball screw lubrication as well, oil does not spread if the oil orifice is installed at the bottom, causing insufficient lubrication. Please consult NSK to correct such situations prior to use. NSK has internal design which allows oil lubricant to flow throughout the system. Table 2.1 shows the criterion of intervals of oil checks and replenishments.

Table 2.1 Intervals of checks and replenishments

Method	Intervals of checks	Items to check	Replenishment or intervals of changes
Automatic intermittent supply	Weekly	Volume of oil, dirt, etc.	Replenish at each check. Suitable volume for tank capacity.
Oil bath	Daily before operation	Oil surface	Make a suitable criterion based on consumption

Note: 1) As with grease lubrication, do not mix oil lubricant with different types.

2) Some components of the linear guide and ball screw are made of plastic. Avoid using an oil that adversely affects synthetic resin.

3) When using oil mist lubricating system, please confirm an oil supply amount at the each outlet part.

3. RoHS Compliant

1. Linear Guides

· Linear Guides listed in the catalog except the products for special environments, are compliant with RoHS.

· Please consult NSK for RoHS of special parts and lubricant provided by customer, and customer-supplied product.

2. Ball Screws

· Ball screws listed in the catalog except the products for special environments, are compliant with RoHS.

3. Monocarriers

· Monocarriers listed in the catalog are compliant with RoHS.

4. Ball Screw Support Bearings

· Ball screw support bearings listed in the catalog are compliant with RoHS.

*For details of country-specific RoHS, contact NSK.

APPENDICES: TABLES

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	$kgf \cdot s^2/m$	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	°	$180/\pi$
			Minute	'	$10\,800/\pi$
			Second	''	$648\,000/\pi$
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	$1/(9.806\,65\times10^3)$
			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	$1/(9.806\,65\times10^4)$
	(Newtons per square meter)	(N/m^2)	Weight kilogram per square millimeter	kgf/mm^2	$1/(9.806\,65\times10^6)$

Prefixes for SI units

Powers of 10	Prefix Name	Prefix Code	Powers of 10	Prefix Name	Prefix Code
10^{18}	exa	E	10^{-1}	deci	d
10^{15}	peta	P	10^{-2}	centi	c
10^{12}	tera	T	10^{-3}	milli	m
10^{9}	giga	G	10^{-6}	micro	μ
10^{6}	mega	M	10^{-9}	nano	n
10^{3}	kilo	k	10^{-12}	pico	p
10^{2}	hecto	h	10^{-15}	femto	f
10^{1}	deca	da	10^{-18}	atto	a

Conversion rates from SI units (continued from previous page)

Item	SI unit: Name of unit	SI unit: Abbreviation	Units other than SI units: Name of unit	Units other than SI units: Abbreviation	Conversion rate from SI unit
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_2O	$1/(9.806\ 65\times10^3)$
			Mercurial column millimeter	mmHg	$760/(1.013\ 25\times10^5)$
			Torr	Torr	$760/(1.013\ 25\times10^5)$
			Bar	bar	10^{-5}
			Atmosphere	atm	$1/(1.013\ 25\times10^5)$
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	$1/(3.6\times10^6)$
			Metric horsepower/hour	PS • h	$\approx 3.776\ 72\times10^{-7}$
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	$\approx 1/735.498\ 8$
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	$4\pi/10^3$
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: $\Delta T = \Delta\theta$. ΔT and $\Delta\theta$ indicate temperature differences measured by Kelvin and Celsius respectively.

Remarks: Names and abbreviations of the unit in parentheses indicate the definition of the unit shown above the parentheses or left to the parentheses.

Conversion example 1 N = 1/9.806 65 kgf

2. Conversion table between N and kgf

[How to read the table]
To convert 10 N to kgf, locate 10 in the center column in the first block. Locate a corresponding kgf figure in the right side column. You will find 10 N is 1.0197 kgf. To convert 10 kgf to N, locate a figure in N column to its left. You will find 10 kgf is 98.006 N.

1 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		Shore hardness
		Standard ball	Tungsten carbide ball	A Scale Load 588.4 N brale penetrator	B Scale Load 980.7 N Diameter 1.5888 mm {1/16 in} sphere	
68	940	—	—	85.6	—	97
67	900	—	—	85.0	—	95
66	865	—	—	84.5	—	92
65	832	—	739	83.9	—	91
64	800	—	722	83.4	—	88
63	772	—	705	82.8	—	87
62	746	—	688	82.3	—	85
61	720	—	670	81.8	—	83
60	697	—	654	81.2	—	81
59	674	—	634	80.7	—	80
58	653	—	615	80.1	—	78
57	633	—	595	79.6	—	76
56	613	—	577	79.0	—	75
55	595	—	560	78.5	—	74
54	577	—	543	78.0	—	72
53	560	—	525	77.4	—	71
52	544	500	512	76.8	—	69
51	528	487	496	76.3	—	68
50	513	475	481	75.9	—	67
49	498	464	469	75.2	—	66
48	484	451	455	74.7	—	64
47	471	442	443	74.1	—	63
46	458	432	432	73.6	—	62
45	446	421	421	73.1	—	60
44	434	409	409	72.5	—	58
43	423	400	400	72.0	—	57
42	412	390	390	71.5	—	56
41	402	381	381	70.9	—	55
40	392	371	371	70.4	—	54
39	382	362	362	69.9	—	52

Rockwell C Scale hardness (1 471 N)	Vickers hardness	Brinell hardness		Rockwell hardness		Shore hardness
		Standard ball	Tungsten carbide ball	A Scale Load 588.4 N brale penetrator	B Scale Load 980.7 N Diameter 1.5888 mm {1/16 in} sphere	
38	372	353	353	69.4	—	51
37	363	344	344	68.9	—	50
36	354	336	336	68.4	(109.0)	49
35	345	327	327	67.9	(108.5)	48
34	336	319	319	67.4	(108.0)	47
33	327	311	311	66.8	(107.5)	46
32	318	301	301	66.3	(107.0)	44
31	310	294	294	65.8	(106.0)	43
30	302	286	286	65.3	(105.5)	42
29	294	279	279	64.7	(104.5)	41
28	286	271	271	64.3	(104.0)	41
27	279	264	264	63.8	(103.0)	40
26	272	258	258	63.3	(102.5)	38
25	266	253	253	62.8	(101.5)	38
24	260	247	247	62.4	(101.0)	37
23	254	243	243	62.0	100.0	36
22	248	237	237	61.5	99.0	35
21	243	231	231	61.0	98.5	35
20	238	226	226	60.5	97.8	34
(18)	230	219	219	—	96.7	33
(16)	222	212	212	—	95.5	32
(14)	213	203	203	—	93.9	31
(12)	204	194	194	—	92.3	29
(10)	196	187	187	—	90.7	28
(8)	188	179	179	—	89.5	27
(6)	180	171	171	—	87.1	26
(4)	173	165	165	—	85.5	25
(2)	166	158	158	—	83.5	24
(0)	160	152	152	—	81.7	24

5. Deviations of shafts used in common fits

Classification of diameter (mm) Over	or less	d6	e6	f6	g5	g6	h5	h6	h7	h8	h9	h10	js5	js6
—	3	−20 −26	−14 −20	−6 −12	−2 −6	−2 −8	0 −4	0 −6	0 −10	0 −14	0 −25	0 −40	± 2	± 3
3	6	−30 −38	−20 −28	−10 −18	−4 −9	−4 −12	0 −5	0 −8	0 −12	0 −18	0 −30	0 −48	± 2.5	± 4
6	10	−40 −49	−25 −34	−13 −22	−5 −11	−5 −14	0 −6	0 −9	0 −15	0 −22	0 −36	0 −58	± 3	± 4.5
10	18	−50 −61	−32 −43	−16 −27	−6 −14	−6 −17	0 −8	0 −11	0 −18	0 −27	0 −43	0 −70	± 4	± 5.5
18	30	−65 −78	−40 −53	−20 −33	−7 −16	−7 −20	0 −9	0 −13	0 −21	0 −33	0 −52	0 −84	± 4.5	± 6.5
30	50	−80 −96	−50 −66	−25 −41	−9 −20	−9 −25	0 −11	0 −16	0 −25	0 −39	0 −62	0 −100	± 5.5	± 8
50	80	−100 −119	−60 −79	−30 −49	−10 −23	−10 −29	0 −13	0 −19	0 −30	0 −46	0 −74	0 −120	± 6.5	± 9.5
80	120	−120 −142	−72 −94	−36 −58	−12 −27	−12 −34	0 −15	0 −22	0 −35	0 −54	0 −87	0 −140	± 7.5	±11
120	180	−145 −170	−85 −110	−43 −68	−14 −32	−14 −39	0 −18	0 −25	0 −40	0 −63	0 −100	0 −160	± 9	±12.5
180	250	−170 −199	−100 −129	−50 −79	−15 −35	−15 −44	0 −20	0 −29	0 −46	0 −72	0 −115	0 −185	±10	±14.5
250	315	−190 −222	−110 −142	−56 −88	−17 −40	−17 −49	0 −23	0 −32	0 −52	0 −81	0 −130	0 −210	±11.5	±16
315	400	−210 −246	−125 −161	−62 −98	−18 −43	−18 −54	0 −25	0 −36	0 −57	0 −89	0 −140	0 −230	±12.5	±18
400	500	−230 −270	−135 −175	−68 −108	−20 −47	−20 −60	0 −27	0 −40	0 −63	0 −97	0 −155	0 −250	±13.5	±20
500	630	−260 −304	−145 −189	−76 −120	—	−22 −66	—	0 −44	0 −70	0 −110	0 −175	0 −280	—	±22
630	800	−290 −340	−160 −210	−80 −130	—	−24 −74	—	0 −50	0 −80	0 −125	0 −200	0 −320	—	±25
800	1000	−320 −376	−170 −226	−86 −142	—	−26 −82	—	0 −56	0 −90	0 −140	0 −230	0 −360	—	±28
1000	1250	−350 −416	−195 −261	−98 −164	—	−28 −94	—	0 −66	0 −105	0 −165	0 −260	0 −420	—	±33
1250	1600	−390 −468	−220 −298	−110 −188	—	−30 −108	—	0 −78	0 −125	0 −195	0 −310	0 −500	—	±39
1600	2000	−430 −522	−240 −332	−120 −212	—	−32 −124	—	0 −92	0 −150	0 −230	0 −370	0 −600	—	±46

Unit: μm

j5	j6	j7	k5	k6	k7	m5	m6	n6	p6	r6	r7	Classification of diameter (mm)	
												Over	or less
±2	+4 −2	+6 −4	+4 0	+6 0	+10 0	+6 +2	+8 +2	+10 +4	+12 +6	+16 +10	+20 +10	—	3
+3 −2	+6 −2	+8 −4	+6 +1	+9 +1	+13 +1	+9 +4	+12 +4	+16 +8	+20 +12	+23 +15	+27 +15	3	6
+4 −2	+7 −2	+10 −5	+7 +1	+10 +1	+16 +1	+12 +6	+15 +6	+19 +10	+24 +15	+28 +19	+34 +19	6	10
+5 −3	+8 −3	+12 −6	+9 +1	+12 +1	+19 +1	+15 +7	+18 +7	+23 +12	+29 +18	+34 +23	+41 +23	10	18
+5 −4	+9 −4	+13 −8	+11 +2	+15 +2	+23 +2	+17 +8	+21 +8	+28 +15	+35 +22	+41 +28	+49 +28	18	30
+6 −5	+11 −5	+15 −10	+13 +2	+18 +2	+27 +2	+20 +9	+25 +9	+33 +17	+42 +26	+50 +34	+59 +34	30	50
+6 −7	+12 −7	+18 −12	+15 +2	+21 +2	+32 +2	+24 +11	+30 +11	+39 +20	+51 +32	+60 +41	+71 +41	50	65
										+62 +43	+73 +43	65	80
+6 −9	+13 −9	+20 −15	+18 +3	+25 +3	+38 +3	+28 +13	+35 +13	+45 +23	+59 +37	+73 +51	+86 +51	80	100
										+76 +54	+89 +54	100	120
+7 −11	+14 −11	+22 −18	+21 +3	+28 +3	+43 +3	+33 +15	+40 +15	+52 +27	+68 +43	+88 +63	+103 +63	120	140
										+90 +65	+105 +65	140	160
										+93 +68	+108 +68	160	180
+7 −13	+16 −13	+25 −21	+24 +4	+33 +4	+50 +4	+37 +17	+46 +17	+60 +31	+79 +50	+106 +77	+123 +77	180	200
										+109 +80	+126 +80	200	225
										+113 +84	+130 +84	225	250
+7 −16	±16	±26	+27 +4	+36 +4	+56 +4	+43 +20	+52 +20	+66 +34	+88 +56	+126 +94	+146 +94	250	280
										+130 +98	+150 +98	280	315
+7 −18	±18	+29 −28	+29 +4	+40 +4	+61 +4	+46 +21	+57 +21	+73 +37	+98 +62	+144 +108	+165 +108	315	355
										+150 +114	+171 +114	355	400
+7 −20	±20	+31 −32	+32 +5	+45 +5	+68 +5	+50 +23	+63 +23	+80 +40	+108 +68	+166 +126	+189 +126	400	450
										+172 +132	+195 +132	450	500
—	—	—	—	+44 0	+70 0	—	+70 +26	+88 +44	+122 +78	+194 +150	+220 +150	500	560
										+199 +155	+225 +155	560	630
—	—	—	—	+50 0	+80 0	—	+80 +30	+100 +50	+138 +88	+225 +175	+255 +175	630	710
										+235 +185	+265 +185	710	800
—	—	—	—	+56 0	+90 0	—	+90 +34	+112 +56	+156 +100	+266 +210	+300 +210	800	900
										+276 +220	+310 +220	900	1000
—	—	—	—	+66 0	+105 0	—	+106 +40	+132 +66	+186 +120	+316 +250	+355 +250	1000	1120
										+326 +260	+365 +260	1120	1250
—	—	—	—	+78 0	+125 0	—	+126 +48	+156 +78	+218 +140	+378 +300	+425 +300	1250	1400
										+408 +330	+455 +330	1400	1600
—	—	—	—	+92 0	+150 0	—	+150 +58	+184 +92	+262 +170	+462 +370	+520 +370	1600	1800
										+492 +400	+550 +400	1800	2000

6. Deviations of holes used in common fits

Classification of diameter (mm) Over	or less	E6	F6	F7	G6	G7	H6	H7	H8	J6	J7	JS6	JS7
—	3	+20 +14	+12 +6	+16 +6	+8 +2	+12 +2	+6 0	+10 0	+14 0	+2 −4	+4 −6	±3	±5
3	6	+28 +20	+18 +10	+22 +10	+12 +4	+16 +4	+8 0	+12 0	+18 0	+5 −3	±6	±4	±6
6	10	+34 +25	+22 +13	+28 +13	+14 +5	+20 +5	+9 0	+15 0	+22 0	+5 −4	+8 −7	±4.5	±7.5
10	18	+43 +32	+27 +16	+34 +16	+17 +6	+24 +6	+11 0	+18 0	+27 0	+6 −5	+10 −8	±5.5	±9
18	30	+53 +40	+33 +20	+41 +20	+20 +7	+28 +7	+13 0	+21 0	+33 0	+8 −5	+12 −9	±6.5	±10.5
30	50	+66 +50	+41 +25	+50 +25	+25 +9	+34 +9	+16 0	+25 0	+39 0	+10 −6	+14 −11	±8	±12.5
50	80	+79 +60	+49 +30	+60 +30	+29 +10	+40 +10	+19 0	+30 0	+46 0	+13 −6	+18 −12	±9.5	±15
80	120	+94 +72	+58 +36	+71 +36	+34 +12	+47 +12	+22 0	+35 0	+54 0	+16 −6	+22 −13	±11	±17.5
120	180	+110 +85	+68 +43	+83 +43	+39 +14	+54 +14	+25 0	+40 0	+63 0	+18 −7	+26 −14	±12.5	±20
180	250	+129 +100	+79 +50	+96 +50	+44 +15	+61 +15	+29 0	+46 0	+72 0	+22 −7	+30 −16	±14.5	±23
250	315	+142 +110	+88 +56	+108 +56	+49 +17	+69 +17	+32 0	+52 0	+81 0	+25 −7	+36 −16	±16	±26
315	400	+161 +125	+98 +62	+119 +62	+54 +18	+75 +18	+36 0	+57 0	+89 0	+29 −7	+39 −18	±18	±28.5
400	500	+175 +135	+108 +68	+131 +68	+60 +20	+83 +20	+40 0	+63 0	+97 0	+33 −7	+43 −20	±20	±31.5
500	630	+189 +145	+120 +76	+146 +76	+66 +22	+92 +22	+44 0	+70 0	+110 0	—	—	±22	±35
630	800	+210 +160	+130 +80	+160 +80	+74 +24	+104 +24	+50 0	+80 0	+125 0	—	—	±25	±40
800	1000	+226 +170	+142 +86	+176 +86	+82 +26	+116 +26	+56 0	+90 0	+140 0	—	—	±28	±45
1000	1250	+261 +195	+164 +98	+203 +98	+94 +28	+133 +28	+66 0	+105 0	+165 0	—	—	±33	±52.5
1250	1600	+298 +220	+188 +110	+235 +110	+108 +30	+155 +30	+78 0	+125 0	+195 0	—	—	±39	±62.5
1600	2000	+332 +240	+212 +120	+270 +120	+124 +32	+182 +32	+92 0	+150 0	+230 0	—	—	±46	±75

Unit: μm

K5	K6	K7	M5	M6	M7	N5	N6	N7	P6	P7	Classification of diameter (mm)	
											Over	or less
0 −4	0 −6	0 −10	−2 −6	−2 −8	−2 −12	−4 −8	−4 −10	−4 −14	−6 −12	−6 −16	—	3
0 −5	+2 −6	+3 −9	−3 −8	−1 −9	0 −12	−7 −12	−5 −13	−4 −16	−9 −17	−8 −20	3	6
+1 −5	+2 −7	+5 −10	−4 −10	−3 −12	0 −15	−8 −14	−7 −16	−4 −19	−12 −21	−9 −24	6	10
+2 −6	+2 −9	+6 −12	−4 −12	−4 −15	0 −18	−9 −17	−9 −20	−5 −23	−15 −26	−11 −29	10	18
+1 −8	+2 −11	+6 −15	−5 −14	−4 −17	0 −21	−12 −21	−11 −24	−7 −28	−18 −31	−14 −35	18	30
+2 −9	+3 −13	+7 −18	−5 −16	−4 −20	0 −25	−13 −24	−12 −28	−8 −33	−21 −37	−17 −42	30	50
+3 −10	+4 −15	+9 −21	−6 −19	−5 −24	0 −30	−15 −28	−14 −33	−9 −39	−26 −45	−21 −51	50	80
+2 −13	+4 −18	+10 −25	−8 −23	−6 −28	0 −35	−18 −33	−16 −38	−10 −45	−30 −52	−24 −59	80	120
+3 −15	+4 −21	+12 −28	−9 −27	−8 −33	0 −40	−21 −39	−20 −45	−12 −52	−36 −61	−28 −68	120	180
+2 −18	+5 −24	+13 −33	−11 −31	−8 −37	0 −46	−25 −45	−22 −51	−14 −60	−41 −70	−33 −79	180	250
+3 −20	+5 −27	+16 −36	−13 −36	−9 −41	0 −52	−27 −50	−25 −57	−14 −66	−47 −79	−36 −88	250	315
+3 −22	+7 −29	+17 −40	−14 −39	−10 −46	0 −57	−30 −55	−26 −62	−16 −73	−51 −87	−41 −98	315	400
+2 −25	+8 −32	+18 −45	−16 −43	−10 −50	0 −63	−33 −60	−27 −67	−17 −80	−55 −95	−45 −108	400	500
—	0 −44	0 −70	—	−26 −70	−26 −96	—	−44 −88	−44 −114	−78 −122	−78 −148	500	630
—	0 −50	0 −80	—	−30 −80	−30 −110	—	−50 −100	−50 −130	−88 −138	−88 −168	630	800
—	0 −56	0 −90	—	−34 −90	−34 −124	—	−56 −112	−56 −146	−100 −156	−100 −190	800	1000
—	0 −66	0 −105	—	−40 −106	−40 −145	—	−66 −132	−66 −171	−120 −186	−120 −225	1000	1250
—	0 −78	0 −125	—	−48 −126	−48 −173	—	−78 −156	−78 −203	−140 −218	−140 −265	1250	1600
—	0 −92	0 −150	—	−58 −150	−58 −208	—	−92 −184	−92 −242	−170 −262	−170 −320	1600	2000

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